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ARTICLE

Sindūra Mañjari: exploring the perspective of traditional botanical knowledge and mineral processing practices in Kerala

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Abstract
Sindūra Mañjari (*SM*), a Malayalam text authored by Aṣṭavaidyan Pazhanellippuratt Taikāṭṭ Nārāyaṇan Mūss in the late 1800s, is renowned for its detailed documentation of metal and mineral-based medicines, a practice relatively uncommon in Kerala compared to northern India. This paper presents a comparative analysis highlighting traditional botanical knowledge and the rational use of herbal plants in mineral processing, as described in SM. Organized into two sections, the first outlines methodologies for preparing six types of Sindūra, while the second elaborates on preprocessing techniques for sixteen distinct mineral and plant materials. Twenty-six plants are documented within the text, with *Aloe vera* (L.) Burm.f. identified as the most frequently utilized, reflecting its essential role in traditional metal-processing practices.

Keywords *Aṣṭavaidya* · *Sindūra Mañjari* · Metal processing · Mineral processing · *Sindūram*

1 Introduction

Kerala's Ayurvedic literature has been deeply intertwined with the state's linguistic and print history. Medical manuscripts form a major share of the palm leaf manuscripts. The Gyan Bharatam Mission (erstwhile National Mission for Manuscripts (NaMaMi)) has documented over 5.2 million manuscripts, including approximately 1.39 lakh texts related to Ayurveda. This number exists despite the loss of many manuscripts, due to factors such as natural deterioration and the reluctance of traditional physician families to share their inherited knowledge.[1] Ayurvedic contributions from Kerala have been multifaceted. The whole Ayurvedic literature can be divided into three categories. The earliest Malayalam books on Ayurveda emerged as vernacular translations and adaptations of ancient Sanskrit texts like *Caraka Saṁhitā*, *Aṣṭāṅgahṛdaya*. In the second, the author narrates their clinical experiences while outlining the fundamental principles for managing various diseases. The third category offers in-depth discussions on formulations, including herbal, mineral, or herbomineral types, and also explores the application of individual medicinal plants in treatments. Written in Malayalam, these texts were instrumental in transferring Ayurvedic wisdom from classical Sanskrit sources. Additionally, they enriched the understanding of regional medicinal practices, tailored to Kerala's unique and diverse flora (Variar, 1985).

Among the foundational texts on medicinal plants of Kerala, "*Hortus Malabaricus*" marked the beginning of the literary tradition, a comprehensive treatise on the plants of Malabar, written in the 17th century (1678–1703) (Thomas et al., 2020). It was originally written in Latin and later translated into English in the late 20th century (Aswathy & Aravind, 2022). *Yogāmṛtam,* published in 1861, is the first

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Malayalam scientific book in the bibliography of Malayalam scientific literature from 1861 to 1971 (Prasad et al., 2019).

Sindūra Mañjari (SM) is assumed to have been written during the late 19th century.[2] SM is a significant work by Aṣṭavaidyan Pazhanellipuratt Taikāṭṭ Nārāyaṇan Mūss. The exact year of writing remains uncertain; however, it is known that the author was born in 1870 (Malayalam calendar year 1046) and passed away in 1907 (Malayalam calendar year 1083), lived for just 37 years. Given this timeline, it is likely that SM was composed towards the end of the 19th century. The book was posthumously published in 1915 by Kerala Chintamani Publishers (Ashtamoorthi & Somanathan, 2019).

Following this, the 20th century witnessed a surge in Ayurvedic publications in Malayalam. Commentaries on classical Ayurvedic texts (predominantly *Aṣṭāṅgahṛdaya*, commentaries like *Pāṭhya* and *Hṛdayabodhikā*), independent texts on fundamentals (*Rasavaiśeṣikasūtra*), general practice (*Vaidyamanorama*, *Cikitsāmañjari*) *Pañcakarma* (Ayurvedic biopurificatory procedures, *Dhārākalpa*), toxicology (*Jyotsnikā*), pediatrics (*Ārogyakalpadrumaḥ*), ophthalmology (*Netrarogacikitsāratnaṃ*) were published during the early-mid 20th century. Although chronological seniority and interrelatedness of these texts are obscure, works like *Ālattiyūr Maṇipravāḷaṃ* (one of the initial texts in the language *Maṇipravāḷaṃ*) have garnered linguistic significance as well (Varrier, 2013). Seminal work like *Vaidyamanorama* (*Chikitsakramam*) by Vayaskara N.S. Mooss was published in 1944 (Menon & Spudich, 2010). In 1946, *Sahasrayogam* by Krishna Vaidyan and S. Gopala Pillai was published, and it has become one of the essential resources on Ayurvedic formulations (Variar, 1985). These works fall into the second category of Ayurvedic literature, which focuses on compiling and detailing various formulations used to manage diverse disease conditions. Their significance endures, as these formulations continue to be studied for their efficacy and safety to this day.

While the majority of Ayurvedic texts from the 17th to the 20th century focused on herbal formulations, SM stands out as a unique contribution that delved into the processing of minerals and metals. This book is notable for its focus on preparing and using metal and mineral-based medicines, a practice less common in Kerala than in the north of India. Studies have shown that in Kerala, herbal medicines are predominantly used due to the state's rich biodiversity and the deep-rooted tradition of Ayurvedic practices. However, a shift towards mineral-based medicines has become evident due to the dwindling availability of certain herbs. This scarcity has necessitated a greater reliance on minerals as alternative therapeutic resources, reflecting a significant adaptation in local medicinal practices (Gaunt, n.d.; Morvin et al., 2014). The term "*sindūra mañjari*" refers to a compendium or compilation of minerals subjected to burning or incineration processes, often transforming into oxides or sulfides. The book serves as a primer for practitioners in Kerala, outlining the preparation, therapeutic applications, and unique processing methods of various "*sindūra*". The text is divided into two main parts; the first part focuses on the preparation of six types of *sindūra* and is further subdivided into three subsections: preprocessing (*śōdhana*), incineration (*māraṇa*), and therapeutic application (*sevā vidhi*). The second part provides a general processing method for seventeen materials comprising herbal drugs, metals, and minerals. Each process discussed in the text utilizes locally available herbs from Kerala, where the author spent his life, emphasizing their practical significance even today.

2 Nomenclature of the text

The text's name comprises '*sindūra'* and '*mañjari'*. The former refers to the dosage form the text specializes in, i.e., incinerated or calcinated metals/minerals, called *bhasma* in conventional Ayurvedic treatises. The term '*sindūra'* is prevalent in the *Siddha* school and may be inferred as a loan word borrowed from Tamil and the *Siddha* system of medicine, which has significantly influenced the then medical literature and practices in Kerala. The latter word, '*mañjari',* generally means 'bouquet', 'garland', 'bunch', and 'cluster', and contextually means 'anthology' or 'collection of ideas on a particular domain'. There are works from periods as early as 9th century, like '*Nyāyamañjari'* (text on *Nyāya* philosophy) using this suffix(Alessandro, 2016). Multiple works with the word *mañjari*, like '*Cikitsāmañjari'*, *Vaidyamañjari*, and *Kaumāramañjari* are prevalent in Kerala.

2.1 About the author

Aṣṭavaidya is a title given to members of distinguished families who practiced Ayurveda in Kerala. Among the *Aṣṭavaidya* families, the *Pazhanellippuratt Taikāṭṭ* Family, recognized as royal physicians to King Zamoorin of Ancient Malabar, played a pivotal role in the region's medical heritage. Seeking to broaden their service, they migrated to the Ancient Cochin Province. Over time, this family was distinguished as a leading proponent of Ayurveda in Kerala (Menon & Spudich, 2010). Aṣṭavaidyan Pazhanellippuratt Taikāṭṭ Nārāyaṇan Mūss, a visionary from this revered lineage, is recognized for his profound understanding of Ayurveda and his writing skills. Under the guidance of Puḷāmantōl Mūsat, Nārāyaṇan Mūss delved deep into the *Aṣṭāṅgahṛdayam*, studying under the tutelage of Kuṭṭañcery Apphan Mūss. His academic pursuits also extended to

[2] PTN Mūss. (1915). *Sindooramanjari*. K C Publications.

Table 1 Process of Māraṇa (incineration) described in SM

Sl No	Material	Liquid medium for trituration	Botanical Equivalents	Number of *Puṭa*[a]	Colour of *Bhasma*
1	*Kānta Lōha Sindūra (KLS)*	*Kumāri svarasa Bhṛṅgarāja Svarasa*[1]	*Aloe vera* (L.) Burn.f. *Eclipta prostrata*(L.)L.	8	*Dāḍima Tvak* (~pomegranate (*Punica granatum* L.) peel.
2	*Abhraka Sindūra*	*Kumāri svarasa Triphala Kāṣāya*[2]	*Aloe vera* (L.) *Burn.f Triphalā,* (Fruits of *Āmalaki* (*Phyllanthus emblica* L.), *Harītaki* (*Terminalia chebula* Retz), *Vibhītaki* (*Terminalia bellirica* (Gaertn.) Roxb),	4	Not mentioned
3	*Vaṅga Sindūra*	*Jambīra svarasa*[1]	*Citrus lemon* (L.) Osbeck	5–6	Flower of *Hibiscus rosa-sinensis* L.
4.	*Lōha Sindūra*	Same as *KLS*	Same as *Kānta lōha*	Same as *KLS*	Not mentioned
5	*Tāmra Sindūra*	*Nimbū svarasa*[1]	*Citrus aurantiifolia* (Christm.) Swingle	3–4	Copper
6	*Pañcaratna Sindūra*	*Nimbū svarasa*[1]	*Citrus aurantiifolia* (Christm.) Swingle	5–6	Not mentioned

[a] *Puṭa*: Number of Incineration cycles, 1: *Svarasa:* expressed juice, 2: *Kaṣāya*: decoction

Alaṅkāraśāstra and *Siddhāntakaumudi*, enriching his intellectual base. Nārāyaṇan Mūss's era was marked by vibrant scholarly exchange, with contemporaries such as Nārāyaṇan Nambīṣan and Kīraṅkuḷaṅgara Cakrapāṇi among his peers and disciples. His literary contributions extend beyond SM to include works like "*Kapōtasandeśaṃ*," "*Naḷacaritaṃ*," and "*Śriṅgāramañjarībāṇa*," although some of these remained incomplete. A hallmark of his writing is the seamless blend of prose and poetry, infusing his narratives with an elegant, poetic quality. Sree Nārāyaṇa Ayurveda *Ouṣhadhaśāla* (SNA Oushadhasala, Thrissur, Kerala), a renowned Ayurveda brand of pharmaceutics and clinics, has been named after the author of the SM, which was written during 1880–1900 (Malayalam calendar year 1070–1100) and first published in 1915. This review focuses on the 1915 edition, currently accessible as a PDF on the SNA website.[3] This article aims to critically examine the mineral processing techniques and botanical practices detailed in this 19th century work, as featured in the online PDF version.

3 Unique methodologies unveiled: simplified processes for mineral-based formulations

The first part of SM narrates about the *sindūra* preparation of five metals, including *kānta lōha, abhraka, vaṅga, lōha,* and *tāmra.* The book mentions a sixth *sindūra* known as *pañca ratna abhra sindūra (PRAS).* It is a combination of the five *sindūra* mentioned above. The author starts with the preparation method of *kānta lōha sindūra* (*KLS*, an incinerated product of Magnetite iron). The pulverized iron sheets are triturated with a combination of *Aloe vera* (L.) Burn.f expressed pulp(*kumāri svarasa*) and expressed juice (EJ) of the whole plant of *Eclipta prostrata* (L.)L. (*Bhṛṅgarāja svarasa*). Eight grinding cycles are prescribed in the first step. The powder is soaked in the EJ of *Syzygium cumini* (L.) Skeels (*jambū)* and sun-dried. If the former is unavailable, it may be substituted with EJ of bark of *Syzygium caryophyllatum* (L.) Alston (*ñjāratoli)* or EJ of *Phyllanthus amarus* L. (*Kīzhārnelli/ Bhūmyāmalaki*). Two further rounds of soaking are mandated, with EJ of lime *Citrus aurantiifolia* (Christm.) Swingle and sour buttermilk. The processed *kānta lōha* is again triturated with *Aloe vera* (L.) Burn.f. and divided into discs form or in the shape of pills, later kept in a mud pot and sundried. These small boluses are then incinerated. Eight consecutive cycles of incineration are prescribed, alternating between EJ of *kumāri* and *bhṛṅgarāja*. The final product, *KLS*, is described as possessing the color of pomegranate peel. The details of the six *sindūra* preparation, the liquid mediums used, and the number of *puṭa* required are listed in Table 1.

3.1 *Abhraka sindūra*

Next, the author delves into the *abhraka sindūra* preparation, a mica-derived product used in Ayurveda. The powdered mica is meticulously ground with expressed pulp juice of aloe vera until it reaches a smooth, buttery consistency. Further, the trituration is continued with a decoction of *triphalā*, a polyherbal formulation composed of equal parts

[3] *Publications, SNA Oushadhasala private limited.* (n.d.). SNA Oushadhasala Private Limited. Retrieved January 24, 2025.

of *Phyllanthus emblica* L. (*Āmalakī*), *Terminalia chebula* Retz (*Harītakī*), and *Terminalia bellirica* (Gaertn.) Roxb) (*vibhītakī*) for a period of twelve hours (four *yāma*). The resulting paste is then shaped into small discs (*cakrikā*) and sun-dried. The incineration process (*puṭa pāka karma*) mirrors the one used for *KLS*, as described earlier. However, for the second incineration cycle, expressed pulp juice of aloe vera is prescribed for trituration. This alternating *triphalā* and aloe vera trituration pattern continues for two more cycles. The classical texts of *Rasaśāstra* describe a method known as quenching (*nirvāpa*) to process mica sheets. The process of quenching is done in several specified liquid media (Rai et al., 2010; Wijenayake et al., 2014). However, SM narrates a different approach, using finely powdered mica as the source material. Later in the text, mica's quenching method is also mentioned separately while explaining the preliminary processing of minerals.

An alternate method for *abhraka sindūra* preparation is also explained. This *abhraka sindūra* is suitable for administering for up to forty days. Here, mica powder is added with *tuttha* (blue vitriol) (half the quantity of mica) and ground with the expressed pulp of *Aloe vera* for around fifteen hours (five *yāma*). This is followed by trituration with EJ of *Alternanthera sessilis* (L.) R.Br. ex DC *ponnāṅgani*), *kāñjika* (sour gruel), and lime juice. Once thoroughly ground, the mixture is shaped into small pellets and sun-dried. Finally, these pellets are incinerated using the same process as *KLS*, requiring a total of ten cycles. A third type of *abhraka sindūra* is also explained in *SM*, specifically for the preparation of *pañca ratna abhra sindūra* (*PRAS*).

3.2 *Vaṅga sindūra*

Next, the author unveils the process for *vaṅga sindūra*, an incinerated product of tin metal. For this, powdered sulfur and blue vitriol (approximately 36 grams each) are mixed until a homogenous mixture is obtained. One hundred twenty grams of tin is heated in an iron crucible until it melts. The sulfur and blue vitriol mixture is added to the molten tin in small increments during this process. As the concoction heats, it gradually transforms into a black powder. To this black powder, further add approximately 9 grams (3/4th *karṣa*) each of sulfur and blue vitriol. The heating process continues for three hours. The resulting powder is further processed to prepare *vaṅga sindūra*. The powder is meticulously triturated (ground) with an EJ of *Citrus lemon* (L.) Osbeck (*jambīra*). Following the established method for *KLS* (described earlier), five to six consecutive cycles of incineration are done to achieve the desired consistency for the final product. The quality and potency of *vaṅga sindūra* are visually assessed by its color. The ideal final product will have a vibrant hue reminiscent of the *Hibiscus rosa-sinensis* L. flower, commonly known as the Chinese hibiscus. According to classical textbooks, tin foils are melted and poured into slaked lime water (*cūrṇōdaka*) or a fresh extract of *Curcuma longa* L. and *Vitex negundo* L. After this, the tin foils are heated and mixed with the dry powder of the whole *Achyranthes aspera* L. plant. This process, known as *jāraṇa*, converts the tin foils into a fine powder. This powder is ground with a fresh extract of *Aloe vera* for incineration. (Kale & Rajurkar, 2019).

This variation in processing methods and choice of liquid media is consistently observed throughout SM. Typically, metals with high melting points, such as iron and copper, are primarily processed using the quenching method (*niṛvāpa*). However, in SM, for the preparation of *lōha sindūra*, the author recommends pulverizing iron sheets into a fine powder. Four parts of finely powdered iron (*lōha*) are mixed with one part of blue vitriol (*tuttha*). This mixture is triturated with the expressed pulp of *Aloe vera* (*Aloe vera* (L.) Burm.f.) followed by the addition of EJ of *Citrus lemon* (L.) Osbeck (*jambīra svarasa*). The combined mixture is spread out and sun-dried until it is completely moisture-free. This process of trituration and sun-drying is repeated three more times until the powder transforms into a vibrant red color. Once the desired hue is achieved, the powder is incinerated following the same method previously described for *KLS* to yield the final *lōha sindūra*.

3.3 *Tāmra sindūra*

Next, the author details the method of preparation of *tāmra sindūra.* Approximately 432 g of copper plates are hammered to convert into thin sheets. Equal parts (three *pala* each; approximately 144 g) of powdered sulfur and blue vitriol are triturated with EJ of the fruits of *Citrus lemon* (L.) Osbeck. The resultant paste is then applied on the copper sheets, which are subsequently left to dry under the sun. Once the paste is completely dried, the sheets are ground back into a powder. For the *sindūra* preparation, this copper powder is triturated with EJ of fruits of *Citrus aurantiifolia* (Christm.) Swingle (*Nimbū svarasa*). Finally, the incineration is followed similarly to that for *KLS*. This incineration stage requires three to four cycles until the end product achieves a characteristic copper color.

3.4 *Pañca ratna abhra sindūra*

Lastly, the author introduces *pañca ratna abhra sindūra (PRAS),* a unique blend of five *sindūra* (five incinerated metals). Contrary to its name, which might suggest a combination of precious stones, PRAS incorporates five metals: *kānta lōha, abhraka, vaṅga, lōha,* and *tāmra*. These five *sindūra* are adequately mixed to get a homogenous powder and then placed in a mortar and triturated with EJ of *Citrus aurantiifolia* (Christm), Swingle (*nimbū svarasa*) for

approximately three hours. The incineration process follows the same method used for KLS. However, the second cycle switches to *bhṛṅgarāja svarasa* (EJ of *Eclipta prostrata* (L.) for trituration. This pattern of alternating *nimbū* and *bhṛṅgarāja svarasa* trituration continues for five additional cycles. While the specific color of the final *sindūra* isn't explicitly mentioned, the author offers a descriptive hint, comparing it to the hues of the evening sun. The text concludes by highlighting the primary use of *PRAS* for treating emaciation (*śoṣa*) when it is administered with butter.

4 A glimpse into the therapeutic applications

Abhraka is indicated for the treatment of various conditions, including *kāmala* (~jaundice), *pāṇḍu* (~anemia), *hṛdayarōga* (~heart diseases), *jvara* (~fever), *atisāra* (~diarrhea), and *śoṣa* (~emaciation). Its usage is guided by the principle that it should be administered according to the predominant *doṣa* in combination with appropriate adjuvants. Additionally, *abhraka* is recommended for conditions such as cracked palms and feet, scrotal swelling, *pakva piḍaka* (~boils), burning sensations in the body, and ulcers, where butter and ghee are commonly used as adjuncts. *Vaṅga* (tin) *bhasma* is known for its *dīpana* (~carminative) properties and its ability to alleviate diseases caused by *kapha* and *vāta doṣās*. Due to its *tīkṣṇa* (~sharp) and *uṣṇa* (~hot) properties, it tends to aggravate *pitta* in the body. Generally, *lōha* (iron) *bhasma* is indicated for disorders associated with *pitta* and *kapha*. *Lōha* is categorized under the *tikta gaṇa* (~Group of bitter-tasting substances). The black variety of *lōha* possesses bitter taste and *lekhana* properties. Due to its *madhura vipāka* it is beneficial for eye diseases, while its *śīta vīrya* (cold potency) makes it prone to aggravate *vāta*. *Lōha bhasma* is indicated for conditions such as *pāṇḍu* (~anemia), *kuṣṭha* (~Skin disorders), *kṛmi* (~Parasitic infections), *śopha* (~edema), and *śoṣa* (~emaciation). It primarily acts on *kapha* and *pitta* disorders. *Urukku* (referred to as wootz steel/ Cementite (or iron carbide/ Fe_3C), with high carbon content in it and believed to be originated in the southern part of India) shares similar qualities to *lōha* (iron Fe_3O_4) but is considered more *tīkṣṇa* (~sharp) in its action. *Tāmra sindūra* is considered akin to *amṛta* (~nectar) for diseases caused by *kapha* and *pitta doṣās* . It has *kaṣāya* (~astringent), *tikta* (~bitter), and *madhura* (~sweet) properties and is particularly indicated for *vraṇa* (~wounds and ulcers). *PRAS* pacifies *śoṣa* (~emaciation) and is traditionally administered with butter to enhance its efficacy. A list of the *sindūras* and the respective therapeutic applications are mentioned in Table 2.

5 An overview of methods of processing minerals and other materials

After explaining the *sindūra* preparation methods for five metals, the author further narrates the methods of processing seventeen herbomineral materials. The process of *gandhaka* (sulfur) is narrated first, for which the author narrates a similar process to the classical *kūrmapuṭa* method of sulfur processing explained in *Rasaratnasamuccaya*, *Rasataraṅgiṇi*, and *Rasendracintāmaṇi* (Chandhiruthil et al., 2024; Gunaratna et al., 2023). To the best of our knowledge, none of these texts mentioned the quantity of milk, the liquid medium used to purify sulfur. However, the author of *SM* here opines that the proportion of sulfur to milk should be 1:16 in the *kūrmapuṭa,* which is a significant contribution from SM (Chandhiruthil et al., 2024). Processing of mercury also takes a turn with the choice of liquid medium. The method used is similar to the classical trituration/grinding method. The choice of liquid medium differs from those seen in the classical textbooks (Bhinde & Patgiri, 2021). Here, a decoction of *aṅkōla* (*Alangium salviifolium* (L.f.) Wangerin) is mentioned to remove for *viṣa dōṣa* (~chemical impurities associated with mercury). For *agni dōṣa* (~incineration-related impurities) decoction of *Citraka* (*Plumbago zeylanica* L*). Mala dōṣa* (~physical impurities like silica particles) is removed from trituration in *gṛha dhūma* (~Kitchen soot). Trituration with expressed pulp of *Aloe vera* is mentioned for *sapta kañcuka dōṣa*. Expressed juice of *Piper betel* L. (*tāmbūla svarasa*) is also indicated for this purpose. The duration of each *bhāvana*/trituration is kept standard, i.e., three hours (one *yāma*). A unique method to process *tuttha* (copper sulfate/blue vitriol) is described. The sample of *tuttha* is covered with rat feces (*mūṣika purīṣa*) or smeared with slaked lime and incinerated in a fire hood for six hours. After this process, the *tuttha* sample is steamed in fresh extract of *Alternanthera sessilis* (L.) R.Br. ex DC *(Ponnāṅgaṇi rasa*). *Sasyaka* is separately mentioned in SM for which trituration in fresh lime extract (*Nimbū svarasa*) and expressed pulp juice of *Aloe vera* (L.) Burn.f. (*kaipuniryāsa*) is mentioned for the preprocessing(Ranade, 2023). Classical processing of *taṅkaṇa* (borax) is frying the powdered borax in an open vessel until its moisture is removed and it attains a puffy texture (Rai & Rajput, 2017). However, in SM, steaming in rock salt brine is mentioned. In this reference, the author introduces *ñjāli yantra* (a device) for the preprocessing of *taṅkaṇa.* The narration of *ñjāli yantra* is as follows: the drug is suspended in a cloth bolus from the brim of the vessel, ensuring it is immersed in the liquid medium, which here is salt water. The bolus should not touch the base of the pot. The pot is covered with a lid or cloth. From the descriptions of the *ñjāli yantra*, it resembles the *dōla yantra* (~Where the drug to be processed is placed in a cloth pouch, immersed in a liquid medium, and steamed for three hours), explained

Table 2 Therapeutic applications, adjuvants, and indications of six *sindūra*

Sl No	*Sindūra*	Adjuvants	Indication
1	*KLS*	*Bhasma* with Honey	*Sarva rōga, Pittaja jvara* (*pittaja sanni*), *Grahaṇi*, *Prameha*, *Rājayakṣma*, *Hṛdroga*, *Kaṇṭha roga*, *Visarpa*, *Sarpa viṣa*.
		Fresh extract of the skin peel of *Punica granatum* L.	*Asṛgdara*
		Fresh extract of the skin peel of *Punica granatum* L., along with *Abhraka bhasma*	*Guhya rōga*
		Butter	*Kṣaya, Prameha*
2	*Abhraka sindūra*	1 part: *Jīraka*/*Cuminum cyminum* L, *Lavaṅga* (*Syzygium aromaticum*(L.) Merr.&L.M.Perry, and *Cīnatippali* (*Piper longum* L.) added with ½ part: *Abhraka Bhasma* mixed with Honey	*Kṣaya*
		one part: *Abhraka Bhasma*, and two part: powdered *Elettaria cardamomum* L.Maton (*Ela cūrṇa*) Butter	*Prameha*
3.	*Vaṅga sindūra*	Equal quantity of *Ela (Elettaria cardamomum* L.Maton) and *kāsīsa bhasma* in butter	*Śvitra*
		Vaṅga bhasma in butter	*Keśa cyuti*
		Lavaṅga *(Syzygium aromaticum*(L.)Merr.&L.M.Perry*)* and Ela *(Elettaria cardamomum* (L.) Maton	*Kapha vṛddhi*
		An equal quantity of *Pippali* (*Piper longum* L.) and honey	*Kapha vṛddhi*
4.	*Tāmra sindūra*	*Pippali* (*Piper longum* L.) and honey	Pain
		Jīraka cūrṇa (*Cuminum cyminum* L.), and honey	Pain
5.	Lōha sindūra	Breast milk, Honey, Ghee, *Ārdraka svarasa* (*Zingiber officinale* Roscoe), Different *Kaṣāya yōga* (formulations of decoction), *Trikaṭu* (*Piper longum* L., *Piper nigrum* L., *Zingiber officinale* Roscoe)	Disease not specified
6.	*Pañcaratna sindūra*	*Taila*	*Sthaulya*
		Ghee	*Atisāra* and *grahaṇi*
		Ela Cūrṇa (*Elettaria cardamomum* (L.) Maton) and butter	*Ūrdhva jatrūgata vikāra*
		Kaṇā cūrṇa (*Piper longum* L.) and honey	*Kāsa*
		Kaṇā cūrṇa (*Piper longum* L.) *Lavaṅga* (*Syzygium aromaticum*(L.)Merr.&L.M.Perry*)* *Jīraka* (*Cuminum cyminum* L.)	*Rājayakṣma*
		Ārdraka svarasa (*Zingiber officinale* Roscoe) (5 *neram kazhicīdiḷ añjīdum śūlamokkeyum*)	*Śūla*
		Āmalaki cūrṇa Phyllanthus emblica L. *Navanīta*	*Unmāda*
		Decoction of *Marica* (*Piper nigrum* L.)	*Apasmāra*
		Castor oil (oil of *Ricinus communis* L. seed)	*Raktavāta*, *Jānu śotha*
		Dāḍima svarasa (Fresh extract of skin peel of *Punica granatum* L.) *Kadaḷi kusuma svarasa* (Flower juice of *Musa paradisiaca* L. *Nālikerambu* (*Cocos nucifera* L.)	*Rakta srāva* and *asthi srāva*
		Milk	*Śukra puṣṭi*
		Castor oil (oil of *Ricinus communis* L.) Seed intake/local application	*Vipādika*
		Ghee application and intake	*Śvitra*
		Elettaria cardamomum (L.) *Maton* and an equal proportion of *Rasa sindūra* along with butter, as *lehana* (~Licking of electuaries)	*Kuṣṭa*
		Nazhi (~192 ml) of *taila* (sesame oil), *ghee*, castor oil (oil of *Ricinus communis* L. seed) One *pala* (~48 g) *ela* (*Elettaria cardamomum* (L.) Maton), ½ *pala pañcaratna sindūra,* Keep it in sunlight. Local application	*Pīnasa*

Table 2 (continued)

Sl No	*Sindūra*	Adjuvants	Indication
		Taila is prepared from *nirguṇḍī svarasa* (expressed juice of *Vitex negundo L.*leaves), and as an ingredient (Kalka), PRS is added	*Karṇa śūla*

in classical textbooks of *Rasa śāstra* (Srimannarayana et al., 2010). The total duration of this process is 6 hours. *Abhraka* is processed by a method referred to as quenching, which is the same method described in classical *Rasaśāstra* textbooks (Gopinath & Shivashankar, 2021). For *lōha śōdhana*, quenching is done in different liquid media. The media and the order of quenching differ from the classical processing of iron sheets. The first round of quenching is done in the expressed juice of *Erythrina variegata* L. leaves. The next one is done in butter milk, followed by sesame oil, cow's urine, *kāñjika* in the prescribed order. The powdered *lōha* is triturated in bark decoction of *jambū* (*Syzygium cumini*(L.) (Skeels) until dried. The author opined to use this iron powder for the preparation of *navasāya cūrṇa*. In the traditional process, instead of the extract of *Erythrina variegata* L., decoction of horse gram (*kulattha kvātha*) is indicated (Punchihewa et al., 2022). The processing of copper also differs from the traditional method (Chaudhari et al., 2014; Jagtap & Prajapati, 2013). To process copper, the plates are converted into thin sheets, and afterward, it is soaked in the expressed juice of *tintriṇī* (*Tamarindus indica* L.) for 21 days. After that, twenty-one rounds of quenching are done in *puḷi rasa* (leaf extract of *Tamarindus indica* L.) and *Aloe vera* pulp extract. For *ayaskānta śōdhana***,** quenching is mentioned in the expressed juice of leaves of *Coccinia grandis* (L.) Voigt seven times, followed by quenching in cow urine for seven rounds. For silver (*rajata*), *nirvāpa* in *kulattha kvātha (Macrotyloma uniflorum* (Lam.) Verdc), and *taṇḍula jala* (rice-soaked water) is mentioned for seven rounds in each liquid medium. For realgar (*manaśśila*) and orpiment (*haritāla*) a common processing method is mentioned. Both are processed by steaming in the following liquid media, slaked lime water (*cūrṇōdaka*), cow's urine, *kūṣmāṇḍa svarasa* (expressed juice of fruit of *Benincasa hispida* (Thunb.) (Cogn.), and *kumārī svarasa*, (expressed pulp of *Aloe vera*). On the contrary, classical literature recommends trituration with the expressed juice of *Zingiber officinale* Roscoe (*Ārdraka*) to purify realgar (Panda & Hazra, 2012; Parekh et al., 2021). The text mentions two varieties of *Gauripāṣāṇa: śveta pāṣāṇa* and *ākhu pāṣāṇa*. For *śveta pāṣāṇa*, the process involves steaming in *jambīra svarasa* (expressed juice of lemon), followed by *cūrṇōdaka* (slaked lime water) and fresh juice of *kūśmāṇḍa* (*Benincasa hispida* (Thunb.) (Cogn.) for approximately six hours. There is also a reference to steaming in an alcoholic beverage (*madya*), though the specific type of *madya* is not indicated.

For *ākhu pāṣāṇa*, the process involves steaming in the expressed juice of *Momordica charantia* L. (*kaipayila nīru*), followed by processing in cow's urine, and fresh *kūśmāṇḍa svarasa* (*Benincasa hispida* (Thunb.) (Cogn.) for around six hours. In the classical *Rasaśāstra* treatises, only *Momordica charantia* L. is indicated for the processing of *gaurīpāṣāṇa.* In the case of chalcopyrite (*mākṣika*), quenching in goat's urine using the *ñjāli yantra* is described. Quenching and frying are both indicated in the classical treatises. However, the decoction of *triphalā* is used as a liquid medium for both processes (Taviad et al., 2018). Additionally, for the herb *vatsanābhi* (*Aconitum chasmanthum* Stapf ex Holmes), the process is steaming in cow's milk for approximately six hours. However, in contemporary practice, cow's urine is used, but soaking is often practiced rather than steaming (Deore et al., 2013; Sarkar et al., 2012).

In the context of *guggulu*, *Commiphora wightii* (Arn.) (Bhandari), a steaming process for a duration of six hours is prescribed. The usage of a *tāli yantra* is recommended; however, no specific description of the *tāli yantra* is provided. Based on practical experience with *guggulu śōdhana,* it is suggested that the *tāli yantra* could resemble the *dōḷa yantra* (Maurya et al., 2015; Sarup et al., 2015). This is likely ambiguous as the author previously described the use of the *ñjāli yantra*, which closely resembles the traditional steamer (*dōḷa yantra*). Following the steaming process, the purified *guggulu* is fried in ghee. Guggulu processed through this method is recommended for the preparation of medicinal pills and tablets. The details of the processing of the Herbo mineral materials are listed in Table 3.

6 Tracing the roots of mineralogy and herbology in Kerala

The use of minerals for disease management in Indian medicinal systems is a practice rich in history and tradition (Sarkar & Das, 2021). In Ayurveda, renowned primarily for its herbal medicine, there exists a sophisticated sub-discipline known as *Rasaśāstra*. This ancient science focuses on mercury and extends to the broader alchemical practices of various metals and minerals for medicinal use (Dubey et al., 2024). Practitioners specializing in this field are referred to as *rasavaidya*, often synonymous with *siddha*, indicating their profound expertise in mineral alchemy. Ayurveda, which is originally a component of the

Table 3 Processing of Herbo mineral materials as explained in *SM*

Sl No	Herb/Mineral	Liquid medium	Botanical equivalents	Method
1	*Gandhaka*	Milk	–	*Kūrmapuṭa* (*Ḍhālana*)
2	*Rasa*	Decoction of *aṅkōla* Decoction of *citraka* Pulp extract of *kumāri* Fresh leaf extract of *tāmbūla*	*Alangium salviifolium* (L.f.) Wangerin *Plumbago zeylanica* L. *Aloe vera*(L.) Burn.f *Piper betle* L	Trituration
3	*Tuttha*	Fresh extract of *ponnāṅgaṇi*	*Alternanthera sessilis* (L.) R.Br. ex DC	Steaming
4	*Taṅkaṇa*	*Saindhava jala* (Salt water)		Steaming
5	*Abhraka*	Decoction of *triphalā*	Fruits of Āmalaki (*Phyllanthus emblica* L), *Harītaki* (*Terminalia chebula* Retz), *Vibhītaki* (*Terminalia bellirica*(Gaertn.) Roxb	Quenching
6	*Urukku*	*Pāribhadra svarasa*, Buttermilk, sesame oil, cow urine, *kāñjika*.	*Erythrina variegate* L.	Quenching
		Extract of the bark of *jambū*	*Syzygium cumini*(L.) Skeels	Trituration
7	*Tāmra*	Fresh leaf extract of *puḷi*	*Tamarindus indica* L.	Soaking 21days Trituration 21 rounds
8	*Ayaskānta*	Expressed leaf extract of *Bimbika,* Cows urine	*Coccinia grandis* (L.) Voigt	Quenching
9	*Rajata*	*Kulattha kvātha, Taṇḍula jala*	Decoction of horse gram Soaked strained rice water	Quenching
10	*Manaśila*	*Cūrṇōdaka*, Cow's urine, *Kūṣmāṇḍa svarasa,* *Kumāri svarasa*	Slaked lime water *Benincasa hispida* (Thunb.) Cogn. *Aloe vera* (L.) Burn.f.	Steaming
11	*Haritāla*	*Cūrṇōdaka*, Cow's urine, *Kūṣmāṇḍa svarasa,* *Kumāri svarasa*	*Slaked lime water, Benincasa hispida* (Thunb.) Cogn. *Aloe vera* (L.) Burn.f.	Steaming
12	*Sasyaka*	Cows urine	-	Steaming– 7 times
13	*Gauripāṣāṇa*	Extract of *jambīra*, *cūrṇōdaka* *kūṣmāṇḍa*	*Citrus limon* (L.) Osbeck Slaked lime water *Benincasa hispida* (Thunb.) Cogn.	Steaming
		Leaf extract of *kaipayila neeīru* Cows urine, Extract of *kuṣmāṇḍa*	*Momordica charantia* L., *Benincasa hispida* (Thunb.) Cogn.	Steaming
14	*Mākṣika*	Goat's urine		Quenching
15	*Vatsanābhi*	Cow's urine		Steaming
16	*Irivi*	Cow's urine		Steaming
17	*Guggulu*	Expressed juice of the leaves of *nimba*. Fresh extract of the rhizome of turmeric	*Azadirachta indica* A.Juss *Curcuma longa* L.	Steaming

Atharvaveda, one of the ancient *vedas* comprises texts composed in Sanskrit by ancient *Ṛiṣis*, who formulated their writings based on empirical evidence and experiential observations. Over time, Sanskrit-centric Ayurvedic practitioners emphasized institutions like the All India Ayurvedic Vidyapeeth (established in 1907) that revered Sanskrit texts as the definitive sources of Ayurvedic knowledge, including seminal works like *Caraka Saṃhitā* and *Suśruta Saṃhitā*, among others (Kanagarathinam & Lourdusamy, 2023). Notably, *Rasaratnasamuccaya* stands out as a pivotal reference for *Rasaśāstra*, accompanied by texts such as *Rasārṇava, Rasahṛdayatantra,* and *Rasataraṅgiṇi*, which gained popularity over time, shaping Ayurvedic mineralogy profoundly through the contributions of northern India's *rasavaidyās*.

Though the knowledge of minerals by humans is as old as 8000 years and is documented in *Ṛgveda*, the first known use of mercury (externally) is by Suśruta, and the first internal use by Vāgbhaṭa (in *Aṣṭāṅgahṛdayaṃ*) (PV Sharma, 2017). The mercury-centric iatrochemistry developed in the medieval period, likely around the 4th–8th century CE, with Nāgārjuna and Agastya as its iconic preceptors in the Northern and Southern parts of India, respectively.

The growth and spread of this science in this period were also augmented by the *Tantraśāstra*, which had confluences of *Śaiva* and *Bauddha* schools. Despite its origin and flourishing around the same period, mineralogy was relatively unexplored by Kerala's original vernacular literature, except for universally accepted polyherbal preparations and those approved by the greater triad of Ayurveda. NVK Varrier identifies the commercial isolation of Kerala from the Northern parts of India after the 5th–6th century CE and the subsequent Aryan invasion as one of the key factors behind this phenomenon (Varrier, 2013). This hesitancy to include minerals was further magnified (as observed by PV Sharma) by the reduced availability of native minerals, lack of technical know-how regarding their extraction and purification methods, and the rising safety concerns about the medicines (Sharma, 2017, p. 551). However, down South, in and around Tamil Nadu, the 18 Siddhas (10th century CE), disciples of Agastya, preserved this science, and their followers updated it, developing a robust knowledge system (Sharma, 2017, p. 474). Though these techniques percolated into Kerala as well, they were not absorbed into mainstream medicine till late, probably because the *Rasa* practitioners belonged to the backward castes of the time, like *Mannan,* and *Velan* communities (Sharma, 2017, p. 551). SM was a brave venture because it was authored by an *Aṣṭavaidya* and exclusively dealt with a subtopic that the elite community was reluctant to discuss.

It is believed that the *siddhas*, including Agastya and his followers, have authored more than 100,000 texts. Notable among these are works such as *Agastiyār Peruntirattu*, *Akastiyar Vaittiya Kāviyam*, *Agastiyār Kuruntirattu*, *Urōmarisi* 500, *Maruttuva Kaṇṇāti*, *Maṇi Nālāyiram*, and *Centūram* 300, which represent just a small fraction of their prolific contributions. Among the earliest Malayalam texts on this subject is *Sindūra Mañjari*. The term "*sindūra*" comes from "*Cendūram*," of the *siddha* system, which denotes an incinerated product. Examples include *Caṇḍamāruta cendūraṃ* (Justin et al., 2022), *Maldevi cendūraṃ* (Shanmugam et al., 2022), and *Liṅga cendūraṃ* (Al-Ansari et al., 2021). Subsequently, numerous publications on similar themes emerged. For instance, '*Cintārmaṇi nīṭṭumurakaḷuṃ auṣadhaprayōgaṅgaḷuṃ'* by N. Kumarapillai, published in 1987, is one of these works. However, unlike the SM text, which focuses primarily on mineral medicine, most of these books explore a wide range of therapeutic applications (mineral and herbal) across various disease domains.

6.1 Contextual and conceptual variations in the SM

The manuscript is written in simple Malayalam language, making it accessible to readers at all levels, especially beginners seeking to understand the processing of metals and other materials for therapeutic purposes. This book serves as a valuable resource for those new to the field, offering a clear and straightforward explanation of the procedures involved in processing and utilizing metals in patient care. Unlike classical treatises, which elaborate on over 30-40 Bhasma preparations (many of which are not commonly used therapeutically), this text focuses on just five important *sindūras*.

6.2 Features of materials (minerals/metals) described in SM

Notably, metals such as *svarṇa* (gold) and *rajata* (silver) are not covered in detail, except for briefly mentioning the method of preprocessing silver in the later sections. However, the incineration process for these metals is omitted, likely due to the prohibitive cost of *svarṇa* and *rajata*, making them challenging to procure. This practical consideration aligns with the book's focus on metals and materials more frequently used in therapeutic contexts. Simplified narratives and a more practical approach to processing metals and materials distinguish this manuscript from classical *rasaśāstra* treatises. Trituration or grinding is employed for the pulverized metals, reflecting the practices commonly used by pharmaceutical companies today. This method significantly reduces the workload, making it feasible to process larger quantities, a practical advantage over the classical quenching process, which can be impractical for larger volumes. Although research on the rationality and uniqueness of these textual references are limited, Reshma et al. during 2013–2016, studied the process of *abhraka bhasma* preparation explained in *SM* and compared it with the method described in classical *rasaśāstra* textbooks like *Rasaratnasamuccaya* and found notable differences in the elemental composition of the final products compared to traditional methods (Reshma & Tharalakshmi, 2016). This underscores the unique contributions of the text to the field of traditional medicine in Kerala.

6.3 Overview of incineration methods detailed in SM

The total heat energy required for preparing any *bhasma* in the traditional method is expressed in terms of *puṭa*. In the absence of temperature-recording devices, the desired heating rate, the maximum temperature attained and maintained, and the subsequent cooling of the mineral were achieved by the judicious selection of the *puṭa,* which was usually cow dung cakes (Pathiraja et al., 2014). More than ten types of *puṭa* are listed in the classical books. In *SM*, only *gajapuṭa* (where a thousand cow dung cakes are incinerated to achieve the desired temperature of 600 (Parmar

et al., 2010) to 900 °C (Wele et al., 2021) to prepare the *bhasma* is mentioned. Whereas classical texts described *kukkuṭapuṭa* and *varāhapuṭa* for preparing *svarṇa mākṣika bhasma*, and *kapōtapuṭa* is advocated in the preparation of *tāmra Bhasma* (Jagtap et al., 2012), while *laghupuṭa* is used for *rajata bhasma* (Chaturvedi & Jha, 2011). In traditional practice, the triturated metal product is typically formed into small pellets before incineration to ensure uniform exposure to heat during the process. However, in SM, during the preparation of *KLS*, the author specifies that the triturated metal be converted into pills before incineration. However, in other text sections, he also refers to shaping the material into coins or pellets (Pal et al., 2014). Another critical distinction is the reduced number of incineration cycles (puṭa) for the preparation of different types of *sindūra* in SM. For example, while classical methods for preparing *lōha bhasma* typically require at least twenty cycles of *puṭa*. In some cases, the procedure may prolong to thirty cycles of *puṭa* (Punchihewa et al., 2022; Singh et al., 2016). SM simplifies this process by reducing the number to a maximum of eight *puṭa* for *KLS*.

6.4 Other salient features in *SM*

In the context of iron (hematite ore), the author suggests using the fine powder obtained after processing iron to prepare *navāyasa cūrṇa* (*NC*), a herbomineral formulation used in the management of anaemia (Sharma et al., 2017). To the best of our knowledge, this may be the only reference that specifies the type of *lōha* that has to be used to prepare *NC*. In the preparation of *abhraka sindūra, SM* omits the intermediate process known as *dhānyābhraka nirmāṇa*, which is typically used to reduce the particle size of *abhraka* in classical methods(Kantak et al., 2020; Wijenayake et al., 2014). Instead, the manuscript directly takes pulverized *abhraka* for the preparation of *abhraka sindūra*. Similarly, for the preparation of *vaṅga sindūra*, the intermediate process of *vaṅga jāraṇa*, which is detailed in classical texts like the *Rasaratnasamuccaya,* is not described in *SM* (Kale & Rajurkar, 2019).

The common misconception about herbomineral preparations is that they can be prescribed for any disease without considering the *dōṣa* and the condition of the patient. The author of *SM* clearly negates this theory by narrating the importance of considering the *daśavidha rōgī pārīkṣya* (*DRP*) of the patient. The *DRP*, which is explained in *Aṣṭāṅgahṛdaya* by Vāgbhaṭa has to be considered before prescribing the medicine (Y. S. Aswathy et al., 2024). The author also opines that they come under the *vyādhi viparīta cikitsa* (one of the three types of treatment modalities explained by Vāgbhaṭa that treats the specific pathology, not its cause).

6.5 Summary of the herbal drugs discussed in *SM*

By the time the text was written, the processing of metals and minerals was already well established in northern India. However, the author has notably explored alternate liquid media that are freely available in Kerala to process the mineral or herbal materials. Even if effective, the herbal drugs mentioned in the text may pose challenges for procurement in northern India due to their variability in habitat. For example, the plant *Alternanthera sessilis* (L.) R.Br. ex DC, as referenced in the text, is primarily found in the southern parts of India. Similarly, *Coccinia grandis* (L.) Voigt, recommended to purify *kānta lōha*, is predominantly grown in Kerala, Karnataka, and Maharashtra. The expressed pulp of *Aloe vera* (L.) Burn.f is predominantly used to process minerals, with *Citrus lemon* (L.) Osbeck is the second most utilized (Fig. 1). The details of the botanicals (including the Habitat and IUCN status) mentioned in the SM are listed in Table 4. Future research should focus on exploring the choice of liquid media, which could lead to new insights into how these liquids influence the transformation processes of minerals. The multiregional practicality of the text needs to be evaluated further. In our years of experience in mineral processing, we have observed a correlation between different minerals and the botanicals used in their processing. This is not just a systematic approach but also demonstrates a deeper understanding of the plants that can be utilized in mineral processing. The use of botanicals in mineral processing is illustrated in Fig. 1.

6.6 Limitations of the text

One of the main limitations of the manuscript is its language, as it is written in Malayalam, restricting access to those who are proficient in the language and can only fully comprehend the processes described. While the minerals in the text are categorized into various subtypes, there are no detailed descriptions of their physical characteristics. For example, for the two varieties of *Gaurīpāṣāṇa* that are mentioned, there is no explanation of the fundamental differences between them. Similarly, *abhraka* is classified into subtypes based on color: black and white. The text notes that the black variety is used for treating *vāta* disorders, while the white variety is prescribed for *pitta* disorders. However, beyond color, no other distinguishing characteristics are given to verify the authenticity of these minerals. This pattern of insufficient descriptive detail persists throughout the text.

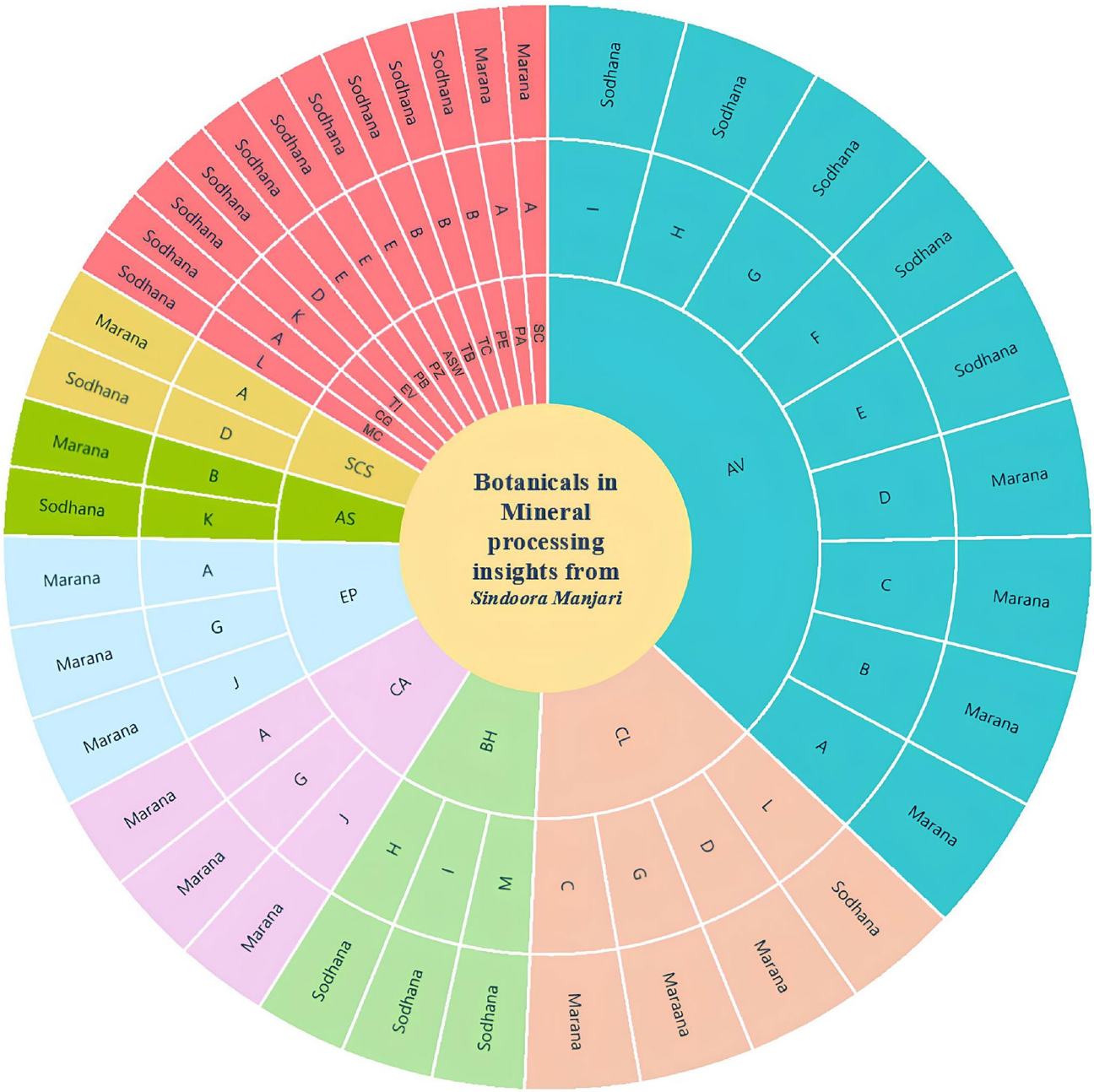

Fig. 1 Botanical descriptions in mineral processing techniques in *'Sindūra Mañjari'*. **A** *Kānta lōha*; **B** *Abhraka*, **C** *Vaṅga*; **D** *Lōha*; **E** *Rasa*; **F** *Sasyaka*; **G** *Tāmra*; **H** *Haritāla*; **I** *Manaśila*; **J** *PRAS*; **K** *Tuttha*; **L** *Ākhu pāṣāṇa*; **M** *Pāsāṇa* (*Śveta, Ākhu*). **AV**: *Aloe vera* (L.) Burn.f; **EP**: *Eclipta prostrata* (L.)L.; **SCS**: *Syzygium cumini* (L.) Skeels; **SC**: *Syzygium caryophyllatum* (L.) Alston; **PA**: *Phyllanthus amarus* L.; **CA**: *Citrus aurantiifolia* (Christm); **PE**: *Phyllanthus emblica* L; **TC**: *Terminalia chebula* Retz; **TB**: *Terminalia bellirica* (Gaertn.) Roxb; **AS**: *Alternanthera sessilis* (L.) R.Br. ex DC; **CL**: *Citrus lemon* (L.) Osbeck; **ASW**: *Alangium salviifolium* (L.f.) Wangerin; **PZ**: *Plumbago zeylanica* L; **PB**: *Piper betle* L; **EV**: *Erythrina variegate* L.; **TI:** *Tamarindus indica* L.

7 Conclusion

Sindūra Mañjari presents a distinctive approach to the processing and therapeutic application of metals and minerals within Ayurvedic medicine. By simplifying classical alchemical methods and focusing on locally available herbal media, particularly those found in Kerala, the text offers a more accessible and practical approach to metal processing and incineration. The book's adaptability, regional specificity, and focus on efficacy uniquely contribute to Ayurvedic literature, offering valuable insights into alchemical preparations' simplified yet potent application.

Table 4 Botanicals used for the processing of minerals as per SM

Sl No	Sanskrit name	Botanical Name	Family	Local name	Habitat[a]	Habit	Part used	IUCN Status
1	*Kumāri*	*Aloe vera* (L.) Burn.f	Asphodelaceae	*Kaṭṭārvazha*	Andhra Pradesh Karnataka Kerala Maharashtra Rajasthan	Herb	Leaf	Not reported
2	*Bhṛṅgarāja*	*Eclipta prostrata* (L.)	Asteraceae	*Kaiyōnni*	Throughout India in marshes, rivers, and lakes or on the foothills of the Himalaya (Satish et al., 2013)	Herb	Whole plant	LC
3	*Jambū*	*Syzygium cumini* (L.) Skeels	Myrtaceae	*Ñjāval*	Andhra Pradesh Karnataka Kerala Madhya Pradesh Maharashtra Arunachal Pradesh, Delhi, UP, Panjab, Assam, Meghalaya	Tree	Seed, bark, leaf	LC
4	*Jambū bheda*	Syzygium *caryophyllatum* (L.)Alston	Myrtaceae	*Ñjāra*	India (Kerala, Karnataka, Tamil Nadu, Goa); Sri Lanka (Devika & Bachan, 2024)	Tree	Seed, bark, leaf	VU
5	*Bhūmyāmalaki*	*Phyllanthus amarus* L	Euphorbiaceae	*Kīzhārnelli*	Andhra Pradesh Karnataka Kerala Odisha Tamil Nadu	Herb	Whole plant	Not reported
6	*Nimbūka*	*Citrus aurantiifolia* (Christm.) Swingle	Rutaceae	*Cerunāraṅga*	Kerala Maharashtra Tamil Nadu	Small tree	Fruit	Not reported
7	*Āmalaki*	*Phyllanthus emblica* L	Euphorbiaceae	*Nellikka*	Andhra Pradesh Karnataka Kerala Madhya Pradesh Maharashtra Arunachal Pradesh, Delhi, UP, Panjab, Assam, Meghalaya Tamil Nadu	Tree	Fruit	LC
8	*Harītaki*	*Terminalia chebula* Retz	Combretaceae	*Kaḍukka*	Andhra Pradesh Karnataka Kerala Madhya Pradesh Maharashtra Arunachal Pradesh, Delhi, UP, Panjab, Assam, Meghalaya, Tripura	Tree	Fruit	LC
9	*Vibhītaki*	*Terminalia bellirica*(Gaertn.) Roxb	Combretaceae	*Tānnikka*	Andhra Pradesh Karnataka Kerala Madhya Pradesh Maharashtra Arunachal Pradesh, Delhi, UP, Panjab, Assam, Meghalaya, Tripura	Tree	Fruit	LC
10	*Matsyākṣaka*	*Alternanthera sessilis* (L.) R.Br. ex DC	Amaranthaceae	*Ponnāṅganni cīra*	Andhra Pradesh Karnataka Kerala Madhya Pradesh Maharashtra Tamilnadu	Herb	Whole plant	LC
11	*Jambīra*	*Citrus lemon* (L.) Osbeck	Rutaceae	*Mātaḷanāraṅga*	Assam, Gujarat, Manipur[b]	Small tree	Fruit	Not reported

Table 4 (continued)

Sl No	Sanskrit name	Botanical Name	Family	Local name	Habitat[a]	Habit	Part used	IUCN Status
12	*Japa*	*Hibiscus rosa-sinensis* L	Malvaceae	*Cembarati*	Kerala , Tamilnadu Maharashtra Punjab	Shrub	Flower, leaf	Not reported
13	*Haridra*	Curcuma longa L.	Zingiberaceae	*Mañjaḷ*	Kerala , Maharashtra Arunachal Pradesh Odisha	Herb	Rhizome	DD
14	*Nirguṇḍi*	Vitex negundo L.	Verbenaceae	*Karinocci*	Andhra Pradesh Karnataka Kerala Madhya Pradesh Maharashtra Arunachal Pradesh, Delhi, UP, Panjab, Assam, Sikkim Meghalaya,Tripura	Small tree	Leaf	LC
15	*Aṅkōla*	*Alangium salviifolium* (L.f.) Wangerin	Alangiaceae	*Aṅkōla*	Andhra Pradesh Karnataka Kerala Tamilnadu Maharashtra Odisha Kashmir	Small tree	Root	LC
16	*Citraka*	*Plumbago zeylanica* L	Plumbaginaceae	*Koduvēli*	Andhra Pradesh Karnataka Kerala Madhya Pradesh Maharashtra Arunachal Pradesh, Delhi, UP, Panjab, Assam, Sikkim Meghalaya,Tripura	Shrub	Root	Not reported
17	*Tāmbūla*	*Piper betle* L	Piperaceae	*Vettila*	Sikkim Arunachal Pradesh, Meghalaya Assam Nagaland Uttar Pradesh Mizoram Manipur Tripura	Climber	Leaf	Not reported
18	*Pāribhadra*	*Erythrina variegate* L.	Fabaceae	*Muḷmurikk*	Andhra Pradesh,assam, Kerala, Maharastra, Odisha, Uttar Pradesh[c]	Tree	Leaf, Bark	Not reported
19	*Ciñca*	*Tamarindus indica* L	Caesalpiniaceae	*Puḷi*	Karnataka Kerala Tamilnadu Panjab UP	Tree	Fruit, leaf	LC
20	*Bimbika*	*Coccinia grandis* (L.) Voigt	Cucurbitaceae	*Kōvakka*	Andhra Pradesh Karnataka Kerala Madhya Pradesh Maharashtra Arunachal Pradesh, Delhi, UP, Panjab, Assam, Sikkim Meghalaya, Tripura	Twiner	Fruit	Not reported
21	*Kulattha*	*Macrotyloma uniflorum* (Lam.) Verdc	Fabaceae	*Mutira*	Karnataka Kerala Tamilnadu Panjab UP	Herb	Seed	LC
22	*Kūṣmāṇḍa*	*Benincasa hispida* (Thunb.) Cogn	Cucurbitaceae	*Kumbaḷam*	Kerala West Bengal Panjab UP	Twiner	Fruit	Not reported

Table 4 (continued)

Sl No	Sanskrit name	Botanical Name	Family	Local name	Habitat[a]	Habit	Part used	IUCN Status
23	*Ārdraka*	*Zingiber officinale* Roscoe	Zingiberaceae	*Iñji*	Kerala Maharashtra	Herb	Rhizome	DD
24	*Kāravella*	*Momordica charantia* L.	Cucurbitaceae	*Kaippakka*	Kerala Karnataka West Bengal Panjab UP	Climber	Fruit	Not reported
25	*Vatsanābhi*	*Aconitum chasmanthum* Stapf ex Holmes	Ranunculaceae	*Vatsanābhi*	subtropical, alpine and subalpine regions of Himalaya (Ali et al., 2019)	Herb	Tuber	CR
26	*Guggulu*	*Commiphora wightii* (Arn.) Bhandari	Burseraceae	*Gulgulu*	Rajasthan Panjab UP	Tree	Resin	CR

[a]India Flora Online. (n.d.). Retrieved October 11, 2024

[b]Citrus lemon (L.) Burm. f. | Species. (n.d.). India Biodiversity Portal. (n.d.)

[c]Erythrina Variegata L. | Species. (n.d.). India Biodiversity Portal, n.d.

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