



## Kharpara, a Forgotten Mineral Drug of Ayurveda: A Review

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### Review Article

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### Abstract

**Introduction:** *Kharpara* is an ore of (*Yashada*) Zinc. In Ayurveda, a description of *Kharpara* (ore) and *Yashada* (extracted metal from *Kharpara*) is also mentioned. *Kharpara* is a highly-negligible *Rasa Dravya* (Drug) in Ayurveda these days.

**Aim & Objective:** To find the description and importance of *Karpara* in Metallurgy and Ayurveda. Also, determine the beginning era of extraction of *Yashada* from *Karpara* in ancient India.

**Data Source:** classical text of *Rasa Shastra* & allied branches and various online and offline research journals on Ayurveda & Metallurgy.

**Review Method:** Word "*Karpara*" and "*Rasaka*" are used to search all aspects, such as types of categorizations among *Rasa Dravya*, classification, pharmacological property, the process of *Shodhana* (Purification), *Marana* (Incineration), *Satvapattana* (Extraction) and *Grahyaagrahyatva* (Acceptable-non acceptable qualities) of *Kharpara* is mentioned in *Rasa Shastra* texts and Ancient Literature.

**Result and Conclusion:** Discovery of *Pittala* (Brass) brings a revolution in the metal industry because it diminished the use of *Kansya* (Bronze). *Pittala* is an alloy of Copper and Zinc. But it is very difficult to answer which one is the real source of Zinc in Brass, either *Kharpara* or Zinc Metal. *Kharpara* is an indirect source of three *Bhasmas* i.e., *Yashada*, *Pittala* and *Varta* (Bronze) Thus, in this review study, every aspect of *Kharpara* is summarized such as the historic review, types, pharmacodynamic properties, pharmaceutical processing of *Karpara Bhasma* procedures, dose and formulations of *Kharpara* from different sources. The age of the beginning of *Karpara* used by Indians is not traceable.

**Keywords:** *Kharpara*; *Rasaka*; Zinc Oxide; *Bhasma*

## Introduction

Rasa Shastra is a very peculiar branch of Ayurveda, as it has various sub-branches, such as chemistry, metallurgy, gemmology, pharmaceutical science and toxicology.

Metallic preparations have become an integral part of Ayurvedic therapeutics due to their additional advantages like smaller doses, quick action etc. *Kharpara* or *Rasaka* (Zinc ore) is one such mineral, which is being advocated in different forms in the management of various diseases. Most of the Acharyas placed it in *Maharasa Verga* (A group of 8 drugs that helps in the preparation of mercury-containing medicine) [1-3]. *Rasaka Satva*, (Zinc) is extracted from *Kharpara*, called *Yashada* or *Jasad*. It is placed in *Puttiloha verga* [4] (A category of metals that has a foul smell on melting). *Yashada* and *Parad* (mercury) are two thermo-labile substances and by various processing, it is converted into a thermo-stable form for further use in medicine and transmutation of metals or conversion of metallic nature. A detailed description of *Yashada* is available in the 13th-century book known as *Ayurved Prakash*, written by Madhav Upadhyay [5]. While much before this time utensils, weapons and artefacts of *Pittala* or *Riti* (Brass), which is an alloy of *Yashada* and *Tamra* (Copper) are found in used from the Bronze age or Chalcolithic Age. *Pittala* metal is *Mishra Loha* (alloy) made up of *Yashada* (Zinc) and *Tamra* (Copper). The beginning of the use of copper and brass tools, medical devices and surgical instruments are exclusively found in practice from the Vedic and Samhita periods. Thus, it is quite an amazing fact that brass has a much longer history than zinc which is published in most of the modern textbooks of Rasa Shastra. In fact, brass has a much longer evident based history than zinc. Brass is produced either by smelting copper ores containing zinc or copper and zinc ore in reduced condition or by mixing copper and zinc metals.

Zinc is silvery-greyish in colour. It is a widely utilized industrial metal and an important constituent of so many alloys. Zinc is an essential microelement for zoonotic. Zinc (Zn) is generally found in veins in association with galena, chalcopyrite, iron pyrite, silver and cadmium and other sulphide ores [6]. Important minerals of Zinc are sphalerite or zinc blende, smithsonite, calamine, zincite, willemite and franklinite. Sphalerite or zinc blende is the most important zinc ore as it contains 64.06% zinc. As it boils at around 900°C, which is lower than the temperature it can be smelted at, therefore it is difficult to smelt this metal. For pure zinc production, therefore distillation technology was developed.

## Materials and Methods

The description of *Kharpara* has been searched through different accesses source i.e., Google Scholar, Scopus, Online Ayurvedic journals and classical textbooks of Rasa Shastra,

etc. But sufficient research information about *Kharpara* is not available on the internet. In this article description of *Kharpara* is collected mainly from Rasa Shastra texts.

## Classical Textual Perspective

*Kharpara* or *Rasaka*, mainly deals with *Lohasiddhi* (Transformation of lower metals into higher metals) and *Dehasiddhi* (Makes the body healthy & strong). During the period of Nagarjunas, a great scholar of Rasa Shastra (8th – 9th century BC) it was used extensively for *Lohasiddhi* [7]. *Kharpara* is not mentioned separately during the Samhita period. (2th – 6th century BC) But in Charaka Samhita [Kushtha Chikitsa Adhyaya 7/108], two types of *Tuttha* are mentioned in the formulation of *Titekshvakadi Taila*, which has been explained by “Chakrapanidatta” as *Mayur Tuttha* and *Kharpariya Tuttha* [8]. In ancient texts, the description of *Kharpara* is found as a type of *Tuttha*. *Kharpara Satva* (Zinc metal) is obtained from the extraction of [ZnCO<sub>3</sub>], [ZnS] and [ZnO] which is an ore of Zinc i.e., Zinc. But in the 12th century, as per Rasarnava and other texts, it has been described by the name of *Rasaka* [3]. In Rajanighantu, two types of *Tutta* are given (i.e., *Tuttha* & *Kharpari tuttha*) along with Six synonyms of *Kharpari Tuttha* [9]. *Tutta* is Blue vitrol [10] and *Kharpara* is Zinc Calamine or Zinc carbonate [11].

It was mentioned in Kautilya's Arthashastra, 4th century BC text, a superintendent of mines in the Mauryan Empire was posted to control over mines. The text mentions the occurrence of silver ores with *Naga* (lead) and *Anjan* (zinc) [12].

## Archaeological Perspective

Archaeological records reveal that the production of Zinc metal began in the 2nd half of the 1st BC. Though, commercial production was ramped up in the early medieval times [13]. In India, Zinc smelting is only known in Zawar in Rajasthan. The antiquity of mining of various types of ores in Rajasthan since back to the Bronze Age (4<sup>th</sup> BC). P.T. Craddock and K.T.M. Hegde 1983 carried out extensive investigations both for ancient mining and smelting of zinc sites at Zawar. They discovered evidence of mining and furnaces used for zinc smelting, and primitive smelting retorts at Zawar. The age detection technology i.e., radiocarbon dating of mining instruments articles strongly suggests that mining and metallurgical activity was performed during the early historic period and medieval times [14] Major deposits of Zinc ore are found in the Aravallis. Sphalerite ore in the form of veins in association with galena and copper-bearing deposits. Evidence suggested that both extensive open-pit mining and underground method was carried out. The entire valley of the Tiri in Zawar is spread by massive dumping of slag and earthen retorts indicating a long tradition and commercial

production of zinc. Findings of radiocarbon dating conform activity belongs to a period of the 12<sup>th</sup> and 18<sup>th</sup> century.

### Comparison of Findings of Study and Rasa Shastra Procedure

- Seven distillation furnaces square-shaped having a size of 66x69 cm was discovered. Two-chambered furnaces, separated by a thick perforated plate of clay into upper and lower. The firing temperature was also recorded based on the degree of verification and it was recorded at 1200-1250 °C [15]. This high heating arrangement or device was used for *Satvapatan* (metallurgical) propose and it is mentioned as '*Paatala Kothi*' in Rasa Ratana Sammurchaya [16].
- Brinjal-shaped earthen retorts, filled with charge, were fixed on the perforated plate in an inverted position in the upper chamber. Dimension of retorts, ranging from 20 to 35 cm in length and 8 to 12cm in diameter. About 36 retorts were arranged in each furnace for smelting and they were heated for 3-4 hours. A retort was made in two parts and luted together after filling the charge. The retort is mentioned as '*Vrintak Musa*' in Rasa Ratana Sammurchaya [17].
- The charge was prepared by crushing and grinding of ore and then mixed with some organic material and cow dung. The mixture was rolled into tiny balls and left under the sun for drying. These dried balls are then kept in retorts after drying. The opening of the snout was obstructed by a wooden match. A thin wooden stick was inserted in the narrow opening of retort, which perhaps prevented the escape of charge before heating when they are initially inverted in the furnace and might also facilitate the escape of zinc vapour formed after melting. In Rasa Ratana Sammurchaya the three fundamental methods of zinc extraction from ore are described and a charge is a mixture of some herbs i.e *Laksha*, *Guda*, *Haritaki*, *Haridra* etc, and borax. In the last method some modification is described which is quite similar to the aforesaid procedure explained by the team of archaeologists.
- This procedure is called 'distillation of Zinc' in metallurgical science and Iatrochemistry the process is known as '*Karphara Satvapatan*'. The appearance of extract has features similar to tin [18].

### The Analytical Finding of Ancient Artefact and Mining Debris

Bronzes found in Harappan only have a few small percentages of zinc. From Kalibangan, another Harappan site

in north Rajasthan, a copper spearhead was found containing only 3.4% of zinc [19] The archaeological record indicates that in the 2<sup>nd</sup> BC the percentage of zinc started increasing and intentional use of brass appears on the scene. In Taxila (Now, in Rawalpindi of Pakistan), a large variety of metal objects including those copper, bronze, brass and iron [20]. Several brass objects datable from the 4th century BC to 1st century AD have been discovered. Evidence of real brass was discovered recently at Senuwar in the Ganga Valley. Since zinc could change the colour of copper and impart it a golden glitter, it was preferred for making Hindu, Buddhist and Jain icons throughout the historical period.

This process is aimed at separating the metallic compound from the undesirable gangue and non-metallic inclusions in the ore manual separation of non-metallic inclusions from the matrix. By doing this, sphalerite [(Zn, Fe) S] components were separated which was easy to identify based on the colour. Roasting sphalerite to zinc oxide is represented in this equation:  $2ZnS + 3O_2 = 2ZnO + 2SO_2$ . Roasting was done on traditional fuels such as wood and charcoal fire until the odour of *Gandhaka* (sulphur) disappeared. The crushed ore was mixed with fresh cow dung and other substances, and after that shaped into balls. Finally, this ball-shaped chunk, which is basically the charge, was dried under a shade. After drying, the charge was finally ready for the smelting process.

The temperature inside the retort was allowed to go up to around 1100 °C for the reaction to be  $ZnO + CO: Zn + CO_2$  [21].

### Description of *Kharpara* in Rasa Shastra

Description of *Kharpara* like its categorization, type, *Shodhana* (Purification of drug) [22], *Marana* (incineration of mineral or metal) [23] *Stavapatan* [24], doses, indication in diseases and, formulations are mentioned in Ayurvedic text viz, Rasarnava, Rasendra Chudamani, Rasa Prakash Sudhakara, Ananda Kanda, Ayurveda Prakasha, Rasa Ratna Samucchaya, Brihad Rasa Raja Sundara, Rasa Jala Nidhi, Rasa Tarangini, etc.

It is stated in the classical book of Rasa Shastra, a well-versed person in the different procedures of Rasa Shastra is capable of making the Rasa (Mercury) and *Kharpara* (Ore of Zinc) thermostable that can acquire the *Siddhi* (magical power) to make that *Dehavada* & *Lohavada* like a slave [25].

**Categorization of *Kharpara*:** Different authors have given their opinion on the classification of *Kharpara* under *Maharasa* and *Uprasa*, *Swarnadi Varga*, *Rasa Varga*.

Varga	Classics of Rasa Shastra
Maharasa	Rasarnava [3], Ras Prakash Sudhakar [2], Rasaratna sammuchaya [1], Bhaisajya Ratnavali [26], Rasa Bindu [27], Rasa Hridaya Tantram [28], RasaMitra [29]
Uprasa	Aurveda prakasha [30], Rasendra sara sangraha [31], Rasa manjari [32], Ananda Kanda [33], Dhanvantari Nighantu [34], Bhav Prakash Nighantu [35]
Swarnadivarga	Rajnighantu [36]
Dhatu-updhatu varga	Shaligram Nighantu [37]
Updhatu	Rasataringini [38], Sharangdhara Samhita [39], Rasendra Sambhav [40]

**Table 1:** Categorization of *Kharpara* mentioned in different Rasa Grantha (classics of Rasa Shastra).

**Synonyms:** *Gobhadra, Kharpara, kshitikita, Rasodbhava, Kharpara, Netrarogari, Reetikrita, Kharpariyak, yashadkarana, Tamraranjaka* [3]; *Chakshhushya, Amritotpanna, Kharpari, Darvika, Tuttha, Kharparituttha, Kharparitutthaka, Yashadodhatu* [37]; *Kharpari, Tuttha kharpari, Amritsambhava* [33]; *Tutthaka, Rasa tutthaka* [35]; *Tutthakharparika* [36]; *Ritikrita and tamraranjaka* [29].

**Vernacular names [41]:** **Hindi-** *Khapariya, Kharpar, Rasaka;* **English-** Blackjack; **Sanskrit-** *Kharpar;* **Bangoli-** *Kharpar;* **Marathi-** *Kalkhapari, Kalkhaparo;* **Panjabi-** *Khapariya;* **Gujrati-** *Khapriyunkalu, Khapariyo.*

**Bheda (Types) of Kharpara:** Different types of classification

Type of Kharpara		Rasa Shastra Text
Numbers	Name	
3	1. <i>Mritikabha</i>	Rasarnava [3], Rasendra sara sangraha [29], and Rasamritam [42]
	2. <i>Gudabha</i>	
	3. <i>Pashanabha</i>	
2	1. <i>Dardur</i>	Ayurveda prakasha [30], Rasendra Chudamani [43], Rasa-prakasha Sudhakar [2], Rasa-ratna Samuchchaya [1], Rasa Taringini [38], Rasamritam [42], Anandakanda [33], Rasendra Sambhava [40], Rasa Mitra [29]
	2. <i>Kaarvellaka</i>	
3	1. <i>Kharpara</i>	Brihat rasa raja sundar [44]
	2. <i>Kalambuk</i>	
4	1. <i>Pita</i>	Brihat rasa raja sundar [44]
	2. <i>Krishna</i>	
	3. <i>Rakta</i>	

**Table 2:** Types of *Kharpara* mentioned in the various text.

In the above table classification of *Rasaka* is based on the *Grahya Lakshan* (Acceptable features). One classification is based on external morphology and quality (i) *Mritikabha*, yellow in colour & soil like in consistency and considered

are found in Texts. In general, the classification of *Kharpara* is based on the *Grahya Lakshan* (Acceptable features). One classification is based on external morphology and quality (i) *Mritikabha*, yellow in colour & soil like in consistency and considered as best in quality. (ii) *Gudabha*, colour and consistency are similar to *Guda* (jaggery) and are considered as a medium in quality. (iii) *Pashanabha*, consistency is similar to stone and considered as inferior in quality. Another classification is based on the appearance or sensory feeling on touch and its use. (i) *Dardura* is scaly in nature & it is best for *Satvapatana*. (ii) *Kaarvellaka* is without *Patra* (scale) & it is good for medicinal use. A summarized view of categorisation adopted in different texts is present in Table 2.

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on the appearance or sensory feeling of touch and its use.

- *Dardura* is scaly & it is best for *Satvapata* (Extraction)
- (ii) *Kaarvellaka* is without a scale (lamellaes) & it is good for medicinal use.

Nowadays, it is quite difficult to procure *Rasaka* as per the specifications stated in Rasashastra texts. So, to combat this problem, the ores of zinc that are available in the present era are taken as the types of *Rasaka*. This nomenclature

is done according to some of the properties of the three varieties of *Rasaka* [45].

**Mrittikabh-** Zinc Carbonate-Smithsonite- ( $ZnCO_3$ )

**Gudabh-** Zinc sulphide ( $ZnS$ )

**Pashanabh-** Zinc oxide- Calamine- ( $ZnO$ ).

*Rasa Panchak* and Ayurvedic pharmacology of *Kharpara* is mentioned in Table 3.

Text Name	Rasa	Guna	Virya	Dosha Karma	Sansthanika Karma
Bhava Prakash Nighantu [35]	<i>Katu, Kashaya, Kshar</i>	<i>Laghu</i>	<i>Sheeta</i>	<i>Kapha-pitta nashak,</i>	<i>Lekhan, Malabhedak, Chakshushya, Vamaka, Visha Ashmarighna, kushta kandughna</i>
Rasarnava [3]		<i>Ruksha</i>		<i>Vatakaraka Kaphashamaka</i>	<i>Netrya Vishadosha nashaka</i>
Rasendrasambhava [40]		<i>Ruksha</i>		<i>Tridoshaghna, Kapha-Pitta shamaka</i>	<i>Atisaara, kshaya, jwaraghna, netra, Kamla nashaka, Deharanjaka</i>
Rasendra Chudamani [43]				<i>Kapha-Pitta shamaka,</i>	<i>Mehaghna, Netra, Kshaghna, Lohaparada Ranjana</i>
Rasamritam[42]	<i>Katu, Kashaya</i>	<i>Laghu, Sheeta</i>	<i>Sheeta</i>	<i>Kaphapittanuta</i>	<i>Vamaka, Lekhana, Bhedana, Chakshushya, Kustha-Kandu Nashak, kshayaghna, mehaghna, Visha Ashmari nashaka</i>
RasaKamdheni [46]		<i>Ruksha</i>		<i>Tridoshaghna</i>	<i>Netraraga nashaka</i>
Rasa Prakash Sudhakara [2]				<i>Kaphapittaghna</i>	<i>Sarvamehaghna</i>
Bhaishajya Ratnavali [26]				<i>Kaphapittaghna,</i>	<i>Sarvamehaghna</i>
					<i>Lohaparada Ranjana</i>
Ayurveda prakash [30]	<i>Katu, Kshara</i>	<i>Laghu, Sheeta</i>	<i>Sheeta</i>	<i>Kaphapittaghna,</i>	<i>Sarvamehaghna, Netraroga kshayaghna, Lohaparada Ranjana</i>
Brihat Rasa Raja Sundara [44]		<i>Ruksha</i>		<i>Tridoshaghna, Kapha-pattaghna</i>	
Rasa ratna Samuchchaya [1]				<i>Kaphapittaghna,</i>	<i>Sarvamehaghna, Netrya, kshayaghna, Lohaparada Ranjana</i>
Raja Nighantu [36]	<i>Katu, Tikta</i>				<i>Chakshusya, Rasayana, Tvagaroganashaka, Ruchikar, Jatharagnidipaka, Pushtikaraka</i>
Rasa Tarangini [38]	<i>Katu, Kashaya</i>	<i>Laghu</i>	<i>Sheeta</i>	<i>Kapha-pittaghna</i>	<i>Lekhana, Chakshushya, Sarvamehaghna, Raktapradara nashaka, Raktapittaghna, Ashmari, shwasa, Gudamaya, Jeernajwara, Vicharchika, Tvagaroga nashaka, Rasayana, Ruchikara, Pushtikaraka, Balavirya vardhaka, Jatharagnidipaka</i>
Yoga Ratnakara [47]	<i>Katu, Kashaya, kshara</i>	<i>Laghu</i>	<i>Sheeta</i>		<i>Vamaka, Lekhana, Netrya, visha-rakta Kandu Nashaka</i>
Shaligram Nighantu [37]				<i>Kaphapittaghna, Kushtha, Visha Nashaka</i>	<i>Sarvamehaghna, Netra, kshaya, Jwara</i>

**Table 3:** Rasa panchak & Sansthanika Karma of *Kharpara*.

Vipaka of *Kharpara* is not mentioned in any text of Rasa Shastra.

- **Necessity of Purification:** Administration of impure *Kharpara* leads to *Vamana* (nausea and vomiting) and *Bhranti* (vertigo) [44].
- **Shodhana of *Kharpara*** (Method of purification): In general practice of Ayurvedic Pharmaceutical science

mostly *Rasa Dravya* (Mineral, metal and herbal poisonous ingredient drugs of the formulation) need *Shodhana*. This process removes the poisonous and deleterious effects present in them. In Rasa Shastra Different methods have been adopted for *Shodhan* of *Kharpara* by Acharyas and summarized in Table 4.

Principle followed	Drugs used	Duration /Process repetition	Reference
<b>Swedan in Dola Yantra</b>	<i>Gomutra</i> (Cow's Urine) / <i>Naramutra</i> (Men's Urine)	7 Days	Sharangdhar Samhita.[39] Brihat Rasa Raja Sundar [44] Yogratanakar [47]
	<i>Nara mutra/ Gomutra/ Saindhava lavana yukta amla jala</i>	3/7 Days	Ayurveda prakash [30]
	<i>Nara mutra/ Khara mutra</i>	7 Days	Rasa manjari [32]
	<i>Gomutra</i>	3 hr	Rasa Pradeep [48]
	<i>Mutra Varga</i>	7 Days	Arka Prakash [49]
<b>Nishechan</b>	<i>Karvellaka rasa</i> (Momordica charantia)/ <i>Kanji</i> (Sour gruel)/ <i>Takra</i> (Buttermilk)/ <i>Nara mutra/ Mesha mutra</i>	7 times	Rasa Prakash Sudhakar [2]
	<i>Beejpur Rasa</i> (Citrus limon), <i>Nara mutra, Mesha mutra</i> (Sheep urine), <i>Takra, Kanji</i>	7 Times	Rasendra chudamani [43]
	<i>Nimbu Swaras</i> (Citrus limon) or <i>takra/ kanji</i>	7 Times	Rasa Tarangini [38], RasaMitra [29]
<b>Nimajjana</b>	<i>Beejpur Rasa, Naramutra, Haya mutra</i> (Horse urine), <i>Takra, Kanji</i>	7 Times	Rasa Ratna Samuchchaya [1]
	<i>Nara Mutra/ Ashva Mutra/ Takra/ Kanji</i>	3/7 Days	Ayurveda prakash [30], Brihat Rasa Raja Sundar [44]
<b>Nimajjana</b>	<i>Nimbubeeja Rasa</i>	-	Rasa sara Samagrah [1]
<b>Paka</b>	<i>Katukalabu Niriyasa</i>	-	Rasa Ratna Samuchchaya [1] Brihat Rasa Raja Sundar [44] Rasarnava [3] Rasendra Sambhava [40]
	<i>Nara mutra/ Go mutra/ Saindhava yukta amla jala</i>	3/7 Days	Rasendra Chintamani [51]
<b>Bhavana</b>	<i>Rajaswala raja/mutra</i>	1 Day	Anandakanda [33]
<b>Bhavana +Paka</b>	<i>Katukalabu niriyas</i>	-	Ayurveda prakash [30]
<b>Nimajjan</b>	<i>Beejpur Rasa</i>	7 Times	Brihat Rasa Raja Sundar [44] Bhaisajya Ratnavali [26] Rasamritam [42] Rasendra Sambhav [40] Rasa Jala Nidhi [52]
<b>Bhavana</b>	<i>Grind the Kharpara with Rakta-peet pushpa then levigated with Nara mutra</i> (Men's Urine), <i>Go mutra</i> (Cow's Urine), <i>Saindhava lavan</i> (Pink salt), <i>Yava</i> (Barley) <i>Kanji</i> (Sour gruel)	3/7 Days	Rasa Ratna Samuchchaya[1]

<b>Bhavana (Levigation)</b>	Respectively Kshar varg, Tail Varg & Amla Varga		Rasa Hridaya Tantra [28]
<b>Dipping</b>	Gomutra	7 times	Siddha Yoga Sangrah [53]
<b>Dipping</b>	Gomutra/Naramutra	7 Days	Rasa Pradeep [48]

**Table 4:** Different summarized textual methods of *Kharpara Shodhana*.

- **Special function of *Kharpara*:** Rasendra Chudamani has mentioned in his book, that when *Kharpara* is kept in *Nara Mutra* (Men's Urine) for one month it acquires a special property that converts the colour of *Shudha Parada*, *Shudha Tamra*, *Shudha Rajata* into golden yellow [43].
- ***Kharpara Marana* (Incineration of *Kharpara*):** Methods of *Kharpara Marana* is categorized in Table 5.

Principle method	Accessory Drugs	Lavigation	Textual reference
<i>Baluka yantra</i>	<i>Shudha Kharpara + Shudha Parada (Pure Mercury) → Baluka yantra</i>		Ayurveda prakash [30] Rasendra sara Samgrah[31] Bhaishajya Ratnavali [26] Brihat Rasa Raja Sundar [44]
<i>Lavana yantra</i>	<i>Kharpara Patra Churna → Lavana yantra</i>		Ayurveda prakash[30] Rasendra Sambhava [40], Brihat Rasa Raja Sundar [44]
<i>Gaja puta</i>	<i>Shudha Kharpara + Hartala (Orpiment) + water → Sadharana puta (3 puta)</i>	Water	Rasa Tarangini [38] Rasendra Sambhava [40] RasaMitra [29]
<i>Gaja puta</i>	<i>2 pala Kharpara + 2 pala parada Churna</i>		Rasa Tarangini [38]
<i>Gajaputa</i>	<i>Karpara + Hanspadi (Adiantum philip-pense), Bandaal, Bad dugdha, Aaka dugdha (Calotropis procera), Thuhar dugdha (Euphorbia nerifolia),</i>		Brihat Rasa Raja Sundar [44]
<i>Baluka Yantra (9 hr)</i>	<i>Equal amount Shudha Rasaka + Shudha Parada</i>	Nimbu swaras	Bhaisajya Ratnavali [26]

**Table 5:** Different summarized textual methods of *Kharpara Marana*.

***Kharpara Satvapatana* (Metallurgy):** Methods of *Kharpara Satvapatana* is categorized in Table 6.

Text	Methodology & Drug used
<b>Rasarnava [3]</b>	Steps- 1 <i>Kharpara yukta potali</i> (muslin cloth containing <i>Kharpara</i> )
	2. <i>Nimajjan</i> (Dipping) in <i>Stree Mutra</i> for 7 days
	3. <i>Bhavana</i> -
	i. <i>Raktvarga pushpa rasa</i>
	ii. <i>Kshar Varga</i>
	iii. <i>Sneha Varga</i>
	iv. <i>Amla Varga</i>
	4. Mix <i>Bhavita Kharpara</i> with <i>Haridra (Curcuma longa)</i> , <i>Haritaki (Terminalia chebula)</i> , <i>Laksha (Laccifer Lacca)</i> , <i>Grhadhuma</i> & <i>Tankana (Borex)</i> then keep it in crucible & subjected to heat
• Resemblance of <i>Satva- Heerak Sadrisha</i> .	

<b>Ayurveda prakash [30]</b>	Steps- 1. Laksha, Guda, Rayi, Harad, Haridra, Raal, & Tankana triturated with an equal amount of Kharpara
	2. boil with cow's milk & made into a ball
	3. Confined in Brintaka musha
	• Resemblance of Satva- Vanga Sadrusha
<b>Rasa Tarangini [38]</b>	I Steps- 1. An equal amount of Kharpara, Laksha, Guda (Jaggery), Haritaki, Haridra, Alsi (Linum usitatissium), Rala & Tankana grind together.
	2. Put it in Andha musha & subjected to heat.
	• Resemblance of Satva- Yashada Sadrisha
	II Steps- 1. Take Laksha, Haritaki, Haridra, Alsi, Guda (Jaggery), Rala & Tankana & mix it properly with Kharpara.
	2. Heated it with cow's milk & Ghee & made it into a ball
	3. Put it in Brintaka musha & subjected to heat
<b>Rasa Ratna Smuchchaya [1]</b>	I Steps- 1. Kharpara & ¼ part of Haridra, Triphala, Rala, Grihadhuma, Tankana, Bhallataka(Semecarpus Anacardium) triturated with Amla rasa & made into a paste
	2. Coating the paste in the inner surface of Brintaka Musha.
<b>Rasajala nidhi [52]</b>	3. When dried, the Musha is to be covered & placed on the mouth of another Musha, subjected to heat until Kharpara gets smelted.
	• Resemblance of Satva- Vanga sadrisha.
	II Steps- 1. Kharpara discharges its essence if mixed with Haritaki, Laksha, Earthworm, Haridra, Grihadhuma, Tankana & heated by means of Muka Musha or Andh Musha.
	III Steps- 1. Laksha, Guda, Rayi (Mustered), Harad, Haridra, Rala & Tankana are powdered by mixing them with Kharpara,
	2. Boil it with cow's milk & ghee & make a ball.
	3. then put that ball in Brintaka Musha & subjected to heat.
	4. Strike the Musha on a stone.
	• Resemblance of satva- Vang sadrisha
<b>Rasa Chinta mani [54]</b>	Steps- 1. Kharpara Swedana in kulatha kwatha for 3 hours.
	2. Mardana with-
	i. ¼ part Paan patra kalka & Vata praroh swarasa
	ii. ¼ part Guda & Tankana+ Triphala kwatha
	1 Make a ball & put it in the Musha for subjected to heat.
• Resemblance of Satva- Naga sadirsha.	
<b>Rasa Prakash Sudhakar [2]</b>	Steps- 1. Kharpara & ¼ part Shudha Manhshila, Haridra churna, Triphala churna, Grihadhuma, Saindhava, Bhallataka, Tankana, all Kshara, & Amla.
	2. made a ball & put it in Brintaka Musha
	3. This musha is kept on another musha, & subjected to heat
	4. Casting a musha on a stone.
	• Resemblance of satva- Seesopamam.



<b>Anandakanda [33]</b>	Steps- 1. Take 1part <i>Kharpara</i> & ¼ part <i>Jayanti</i> ( <i>Sesbania sesban</i> ) <i>Patra churna</i> , <i>Triphala churna</i> , <i>Haridra churna</i> , <i>Guda</i> , <i>Tankana</i> .
	2. Take 2 musha.
	3. Do the <i>Rsakadipishti lepa</i> in 1 musha & keep the 2nd musha empty, with holes
	4. Do the <i>Sandhi Bandhan</i> & <i>Paka</i> by <i>Patalyantra</i> methods
	5. <i>Satva</i> of <i>Kharpara</i> is collected in the musha placed below
<b>Rasendra Sambhava [40]</b>	Steps- 1. Mix <i>Haritaki</i> , <i>Laksha</i> , <i>Bhunaga</i> , <i>Haridra</i> , <i>Grihadhuma</i> , <i>Tankana</i> & <i>Kharpara</i> altogether.
	2. Put the above mixture in <i>Muka Musha</i> & subjected to heat.
<b>Rasendra Mangal [55]</b>	Steps- 1- <i>Kharpara</i> triturated with <i>Kshara</i> , <i>Sneha</i> & <i>Amla dravya</i>
	2. Mix it with wool, <i>Laksha</i> , <i>Haritaki</i> , <i>Grhadhuma</i> & <i>Tankana</i>
	3. put the mixture in <i>muka musha</i> & subjected to heat.
	4. Resemblance of <i>Satva- Kutila Sadrisha</i>

**Table 6:** Different summarized textual methods of *Kharpara Satvapatana* (Metallurgy).

- ***Kharpara Satva Marana*:** Put the *Kharpara* & *Hartala* in equal amounts in the pan, keep it on the fire & keep stirring it with *laohadanda*. In this way, *Kharpara satva Bhasma* is formed [1,2].

Took 1 *pala* (48gm) *Kharpara satva* in the pan & subjected to heat. When the *Sattva* melts, stirring it with a ladle, while

add a little amount of fine powder of *Hartala* in it & stir with a ladle [38].

- ***Kharpara amayika prayoga*:** *Amayika prayoga* means dose and indication of drug. The Dose, adjuvant, and indication of *Kharpara Bhasma* is illustrated in Table 7.

Drug	Anupana	Disease
<i>Sama bhaga Kharpara bhasma + Kantalaubhhasma</i>	<i>Triphala kwatha &amp; Tila taila</i>	<i>Madhumeha, Pitta roga, kshya, Pandu, Gulma, Raktaj gulma, Pradara, Somroga, Yoniroga, Vishama Jwara, Rajah shula, Shwas, Hikka, Svayathu.</i>
<i>Kharpara bhasma</i>	<i>Gokharu kwatha</i>	<i>Mutrakriccha</i>
<i>Kharpara bhasma</i>	<i>Vanshlochana</i>	<i>Kaas, shwas, kshayaj kaas</i>
<i>Kharpara bhasma + Prawala bhasma + black paper + Rasasindur</i>	<i>Nimbu swaras</i>	<i>Dhatugata jwara, Agnimandhya, Jirna jwara</i>
<i>Kharpara bhasma + Rasasindur</i>		<i>Jeerna jwara</i>

**Table 7:** Indication of *Kharpara* in disease and their *Anupana* [38].

**Matra of *Kharpara Bhasma*** [38]: 1/2- 2 Ratti

***Kharpara Viakara Shanti Upaya*** [44] - *Gomutra* for 7 days.

***Kharpara Yoga*** [56] (**Formulation of *Kharpara Bhasma***)-

*Mahajwarankusha rasa*  
*Basant Malti Rasa*  
*LaghuBasant Malti Rasa*  
*Lakshmi Vilasha Rasas*

## Discussion

*Yashada* or Zinc is obtained by the *Satvapatana* of *Kharpara* (extract). *Satva* of *Kharpara* has *Vangakriti*

(appearance of Tin). *Satva* merely indicates the color and appearance of Zinc. *Pittala* or Brass, an alloy of Zinc is used since the 2nd century while the description of *Kharpara* is obtained from the 10th century, and its extract of it is called "*Karpara Satva*". In *Rasa Ratana Sannucaya*, a 13th-century book, the word *Ritikrita* (constituents of Brass), *Tamraranjaka* (impart colour to copper), both words self-explored that *Karpara* is used in the preparation of Brass [57]. The word *Yashada* is first time found in the 15th-century book, *Madanpal nighantu*. But the Elemental analysis of material shows that Brass made by Indian metallurgists has 18 to 34 percent of zinc. Such a high quantity of Zinc is only

infused when pure zinc is used instead of Zinc ore. Therefore, it is a quite surprising fact that *Satava* or extract of *Kharpara* ie. *Yashada* is known in the community of iatrochemistry but *Kharpara* is not.

Zinc is used in Brass for the purpose of value addition in copper. Brass is superior in metallic property and appearance. Zinc improves the colour, tensile strength, ductility, malleability and glitters and reduces the corrosion of ferrous metals. Additionally, it is easy to cast, recast and mold [58]. Thus, this might be the possible reason that earlier metallurgists replace the Tin by Zinc in making a much better alloy of copper. The Classification of Pittala in Rasa Shastra is based on colour-changing property of *Pittala* after quenching in *Kanjika* (Sour gruel).

Among all *Dravyas* of *Maharasa*, *Uprasa* & *Sadharana Rasa*, *Bhasma* of *Kharpara* [Incinerated formulation, Calyx] is only made by *Kupipakwa* (Baking of drug in a glass bottle by indirect heat) and *Putta* (Baking of drug in an earthen pot) method. In one of the *Kupipakwa* methods, *Kharpara* is mixed with *Parada* (Mercury). *Parada Bhasma* & other preparation of *Parada* are made by *Kupipakwa* method by using *Kajjali* [Black Sulphide of Mercury], a mixture of *Parada* and *Gandhaka* (Sulfur).

*Kharpara* comes under the group of *Maharas Varga* which is described by most of the texts of Rasashastra while Some Acharyas had described it under *Uparasa*, *Dhatu-Updhatu*. *Swarnadi Varga* etc. It has a wide range of therapeutic applications including in diseases like *Prameh*, *Stree Roga*, *Pandu*, *Netra Roga*, *Yoniroga*, *Kasa*, *Shwasa*, *Jwara* etc [5].

*Nirvapa* is the commonest amongst the many *Samanya Shodhana* procedures of *Kharpara*. In this process hardness of the metal gets reduced and it becomes more brittle due to repeated heating and quenching.

## Conclusion

*Karpara* is known to Indian metallurgists since Bronze Age, but it is impossible to find the date of its conversion into Zinc due to the absence of rigid proof. In the medieval age, the production of zinc in India is stated in the Udaipur District of Rajasthan State. Here so many remnants of retorts, furnaces, Mining and smelting equipment are present on the bank Tiri River. Indian Metallurgist begins the high percentage of *Pittala* (Brass) production before the 13th century. Thus, it is very mysterious to know the exact time of *Karparasatvapattan*. In Rasa Shastra it is an equally important drug as mercury. Various pharmaceutical procedures are mentioned in many classical books. *Kharpara* is kept in so many classes e.g., *Maharasa*, *Uprasa*, *Dhattu* and *Updhattu* etc. Its *Rasa* (Taste) is *Kattu-*

*Kasahya*; *Guna* is *Laghu*, *Sheeta* & *Ruksha*; *Sheeta* in *Virya* and *Kapha-pitta samaka* in nature. Its *Bhasma* is made by Both *Kupipakwa* (heating in an open pot) and *putta* (heating in a closed pot) Methods. The practice of *Kharpara Bhasma* preparation has been declined due to many reasons but it is mentioned in various diseases in Classical texts.

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