ISSN: 2322 - 0902 (P)
ISSN: 2322 - 0910 (O)

International Journal of Ayurveda and Pharma Research

Review Article

PITTALA (BRASS) IN TRADITIONAL INDIAN KNOWLEDGE SYSTEM: A REVIEW

Punam Kumari[1]*, Yadevendra Yadav[2], Khem Chand Sharma[3]

*[1]MD Scholar, [2]Assistant Professor, [3]Professor and H.O.D, P.G Department of Rasa Shastra & Bhaishajya Kalpana, Uttarakhand Ayurved University, Rishikul Campus Haridwar, India.

Article info

Article History:

Received: 01-08-2022

Revised: 29-08-2022

Accepted: 19-09-2022

KEYWORDS:

Bhasma, Brass, *Mishra Loha, Puti Loha, Pittala, Ritika, Tamra*.

ABSTRACT

Brass (*Pittala*) is a very popular and common metal alloy typically comprised of 66% copper and 34% zinc. Undoubtedly, it has a much longer history than Zinc. Ayurvedic treatises such as Charaka Samhita (2nd century BC) and Sushruta Samhita (3rd century BC) have mentioned some instruments used for various therapies and surgical procedures made of *Pittala* such as *Jeevah-nirlekhana* (tongue scarper), *Vasti Netra* etc. The original Sanskrit equivalent for brass was *Riti*, the word *Pittala* being subsequently adopted for it. In Kautilya Arthasastra (4th century) it is known as *Arakuta*. *Pittala* kills a large number of microorganisms within a few minutes to hours of contact. So, it is a good antifouling material. Its ethno-medicinal use is in *Raktapitta, Krimi, Kushta* and *Pandu Roga*. Probably, there is no available literary research study done on *Pittala* so far. Most of the information is obtained from *Rasa Ratan Samuchchaya*. *Pittala Bhasma* retains the property of both *Tamra* (copper) and *Yashada* (zinc). It has *Tikta Rasa* (bitter taste), and its *Virya* (temperament) is either *Ushna* (hot) or *Sheeta* (cold), which depends on the variety of *Pittala* and various drugs used in the process to make *Bhasma*. It appears from the thorough search of the process of *Marana*, that its *Bhasma* preparation is easier than *Tamra*.

INTRODUCTION

Position of *Pittala* in Ayurveda: *Pittala* (Brass) has been in use since prehistory, it is an alloy of copper-zinc. By the Roman period, brass was being deliberately produced from metallic copper and zinc minerals. In Rasa Shastra or Iatrochemistry, a discipline of Ayurveda, *Loha* (metal) is divided into 3 classes i.e., *Shudha Loha* (noble metal), *Puti Loha* (foul smell producing metal, on heating), and *Mishra Loha* (alloy). *Pittala* is one of the *Mishra Loha*. Initially, it has been included in the *Loha* group and later on in the *Mishra Loha* group along with *Kamsya* (white copper) and *Varta Loha* (bronze).[1] In Rasahridaya Tantra, a classical textbook of Rasa Shastra, *Loha* is divided into 3 different classes i.e., *Saara Loha, Satvaloha* and *Putiloha* where *Pittala* is categorized into *Satvaloha*.[2] In ancient times in India, when *Yashada* (zinc) as a separate metal was not known, the *Pittala* (brass) was being made by mixing *Rasaka* or *Kharpara Satva* with *Tamra* (copper) and probably for this reason *Rasaka* was said as *Ritihetu* or *Ritikrit*[3]. *Pittala* is mentioned in various authentic texts of Rasa Shastra; like Rasa Tarangini, Rasa Ratan Samuchchya, Ayurved Prakash, Rasendra Chudamani, Rasa Prakash Sudhakar, Rasa Jal Nidhi, Brihada Rasa Raj Sunder etc. *Pittala Bhasma* is used in the treatment of a wide array of diseases like *Pandu* (anemia), *Krimi* (worm infestation) *Raktapitta* (bleeding disorder), *Kushtha* (skin diseases), *Jwara* (fever) etc. It is an ingredient in formulations, such as *Pittala Rasayana*, *Meghnaad Rasa, Ratna Prabha Vati, Shadanan rasa, Swarna Sindoor Rasa.*

Etymology of Brass in different Languages: In Sanskrit, it is called *Pittala* due to its colour similar to Bile, "*Pitum tadavarnaum laititi*"[4]. The Turkish etymology of the *Birinj* (Brass and Bronze) from the Sanskrit *Vrihi* and the Greek *Oryza, Bryza*, due to brass has a polished rice-like gloss. The general Persian term for zinc ores and zinc oxide is *Tutiya*, which occurs frequently in medieval literature as *Tutia* or *Totia*. In Chinese, *Thoushi* (a metallic product from Sassanian Persia) was brass but this is neither quite sure nor it has any connection with *Tutiya*. The Sanskrit *Tuttha* is derived from *Tutiya*.[5] In Rasa Shastra literature, *Tutta* is well-known as blue vitriol and *Kharpari Tuttha* is

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https://doi.org/10.47070/ijapr.v10iSuppl2.2352

known as *Rasaka* (An ore of Zinc)[6]. The Aini-Akbari refers to '*Ruh-i-tutiyii*', 'extract of *Tutiyii* (zinc), being found in the Zawar mine of Rajasthan[7]. In China, the Buddhist literature belonging to the Tan dynasty (619-917 AD) the earliest literary record about brass mentioned as *Toushi* or *Thoushih* (a metallic product from Sassanian Persia) was brass. Brass was not a common commodity in the early centuries of the Christian Era at least before the 3rd century AD in China[8].

Archaeological Evidence: Description available in Rasa Shastra Text, *Pittala* is made up of *Tamra* (copper) and *Yashada* (zinc) in 2:1 proportion[9]. But these days generally, the composition of Brass is 66% copper and 34% zinc which can be varied to achieve varying mechanical and electrical properties. In brass, zinc percentage can vary from 10-54% and other metals like lead, manganese, nickel, tin and magnesium etc. are also found. Today, almost 90% of brass alloys are recycled. The primitive alloys with less than 28 per cent zinc were prevalent in many parts of the world before India. While Palestinian brass from the 14th to 10th centuries BC contains 23% zinc. Brass in Taxashila has been dated from the third century BC to the fifth century AD. A vase from Takshashila is of particular interest because of its 34.34 percent zinc content and has been dated to the third century BC. Brass bangles belonging to the Kushana period are discovered from Senuwar (U.P.), which also shows 35 per cent zinc[10]. Since zinc could change the colour of copper and impart it a golden glitter, it was preferred for making Hindu, Buddhist and Jain icons or worship substances e.g., lamp, bell, wind chimes, idols; throughout the historical period. The higher percentage of Zinc (containing 30% zinc) in brass can be ease shaped and moulding forming machinery led to its extensive use for articles having complex shapes and is popularly known as cartridge brass[11]. In Zawar, a place in Rajasthan, shreds of evidence of zinc smelting such as retorts, slags, furnaces and mines of Zinc ore are found which belongs to the 7th century AD.[12]

MATERIAL AND METHOD

A bibliographic exploration was carried out to compile the information available on *Pittala*. Various classical books of Rasa Shastra having English or Hindi translation were taken for a better understanding of the text. With the help of different indexed journals, Standard Ayurvedic Terminology with appropriate English colloquial terms is used here. The keywords used for the search included *Pittala*, brass, *Tamra* and *Yashada* and to retrieve online literature published, work available on periodicals, peer-reviewed indexed journals, Pub Med, Science Direct and Scopus.

Table 1: Categorization of *Pittala* in Classics

Name of the Text	Category
Rasa Tarangini[13], Rasa Mitra[14], Rasa Ratan Samuchchya[1], Rasendra Chudamani[15], Rasa Prakash Sudhakar[16] Rasa Jal Nidhi[17], Brihada Rasa Raj Sunder[18].	*Mishra Loha Varga*
Rasayana Sara[19] Yog Ratnakara[20] Rasendra Sambhava[21] Sharngadhar Samhita[22] Rasa Manjari[23]	*Dhatu Varga*
Ayurved Prakash[24] Bhavaprakash Nighantu[25] Rasa Darpana[26] Rasa Chikitsa[27]	*Updhatu Varga*
Rasamritam[28] Rasendra Chinta Mani[29]	*Loha Varga*
Rasa Paddhati[30]	*Uploha Varga*
Rasa Hridya Tantra[2]	*Satva Loha*
Shaligram Nighantu[31]	*Dhatupdhatu Varga*
Raj Nighantu[32] Dhanvantri Nighantu[33] Shodhala Nighantu[34] Madanpala Nighantu[35]	*Swarnaadi Varga*
Kaidev Nighantu[36]	*Dhatu Varga*

Table 2: *Rasa Panchaka* (Ayurvedic Pharmacological Property) of *Pittala* in Various Classical Text

Nighantu	*Rasa Panchaka*					Therapeutic use
	Rasa	***Guna***	***Virya***	***Vipaka***	***Dosha Karma***	
Shaligram Nighantu[31]	*Tikta, Lavana*	*Ruksha*	-	-	*Kaphahara, Vatanashak*	*Shodhani, Panduroghana Krimighana, Na-atilekhana, Mehahara, Gudajroga nashaka, Grehniroganashaka, Pandurogahara, Shwasa, Kamla, Shoolaghana*
Bhavaprakash Nighantu[37]	*Tikta, Lavana*	*Ruksha*	-	-	-	*Shodhani, Panduroghana Krimighana, Na-atilekhana*

Raj Nighantu[38]	*Tikta Lavana*	*Sheeta*	-	-	*Vata-ghana Pitta-jitta*	*Shodhaka, Pandurogahara, Krimihara, Pliharoga nashaka.*
Dhanvantri Nighantu[39]	*Lavana*	*Ruksha Sara*	-	-	*Vataghana*	*Pandu, Krimihara, Vishghana, Vrishya, Valipalita nashaka, Aayuvardhaka, Rasayana*
Kaidev Nighantu[36]	*Tikta*	*Ruksha*	*Sheeta*	-	*Vata-karaka Kapha-Pitta hara*	-
Ayurved Prakash[40]	*Tikta, Lavana*	*Ruksha*	-	-	-	*Shodhani, Panduroghana, Krimighana, Na-atilekhana.*
Rasa Tarangni[41]	*Tikta*	*Ruksha*	-	-	-	*Na-ativilekhnam Krimighana, Kushtha shamaka, Panduroga nashaka*
Rasa Ratna Samuchchaya[42]	*Tikta*	*Ruksha*	-	-	*Kapha-Pittanuta*	*Jantughana Raktapitanuta Pandu-Kushtha hara Yakrit- Pliha hara*
Yoga Ratnakara[43]	*Tikta Lavana*	*Ruksha Sara Sheeta*	*Sheeta*	-	-	*Shodhaka, Panduroghana, Krimighana, Lekhana*
Anand Kanda[44]	*Tikta Lavana Katu*	*Ruksha Sara*	-		*Vataghana Kaphahara*	*Shodhaka, Panduroghana Bal-virya-ayuvardana Pliha- Anaha Ghana, Jantughana, Raktapitnuta, Kushthahara*
Rasendra Chinta Mani[45]	-	-	-	-	*Shaleshma-Pittaghana*	
Rasendra Sambhav[21] Brihad Rasa Raj Sunder[18]					*Vaat-Kaphaghana*	*Prameha hara, Guda ankur, Grahnika Pandurog hara, Swasa-Kasa, Kamla, Shoola nashaka*
Rasendra Chuda mani[46]	*Tikta*	*Ruksha*	-	-	*Kapha-Pittanuta*	*Jantughana, Raktapitanuta, Krimi-Kushtha hara, Yakrit- Pliha hara*
Rasa Prakash Sudhakar[47]	-	*Ruksha*	*Ushna*	-	-	*Raktapitahara, Krimighana, Kushtha hara*
Rasamritam[28]	*Tikta*	*Ruksha*	-	-	-	*Shodhani, Panduroghani Krimi-Kushthaghani, Lekhani, Asrapittanut*
Rasa Darpana[26]	*Tikta*	*Ruksha*	*Ushna*	-	-	*Shodhani, Panduroghani Krimi-Kushthaghani, lekhani, Asrapittanut*
Rasa Chikitsa[48]	*Tikta*	*Ruksha*	*Ushna*	-	*Pitta-nashaka*	*Rakta Vikara, Shodhani, Lekhani, Pandurogaghani Krimi-Kushtha-hara, Udararoga*
Rasa Jala Nidhi[17]	*Tikta*	*Ruksha*	-	-	*Kapha-Pittnuta*	*Jantughani, Raktapittnuta, Basti-vishodhini, Yakrit-Plihahara, Panduroghana, Kriminashnam*

Note:

Virya of *Ritika Pittala* is *Sheeta Virya* whereas *Kaktundi Pittala* is *Ushna Virya* but in some classical texts such as Anand Kanda, Rasendra chuda mani, Rasa Ratan Samuchchaya and Rasa Jala Nidhi, the *Virya* (temperament) of *Pittala* is said to be either *Ushna Virya* or *Sheeta Virya*, which depends on the drugs used in the process to make *Bhasma*.

Synonyms of *Pittala*

Riri, Sulohaka, Brahmi, Ragyi, Kapila, Brahmriti[31]*, Shudrasuvarna, Sinhlaka, Pingal, Pitalak, Lohitak, Bhaarkutta, Pingal Loha, Peetak*[38]*, Peetloha, Vartloha, Triloha, Aara, Aarkuta, Rajriti, Ragyi, Riti, Maheshvari*[36]*, Lohaka, Pinga, Kapiloha, Suvarnaka, Aara, Sehlaka, Nishthur, Darukantaka* [39]*, Dravyadaaru, Mishra, Patikaver*[17]*, Sokyamarak, Vartloha, Triloha, Sheshnaka, Bharat*[49]*, Sitkanaka, Pingalaloha*[44]*, Peetloha, Kapiloha*[26]*.*

Vernacular Names[31]

Sanskrit- Pittala, Aar, Aarkuta, Riti; **English**– Brass; **Hindi-** Peetala, Kanchi Peetala; **Marathi**– Sonapittala; **Gujrati**– Peetala; **Farsi**– Viranja, **Telungni-** Ittadi.

***Pittala Nirmana Vidhi* (Traditional method of Brass manufacturing)**[50]: In Rasa Tarangni it is mentioned that if *Tamra* and *Yashada* are heated in 2:1 proportion in *Gaara Musha* (a special type of crucible), it melts and mixed to get *Riti* i.e., a kind of best quality *Pittala*. So here we can say that *Acharaya* has mentioned the composition as well as the method of preparation of *Pittala*.

***Pittala Bheda* (Classification of Brass):** There are 2 varieties of *Pittala* viz., *Rajritika* and *Kaktundi*[18,21,40,43]. In some texts, the 2 varieties are said to be *Ritika* and *Kaktundi*[26,42,44,46,47]. In Rasa Jala Nidhi the two varieties are named *Rajriti* and *Bhramariti*[17]. In Rajnighantu the 2 varieties are considered to be *Riti* and *Rajriti*, in which *Rajriti*, *Bhramariti* and *Kaktundi* are said to be synonyms of each other38. In *Rasayana Sara*, the 2 varieties mentioned are *Rajriti* and *Shuktunda*[19].

Pariksha (Examination): The above-mentioned classification is based on the colour-changing property of *Pittala* after quenching in *Kanjika* (Sour gruel). The *Pittala* that turns *Tamrabha* (red) on quenching in *Kanjika* is called *Ritika/Rajriti* and which turns *Krishnabha* (black) on quenching in *Kanjika* is called *Kaktundi/Bhramariti/Shuktunda.*[18,19,40,43,42,44,46,47].

Ritika is *Ruksha* (dry) in *Guna*, *Krimighana* (anti-microbial) in Karma and cures *Raktapitta* (Bleeding disorder), whereas *Kaktundi* is *Ushna* (Hot) in *Virya*, *Sara* (Mobility) in Guna and *Kushthahara* (treats skin disease) in Karma[47].

***Grahya Lakshana* (Acceptable attributes)**[26,42,44,46,47]. *Pittala* has characteristics like *Guru* (Heavy), *Mridu* (Soft), *Peetabh* (Yellow), *Tadanshama* (can resist hammering), *Snigdha* (Smooth), *Mrisana* (soft) and is considered acceptable for therapeutic uses.

***Uttam Pittala Lakshana* (Properties of Best quality of *Pittala*)**[38,40,44]: In some other classical texts *Pittala* has Characteristics like *Shudha* (Pure), *Snigdha* (Smooth), *Mrudu* (Soft), *Sheeta* (Cold potency), *Suranga* (Good Colour), *Sutrapatrini* (Ductile), *Hemaoppam* (Golden in colour), *Swacha* (Clear) are considered superior. In Ayurveda Prakash *Himaoppam* (Cold as Ice) is mentioned in place of *Hemaoppam* (Golden in colour) and *Sutrarupini* (thread-like) is mentioned in place of *Sutrapatrini* (Thin sheets).

***Agrahya Lakshana* (Non-acceptable Properties)**[17,42,44,46,47,51]. *Pittala* has characteristics like *Khara* (Rough) on touch, *Pandura* (Pale) in colour, *Ruksha (Dry), Tadan-akshama* (Can't resist hammering)*, Putigandha* (Foul smell), *Laghu* (Light), and is considered inferior and not recommended for *Rasayana* purpose. *Stabdha* (Stiff), *Sara* (mobility), *Sweta* (White), *Rakta-ati* (Red), and *Malayukta* (Full of impurities).

Author of Rasa Tarangni, Acharaya Sadananda Sharma has mentioned that *Grahya Pittala* is that which turns red on quenching in *Kanjika* and *Agrahya Pittala* is that which turns black on quenching in *Kanjika*[52].

Formulation of *Pittala Bhasma*: All metals are converted into the final dosage form i.e., *Bhasma* through two necessary steps of *Shodhana* and *Marana*. *Bhasma* is nano-sized or micron-sized oxide, carbonate, sulphite and sulphate of metal(s). *Shodhana* process is categorized further into *Samanya* (General procedure for all metals) and *Vishesha* (Specific procedure for a single metal). After this operation, the Marana process is performed. In this process, a definite quantum of heat is provided to the medicine using traditional fuel in an underground selected sized pit or by an electric muffle furnace. This unit operation is called *Bhasmikarana* or *Bhasma Nirmana*.

***Shodhana* (Ayurvedic method of purification):** For medicinal purposes, *Pittala* should be subjected to *Shodhana* and *Marana* procedures. *Samanya Shodhana* of all metals is depicted in books like Rasa Ratna Samuchchaya, Bhavprakash Nighantu, Ayurved Prakash, Rasa Ratnakara, Yogratnakara, Rasendra Chinta Mani, etc. It is a series of processes in which five fluids are used as quenching media viz, *Taila* (Sesame oil), *Takra* (Buttermilk), *Gomutra* (Cow's urine)*, Kajika* (Sour Gruel), *Kultha Kwatha* (decoction of Horse gram). *Pittala* is heated and quenched 7 consecutive times in each media, in successive order. After *Samanya Shodhana* it is necessary to subject it to *Vishesh Shodhana* to reduce toxicity and enhance its potency.

Table 3: *Vishesha Shodhana* of *Pittala* as mentioned in different Classics

Name of the Text	Principle Method	Ingredients used	Number
Rasa Tarangni[53]	Boiling	Put foils of brass in *Gomutra* (Cow's Urine) taken in a Tin coated vessel and heat it.	4 *Yama (12 hour)*
Rasa Tarangni[53] Rasa Rattan Samuchchaya[42] Rasendra Chuda Mani[46] Rasa Jala Nidhi[17] Rasamritam[28] Rasa Darpan[26] Rasendra Sambhav[21]	Quenching	*Haridra Churna* (Powder of *Curcuma longa*) Mixed *Nirgundi Swarasa* (*Vitex negundo*)	5 to 7
Rasa Prakash Sudhakara[47]	Quenching	*Nirgundi Swarasa* (*Vitex negundo*)	5
Ayurved Prakash[40]	Quenching	*Nishoth* (*Operculina turpenthum*) mixed *Nirgundi Swarasa* (*Vitex negundo*)	Not mentioned
Rasa Jala Nidhi[17] Anand Kanda[44] Rasendra Mangalam[54] Brihad Rasa Raj Sunder[18] Rasa Ratnakara[55]	*Puta*	Three *Kshara* (*Tankana, Sarjikshara & Yavakshara*) and *Panch-Lavan* (five salts) are to be subjected to *Bhavana* for 7 times with *Nimboo Swarasa* (*Citrous Limon*). Foils of Brass are smeared with this paste.	Not mentioned
Rasendra Mangalam[54]	*Puta*	Paste of *Kshara* (Alkali), *Guda* (Jaggery), *Hamspadi* & *Laksha* (*Laccifer lacca*) is prepared and is applied on foils of Brass along with *Kankushtha* (Latex of *Garcinia morella*) and *Nisha* (Turmeric) then blow the fire. Repeat this 7 times	7 *Puta*

***Marana* (Incineration):** After the *Shodhana* process, *Pittala* has to be subjected to the process of *Marana,* to make it suitable for internal use. In other words, it is called the last step of nanoparticle preparation of metals or minerals. Various methods have been given which are classified based on the *Bhavana Dravya* (media) used for the *Marana* procedure.

Table 4: Marana of Pittala as mentioned in different Classics

Name of the Text	Levigation Media	Procedure	No of *Puta* (s)
Rasa Tarangani[56]	*Shudha Manahshilla* (As_2S_2), *Shudha Gandhaka* (S), *Ghrita Kumari* (*Aloe vera*)	An equal amount of *Shudha Manahshilla* (As2S2), *Shudha Gandhaka* (S) and *Pittala churna* (Powder of brass) are given *Bhavana* (Wet levigation) of *Ghrita Kumari* (*Aloe vera*) then dried under the sun. Then kept in *Musha* (Crucible) after this *Puta* is given.	3
	Shudha Gandhaka (S), *Arka ksheera (Calotropis Procera)*	An equal amount of *Shudha Gandhaka* (S) and *Pittala churna* (Powder of brass) is given *Bhavana* (wet levigation) of *Arka ksheera (Calotropis Procera)* then dried under the sun. Then kept in *Musha* (Crucible) after this *Puta* is given.	3
Rasendra Sambhav[21] Rasa Tarangani[56]	*Shudha Hingul* (Cinnabar), *Shudha Hartala* (As_2S_3), *Ghrita Kumari* (*Aloe vera*)	Take an equal amount of *Pittala churna* (powdered Brass) *Shudha Hingul* (Cinnabar) and *Shudh Hartala* (As_2S_3) and add *Ghrita kumari* (*Aloe vera*) into this mixture then triturate until it becomes dry. Keep this in *musha* (Crucible) and then subject it to *Gajaputa*.	3
Rasa Ratan Samuchchaya[42] Rasendra Chuda Mani[46] Rasa Jala Nidhi[17]	*Shudha Manahshilla* (As_2S_2) *Shudh Gandhaka* (S)	*Bhavana* (Wet levigation) of *Nimboo Swarasa* (*Citrous Limon*) is given to both drugs to make a thick paste. This mixture is applied on *Pittala Patra* (foil) and then dried under the sun after this *Puta* is given. A total of 8 *Puta* are required.	8

Rasamritam[28] Rasa Darpan[26]	*Shudha Manahshilla* (As_2S_2) *Shudh Gandhaka* (S)	*Bhavana* (Wet levigation) of *Nimboo Swarasa* (*Citrous Limon*) is given to both drugs to make a thick paste. This mixture is applied on *Pittala Patra* (foil) and then dried under the sun after this *Puta* is given. A total of 8 *Puta* are required.	3
Bhav Prakash Nighantu[57] Ayurved Prakash[40] Rasa Pradeepa[58] Sharngadhar Samhita[59]	*Shudha Gandhaka*(S) *Arka ksheera (Calotropis Procera)*	Paste of *Shudha Gandhaka* (Sulphur) and *Arka sheer* (Milk of *Calotropis Procera)* is prepared, applied over *Pittala Patra* on both surfaces, keep *Patra* in *Musha* (Crucible) and then subject it to *Gajaputa*. After 2 *Puta Pittala Bhasma* is prepared.	2
Sharngadhar Samhita[59]	*Shudha Gandhaka* (S) *Aja Khseera (Goat milk) or Nirgundi Swarasa* (*Vitex negundo*)	Paste of *Shudha Gandhaka* (Sulphur) and *Aja Khseera* (Goat milk) or *Shudha Gandhaka* (Sulphur) and *Nirgundi Swarasa* (*Vitex negundo*) is prepared, applied over *Pittala Patra* on both surfaces, keep *Patra* in *Musha* (Crucible) and then subject it to *Puta*.	2
Rasa Prakash Sudhakar[47]	*Shudha Manahshilla* (As_2S_2) *Shudh Gandhaka* (S) *Sendhava Lavana* (Rock Salt)	All three media are given Bhavana of *Nimboo Swarasa (Citrous Limon)*, this paste is applied on *Pittala Patra* and then subject to heat. Repeat this process 8 times.	8
Rasa Jala Nidhi[17]	*Shudha Gandhaka* (S) *Shudha Hartala* (As_2S_3)	*Pittala* is subjected to heat by *Puta* after having smeared with the paste made of both drugs with suitable liquid.	-
Rasa Jala Nidhi[17] Brihad Rasa Raj Sunder[18] Rasa Pradeepa[58]	*Arka ksheera (Calotropis Procera), Vata ksheera (Ficus benghalensis), Nirgundi ksheera* (*Vitex negundo*), *Shudha Gandhaka (S)*	In Another method only Sulphur is levigated with an equal amount of *Ksheera* (milk) of *Arka* (*Calotropis Procera*), *Vata* (*Ficus benghalensis*) and *Nirgundi* (*Vitex negundo*) to make into a paste. This paste smeared on *Pittala* for *Marana*	
Brihad Rasa Raj Sunder[18]	*Shudha Gandhaka* (S), *Shudha Hartala* (As_2S_3), *Arka ksheera (Calotropis Procera)*	An equal amount of *Shudha Gandhaka* (S) and *Shudha Hartala* (As_2S_3), is taken to make into a paste using *Arka ksheera (Calotropis Procera).* This paste was then smeared on *Pittala Patra* for *Marana.*	2

In all the *Marana* procedures, *Gajaputa* is mentioned in the maximum text.

***Pittala Druti*:** A young goat of black colour is to be fed with powdered brass of excellent colour, which when coming out in the stool, is to be burnt in an earthen vessel with the result an excellent brass resembling gold will come out of it and this brass when properly incinerated, serves to strengthen the body (*Dehalohakari*). It is important both in alchemy and in medicine *(Rasa-Rasayan)* [42]. In Rasa Jala Nidhi this same procedure has been mentioned under *Pittala Shodhana.*[17]

***Vedha Kriya* (Transformation of base metal into higher metal-silver):** Brass and Silver, equal in quantity, are to be melted. Incinerated *Vanga* is then mixed little by little, as a result, the whole thing will turn into silver[17,18]

***Bhasma Varna* (Colour):** The Colour of *Pittala Bhasma* in the classical text of Rasa shastra is mentioned as *Kajjalabha* (Black)[21,56] but in Brihadrasarajsunder the colour of *Pittala Bhasma* is given as *Kapota-Kanthabha* (like pigeon neck colour)[18]

Dose: In combination with other medicine in a regime, it is used in a dose of ½ *Gunja* to 1 *Gunja* (62.5mg to 125mg).[60]

***Anupana* (Vehicle):** *Madhu, Makhana*[26] *Madhu, Dadima swarasa*[48] *Pippali, Madhu*[18]

***Pittala Bhasma Dosha*:** Consuming *Ashudha* (not properly purified) & *Apakwa* (improperly incinerated) *Pittala Bhasma* cause *Bhrama* (Vertigo), *Guda-ruja* (Piles), *Prameha* (Diabetes) and it may even lead to *Mrityu* (death).[18]

DISCUSSION

All traditional medicinal systems of the world use drugs of different origins herbal, earthy metal or mineral and, animal. In Ayurveda codes of conduct and dietary regulations are suitable tools to maintain health in healthy and eradicate diseases in diseased person and it is an additional weapon to fight the disease. Green synthesis of nano-sized metallic preparations in healthcare is a unique feature of the Indian system of medicine. It is clear from the literature review and archaeological survey that *Tamra* is considered an earlier known metal for the preparation of the metal alloy *Pittala* (brass) and *Kansya* (bronze) of which it is a component. Articles of *Pittala* in 1st century A.D. have been found during the excavation of ancient Buddha stupas. The word "*Riti*", a synonym of *Pittala* probably derived from "*Harita*" or yellow, though the term "*Harita*" was used in Veda as a synonym for gold which is also yellow. The same word is found in Manu's school of thought. The chemical composition of *Pittala* as an alloy and of its preparation from pure *Yashada* (zinc metal) not from *Rasaka* (calamine) was more advanced in India[61]. Metallic zinc was prepared in India several centuries earlier than in Europe. Zinc is used in Brass for value addition in copper. Zinc improves the colour, tensile strength, ductility, and malleability and provides greater corrosion resistance. Additionally, it is easy to cast and mold. Thus, this might be the possible reason that earlier metallurgist replaces Tin with Zinc to make a much better alloy of copper. Acharya Nagarjuna, a well-known alchemist writes in his book titled Rasaratnakara of the 7th century, zinc extraction from *Rasaka* or *Kharpara* (calamine) by distillation. A similar description is to be found in other alchemical works of this and later times, showing that by the 13th century the process was quite common which records that brass is an alloy of copper and zinc.[62]

Most of the Indian Alchemists classified *Pittala* in *Mishra Dhattu* but it is also considered as *Updhattu* of *Tamra* and *Yashada. Pittala Bhasma* was not frequently used as compared to *Bhasma* of *Tamra* (copper) and *Yashada* (zinc) in *Rasaaushadhis*. In the various classical text of Rasa Shastra, it is mentioned that the *Shodhana* and *Marana* (process of *Bhasma Nirman*) process of *Pittala Bhasma* can be adopted similar to the methods of *Tamra Marana*. Classification of *Pittala* is based on the appearance of colour after quenching in *Kanji* (sour gruel). Lead in brass suggests that it was deliberately added to increase the casting ability of the metal. Such leaded brasses were called *Kakatundi* in ancient India[61]. *Vipaka* is not mentioned by any Acharya of Rasa Shastra. *Virya* (Temperament) of *Pittala* is said to be either *Ushna Virya* or *Sheeta Virya*, which depends on the drugs used in the process to make *Bhasma* so we can say that *Pittala* possesses "*Yogavahi*" property. Two methods of *Shodhana* of *Pittala* by *Puta Pakwa* are mentioned[17,18,44]. *Marana* process can be performed in *Ardha-Gajaputa* and *Gajaputa. Marana Dravya* is a drug required for levigation during the *Marana* step. In all methods of *Pittala Marana,* Sulphur or Sulphur-containing compound is used like *Tamra. Pittala Bhasma* is used in the treatment of a wide range of diseases. Adulterated or improperly prepared *Bhasma* could cause *Brahma* (vertigo), *Arsha* (piles), *Bhagendra* (fistula in ano) *Prameha* (urinary disorder), *Jwara* (fever) and *Mrityu* (death).

CONCLUSION

Pittala (Brass) and *Varta Loha* (Bronze) were known in the later Vedic age, especially Bronze Age. Literary surveys and archaeological evidence stated that *Pittala* was more popular than *Yashada* in ancient times. One possible reason is that it has an appearance of gold and another one is used to make musical instruments. The higher percentage of Zinc in making Brass was first started in India. This is also evident that Indians extracted the Zinc from its ores and then cemented it in copper. Ancient scholars also mentioned the modern terminology to characterize the metallic property of Brass such as metallic luster (*Suvarnabha*), Ductile (*Sutrapatrini*) and Malleable (*Tandan-shama*). Classification is based on the percentage of other metals like *Naga* (lead) infusion in it. *Kakatundi* has a maximum percentage of lead after zinc in copper. Lead can be used for altering its *Virya*. Both *Tamra* and *Yashada* metals are very frequently used for making *Bhasma*. Undoubtedly, the *Bhasma* of *Pittala* might be easy to prepare compared to Tamara, but there is no research study done on the Pharmaceutical, Analytical and Pharmacological evaluation of *Pittala Bhasma*. *Pittala* could be a good substitute for *Tamra Bhasma* because it is convenient to formulate. Moreover, it is mild in temperament than *Tamra.*

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Cite this article as:
Punam Kumari, Yadevendra Yadav, Khem Chand Sharma. Pittala (Brass) in Traditional Indian Knowledge System: A Review. International Journal of Ayurveda and Pharma Research. 2022;10(Suppl 2):70-78.
https://doi.org/10.47070/ijapr.v10iSuppl2.2352
Source of support: Nil, Conflict of interest: None Declared

***Address for correspondence**
Dr. Punam Kumari
MD Scholar,
P.G Department of Rasa Shastra & Bhaishajya Kalpana, Uttarakhand Ayurved University, Rishikul Campus Haridwar, India.
Email: punamaryan4@gmail.com