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Standardization of *Parada* (Mercury) Extraction from *Hingula* through a Modified *Nada-Yantra* Process"

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ABSTRACT

Background: *Parada* (mercury) holds both significant therapeutic value and cultural importance. Naturally sourced mercury often contains impurities, making its direct use unsuitable. However, extracting mercury from *Hingula* (cinnabar) is a simpler and more cost-effective alternative, and it is suitable for use in pharmaceutical preparations. Ayurvedic texts describe *Hingullotha Parada* (mercury obtained from *Hingula*) as being equivalent in quality to mercury processed through eight traditional purification steps. Classical literature describes around 18 methods for extracting mercury from *Hingula*, including techniques like *Urdhwapatana* (upward sublimation), *Adhopatana* (downward sublimation), and *Tiryakapatana* (lateral distillation). Among them, the *Urdhwapatana* method, which utilizes *Nada-Yantra* (a type of apparatus), is traditionally mentioned; however, it often results in the loss of mercury as vapor, reducing the yield and posing health hazards due to toxic mercury fumes. **Objective:** This study aimed to develop a refined and standardized procedure for mercury extraction from *Hingula*, to maximize yield while minimizing health risks and material loss. **Materials & Methods:** A modified version of the classical *Nada-Yantra* method was developed and implemented in this pharmaceutical study. The procedure was critically assessed, and a standard operating protocol (SOP) was established. **Results:** The improved technique significantly reduced mercury vapor emission and resulted in an Average yield of 67.81%. **Conclusion:** Extraction of mercury from *Hingula* using a modified classical technique proves to be both efficient and safer. Minor adjustments to the traditional process can enhance yield and reduce associated risks, making this approach highly effective for Ayurvedic pharmaceutical applications.
Keywords: *Hingula, Parada, Nada-yantra.*

Introduction:

Parada, also known as *Shiva-virya*[1] (the essence or semen of Lord Shiva), holds immense therapeutic value in *Ayurveda*. It is often referred to as *Amruta*[2] (nectar), symbolizing its power to grant longevity and enhance the quality of life. According to *Rasaeshwar Darshana*, liberation (moksha) can only be attained through a stable physical form, and *Parada* is seen as the agent that provides such stability[3]**.** In the *Upanishads, Rasa* is equated with *Brahma*, highlighting its divine significance. These classical references underscore the supreme importance of *Parada*. In fact, its value is so profound that an entire Ayurvedic branch, Rasa Shastra, is named after it. However, due to its immense worth, it is believed that *Indradeva* requested Lord *Shiva* to infuse it with impurities (doshas), making its purification a crucial and challenging task. To harness the therapeutic potential of *Parada* (mercury), scholars of *Rasa Shastra* have described elaborate procedures, including *Samanya Shodhana* (general purification), *Vishesh Shodhana* (specific purification), and multiple *Samskaras* (processing techniques). However, these traditional methods are often time-consuming and expensive. As an alternative, researchers have adopted the method of *Hingulotha Parada*[4]—the extraction of mercury from cinnabar. This process involves separating mercury from *Hingula* (mercuric sulfide or HgS), a red-colored mineral considered the best natural ore of mercury. According to *Acharya Rasavagbhatta*, the mercury obtained through *Hingulotha* is equally potent as *Ashta-Samskarita Parada*[5]**.** Around 18 classical references mention *Hingulotha Parada*, all

based on *Patana* (sublimation) techniques, including *Urdhva Patana* (upward sublimation), *Adho Patana* (downward sublimation), and *Tiryaka Patana*[6] (lateral sublimation). Each of these methods requires specific instruments such as *Damaru Yantra*, *Sthalika Yantra*, *Nada Yantra*, and *Vidhyadhara Yantra*. In this particular pharmaceutical study, the *Urdhawapatana* method was employed with the help of a modified Nada-Yantra.

The whole study was completed in following steps: 1. Collection of raw material 2.*Hingula Shodhana* (purification of cinnabar) 3.Extraction of Parada 4. Collection of *Parada.*

Purification(Shodhana):
Shodhana refers to the process used to remove *Doshas* (undesirable or toxic components) from a substance. It also serves to concentrate the active compound within a formulation, thereby enhancing the final yield. *Hingula* can be purified using two main methods: *Swedana* (boiling) and Bhavana (levigation). In the Swedana method, *Hingula* is boiled in a *Dola-Yantra* using mediums such as *Jayanti* leaf juice (*Sesbania sesban*), cow urine, *Kanji* (fermented rice gruel), or lemon juice[7]. In the *Bhavana* method, *Hingula* is triturated with media like *Amlavarga* (sour-tasting substances), sheep's milk (*Meshiksheera*), or ginger juice. These agents help eliminate impurities from *Hingula*. In the present study, *Hingula* was purified using the *Bhavana* method with lemon juice as the levigation medium. The purification process involves two steps: first is *Bhavana* (trituration), and another is *Prakshalan* (hydraulic wash). *Bhavana* or levigation helps in dissociation of the bond between ore and gangue, followed by hydraulic washing separates them on the basis of different specific gravities.

Separation of Mercury *(Parada)*: To extract mercury, the purified *Hingula* is tied in a cloth and formed into a bolus, which is then heated. This process relies on sublimation, where mercury vaporizes under high temperature. As the ore-gangue bonds break, mercury vapor travels upward and condenses on the upper part of the *Nada-Yantra*, which is cooled with a moist cloth to maintain a relatively lower temperature.

Collection of Mercury: The majority of mercury condenses and collects in the *Nada* section, though some residue may be found in the ash. Mercury droplets must be carefully collected from both these regions.

Materials Used: *Hingula* (Cinnabar), Lemon juice, *Kharal* (mortar and pestle), Water source, Cotton cloth and scissors, *Sharava* (earthen pot), *Nada-Yantra* (earthen distillation apparatus), Tray, Coal, Fire gun.

Method – In this research, the *Urdhwapatana* method was employed to extract mercury from *Hingula* in a standardized manner to ensure optimal yield.

Pharmaceutical Study – The entire pharmaceutical procedure was carried out in the following sequential steps:

Collection of raw material

- 785gm *Ashudhha- Hingula* was purchased from Phophaliya herbal Jodhpur. It gets authenticated based on their *Prashasta Lakshanas* (acceptable characters) such as *Shwetarekhah* (silver strips on fracture), *Pravalabho* (appearance like coral leaves),[8] *Bharpurno* (weighty)[9].
- Fresh lemons were purchased from the local market, and 450ml juice was extracted from 1.5kg of lemons. The juice was extracted manually. The pH of lemon juice was 2.5.

Purification of *Hingula:*
Impure *Hingula* was first powdered using a mortar and pestle. It was then triturated with lemon juice and left to dry in the sunlight. This process was repeated for a total of seven *Bhavanas* using *Nimbu Swarasa* (lemon juice). The *Hingula* purified through this method is considered undoubtedly suitable for use in all types of formulations (Yogas)[10].

Table 1: Showing the amount of lemon & trituration time

Day	Amount of lemon juice	Criteria to stop trituration	Time taken in the process of trituration
1st	75 ml	Till it gets absorbed completely	3hrs 35min
2nd	70 ml	Till it gets absorbed completely	3hrs 20 min
3rd	65 ml	Till it gets absorbed completely	3hrs20 min
4th	60 ml	Till it gets absorbed completely	3hrs 10 min
5th	60 ml	Till it gets absorbed completely	3 hrs
6th	60 ml	Till it gets absorbed completely	3 hrs
7th	60 ml	Till it gets absorbed completely	3 hrs

Observations: The amount of lemon juice required for trituration gradually reduces. During trituration, it gradually became sticky to the pestle. The color of *Hingula* changed gradually during trituration, from *Kumkumprabham*[11] (reddish orange color) to *Japakusumsamkashama*[12](bright red color). *Prakshalan* or hydraulic wash was done three times to remove acidity. After washing and drying in sunlight, 791 g of *Hingula* was obtained.

Extraction and Collection of Mercury

Materials Required: *Nada-Yantra*, coal, *Sharava* (earthen shallow vessel), cotton cloth pieces, loose cotton, and a fire gun.

This step is the core part of the entire process. The procedure was carried out in the following sequence:

1. Take a cotton cloth along with loose cotton.
2. Evenly spread the powdered *Hingula* over the cloth and cover it completely using the cotton.
3. Fold the cloth diagonally to form a bolus (round bundle). Secure the bolus by tightly tying it with a cotton cloth strip.
4. Place coal inside a *Sharava*.
5. Using the fire gun, ignite the coal until it glows red-hot. Then place the prepared bolus at the center of the *Sharava*.
6. Set the *Nada* (hollow metal tube or apparatus) on a stone and slightly tilt it on one side to allow oxygen flow. This step must be done carefully—excessive tilting can lead to loss of mercury vapors, while insufficient spacing may prevent oxygen entry and cause the fire to go out.
7. To cool the upper portion of the *Nada*, place a wet cloth over it.
8. As yellow sulfur fumes begin to appear, continue applying wet cloths to maintain a controlled temperature.
9. After approximately two hours, the intensity of fumes reduces significantly, and within the next 30 minutes, all sulfur vapors disappear completely.
10. Whole the instrument left as it is to self-cool

Table 2 : Yield of *Parada* from *shuddha Hingula*

S. No.	Materials	1st Extraction	2nd Extraction	3rd Extraction
1	*Shuddha Hingula* (g)	200	200	200
2	Cotton cloth (g)	14.5	13	14
3	Cotton (g)	40	35	38

4	Pieces of cotton cloth (g)	10	5	8
5	Charcoal (g)	140	130	135
6	*Parada* obtained (g)	118.4	143.3	145.5
7	% Yield	59.2	71.5	72.75
8	Average Yield (%)	**67.81**		

The extraction of *Parada* from *Shuddha Hingula* was performed in three successive extractions. The yield increased from 59.2% in the first extraction to 71.5% in the second, and 72.75% in the third, with an average yield of 67.81%

Observations:

- Pungent yellow sulfur fumes began to emerge within the first 15 minutes of initiating the procedure.
- The intensity of the fumes began to reduce after two hours and had completely dissipated within the following 30 minutes.

Collection of Mercury: On the following day, the *Nada Yantra* is carefully lifted, revealing numerous droplets of mercury on its surface. These are collected using a clean cloth. Some quantity of mercury is also found within the coal and ash residues. To extract it, the ash is filtered through a four-layered cloth (*Chaturguna Vastra*). Upon squeezing, the mercury passes through the micro-pores of the cloth and collects in a vessel, while the ash remains on the upper layer. The cloth is then gently opened over a tray, as additional mercury may be trapped between the layers, which should also be collected. The remaining coal and ash are washed with water and allowed to settle, enabling any leftover mercury to separate and be collected. All the retrieved mercury is then stored in a sealed container. From 600 grams of *Hingula*, a total of 407.2 grams of mercury was obtained, resulting in a yield of 67.81%.

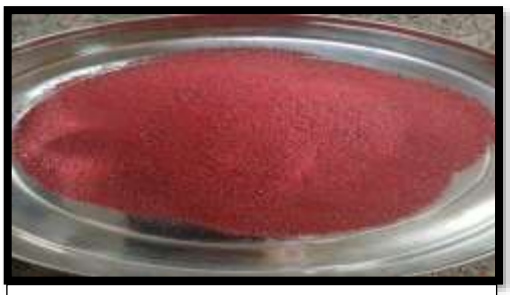
DISCUSSION

Hingula, chemically known as mercury sulfide (HgS), is considered the most valuable ore of mercury due to its high mercury content—approximately 86%[13]. For purification, lemon juice was used as the medium. Gentle grinding (trituration) followed by exposure to sunlight likely helps weaken the bond between mercury and sulphur. It is assumed that more thorough trituration might improve the yield of *Parada* (mercury). The requirement for *Bhavana Dravya* (triturating liquid) seems to decrease over time, possibly because, as particle size reduces, the material occupies less volume. This follows the classical principle: *"Draven Yavata Dravyam Churnitam Tvadratamvrajet"*—meaning the quantity of *Bhavana Dravya* should be enough to keep the material moist during the grinding process[14]. Weather conditions can also influence the amount needed[15]. Intense trituration generates a small amount of heat, which may help initiate chemical reactions and reduce particle size further. The hydraulic washing process aids in removing acidic substances and toxins based on their differing specific gravities. A small amount of loose cotton is preferred over cloth during combustion because it ignites more easily. Proper ignition of coal is crucial; if the coal doesn't burn completely or evenly, the *Hingula* bolus may only partially combust, resulting in reduced mercury yield. Moreover, placing the *Nada* on the *Sharava* can restrict airflow, causing poor combustion. Using a fire gun ensures the coal quickly becomes red-hot, generating the necessary heat for effective dissociation. The heat applied to the powdered *Hingula* breaks the mercury-sulfur bond. Sulfur is released as sulfur dioxide (SO_2), while mercury converts to mercury oxide. Once the appropriate temperature is reached, mercury oxide breaks down, and mercury begins to sublimate, forming tiny globules. These sublimated droplets accumulate on the top of the *Nada*, where the temperature is lower due to the presence of a wet cloth.

Probable causes of loss :

- Some amount of mercury comes out in the form of vapors from the instrument with fumes.
- It was very time-consuming to collect very small droplets of mercury, so some amount gets lost in this form.

Conclusion: Considering the significance of *Rasa-aushadhies* (herbo-mineral medicines in Indian alchemy), obtaining purified mercury (*Shuddha Parada*) is essential. *Hingula* (cinnabar) serves as the primary source of mercury and has been highly regarded by ancient alchemists for mercury extraction. Following classical procedures, *Hingula* was processed using the *Urdhwapatana* method with the help of a *Nada Yantra* apparatus. From 600 grams of *Hingula*, a total of 407.2 grams of mercury was obtained, resulting in a yield of 67.81%.



Ashuddha Hingula

Bhavit Hingula

Nada Yantra

Inner surface of *Nada*

Ashtasanskarita Parada

Shuddha Parada

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