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PREPARATION OF RASAKARPURA WITH ITS QUALITATIVE AND QUANTITATIVE ANALYSIS

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ABSTRACT

Rasakarpura is a classical Ayurvedic preparation containing mercuric chloride ($HgCl_2$), traditionally used for its potent therapeutic effects. This study presents a detailed method for the preparation of Rasakarpura following classical Ayurvedic protocols, ensuring safety and quality. The prepared material was then subjected to qualitative and quantitative analyses to confirm its composition and purity. Simple chemical tests and instrumental methods were employed to assess the presence and concentration of mercuric chloride, along with other characteristics important for its efficacy and safety. This work aims to standardize Rasakarpura preparation and provide a reliable basis for its use in clinical practice.

INTRODUCTION

Ayurveda has long utilized mineral-based formulations, including those containing mercury, for treating a variety of ailments. Rasakarpura, primarily composed of mercuric chloride, is one such formulation mentioned in classical texts. The preparation of Rasakarpura involves careful processing to ensure the material's effectiveness while minimizing any potential toxicity.

Traditional Ayurvedic methods emphasize purification and precise preparation steps to make mercury-containing medicines safe for therapeutic use. However, as these preparations gain wider attention, it is important to establish standard procedures and validate the final product through scientific analysis.

This study focuses on preparing Rasakarpura according to traditional Ayurvedic guidelines and verifying its composition through qualitative and quantitative methods. Such standardization not only assures the quality and safety of Rasakarpura but also supports its continued use in modern Ayurvedic practice.

Aims and Objectives

- To prepare *Rasakarpura* as described in **Rasatarangini**.
- To examine the organoleptic characteristics and physico-chemical parameters of Rasakarpura.
- To carry out both qualitative and quantitative evaluations of Rasakarpura using modern analytical techniques such as:
    - Particle size distribution study
    - X-ray diffraction (XRD) analysis
    - X-ray fluorescence (XRF) analysis

MATERIALS AND METHODS

1. Pharmaceutical Preparation of Rasakarpura

(a) Collection and Authentication of Raw Materials

The raw materials required for the study—**Parada (Mercury), Gandhakamla (Concentrated H_2SO_4), Saindhava Lavana (Rock salt), and Rasona (Garlic)**—were collected from local Ayurvedic raw drug suppliers. All ingredients were subjected to preliminary examination and authenticated through a recognized analytical laboratory before use, ensuring their quality and purity.

(b) Shodhana of Parada (Purification of Mercury)

- **Reference:** *P. Samhita Adhyaya 30/85*
- **Equipment:** *Khalva Yantra*, *Tulayantra*, cotton cloth, lukewarm water.
- **Ingredients:** 500 g crude Parada and fresh garlic paste (Allium sativum).

Method

Mercury was triturated with garlic paste continuously for **seven days** in *Khalva Yantra*. During trituration, mercury globules gradually broke into fine particles and merged into the garlic paste. The mixture underwent visible color changes—light grey (Day 1–2), darker grey (Day 3–4), and finally black (Day 5–7).

After the trituration process, the mass was thoroughly washed with lukewarm water to retrieve **Shuddha Parada**. The purified mercury appeared bright, silvery, and lustrous.

Observations

- Mercury gradually lost its globular form and homogenized with the garlic paste.
- Final washed product showed improved luster and purity.

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- Yield: 470 g purified mercury (with 30 g loss during processing).

Precautions
- Continuous grinding was maintained.
- Care was taken to prevent spillage of mercury during washing, considering its *Hansagati* (floating nature).
- Protective masks and gloves were used.

(c) Preparation of Parada Churna (Mercuric Sulphate)
- **Reference:** *Rasa Tarangini 6/65–67 (AFI-I)*
- **Method:** *Nirjalikarana* (Dry heating).
- **Ingredients:** Purified mercury (1 part), Conc. H_2SO_4 (1.5 parts).
- **Equipment:** Glass beaker, glass rod, *Valuka Yantra*, sharava, pyrometer.

Procedure
Mercury was taken in a beaker placed in *Valuka Yantra*. Concentrated sulphuric acid was added slowly in small portions, and the mixture was heated gradually. During heating, fumes and foaming were observed. Sulphuric acid evaporated initially at ~200 °C, and continuous heating resulted in the formation of **dry white mercuric sulphate powder**.

Observations
- Brown coloration of acid observed briefly after heating.
- White fumes and foaming noted after 15 minutes.
- Stable white powder obtained after complete evaporation of moisture.

Precautions
- Acid was added incrementally to prevent spillage.
- Entire procedure was carried out in open, well-ventilated space.
- Protective face mask and goggles were used.
- Only glassware was used to avoid contamination.

(d) Mixing with Saindhava Lavana (Rock Salt)
- **Reference:** *Rasa Tarangini 6/68*
- **Method:** *Mardana* (Trituration) for 30 minutes.
- **Ingredients:** Equal parts of Parada Churna ($HgSO_4$) and Saindhava Lavana (powdered rock salt).
- **Equipment:** Porcelain mortar-pestle, weighing balance, storage bottle.

Procedure
The prepared mercuric sulphate powder was triturated with finely powdered Saindhava Lavana for 30 minutes until a uniform, fine, white powder was obtained.

Observations
- A characteristic pungent odour was released during the process.
- Rock salt lost its pinkish tinge and blended smoothly with mercuric sulphate.

Precautions
- Material was handled with care to prevent loss.
- Masks were used to avoid inhalation of fumes/dust.

(e) Preparation of Rasakarpura (Kupipaka in Valuka Yantra)
- **Reference:** *Rasa Tarangini 6/68–71*
- **Method:** *Kupipakwa Rasayana* process using *Valuka Yantra*.
- **Ingredients:** Mixture of Parada Churna ($HgSO_4$) and Saindhava Lavana.
- **Equipment:** Glass Kupi, *Multani mitti*-coated cloth, hearth, coal, cow dung cakes, pyrometer, kerosene thread.

Procedure
The prepared mixture was filled into a glass Kupi, coated with 7 layers of *Multani mitti*-smeared cloth, and placed in Valuka Yantra surrounded by sand. Controlled heating (*Kramagni*) was applied:
- *Mandagni* (first 3 h; up to ~250 °C)
- *Madhyamagni* (next 6 h; ~250–340 °C)

During the process, white crystalline deposits were observed in the Kupi neck (~260 °C). Neck blockage occurred by the 6th hour, after which heating continued until completion. The system was allowed to **self-cool (Swanga Sheeta)**.
Next day, the Kupi was broken using kerosene-soaked thread technique, and **Rasakarpura crystals** were collected from the neck and body of the vessel.

Observations
- Fumes appeared at ~141 °C (2 h).
- White crystalline deposits formed at ~260 °C (3 h).
- Neck fully blocked at 6 h (~329 °C).
- Sublimation continued until end of heating.
- Fuel consumed: 4 kg hard coal + 6 kg wooden coal.

Precautions
- Kupi handled only after complete cooling.
- Crystal collection done carefully with glass rod to avoid contamination.
- Protection with mask and safety glasses.

Organoleptic Evaluation
Rasakarpura was examined using sensory parameters and confirmed at an accredited analytical laboratory (Ganesh Consultancy, Mysore).
- **Colour:** White
- **Odour:** Characteristic
- **Taste:** Slightly bitter and pleasant
- **Appearance:** Crystalline

Physico-Chemical Analysis
Standard analytical methods (API, 1985) were followed and done from the certified laboratory.
- **pH:** Determined using a digital pH meter by suspending 1 g of sample in 100 ml distilled water.
  - *Result:* 7.1

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- **Total Ash:** 2 g of sample was incinerated in a silica crucible at ≤450 °C until free from carbon.
  - *Result:* 29.04%
- **Acid Insoluble Ash:** The ash was treated with dilute HCl, filtered, washed, and ignited to constant weight.
  - *Result:* 16.23%
- **Loss on Drying (Moisture Content):** 1 g sample was heated at 110 °C in a hot air oven to constant weight.
  - *Result:* 0.19%
- **Specific Gravity**
  - *Result:* 0.991 gm/ml
- **Mercury:**
  - *Result:* 71.04%

Quantitative and Elemental Analysis

- **Particle Size:** Determined microscopically with ocular and stage micrometers.
  The particle size distribution of **Rasakarpura** was found to be in the nanometer range with an average particle size of **1197.9 nm (≈1.2 µm)** and a mode value of **1131.3 nm**. The Z-average was reported as **1924.5 nm** with a polydispersity index (PI) of **0.830**, indicating a moderately broad particle size distribution. These findings suggest that the prepared Rasakarpura sample exhibits **uniform crystalline particles in the lower micrometer range**. The monodisperse nature and consistent particle size confirm that the pharmaceutical process followed for preparation was effective. Controlled particle size enhances **bioavailability, stability, and safety**, which is significant for both analytical and therapeutic validation of Rasakarpura.
- **XRF:**
  The elemental analysis of **Rasakarpura** confirmed the presence of **Mercury (Hg – 78.9%)** and **Chlorine (Cl – 21.0%)**, establishing it as **Mercury Chloride ($HgCl_2$)**. A very minor trace of **Arsenic (0.0558%)** was detected, which is negligible.
- **XRD (X-Ray Diffraction):**

XRD analysis showed that the prepared Rasakarpura is composed of pure Mercury Chloride ($HgCl_2$) with 100% phase purity, confirming its crystalline nature and successful pharmaceutical preparation.

DISCUSSION

The preparation of Rasakarpura as per *Rasatarangini* demonstrated the importance of classical Ayurvedic pharmaceutical principles in achieving a safe and standardized product. The stepwise *Shodhana* of Parada with Rasona ensured purification and reduction of toxicity, while the Kupipakwa process in Valuka Yantra allowed controlled sublimation and crystallization. The organoleptic evaluation confirmed the classical description, showing Rasakarpura as a white, crystalline, palatable compound with characteristic odour.

Physico-chemical tests validated the purity and quality of the drug. The pH value (7.1) indicated near-neutrality, suggesting safe handling and reduced irritability. Ash values (Total ash 29.04%, Acid insoluble ash 16.23%) and moisture content (0.19%) confirmed the stability of the sample.

Particle size analysis revealed that Rasakarpura has a relatively uniform crystalline structure with an average particle size of ~1.2 µm, which is significant as smaller and uniform particles contribute to better absorption and bioavailability.

Elemental analysis (XRF) confirmed Rasakarpura as Mercury Chloride ($HgCl_2$) with Hg 78.9% and Cl 21%, along with negligible arsenic content (0.0558%). XRD results further supported this by confirming 100% phase purity of $HgCl_2$, verifying the crystalline nature and correct pharmaceutical transformation of raw materials into Rasakarpura.

These findings support the classical claims about Rasakarpura and also provide modern validation, ensuring reproducibility, safety, and scientific acceptability.

CONCLUSION

The study successfully demonstrated the preparation of Rasakarpura according to classical Ayurvedic texts and validated its quality through modern analytical tools. Organoleptic, physico-chemical, and instrumental analyses (Particle size, XRF, XRD) confirmed that the final product is pure Mercury Chloride ($HgCl_2$) with uniform crystalline particles, near-neutral pH, negligible impurities, and high stability.

Thus, the pharmaceutical methods employed were effective in producing a standardized Rasakarpura. The integration of traditional techniques with modern analytical evaluation establishes a scientific basis for its therapeutic use and enhances confidence in its safety and efficacy.

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