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Pharmaceutical Processing and Elemental Profiling of Gandhaka: A Comparative Study Pre and Post Post-Shodhana by Dhalana-Swedana Method

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ABSTRACT:

Gandhaka (Sulphur) holds significant therapeutic relevance in the preparation of Ayurvedic Rasaushadhis. However, its raw form may contain physical and chemical impurities, which can have a hazardous impact on the human body and hence require purification by classical shodhana methods. This article explores the pharmaceutical processing of Gandhaka using the dhalana followed by the Swedana method and evaluates the elemental profile before and after shodhana using ICPAES analysis. Quantitative analysis revealed changes in the sulphur percentage before and after shodhana. These findings are critically analysed with support from earlier studies and data, suggesting potential mechanisms behind the observed changes. The pharmaceutical process was completed with negligible material loss. ICP-AES analysis revealed a significant increase in sulphur content from 78.68% in Ashuddha Gandhaka to 99.95% in Shuddha Gandhaka. Distinct changes in organoleptic characteristics were also observed following Shodhana. The study demonstrates that Dhalana followed by Swedana using Godugdha, effectively purifies Gandhaka by removing impurities and enhancing elemental purity. This pharmaceutical transformation supports the classical rationale of Gandhaka Shodhana and underscores its clinical relevance in ensuring the safety and therapeutic efficacy of Gandhaka-containing formulations.

Keywords: Gandhaka, shodhana, swedana, ICPAES, elemental analysis

INTRODUCTION:

In nature, Gandhaka is found in free state along with soil and stone, etc. But in compound form, it is found as the ores of minerals. In raw form gandhaka contains many impurities which can cause harm to the human body if ingested without carrying out its shodhana (purification) properly. In classics they have mentioned that consumption of Ashuddha Gandhaka leads to many vikaras (diseases) such as Kustha, tapa, bhrama, paittika rogas, bala-veerya hani, etc. Hence, to get rid of these impurities, it is necessary to do shodhana of raw Gandhaka. Many methods of shodhana have been mentioned in classics. The method adopted in this study is Dhalana followed by the Swedana method. The sample was studied for % of sulphur before and after the shodhana procedure for which the modern analysis technique of ICPAES was used.

The study aims to describe in detail the pharmaceutical process of Gandhaka shodhana by the Swedana method, along with the analytical findings. It also attempts to critically analyse the results to reach possible reasons for the observed changes.

MATERIAL AND METHODS:

I. Collection of Raw material: Ashuddha Gandhaka and go-ghrita were procured from KLE Ayurveda Pharmacy and Godugdha was purchased from the local market of Belagavi. Authenticated of Gandhaka was done in AYUSH approved Drug Testing Laboratory, KAHER'S Shri BMK Ayurveda Mahavidyalaya, Belagavi, Karnataka.

II. Pharmaceutical study: was carried out at the Department of Rasashastra and Bhaishajya Kalpana, KAHER's Shri. B.M.K Ayurveda Mahavidyalaya, Belagavi, Karnataka.

III. Analytical study: ICPAES analysis was carried out at SAIF, IIT Bombay.

IV. Pharmaceutical study:

1. Reference: Rasa Ratna Samucchaya 3/20-22

2. Principle: Dhalana and Swedana

3. Required equipment: weighing machine, Khalwa yantra, iron ladle (volume: 500 ml, diameter: 15 cm, Depth: 6 cm, weight: 430 gm), gas stove, lighter; stainless steel vessel, spoon, and plate; cotton cloth, thread, thermometer, pycnometer, pH paper.

4. Ingredients:

5. Method of preparation:

S. No.	Ingredient	English name	Quantity
1	Amlasara Gandhaka	Sulphur	200 gm
2	Godugdha	Cow's milk	Q.S. ~ 500 ml
3	Goghrita	Cow's ghee	Q.S. ~ 30 ml

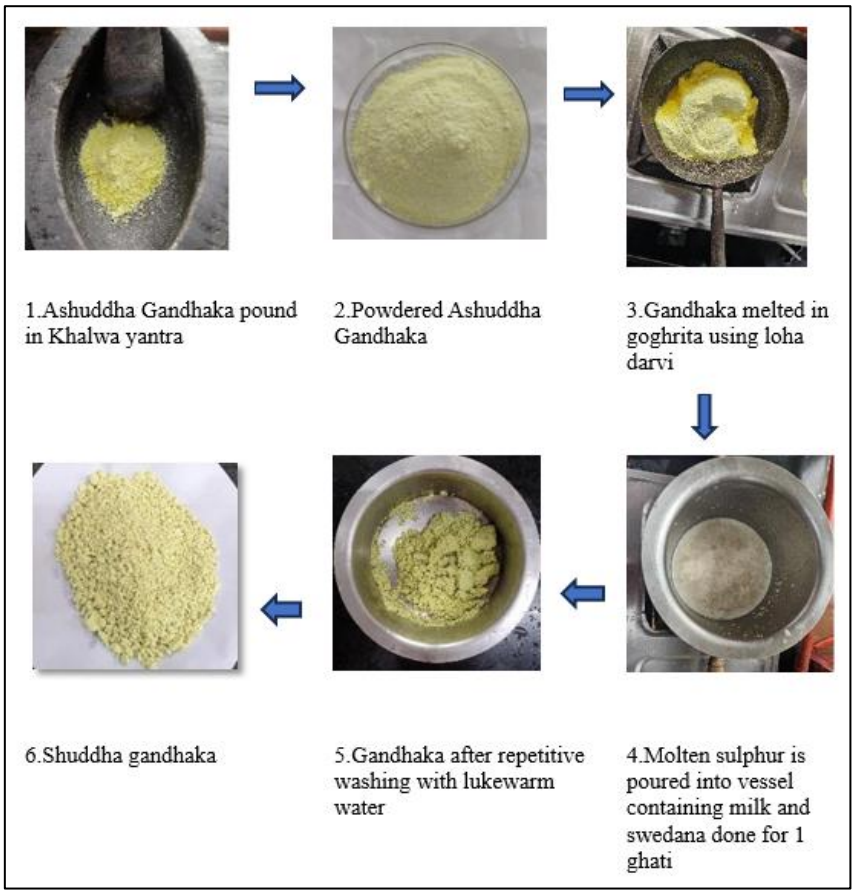

Figure 1: Procedure of Gandhaka shodhana

A. **Purvakarma**:

- Weigh the required quantity of Amlasara Gandhaka using the weighing machine.
- Pound it in the Khalwa yantra to obtain fine powder of Ashuddha gandhaka.

B. Pradhana karma:

- The powdered Gandhaka is taken in a loha darvi (iron ladle) with a sufficient quantity of goghrita (utilised quantity was 30 ml) and is subjected to mandagni.
- Gandhaka should be stirred with a spoon intermittently to ensure its proper melting.
- When the gandhaka melts completely, it is poured into a stainless-steel vessel (over whose mouth cotton cloth has been tied with a thread) containing a sufficient quantity of lukewarm Godugdha to completely immerse the gandhaka.
- Then the cloth is removed and it is allowed for swedana in the same milk for 1 ghati Pramana i.e. 24 minutes.

C. Pashchat karma:

- It is allowed to cool itself. Once cool, it is washed with lukewarm water until the stickiness of ghrita is removed.
- Shuddha gandhaka is obtained.
- It is then dried properly. Once dry, it is pounded in the Khalwa yantra to obtain its fine powder.
- It is stored in a non-reactive airtight container.

6. Precautions taken:

- Equipments should be clean and dried.
- Mandagni should be maintained throughout the procedure.
- Gandhaka should be poured as soon as it melts.
- Gandhaka should be washed thoroughly post swedana with lukewarm water.
- Care should be taken while washing to avoid loss.

RESULTS AND OBSERVATIONS:

The observations made during the procedures have been tabulated in Table No.01.

S. No.	Parameter	Result
1.	Weight of powdered Gandhaka before Swedana (grams)	200 gms
2.	Quantity of cow's milk taken for Swedana (litres)	500 ml
3.	Quantity of ghrita required	30 ml
4.	Room temperature	22 degrees centigrade
5.	pH of milk before Swedana	07
6.	Specific gravity of Godugdha	1.030
7.	Specific gravity of Goghrita	0.913
8.	Lukewarm milk temperature	40 degrees centigrade
9.	Temperature at which Gandhaka melts	118 degrees centigrade
10.	Temperature of milk after Dhalana	60 degrees centigrade
11.	pH of cow's milk after Swedana	6.5
12.	Time taken for Swedana	24 minutes
13.	Temperature of milk after 24 minutes	85 degrees centigrade
14.	Time taken for self-cooling after Swedana	1.5 hours
15.	Quantity of warm water required for washing	6 litres
16.	Weight of Gandhaka obtained after washing(g)	234.8 gms
17.	Weight of Gandhaka obtained after drying(g)	199.8 gms
18.	Loss in weight of Gandhaka	0.1 %

The ICPAES Analysis results for Gandhaka have been tabulated in Table No. 02

	Before Shodhana	After shodhana
Percentage of Sulphur	78.68 %	99.95 %

Organoleptic characteristics of Gandhaka are tabulated in Table No. 03

Organoleptic characteristics	Form	Colour	Odour	Touch
Ashuddha Gandhaka	Solid crystal	Lemon yellow	Characteristic	Rough
Shuddha Gandhaka	Solid granular	Cream yellow	Characteristic	Rough

DISCUSSION:

Gandhaka is one of the most extensively utilized minerals in Rasashastra, particularly in the preparation of Kupipakwa Rasayana, Kajjali, and various herbo-mineral formulations. Classical texts consistently emphasize that the therapeutic efficacy and safety of Gandhaka are highly dependent on the adequacy of its Shodhana[1,2]. The present study evaluated the pharmaceutical transformation of Gandhaka subjected to Dhalana followed by Swedana using Godugdha, and critically assessed the elemental changes through ICP-AES analysis.

During pharmaceutical processing, melting of Gandhaka was observed at approximately 118 °C, which corresponds closely with the reported melting point of elemental sulphur. The use of Goghrita during melting plays a crucial role by preventing direct overheating, reducing oxidative degradation, and facilitating uniform liquefaction[3]. Immediate Dhalana into lukewarm milk ensures rapid solidification of sulphur in a dispersed form, thereby increasing the surface area and promoting effective interaction with the Shodhana dravya[1].

The Swedana phase conducted for one Ghati (24 minutes), as described in Rasa Ratna Samucchaya[1], allowed prolonged contact between Gandhaka and milk constituents under controlled thermal conditions. Milk, being mildly acidic and rich in proteins, lipids, and lactose, acts as a complex purification medium. The observed reduction in milk pH from 7.0 to 6.5 after Swedana suggests leaching of basic impurities into the shodhana media and possible interaction between sulphur and milk proteins. Similar pH changes during Gandhaka Shodhana have been reported in earlier pharmaceutical studies[3,4].

The minimal loss in weight (0.1%) after completion of the procedure indicates that the adopted method primarily facilitates purification rather than material loss. Temporary weight gain observed immediately after washing may be attributed to moisture retention and surface adsorption, which normalised after complete drying. Comparable observations have been documented in previous standardisation studies of Gandhaka Shodhana[4,5], supporting the reproducibility and material efficiency of the process.

A significant outcome of the present study is the marked increase in sulphur content from 78.68% before Shodhana to 99.95% after Shodhana, as revealed by ICP-AES analysis. This substantial increase indicates effective removal of extraneous inorganic and organic impurities present in Ashuddha Gandhaka. Classical descriptions of Gandhaka doshas such as Pashana, Mala, and Visha ansha[1,2] may be correlated with these contaminants, which are either volatilized, leached, or chemically transformed during the Shodhana process.

Organoleptic changes further substantiate the pharmaceutical transformation. The transition from crystalline lemon-yellow Gandhaka to granular cream-yellow Shuddha Gandhaka reflects structural modification, possibly due to recrystallization during melting and rapid cooling. Granular form is considered pharmaceutically superior as it facilitates better trituration and uniform incorporation into compound formulations[6].

From a mechanistic perspective, the combined effect of controlled thermal processing, lipid mediation (ghrita), aqueous-protein medium (milk), and sustained heating contributes to detoxification, stabilization, and enhancement of Gandhaka's physicochemical profile. Modern analytical studies employing ICP-AES have similarly demonstrated improved elemental purity following traditional purification techniques[5,8]. These findings support the classical assertion that Shuddha Gandhaka is safer, more potent, and suitable for internal administration, whereas Ashuddha Gandhaka is contraindicated due to its toxic potential[1,2].

Thus, the present study provides experimental validation for classical Shodhana principles and establishes a scientific basis for the observed improvement in elemental purity following Swedana-based purification of Gandhaka.

CONCLUSION:

The present study successfully demonstrates the pharmaceutical processing of Gandhaka by Dhalana followed by Swedana using Godugdha as described in classical Rasashastra texts. The procedure was found to be efficient, reproducible, and associated with negligible material loss. Analytical evaluation using ICP-AES revealed a significant increase in sulphur purity following Shodhana, indicating effective removal of impurities.

The observed physicochemical and organoleptic changes support the classical rationale of Gandhaka Shodhana and confirm that the processed material is pharmaceutically superior to its raw form. The findings provide scientific validation to traditional purification methods and reinforce the necessity of Shodhana prior to therapeutic use of Gandhaka. Further studies exploring molecular changes and toxicological parameters may help in a deeper understanding of the transformation induced by this method of Shodhana.

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Conflict of Interest Statement: All authors have nothing else to disclose.