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# "PHARMACEUTICAL PROCESSING AND FTIR-BASED ANALYTICAL CHARACTERIZATION OF GANDHAKA DRUTI PREPARED BY A ANUBHUTA METHOD"

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**ABSTRACT:**
**Introduction:** Gandhaka Druti is a classical Rasashastra formulation predominantly indicated for external application, especially in various skin disorders. Anubhuta procedure mentioned in text Ayurvediya Rasashastra remain less practiced and inadequately explored through modern analytical parameters. Scientific evaluation of such methods is essential to understand the pharmaceutical transformation of Gandhaka.
**Methods:** Gandhaka Druti was prepared following a classical Anubhuta method in accordance with Rasashastra principles. The formulation was evaluated for organoleptic characters, Physico-chemical parameters and Fourier Transform Infrared Spectroscopy (FTIR) analysis was carried out to identify and observe structural modifications after processing.
**Results:** The prepared Druti exhibited organoleptic features consistent with classical descriptions. Physico-chemical values were within permissible limits, indicating proper pharmaceutical processing and purity. FTIR spectra demonstrated characteristic absorption peaks suggesting structural modification of sulphur, reflecting transformation achieved through Samskara.
**Conclusion:** The study analytically substantiates the Anubhuta method of Gandhaka Druti preparation. Such integrative evaluation strengthens the scientific foundation of Rasashastra formulations.

**KEYWORDS:** Gandhaka Druti, Anubhuta Method, FTIR Analysis

## INTRODUCTION

Rasashastra in ayurveda deals with pharmaceutical processing and therapeutic application of metals and minerals. Various procedures like Shodhana, Marana, Jarana, Satvapatana etc are used. These pharmaceutical processes are used not only to remove impurities but also to modify their physiochemical characteristics, enhance bioavailability and improves therapeutic efficacy.
Gandhaka is widely used in various formulations, including kajjali, Kupipakwa, Parpati and various external formulation. It has properties like Rasayana, Yogavahi, Kushtaghna, Krimighna, Kandughna, Vishahara and Vranaropana[1]. Widely used in management of skin disorders, Chronic wounds, Respiratory disorders etc.
Despite its medicinal importance, Gandhaka is not suitable for direct therapeutic use because of physical impurities and undesirable constituents acquired during its natural occurrence. Therefore Shodhana is done before incorporating into medicinal formulations. Among various shodhana procedures here Bhoodhara Method is selected.
Gandhaka undergoes various pharmaceutical transformations depending upon the intended dosage form. Druti Kalpana is one such pharmaceutical procedure which denotes liquification or melting, refers to transformation of solid substance into liquid form by controlled application of heat.

### Aims

To prepare Gandhaka Druti by Anubhuta method after Shodhana of Gandhaka and to evaluate its physicochemical and FTIR charactersitics.

### Objectives

Gandhaka shodhana by Bhoodhara method.
Preparation of Gandhaka Druti – Anubhuta method.
To evaluate physicochemical parameters and FTIR characterization.

## MATERIALS AND METHODS

Pharmaceutical steps involved in preparation of Gandhaka Druti.

### 1.Shodhana of Gandhaka – Bhoodhara Method[2]

Gandhaka was first powdered in a clean khalvayantra until a fine powder was obtained. A mud pot containing cow milk was covered with a clean khora cloth and tied properly. The powdered gandhaka was then evenly spread over the tied

cloth and then it is covered with sharava. The entire mud pot is placed in a pit and subjected for laghu puta and cow dung cakes were arranged over the sharava and then ignited and allowed to burn completely. After complete self-cooling, the purified gandhaka which had melted during heating had passed through the cloth into milk. The collected gandhaka was then washed thoroughly with hot water to remove adhering milk residue and other impurities followed by complete drying before subjecting to further pharmaceutical processing.

**2. Preparation of Gandhaka Druti – Anubhuta Method[3]**

Purified Gandhaka and Tila taila were taken in the ratio of 1:16

Initially the required quantity of tila taila was transferred into a clean iron vessel and heated over mild flame. Once the oil became sufficiently warm, the finely powdered Suddha Gandhaka was added gradually with continuous stirring to ensure uniform dispersion.

The mixture was heated and stirring done continuously throughout the process. The temperature was maintained at mild level to facilitate the gradual melting and dissolution of Gandhaka into oil. As heating progressed the sulphur particles gradually dissolved resulting in a clear, homogeneous oil which indicates complete conversion of Gandhaka into Gandhaka druti. After complete dissolution of Gandhaka, the heating was discontinued and the preparation was allowed to cool naturally to room temperature and then it was then transferred into clean, dry and airtight container and stored in a cool, dry place until further use. The final preparation appeared as a clear, transparent oil.

## OBSERVATIONS AND RESULTS

### Gandhaka Shodhana

The total processing time taken for Gandhaka Shodhana was three hours. As heating progressed over a mild flame, sulphur gradually melted and dissolved completely in oil. The purified gandhaka exhibited bright yellow colour, soft texture with appearance like Mani (Granules/ beads).

**Table No- 1: Gandhaka Shodhana**

| Shodhana Dravya | Gandhaka taken | Gandhaka obtained | Time taken | Total loss |
|---|---|---|---|---|
| Milk – 1 litre | 500gm | 475gm | 3 hours | 25gm |

**Figure No 1: Bhoodhara Method of Gandhaka Shodhana**

### Gandhaka Druti

At the beginning, fine sulphur particles suspended in the oil, as heating continued gandhaka gradually melted and dissolved completely in the oil. No undissolved sulphur particles were visible at the end of heating process. After natural cooling, the preparation remained uniform without precipitation or phase separation.

**Table No- 2: Gandhaka Druti**

| Quantity of Gandhaka | Quantity of Tila taila | Time taken | Final product obtained |
|---|---|---|---|
| 20 gm | 320ml | 40 minutes | 325ml |

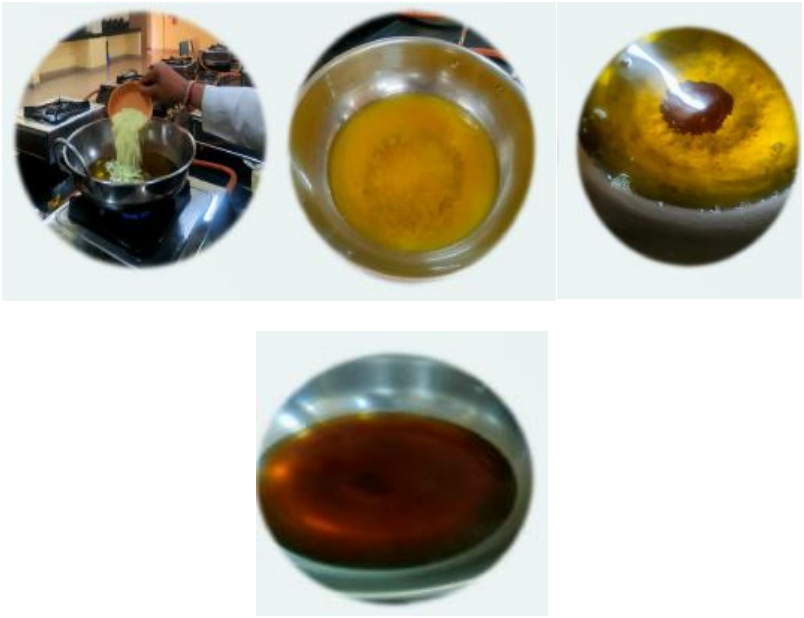

**Figure no 2: Preparation of Gandhaka Druti**

**Table No- 3: Analytical Results of Gandhaka Druti**

| SI. No. | Tests | Result |
|---|---|---|
| 1 | Rancidity | Not Rancid |
| 2 | Saponification Value | 61.4 |
| 3 | Iodine Value | 49.7 |
| 4 | Peroxide Value | 1.14 |
| 5 | Acid Value | 2.13 |
| 6 | Free Fatty acid | 1.07 |
| 7 | Total Fatty matter | 57.18% |
| 8 | pH | 6.56 |
| 9 | Weight per mL | 0.9425g/mL |
| 10 | Refractive index @ 40C | 1.485 |
| 11 | Free fatty acid | 2.2 % |
| 12 | Viscosity | 299.87 |

**FTIR Analysis**

**Procedure**

FTIR analysis of Gandhaka Druti was carried out using a Nicolet Summit X FTIR spectrophotometer equipped with an Everest ATR (Attenuated Total Reflectance) accessory with a diamond crystal. The spectrum was recorded in the range of 3496.41–560.07 $cm^{-1}$ by employing 32 sample scans and 32 background scans. The obtained spectrum was expressed

as wavenumber ($cm^{-1}$) versus percentage transmittance. The analysis was performed to identify the characteristic functional groups present in Gandhaka Druti and to evaluate the chemical integrity of the formulation after preparation.

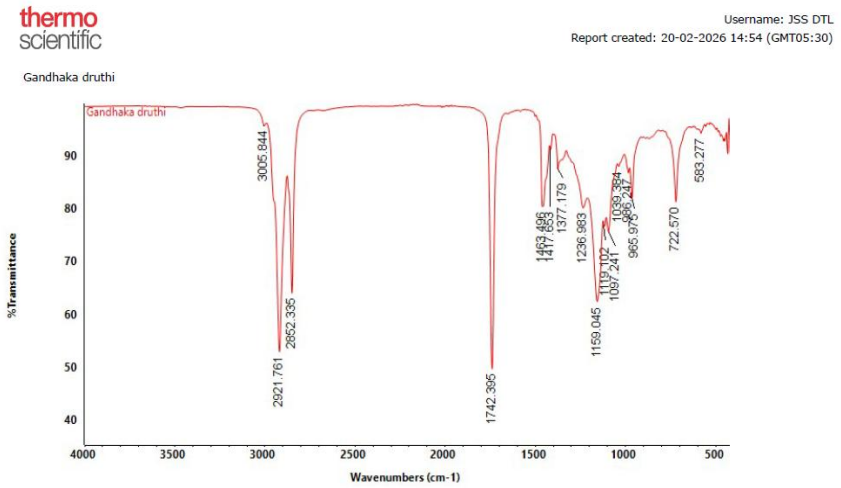


**Figure No 3: FTIR Spectroscopy of Gandhaka druti**

**Table No -4: Interpretation of FTIR Spectrum of Gandhaka druti**

| Sl. No. | Wavenumber ($cm^{-1}$) | Peak intensity | Stretching vibration | Probable functional group | Reference range ($cm^{-1}$) |
|---|---|---|---|---|---|
| 1 | 3005.84 | Weak | =C–H stretching | Unsaturated fatty acids (cis alkene) | 3100–3000 |
| 2 | 2921.76 | Strong | Asymmetric C–H stretching | Aliphatic –$CH_2$ groups | 2950–2915 |
| 3 | 2852.34 | Strong | Symmetric C–H stretching | Aliphatic –$CH_2$ groups | 2865–2845 |
| 4 | 1742.40 | Strong | C=O stretching | Estercarbonyl (Triglycerides) | 1750–1735 |
| 5 | 1463.50 | Medium | $CH_2$ bending | Long-chain fatty acids | 1470–1450 |
| 6 | 1417.65 | Medium | $CH_2$/$CH_3$ bending | Aliphatic hydrocarbons | 1425–1400 |
| 7 | 1377.18 | Medium | $CH_3$ bending | Methyl groups | 1390–1360 |
| 8 | 1236.98 | Medium | C–O stretching | Ester linkage | 1260–1210 |
| 9 | 1159.05 | Strong | C–O–C stretching | Triglyceride ester | 1175–1145 |
| 10 | 1119.10 | Medium | C–O stretching | Glycerol ester | 1130–1100 |
| 11 | 1097.24 | Medium | C–O stretching | Alcohol/Ester | 1110–1080 |
| 12 | 1039.38 | Medium | C–O stretching | Alcohol/Ether | 1060–1020 |
| 13 | 986.25 | Medium | =C–H out-of-plane bending | Unsaturated fatty acids | 990–960 |
| 14 | 965.98 | Medium | Olefinic C–H bending | Trans/unsaturated hydrocarbons | 970–950 |
| 15 | 722.57 | Weak | $CH_2$ rocking | Long-chain hydrocarbons | 730–720 |
| 16 | 583.28 | Weak | C–S/S–S vibration | Sulphur-containing linkage | 650–500 |

**DISCUSSION**

In the present study Bhoodhara method of Gandhaka shodhana was adopted. Gandhaka melted and filtered through khora cloth into the milk, whereas insoluble impurities remained on the cloth. Gogritha acts as lipid medium that absorbs fat soluble toxic elements. Godugdha acts as aqueous medium that extracts water soluble chemical impurities and also by balancing the thermal shock when hot sulphur is poured.[4]

Gandhaka druti was prepared using purified Gandhaka and Tila taila. Tila taila is used as a base in ayurvedic formulation because it has Sukshma and Vyavayi properties which facilitates diffusion deep into the tissue layer and micro channels of body[5]. It contains phytochemicals like sesamol and sesamin which has antioxidant activity and high oxidative stability, thereby prevents rancidity and give it a long shelf life.[6]

Mild and controlled heating ensured gradual dissolution of Gandhaka without causing thermal degradation, Continuous stirring facilitates uniform heat distribution results in complete dissolution of Gandhaka within the oil matrix. The absence of precipitation or phase separation after cooling indicates uniform incorporation of Gandhaka into lipid medium and reflects the stability of formulation. The pharmaceutical observations demonstrate that appropriate control of temperature and continuous stirring is essential to obtain stable Gandhaka druti. Excessive heating may lead to oxidation of oil or degradation of sulphur whereas inadequate heating may result in incomplete dissolution and poor product quality.

The physicochemical evaluation confirmed the quality and stability of the prepared Gandhaka druti. The formulation showed no evidence of rancidity which indicates Tila taila remained stable throughout the preparation process.
The acid value and free fatty acid values are low, indicates minimal hydrolysis of triglycerides during process and that are generally associated with better quality oils and greater storage stability.
The iodine value reflects the presence of unsaturated fatty acids characteristics of Tila taila. The value indicates that degree of unsaturation is preserved during pharmaceutical process.
The saponification value represents the average molecular weight of fatty acids present in formulation. The obtained value indicates the presence of long chain fatty acid esters and confirms the retention of triglyceride components in the oil after incorporation of Gandhaka.
The pH indicates formulation is nearly neutral and less likely to produce irritation during external application.
The refractive index is within characteristic range suggests preservation of properties and purity of lipid medium.
Viscosity confirms semiviscous nature of Gandhaka druti, which promotes better spreadability facilitates topical application and improves retention of formulation over skin surface.
The FTIR spectroscopy was performed to evaluate the functional groups present in Gandhaka Druti and to determine whether any significant chemical changes occurred during preparation. The spectrum exhibited characteristic absorption bands corresponding to the lipid constituents of sesame oil. Strong absorption bands at 2921 $cm^{-1}$ and 2852 $cm^{-1}$ represented aliphatic C–H stretching vibrations, while the peak at 1742 $cm^{-1}$ corresponded to the ester carbonyl (C=O) group of triglycerides, confirming the preservation of the oil matrix.
The absorption bands observed in the region of 1236–1039 $cm^{-1}$ represented C–O and C–O–C stretching vibrations of ester linkages, further confirming the structural integrity of sesame oil. Peaks at 3005 $cm^{-1}$, 986 $cm^{-1}$, and 965 $cm^{-1}$ indicated the presence of unsaturated fatty acids characteristic of Tila Taila.
A weak absorption band around 583 $cm^{-1}$ was observed in the sulphur vibration region. Although elemental sulphur exhibits weak infrared absorption because of its non-polar nature, this peak suggests successful incorporation or interaction of Gandhaka within the lipid matrix. Importantly, no additional absorption bands corresponding to oxidative degradation or undesirable chemical by-products were detected. These findings indicate that the pharmaceutical process preserved the chemical integrity of sesame oil while enabling successful incorporation of purified Gandhaka.

## CONCLUSION

The present study establishes pharmaceutical and analytical standards for Gandhaka Druti prepared by the Anubhuta method. The physicochemical and FTIR findings confirmed the quality and stability of the formulation, providing baseline reference data for its standardization and supporting future pharmacological, stability, and clinical studies.

## REFERENCES


1. Madduru Muni Haritha, Prashant G Jadar. A Review on Probable Mode of Action of Gandhaka Rasayana- An Ayurvedic Herbo-mineral Formulation with Multifaceted Action. International Journal of Ayurveda and Pharma Research. 5th March 2024; ISSN: 2322- 0902.
2. Dr Anuroopa HK, Textbook of Rasashastra, Chaukhambha Orientalia, Varanasi 1st edition 2022; 201.
3. Chandrabushan Jha, Ayurvedia Rasashastra, Chaukhambha Surabharathi Prakashana, Varanasi, edition 2003; 248.
4. Krushnkumar Taviad, Ankesh Agarwal, Swapnil Chaudhari et.al, Modified methods for Gandhaka Sodhana – A Pilot Study. Anveshana Ayurveda Medical Journal. Vol 2; Issue 2: March- April 2016; ISSN: 2395- 4159.
5. Sreekala AP, Anup B Thakar et.al, Pharmaceutico- Analytical Study of Shadbindu taila. International Journal of Ayurvedic Medicine. Vol 12(2), 332-337; ISSN: 0976-5921.
6. Anita kale, Shilpa A Varade. A Review on Nutritional Value and Therapeutic Properties of Tila. International Ayurvedic Medical Journal. May 2021; ISSN: 2320- 5091.