

Pharmaceutical Preparation and Analytical Standardization of *Gandhaka Kalpa*: A Herbo-Mineral Ayurvedic Formulation

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DOI: <https://doi.org/10.52403/gijhsr.20260409>

ABSTRACT

Gandhaka Kalpa is a herbo-mineral formulation described in *Rasa Tarangini* for the management of *Timir*, comprising *Shuddha Gandhaka*, *Bhringraj* and *Triphala*, with *Bhringraj Swarasa* used as the liquid medium for *Gandhaka Shodhana* and *Bhavana*. The present study was undertaken to document the pharmaceutical preparation of *Gandhaka Kalpa* and to evaluate the prepared formulation through organoleptic, physicochemical, FTIR and HPTLC parameters. *Bhringraj Swarasa* was prepared by boiling dried *Bhringraj Panchanga* with sixteen parts of water and reducing the volume to one-fourth. *Gandhaka Shodhana* was carried out over seven cycles by *Dhalana* and *Galana*, yielding 1800 g of *Shuddha Gandhaka* from 2000 g *Ashuddha Gandhaka* (10% loss). *Triphala Churna* was prepared from *Amalaki*, *Haritaki* and *Bibhitaki* (1910 g obtained from 2000 g raw material). *Shuddha Gandhaka* and *Triphala Churna* were triturated with *Bhringraj Swarasa* in three batches, yielding 3357.8 g of *Gandhaka Kalpa* from 3600 g combined

material (6.73% loss). The finished formulation was greyish-brown, with a citric odour, soft consistency and sour-bitter taste; pH 5.5, loss on drying 2.59%, total ash 2.98%, acid-insoluble ash 0.49%, water-soluble extractive 32.48% and alcohol-soluble extractive 24.54%. FTIR analysis revealed fourteen characteristic absorption bands corresponding to hydroxyl, carbonyl, aromatic and sulphur-containing functional groups, while HPTLC analysis confirmed the presence of Wedeloacetone (Rf 0.30) and Gallic acid (Rf 0.37) as marker compounds of *Bhringaraja* and *Triphala* respectively. These pharmaceutical and analytical observations provide preliminary standardization data that may serve as reference information for the reproducibility and quality evaluation of *Gandhaka Kalpa*.

Keywords: *Gandhaka Kalpa*, *Rasashastra*, *Gandhaka Shodhana*, *Bhavana*, HPTLC, FTIR.

INTRODUCTION

Ayurvedic pharmaceutical preparations involve the processing of raw materials through various pharmaceutical procedures

(*Samskara*) to obtain the desired medicinal formulation. In *Rasashastra*, practical knowledge of pharmaceutical procedures along with appropriate handling of materials and methods is important, particularly in the preparation of formulations containing mineral components. The pharmaceutical process includes systematic selection and authentication of raw materials followed by appropriate processing to obtain the finished formulation.

Gandhaka Kalpa is a herbo-mineral formulation described in *Rasa Tarangini*. The formulation comprises *Shuddha Gandhaka*, *Bhringraj*, and *Triphala*, with *Bhringraj Swarasa* being utilized as the medium for *Gandhaka Shodhana* as well as *Bhavana*. The classical formulation is described in relation to the management of *Timir* (disorder of vision).^[1]

The pharmaceutical preparation of *Gandhaka Kalpa* involves a sequence of procedures, beginning with collection and authentication of the raw materials, followed by *Gandhaka Shodhana* and preparation of the herbal components. The prepared ingredients are subsequently subjected to *Bhavana* and other pharmaceutical processing steps to obtain the final formulation. In the present study, these pharmaceutical procedures were systematically carried out and the relevant observations during processing were documented.

Along with pharmaceutical evaluation, analytical examination of the prepared *Gandhaka Kalpa* was undertaken. The analytical study included assessment of organoleptic characteristics and physicochemical parameters, together with HPTLC and FTIR analysis. The physicochemical evaluation included pH, loss on drying/moisture content, total ash, acid-insoluble ash, water-soluble extractive and alcohol-soluble extractive values.

HPTLC analysis was performed to obtain chromatographic profiles corresponding to selected markers of *Bhringaraja* and *Triphala*, while FTIR analysis was performed to record characteristic

absorption bands of the prepared formulation. Therefore, the present study was undertaken to document the pharmaceutical preparation of *Gandhaka Kalpa* and to evaluate the prepared formulation through selected organoleptic, physicochemical, FTIR and HPTLC parameters.

MATERIALS & METHODS

Materials

The ingredients used for preparation of *Gandhaka Kalpa* were *Shuddha Gandhaka*, *Bhringraj Swarasa*, *Triphala* and *Madhu* (honey). *Triphala* comprised *Amalaki* (*Emblia officinalis*), *Haritaki* (*Terminalia chebula*) and *Bibhitaki* (*Terminalia bellirica*). *Bhringraj Swarasa* was used as the liquid medium for *Gandhaka Shodhana* and subsequent *Bhavana*.

Ashuddha Gandhaka (crude sulphur) and the required herbal drugs were procured from the local market of Jodhpur, while *Goghrita* (cow ghee) was procured from a cow dairy farm. The raw drugs were authenticated by experts from the departments of *Rasa Shastra & Bhaishajya Kalpana* and *Dravya Guna* before pharmaceutical processing.

Pharmaceutical preparation

The pharmaceutical preparation of *Gandhaka Kalpa* was carried out in sequential stages comprising preparation of *Bhringraj Swarasa*, *Gandhaka Shodhana*, preparation of *Triphala Churna*, *Bhavana*/trituration of *Shuddha Gandhaka* and *Triphala* with *Bhringraj Swarasa*, and *Churnikarana* (pulverisation) of the prepared formulation.^[1]

विशोधितः सुगन्धको वराजभृङ्गसंयुक्तः।

सामाक्षिको विधानतन्त्रिमासमात्रसेवितः ॥

हन्ति दारुणान् गदान् चिरोत्थानपि द्रुतम्।

करोति लोचनद्वयं विकाशि गृध्रनेत्रवत्॥

दुग्धं सशर्करं कोष्णं त्वोदनं षष्टिकोद्धवम् ।

शीतवीर्यं भवेद्यच्च पथ्यमेतत्समासतः ॥ (R.T.8/68)

Preparation of *Bhringraj Swarasa*

Dried *Panchanga* (whole plant) of *Bhringraj* was soaked overnight in 16 parts of water in a stainless-steel vessel. The

soaked material was boiled on mild to moderate heat with continuous stirring until the volume was reduced to one-fourth of the initial quantity. After slight cooling, the preparation was filtered through clean cotton cloth and allowed to cool before further use. Sixteen parts of water were used

because the dried *Bhringraj Panchanga* was not adequately soaked with eight parts of water. During boiling, the plant material was observed floating on the surface, and the prepared *Swarasa* exhibited dark brown colour with a mild pungent odour.^[2]



Fig. 1: Removal of dirt (washing)



Fig. 2: Overnight soaked *Bhringraja*



Fig. 3: Stirring during process



Fig. 4: Transferring of prepared *Bhringraja Swaras* in measuring cylinder

Gandhaka Shodhana

Gandhaka Shodhana was performed by the principle of *Dhalana* and *Galana* using *Bhringraj Swarasa* as the liquid medium. The process was repeated seven times. A total of 2 kg *Ashuddha Gandhaka* was divided into four batches of 500 g each for ease of handling. *Goghrita* (20 g for each *Shodhana*) was used for coating the iron vessel. For each 500 g batch, 2 L of freshly prepared *Bhringraj Swarasa* was used in each cycle; therefore, 14 L was used for

each 500 g batch and 56 L in total for 2 kg *Gandhaka*.

The powdered *Gandhaka* was placed in a ghee-coated iron vessel and heated over low flame with continuous stirring until complete melting. The molten *Gandhaka* was filtered through cotton cloth into freshly prepared *Bhringraj Swarasa*. After cooling and solidification, the *Gandhaka* was washed repeatedly with hot water 3-4 times and dried under sunlight. The procedure was repeated for seven cycles using freshly prepared *Bhringraj Swarasa*.^[1]



Fig. 5: Melting of *Gandhaka* during *Shodhana*



Fig. 6: Needle like structure (suchiakara)

Preparation of Triphala Churna

The raw ingredients of *Triphala* were thoroughly washed and sun-dried until free from moisture. The dried *Amalaki*, *Haritaki* and *Bibhitaki* were separately pounded in an *Udukhal Yantra* to obtain coarse powder and passed through sieve No. 85. The sieved powders were subsequently mixed thoroughly to prepare *Triphala Churna*. A total of 2 kg of raw *Triphala* ingredients was processed, yielding 1910 g of *Triphala Churna*. Of the obtained quantity, 1800 g was utilized for preparation of *Gandhaka Kalpa*.

Trituration of Gandhaka Kalpa

Shuddha Gandhaka was powdered in an *Udukhal Yantra*. Trituration of *Shuddha Gandhaka* and *Triphala Churna* with *Bhringraj Swarasa* was carried out in a wet grinder in three batches. Three *Bhavana* cycles were performed for each batch. A total of 1800 g *Shuddha Gandhaka* and 1800 g *Triphala Churna* were utilized, with *Bhringraj Swarasa* added as required. The

three batches had variable quantities according to the practical requirements of the pharmaceutical process. A duration of 8 hours was considered as one *Bhavana*.

Batch 1: 500 g *Shuddha Gandhaka* and 500 g *Triphala Churna* were subjected to three *Bhavana* cycles using a total of 2270 mL *Bhringraj Swarasa*. The total trituration duration was 25 h 6 min. The initial quantity was 1000 g, from which 932.72 g was obtained, with a loss of 67.28 g.

Batch 2: 700 g *Shuddha Gandhaka* and 700 g *Triphala Churna* were subjected to three *Bhavana* cycles using a total of 3000 mL *Bhringraj Swarasa*. The total trituration duration was 26 h 35 min. From an initial quantity of 1400 g, 1305.81 g was obtained, with a loss of 94.19 g.

Batch 3: 600 g *Shuddha Gandhaka* and 600 g *Triphala Churna* were subjected to three *Bhavana* cycles using a total of 2800 mL *Bhringraj Swarasa*. The total trituration duration was 27 h 25 min. From an initial quantity of 1200 g, 1119.27 g was obtained, with a loss of 80.73 g.



Fig. 7: Transferring of *Shudha Gandhaka* and *Triphala churna* in wet grinder along with *Bhringraja Swaras*



Fig. 8: Semisolid material after trituration



Fig. 9: Sun drying process



Fig. 10: After complete drying; Gandhaka Kalpa powder



Fig. 11: Gandhaka Kalpa (final formulation)

Analytical evaluation

The prepared *Gandhaka Kalpa* was evaluated for organoleptic and physicochemical parameters. The analytical evaluation included colour, odour, consistency, taste, pH, loss on drying/moisture content, total ash, acid-insoluble ash, water-soluble extractive, alcohol-soluble extractive, FTIR and HPTLC analysis.

Organoleptic evaluation

The prepared *Gandhaka Kalpa* was examined for its organoleptic characteristics, including colour, odour, consistency and taste.

Physicochemical evaluation

The physicochemical evaluation was performed according to the analytical procedures with reference to the Ayurvedic Pharmacopoeia of India.

pH: For pH determination, 2.5 g of the powdered *Gandhaka Kalpa* was dispersed in 50 mL of distilled water to prepare a 5% aqueous solution. The mixture was stirred for 15 min and filtered. The pH of the clear filtrate was measured using a digital pH meter after obtaining a stable reading. The analysis was performed at $25 \pm 2^\circ\text{C}$.

Loss on drying/moisture content: Loss on drying was determined to assess the moisture content of the prepared formulation.

Total ash: Total ash was determined to assess the total inorganic residue remaining after incineration of the sample.

Acid-insoluble ash: Acid-insoluble ash was determined to assess the portion of the ash that remained insoluble following treatment with acid.

Water-soluble extractive: The water-soluble extractive value was determined to assess the proportion of constituents soluble in water.

Alcohol-soluble extractive: The alcohol-soluble extractive value was determined to assess the proportion of constituents soluble in alcohol.

FTIR analysis

FTIR analysis was performed using an ATR-based FTIR spectrometer. Before analysis, the ATR crystal was cleaned and a background scan was recorded. The powdered sample was placed directly onto the ATR crystal and appropriate pressure was applied to ensure adequate contact. The spectrum was recorded over the range of $4000\text{--}400\text{ cm}^{-1}$ using 32 scans at a resolution of 4 cm^{-1} . The obtained absorption bands were evaluated by comparison with functional-group libraries.

HPTLC analysis

HPTLC analysis was performed to obtain the chromatographic profiles of selected phytochemical markers associated with *Bhringaraja* and *Triphala* in the prepared *Gandhaka Kalpa*. The test sample and respective reference samples were extracted using methanol. Pre-coated Silica Gel 60 F254 HPTLC plates ($20 \times 10\text{ cm}$; 0.2 mm thickness) were used as the stationary phase. The samples were applied as uniform bands using a CAMAG Linomat 5 sample applicator fitted with a Hamilton microsyringe. The developing chamber was saturated with the respective mobile phase for approximately 20 min, and the plates were developed up to approximately 7 cm. The developed plates were allowed to air-dry at room temperature and examined under UV light at 254 and 366 nm using a CAMAG TLC Visualizer. The chromatograms were scanned using a CAMAG TLC Scanner 4 and recorded with vision CATS software. The observed R_f values and band patterns were compared with the corresponding reference markers. For *Bhringaraja* marker analysis, ethyl acetate (1:9, v/v) was used as the mobile phase. Wedeloacetone was used as the reference marker, with an observed R_f value of 0.30. For *Triphala* marker analysis, methanol acid acetate (1:4:15:15, v/v/v/v) was used as the mobile phase. Gallic acid was used as the reference marker, with an observed R_f value of 0.37.

Statistical Analysis

The present study was descriptive and pharmaceutical/analytical in nature. Data obtained during preparation (weights, volumes, durations and processing losses) and analytical evaluation (organoleptic, physicochemical, FTIR and HPTLC parameters) were recorded as actual observed values and expressed in tabular form. No inferential statistical test was applied to the data generated in this study.

RESULT

Preparation of Bhringraj Swarasa

Bhringraj Swarasa was prepared over nine cycles from 10 December 2025 to 8 January 2026 using dried *Bhringraj Panchanga*. The quantity of *Bhringraj Panchanga* used in

individual cycles ranged from 500 g to 2 kg. Sixteen times the quantity of water was used for soaking, followed by reduction of the liquid to one-fourth of the initial volume. The duration of boiling ranged from 45 min to 2 h 40 min depending upon the quantity of *Bhringraj Panchanga* processed (Fig. 1-4).

The use of 16 parts of water was based on the practical observation that the dried *Bhringraj Panchanga* was not adequately soaked with eight parts of water. During boiling, the *Bhringraj Panchanga* was observed floating on the surface of the liquid. The prepared *Swarasa* exhibited a characteristic dark brownish colour with a mild pungent odour.

Table 1: Batch-wise observations during preparation of Bhringraj Swarasa

Cycle	Date	Bhringraj Panchanga	Water	Boiling time	Volume reduced to 1/4th
1	10/12/2025	500 g	8 L	50 min	2 L
2	11/12/2025	1 kg	16 L	1 h 20 min	4 L
3	12/12/2025	500 g	8 L	45 min	2 L
4	15/12/2025	2 kg	32 L	2 h 30 min	8 L
5	19/12/2025	2 kg	32 L	2 h 40 min	8 L
6	26/12/2025	2 kg	32 L	2 h 30 min	8 L
7	31/12/2025	2 kg	32 L	2 h 30 min	8 L
8	05/01/2026	2 kg	32 L	2 h 20 min	8 L
9	08/01/2026	2 kg	32 L	2 h 30 min	8 L

The batch-wise observations demonstrated that the quantity of water was consistently maintained at 16 times the quantity of *Bhringraj Panchanga* and the final volume was reduced to one-fourth in each cycle. The boiling duration varied with the quantity of plant material processed, ranging from 45 min for 500 g to 2 h 40 min for 2 kg.

The prepared *Bhringraj Swarasa* was subsequently utilized as the liquid medium for *Gandhaka Shodhana* and later for *Bhavana* during preparation of *Gandhaka Kalpa*. The use of freshly prepared *Swarasa* in these subsequent pharmaceutical procedures made its repeated preparation an

essential part of the overall pharmaceutical process.

Gandhaka Shodhana

Gandhaka Shodhana was carried out from 10 December 2025 to 7 January 2026 by *Dhalana* and *Galana* using *Bhringraj Swarasa* as the liquid medium. A total of 2 kg *Ashuddha Gandhaka* was processed in four batches of 500 g each for ease of handling. The *Shodhana* procedure was repeated for seven cycles, and the purified *Gandhaka* obtained from all four batches was finally collected and weighed together. During the process, the powdered *Gandhaka* was heated in a ghee-coated iron vessel

under low flame with continuous stirring. Complete melting began at approximately 107°C during the first two cycles and at approximately 110°C from the third to seventh cycles. The molten *Gandhaka* was

filtered through cotton cloth into freshly prepared *Bhringraj Swarasa*, allowed to solidify, washed repeatedly with hot water and subsequently dried under sunlight (Fig. 5, 6).

Table 2: Cycle-wise observations during Gandhaka Shodhana

Shodhana cycle	Gandhaka processed (g)	Bhringraj Swarasa (L)	Goghrita (g)	Melting temperature (°C)	Gandhaka obtained (g)
1	2000	8	80	107	1956
2	1956	8	75	107	1946
3	1946	8	75	110	1915
4	1915	8	75	110	1885
5	1885	8	70	110	1865
6	1865	8	70	110	1835
7	1835	8	70	110	1800

The table shows a progressive reduction in the weight of *Gandhaka* after each *Shodhana* cycle. The final quantity obtained was 1800 g from an initial 2000 g, corresponding to a total loss of 200 g (10%). The loss was associated with adherence of a small quantity of *Gandhaka* to the mortar and pestle during powdering, retention on the cotton cloth during *Galana* and loss of some fine particles with hot wash water. During heating, the *Gandhaka* initially appeared as a fine yellow powder. With progressive heating, it transformed into a crystalline or *Parpati*-like mass and subsequently underwent complete liquefaction. A gradual colour change from yellow to dark yellow, orangish-yellow and

finally brownish-yellow was observed. Dense fumes accompanied by a characteristic pungent sulphurous odour were also observed during heating. Following immersion in *Bhringraj Swarasa*, the *Gandhaka* developed a coral-like structure. After washing, it exhibited a mildly soft texture before drying. Following collection and drying, the material showed increased density and acquired a *Suchyakara* (needle-like) shape. Physical impurities such as stones and other foreign materials were retained on the cotton cloth during the filtration process. A progressive change in the quality and texture of *Gandhaka* was observed with successive cycles.

Table 3: Overall observations of Gandhaka Shodhana

Parameter	Initial	Final
Weight	2000 g	1800 g
Appearance	Crystalline	Granules
Colour	Lemon yellow	Golden brownish yellow
Weight loss	-	200 g (10%)

The observed reduction in weight during *Shodhana* may be attributed to material retention during powdering and filtration as well as loss of fine *Gandhaka* particles during washing. The progressive changes in

colour, texture and physical form documented during the seven cycles represented the principal pharmaceutical observations recorded during the *Shodhana* process.

Preparation of Triphala Churna

The three ingredients of *Triphala*, namely *Amalaki*, *Haritaki* and *Bibhitaki*, were thoroughly washed with water to remove adhering dirt and extraneous matter. The washed ingredients were sun-dried until completely free from moisture. Each ingredient was then separately pounded in an *Udukhal* Yantra to obtain coarse powder. The powders were passed through sieve No. 85 to obtain a uniformly fine

powder and were subsequently mixed thoroughly to prepare *Triphala Churna*.

A total of 2 kg of raw *Triphala* ingredients was taken for the preparation. After completion of the processing, 1910 g of *Triphala Churna* was obtained. Of the total quantity obtained, 1800 g was utilized for the preparation of *Gandhaka Kalpa*, while the remaining quantity was retained as excess material.

Table 4: Observations during preparation of Triphala Churna

Parameter	Observation
Initial quantity of raw Triphala	2000 g
Quantity of Triphala Churna obtained	1910 g
Quantity utilized for Gandhaka Kalpa	1800 g
Quantity retained as excess	110 g
Sieve used	No. 85

The processing resulted in a reduction from 2000 g of raw material to 1910 g of *Triphala Churna*, corresponding to a loss of 90 g (4.5%). The loss was associated with the practical processing of the individual ingredients, including powdering and sieving. The obtained *Churna* was further utilized as one of the principal solid components in the subsequent *Bhavana* and trituration process of *Gandhaka Kalpa*.

The use of sieve No. 85 provided a uniformly fine powder, which was subsequently mixed thoroughly before incorporation with *Shuddha Gandhaka*. Thus, the prepared *Triphala Churna* served as the herbal powder component for the subsequent pharmaceutical preparation of *Gandhaka Kalpa*.

Bhavana and trituration of Gandhaka Kalpa

The total initial quantity of *Gandhaka* and *Triphala* was 3600 g, from which 3357.80 g was obtained after *Bhavana* and trituration, with a total loss of 242.20 g (6.73%). The observed loss was mainly attributed to retention of material on the walls and

grinding assembly of the wet grinder during processing (Fig. 7-11).

The prepared material was subsequently subjected to drying and *Churnikarana* to obtain the final *Gandhaka Kalpa* powder. The combined initial quantity of *Shuddha Gandhaka* and *Triphala Churna* was 3600 g. After completion of *Bhavana*, trituration, drying and *Churnikarana*, 3357.80 g of *Gandhaka Kalpa* was obtained, with a total processing loss of 242.20 g (6.73%). The observed loss was mainly attributed to retention of the material on the walls and grinding assembly during processing.

Organoleptic characteristics of Gandhaka Kalpa

Table 5: Organoleptic characteristics of Gandhaka Kalpa

Parameter	Observation
Colour	Greyish brown
Odour	Citric smell
Consistency	Soft
Taste	Sour-bitter

The final *Gandhaka Kalpa* exhibited greyish-brown colour, citric odour, soft consistency and sour-bitter taste. These organoleptic characteristics represent the physical profile of the formulation obtained after completion of the sequential pharmaceutical procedures.

Physicochemical parameters of Gandhaka Kalpa

Table 6: Physicochemical parameters of Gandhaka Kalpa

Parameter	Observation
pH	5.5
Loss on drying/moisture content	2.59%
Total ash	2.98%
Acid-insoluble ash	0.49%
Water-soluble extractive	32.48%
Alcohol-soluble extractive	24.54%

The physicochemical evaluation showed a pH of 5.5, loss on drying/moisture content of 2.59%, total ash of 2.98%, acid-insoluble ash of 0.49%, water-soluble extractive of 32.48% and alcohol-soluble extractive of 24.54%. These parameters provide quantitative characteristics of the prepared formulation and may serve as useful reference values for its quality evaluation.

FTIR analysis

The FTIR spectrum of *Gandhaka Kalpa* showed characteristic absorption bands in the range of 4000-400 cm^{-1} . Fourteen absorption peaks were recorded, with prominent bands corresponding to hydroxyl, aliphatic C-H, carbonyl, aromatic, C-O/C-N and C-O-C stretching vibrations. Bands in the lower wavenumber region were also observed corresponding to sulphur-containing constituents and mineral components (Fig. 12).

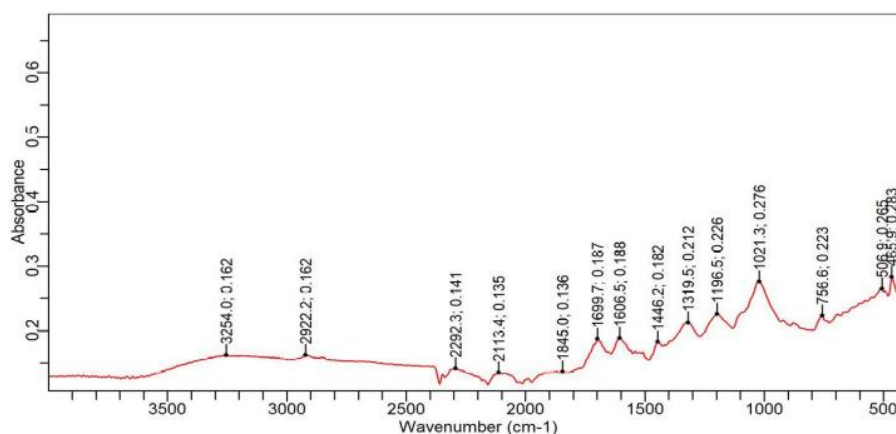


Fig. 12: FTIR spectrum of Gandhaka Kalpa

Table 7: FTIR wavelength and intensity

Peak number	Wavelength (cm^{-1})	Intensity
1	465.9	0.283
2	506.9	0.265
3	756.6	0.223
4	1021.3	0.276
5	1196.5	0.226
6	1319.5	0.212
7	1446.2	0.182
8	1606.5	0.188

Peak number	Wavelength (cm ⁻¹)	Intensity
9	1699.7	0.187
10	1845	0.136
11	2113.4	0.135
12	2292.3	0.141
13	2922.2	0.162
14	3254	0.162

Interpretation: The band at 3254 cm⁻¹ indicated O-H stretching (hydroxyl groups); 2922 cm⁻¹ indicated C-H stretching of aliphatic compounds; 1699 cm⁻¹ indicated C=O stretching (carbonyl groups); 1606 cm⁻¹ indicated aromatic C=C stretching; 1446 cm⁻¹ indicated C-H bending; 1319 cm⁻¹ indicated C-N or C-O stretching; 1196 cm⁻¹ indicated C-O stretching of alcohols and phenols; 1021 cm⁻¹ indicated C-O-C stretching of glycosides/carbohydrates; and bands between 500-450 cm⁻¹ were attributed to sulphur-containing constituents and mineral components. The FTIR spectrum of

Gandhaka Kalpa thus revealed characteristic absorption bands corresponding to a sulphur-containing compound along with hydroxyl, carbonyl, aromatic and other phytoconstituents.

HPTLC analysis

HPTLC fingerprinting of the prepared *Gandhaka Kalpa* was performed with reference to *Bhringaraja* and *Triphala* markers. The chromatographic profiles were evaluated at 254 nm and 366 nm and compared with the respective reference profiles (Fig. 13-18).

Table 8: HPTLC fingerprint profile of Gandhaka Kalpa

Reference drug	Marker compound	Mobile phase	Observed Rf
Bhringaraja	Wedeloacetone	Ethyl acetate (1:9)	0.30
Triphala	Gallic acid	Methanol acid acetate (1:4:15:15)	0.37

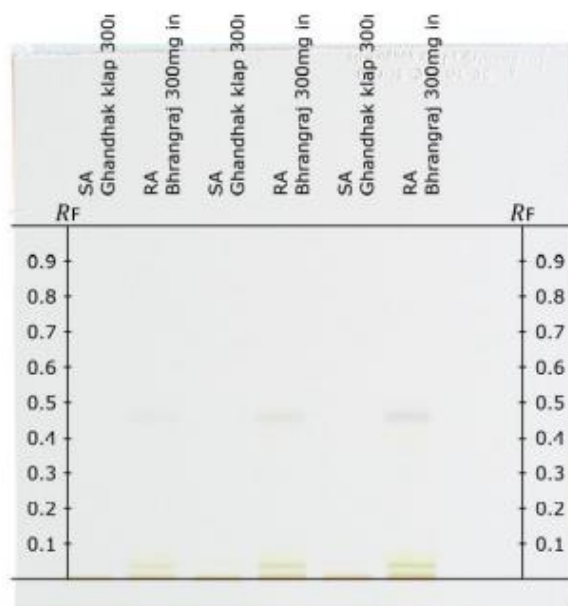


Fig. 13: HPTLC plate showing Bhringaraja marker (Wedeloacetone) tracks

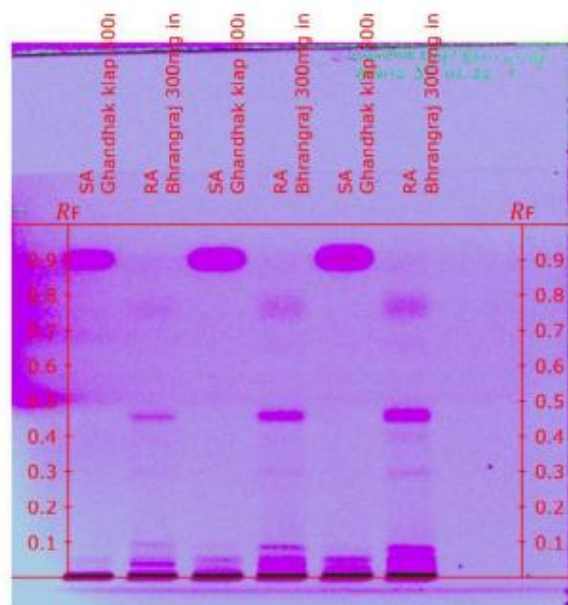


Fig. 14: HPTLC chromatogram of Bhringaraja marker at 254 nm

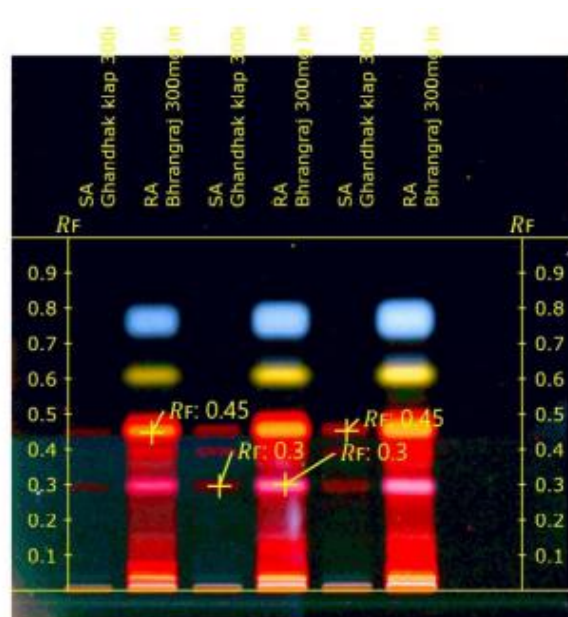


Fig. 15: HPTLC chromatogram of Bhringaraja marker at 366 nm

For *Bhringaraja*, a characteristic band corresponding to the reported marker Wedeloacetone was observed at Rf 0.30. The similarity of the test and reference chromatographic profiles indicated the presence of *Bhringaraja*-derived phytochemical constituents in the prepared formulation. The similarity between the

chromatographic profile of the reference marker and the test sample indicates that the phytochemical constituents of *Bhringaraja* were retained during pharmaceutical processing and *Bhavana*. These findings support the identity, authenticity and chromatographic standardization of the prepared formulation.

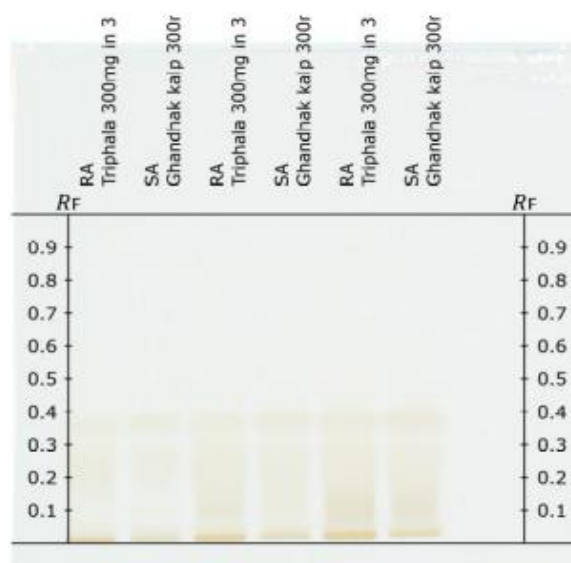


Fig. 16: HPTLC plate showing Triphala marker (Gallic acid) tracks

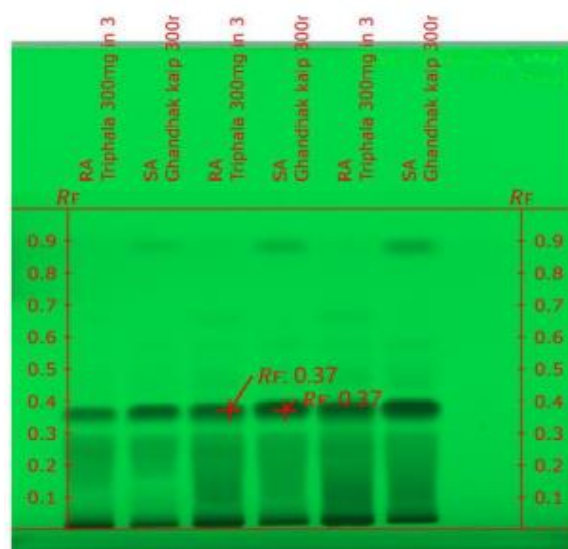


Fig. 17: HPTLC chromatogram of Triphala marker at 254 nm

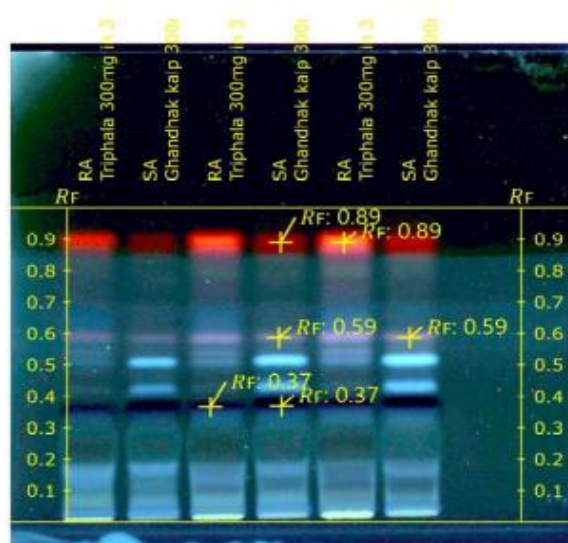


Fig. 18: HPTLC chromatogram of Triphala marker at 366 nm

For *Triphala*, a characteristic band corresponding to Gallic acid was observed at Rf 0.37. The observed chromatographic profile indicated the presence of *Triphala*-derived phytochemical constituents in *Gandhaka Kalpa* following the *Bhavana* process. The similarity between the chromatographic fingerprints of the reference and the test sample supports the successful incorporation of *Triphala*-derived phytoconstituents during the *Bhavana* process. The HPTLC findings contribute to the identity and analytical standardization of the prepared formulation.

DISCUSSION

The present study was undertaken to document the pharmaceutical preparation and analytical evaluation of *Gandhaka Kalpa*, a herbo-mineral formulation described in *Rasa Tarangini* in relation to *Timir*. The formulation comprised *Shuddha Gandhaka*, *Triphala* and *Bhringraj*, with *Bhringraj Swarasa* being used as the liquid medium for *Gandhaka Shodhana* as well as subsequent *Bhavana*. The pharmaceutical preparation was carried out systematically through preparation of *Bhringraj Swarasa*, *Gandhaka Shodhana*, preparation of *Triphala Churna*, *Bhavana* and trituration, followed by *Churnikarana*. The prepared formulation was subsequently evaluated using organoleptic, physicochemical, FTIR and HPTLC parameters.

The consistency observed across the nine preparation cycles of *Bhringraj Swarasa* demonstrated that the use of 16 parts of water facilitated adequate soaking and preparation of the liquid medium required for subsequent pharmaceutical procedures. During *Gandhaka Shodhana*, a progressive reduction in the weight of *Gandhaka* was observed, with the initial quantity of 2000 g reduced to 1800 g after seven cycles, representing a total loss of 10%. Along with the reduction in weight, progressive changes in colour and physical form were observed, with *Gandhaka* changing from the initial lemon-yellow crystalline appearance to

golden-brownish-yellow granules after completion of *Shodhana*.

Triphala Churna processing observations indicate that powdering and sieving resulted in a relatively small material loss (4.5%) and provided a suitably fine herbal powder for incorporation with *Shuddha Gandhaka*. The combined *Bhavana* and trituration of *Shuddha Gandhaka* and *Triphala Churna* with *Bhringraj Swarasa* in three batches, with three *Bhavana* cycles per batch, provided useful information regarding material handling, processing losses and the practical reproducibility of the pharmaceutical procedure.

The FTIR profile provides a characteristic spectral fingerprint of the prepared formulation and contributes to its analytical characterization, while the HPTLC findings are particularly relevant for chromatographic fingerprinting of the herbal components of *Gandhaka Kalpa*. The observed Wedeloacetone and Gallic acid bands provide marker-associated evidence for the presence of *Bhringaraja*- and *Triphala*-derived phytochemical constituents in the final formulation.

Overall, the present study demonstrated that *Gandhaka Kalpa* can be prepared through a systematic sequence of pharmaceutical procedures involving *Gandhaka Shodhana*, preparation of *Triphala Churna*, *Bhavana* with *Bhringraj Swarasa*, trituration, drying and *Churnikarana*. The documented changes in weight, colour, texture and physical appearance during processing provide useful pharmaceutical observations, while the organoleptic and physicochemical parameters establish a preliminary quality profile of the finished formulation. Collectively, these pharmaceutical and analytical observations provide preliminary standardization data for *Gandhaka Kalpa* and may serve as reference information for reproducibility and quality evaluation of the formulation.

CONCLUSION

The present study successfully documented the pharmaceutical preparation and

analytical evaluation of *Gandhaka Kalpa*, a herbo-mineral formulation comprising *Shuddha Gandhaka*, *Triphala* and *Bhringraj Swarasa*. The formulation was prepared through sequential pharmaceutical procedures including *Bhringraj Swarasa* preparation, *Gandhaka Shodhana*, preparation of *Triphala Churna*, *Bhavana*, trituration and *Churnikarana*. The observed changes in weight, colour, texture and physical appearance during processing provided useful pharmaceutical observations for documenting the preparation process.

The prepared *Gandhaka Kalpa* exhibited characteristic organoleptic properties and physicochemical parameters, including pH 5.5, loss on drying 2.59%, total ash 2.98%, acid-insoluble ash 0.49%, water-soluble extractive 32.48% and alcohol-soluble extractive 24.54%. FTIR analysis demonstrated characteristic absorption bands corresponding to various functional groups and provided a spectral profile of the formulation. HPTLC analysis showed marker-associated bands corresponding to Wedeloacetone of *Bhringaraja* at Rf 0.30 and Gallic acid of *Triphala* at Rf 0.37.

Overall, the pharmaceutical observations together with organoleptic, physicochemical, FTIR and HPTLC findings provide a preliminary analytical profile for *Gandhaka Kalpa* and contribute to its quality evaluation and standardization. The documented findings may serve as

reference data for reproducibility of the pharmaceutical process and for further analytical studies on the formulation.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

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How to cite this article: Peeyusha Pandey, Preeti, Manisha Goyal, Govind Sahay Shukla, Rajaram Agarwal, Rajiv Soni et al. Pharmaceutical preparation and analytical standardization of *Gandhaka Kalpa*: a herbo-mineral ayurvedic formulation. *Gal Int J Health Sci Res.* 2026; 11(4): 76-91.

DOI: <https://doi.org/10.52403/gijhsr.20260409>
