

A Study on the Analytical Aspects of Kalingadi Arka Nasal Spray

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ABSTRACT

Nasal drug delivery is important in Ayurveda as it provides rapid action and direct access to the Urdhva Jatrugata region. Kalingadi Arka is a classical formulation indicated in the management of Nasa rogas due to its Katu tikta rasa, Ushna virya and Kapha-Vata shamaka properties. In the present era, there is a need to modify classical medicines into patient-friendly, hygienic and accurately dosed forms without affecting their therapeutic integrity, and standardization is essential to ensure quality, safety and reproducibility. Hence, the present study aimed to prepare Kalingadi Arka as a nasal spray and evaluate its analytical parameters. The formulation was prepared by Arka kalpana and assessed for organoleptic characters, physicochemical properties and HPTLC profiling. The nasal spray was clear, colorless and pleasant in odor, with pH 6.54 and low viscosity indicating suitability for intranasal use. HPTLC showed reproducible bands at R_f values around 0.67, 0.68 and 0.87, suggesting the presence of bioactive constituents such as flavonoids, terpenoids and volatile oils. The study highlights that modification of classical Kalingadi Avapeedana into a standardized nasal spray enhances its safety, convenience, acceptability and therapeutic applicability in the management of Nasa rogas.

Keywords: Ayurveda, Kalinga, Ayurvedic Nasal Spray, Arka

INTRODUCTION

Nasal drug delivery has gained significant importance in both conventional and traditional systems of medicine due to its rapid onset of action, better bioavailability, and direct access to the Urdhva Jatrugata region. In Ayurveda, Kalingadi Arka modification of Kalingadi avapeeda nasya is a classical Ayurvedic formulation described in authoritative texts for the management of Nasa rogas and allied conditions ¹. The formulation predominantly contains drugs possessing Katu tikta rasa, Ushna virya, Kapha vata shamaka, and Lekhana properties, which are therapeutically beneficial in conditions involving nasal obstruction, inflammation, discharge, and microbial involvement. Traditionally, Kalingadi Arka is prepared through Arka kalpana ², a unique pharmaceutical process aimed at extracting volatile and water-soluble active principles, thereby enhancing potency, stability, and shelf life ³

In the present era, there is a growing demand to convert classical Ayurvedic formulations into patient-friendly, standardized dosage forms without compromising their therapeutic integrity. Transforming

Kalingadi Arka into a nasal spray ensures accurate dosing, ease of administration, improved patient compliance, and hygienic delivery, making it suitable for contemporary clinical practice. Despite the wide clinical utility of Arka preparations, there is a need of systematic analytical evaluation and standardization of Kalingadi Arka when formulated as a nasal spray. Analytical assessment is essential to ensure quality, safety, consistency, and reproducibility, especially when the formulation is intended for nasal use, where parameters such as pH, clarity, sterility, and physicochemical stability are of paramount importance. Therefore, the present analytical study has been undertaken to evaluate the pharmaceutical and analytical parameters of Kalingadi Arka Nasal Spray, employing standard physicochemical and organoleptic assessment methods. Such analytical validation not only supports traditional claims but also helps in establishing quality control standards, thereby contributing to the scientific acceptability and wider therapeutic application of Ayurvedic nasal formulations.

AIM AND OBJECTIVES

To carryout Physio-chemical analysis of Kalingadi Arka nasal spray

MATERIALS AND METHODS

Pharmaceutical Study: Pharmaceutical study started from collection of genuine raw materials, followed by its pre- processing and finally conversion to the product Kalingadi Arka

1. ORGANOLEPTIC EVALUATION:

Organoleptic tests are qualitative assessments using the human senses. The results for Kalingadi Arka are as follows:

- **Color:** Colorless – Indicates absence of any pigmentation, suggestive of clean distillation.
- **Odor:** Pleasant – A good indication of acceptable aroma, which may be therapeutically important and palatable.
- **Taste:** Acrid – Suggests the presence of pungent and sharp-tasting compounds, aligning with its potential Tridosahara or especially Kaphavatahara properties.
- **Clarity:** Clear solution – No visible particles suggest a well-filtered and properly prepared Arka.

These parameters confirm that the formulation is organoleptically acceptable, safe for internal use, and consistent in sensory quality.

2. PHYSICOCHEMICAL PARAMETERS:

Parameters	Results	Interpretation
Volatile Matte	0.18%	Low volatile content ensures minimal loss of active constituents and good shelf-life.
Specific Gravity	0.9630	Close to water (1.0), indicating lightness and consistency with Arka preparations.
Refractive Index	1.33157	Same as distilled water, suggesting purity and absence of dense oils.
pH	6.54	Mildly acidic – ideal for nasal formulations
Viscosity	1.12	Very low acidity, again supports its safety and suitability for internal use.
These parameters collectively confirm that the formulation is pharmaceutically stable, non-irritant, and safe for administration.		

3. HPTLC PROFILE (HIGH PERFORMANCE THIN LAYER CHROMATOGRAPHY):

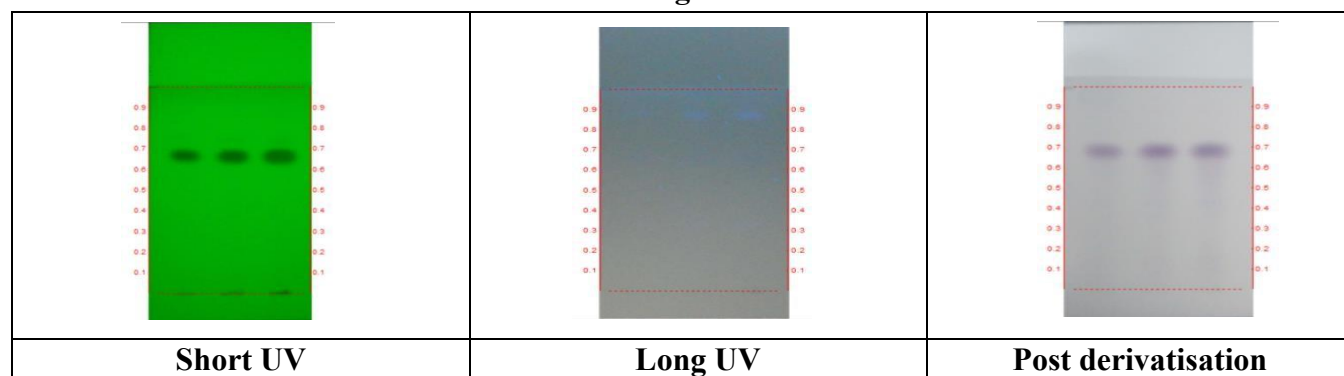
High Performance Thin Layer Chromatography (HPTLC) was performed to evaluate the chemical fingerprint of the **n-hexane extract of Kalingadi Arka**. This method helps in qualitative identification, profiling, and standardization of the formulation by visualizing the presence of phytoconstituents through chromatographic separation.

1. Sample Preparation and Methodology:

- **Sample:** Kalingadi Arka (10 ml extracted with 20 ml n-Hexane)
- **Application volumes:** 3 μ l, 6 μ l, 9 μ l applied on pre-coated silica gel F254 aluminum plates
- **Stationary phase:** Silica gel 60 F254
- **Mobile phase (Solvent system):** Toluene: Ethyl acetate (9:1 v/v)
- **Detection:**
- **Before derivatization:** Under Short UV (254 nm) and Long UV (366 nm)
- **After derivatization:** With vanillin-sulphuric acid reagent, observed under white light and scanned at 620 nm

2. Chromatographic Observations:

Fig .1



Track Information:

Track	Sample volume	Observation method	Rf Value	Color of Spot	Inferred Constituents
1	3 μ l	Short UV (254 nm)	0.67	Green	Possibly alkaloids/flavonoids or aromatic compounds
2	6 μ l	Long UV (366 nm)	0.87	Fluorescent Blue	Indicative of volatile oils, coumarins, terpenoids
3	9 μ l	After derivatisation	0.68	Purple	Reacting constituents, possibly phenols, aldehydes, steroids

A. Short UV (254 nm)

- **Visible Bands:** A prominent green fluorescent band is observed at **Rf ~ 0.67**.
- **Inference:**
 - Indicates presence of **UV-absorbing compounds** such as **flavonoids, phenolic compounds, or alkaloids**.
 - The intensity increases from Track 1 to Track 3, confirming **consistency and concentration-dependent visibility**.

B. Long UV (366 nm)

- **Visible Bands:** A bright **fluorescent blue band** is noted at **Rf ~ 0.87**.
- **Inference:**
- Typical for **volatile oils, terpenoids, or coumarins**, which fluoresce under 366 nm.
- The appearance of this band highlights the **presence of volatile or aromatic compounds**, which are expected in Arka prepared via distillation.

C. Post-Derivatisation (White light at 620 nm)

- **Visible Bands:** A **purple-colored band** appears at **Rf ~ 0.68**.
- **Inference:**
- Derivatisation with **vanillin-sulphuric acid** reveals phytochemicals like **terpenoids, steroids, aldehydes, or saponins**, which otherwise may not be visible under UV light.
- The color reaction also confirms the **chemical reactivity and class identity** of compounds present.

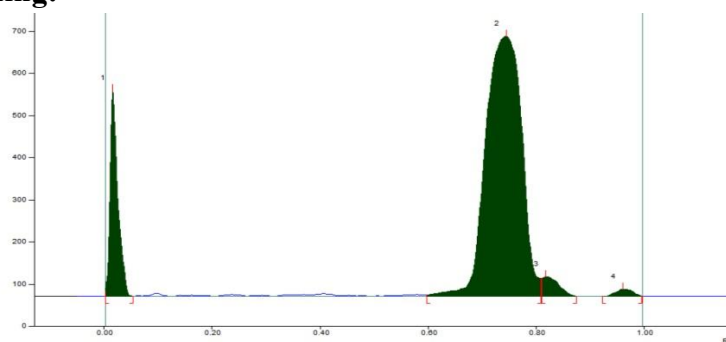
Significance of Visual Data:

- The consistent visibility of bands across all three tracks (3 µl to 9 µl) indicates a **stable and reproducible chemical profile**.
- The Rf values observed are aligned with **typical plant-based secondary metabolites**, which supports the **polyherbal and bioactive nature** of Kalingadi Arka.
- The intensity and clarity of bands under various light conditions serve as a **standard fingerprint** for this formulation and ensure **quality control** in future batches.

Conclusion:

Figure 1: provides visual evidence of the phytochemical richness and reproducibility of Kalingadi Arka. The bands at Rf 0.67, 0.68, and 0.87 under different detection systems confirm the presence of diverse bioactive compounds such as flavonoids, terpenoids, and volatile oils. The consistency in band intensity across sample volumes confirms the standardization of the preparation. This visual profile acts as a reliable chromatographic fingerprint for future quality assurance and authentication of the formulation.

3. Densitometric Scanning:

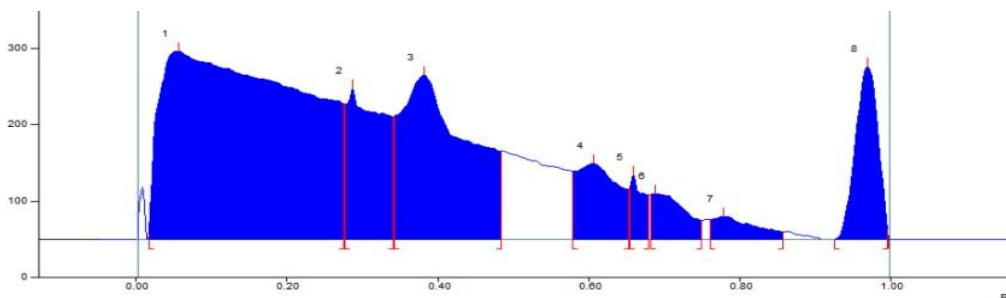


Track 3, ID: Kalingadi arka

Peak	Start Position	Start Height	Max Position	Max Height	Max %	End Position	End Height	Area	Area %
1	0.00 Rf	10.8 AU	0.02 Rf	487.6 AU	41.78 %	0.05 Rf	0.1 AU	5015.8 AU	13.85 %
2	0.60 Rf	3.6 AU	0.75 Rf	616.2 AU	52.80 %	0.81 Rf	42.2 AU	29757.1 AU	82.17 %
3	0.81 Rf	42.4 AU	0.82 Rf	46.1 AU	3.95 %	0.88 Rf	0.7 AU	1045.0 AU	2.89 %
4	0.92 Rf	0.1 AU	0.96 Rf	17.1 AU	1.47 %	1.00 Rf	0.5 AU	395.6 AU	1.09 %

1. Figure 2a – Densitogram at 254 nm (Short UV)

- Rf ~ 0.67: A prominent peak is observed here, which indicates the presence of a major compound that absorbs UV at 254 nm.
- Compounds absorbing at 254 nm are usually aromatic rings, flavonoids, phenolic compounds, and alkaloids.
- Interpretation: This indicates the presence of chemically active principles like flavonoids or polyphenolic derivatives, known for their antioxidant and anti-inflammatory properties.

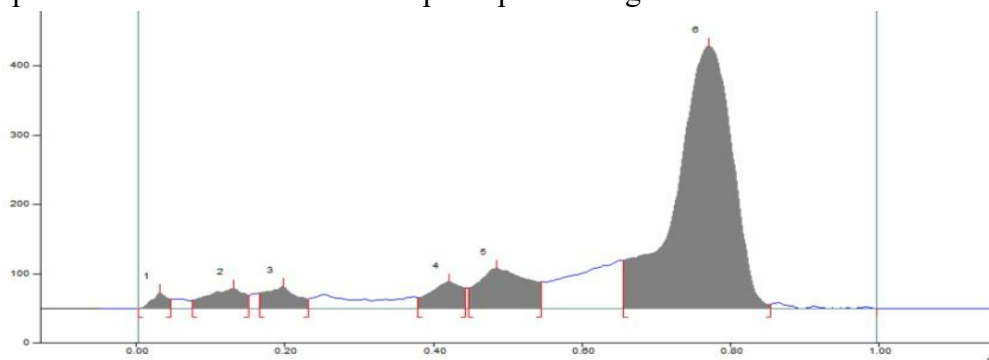


Track 3, ID: Kalingadi arka

Peak	Start Position	Start Height	Max Position	Max Height	Max %	End Position	End Height	Area	Area %
1	0.02 Rf	6.3 AU	0.06 Rf	245.7 AU	21.26 %	0.28 Rf	76.8 AU	33160.7 AU	49.55 %
2	0.28 Rf	176.9 AU	0.29 Rf	196.7 AU	17.02 %	0.34 Rf	59.9 AU	6976.9 AU	10.43 %
3	0.34 Rf	160.7 AU	0.38 Rf	215.1 AU	18.61 %	0.48 Rf	15.1 AU	13609.4 AU	20.34 %
4	0.58 Rf	88.9 AU	0.61 Rf	99.0 AU	8.56 %	0.65 Rf	65.5 AU	4004.6 AU	5.98 %
5	0.65 Rf	67.5 AU	0.66 Rf	84.1 AU	7.28 %	0.68 Rf	58.5 AU	1127.7 AU	1.69 %
6	0.68 Rf	58.7 AU	0.69 Rf	59.2 AU	5.13 %	0.75 Rf	24.9 AU	1971.8 AU	2.95 %
7	0.76 Rf	25.5 AU	0.78 Rf	30.3 AU	2.62 %	0.86 Rf	9.7 AU	1241.0 AU	1.85 %
8	0.93 Rf	0.0 AU	0.97 Rf	225.6 AU	19.52 %	1.00 Rf	12.7 AU	4829.5 AU	7.22 %

2. Figure 2b – Densitogram at 366 nm (Long UV)

- Rf ~ 0.87: A distinct peak appears with fluorescence properties under long UV.
- Such compounds typically include terpenoids, essential oils, and coumarins, which are often fluorescent in nature.
- Interpretation: Confirms the presence of volatile and aromatic phytochemicals, in line with the nature of Arka preparations which extract volatile principles through distillation.



Track 3, ID: Kalingadi arka

Peak	Start Position	Start Height	Max Position	Max Height	Max %	End Position	End Height	Area	Area %
1	0.00 Rf	0.1 AU	0.03 Rf	23.2 AU	4.15 %	0.05 Rf	14.1 AU	339.4 AU	1.26 %
2	0.08 Rf	11.9 AU	0.13 Rf	29.3 AU	5.25 %	0.15 Rf	19.0 AU	1028.9 AU	3.82 %
3	0.17 Rf	22.4 AU	0.20 Rf	31.8 AU	5.69 %	0.23 Rf	14.1 AU	962.1 AU	3.57 %
4	0.38 Rf	15.9 AU	0.42 Rf	38.5 AU	6.90 %	0.44 Rf	29.6 AU	1183.9 AU	4.40 %
5	0.45 Rf	30.1 AU	0.49 Rf	58.0 AU	10.38 %	0.55 Rf	38.3 AU	2789.4 AU	10.36 %
6	0.66 Rf	69.8 AU	0.77 Rf	378.0 AU	67.65 %	0.85 Rf	5.9 AU	20627.1 AU	76.59 %

3. Figure 2c – Densitogram at 620 nm (After Derivatisation with Vanillin Sulphuric Acid)

- Rf ~ 0.68: Shows a strong peak, with visible color development (purple as per report) after derivatization.
- Vanillin sulphuric acid reacts with a wide range of compounds such as steroids, terpenoids, and aldehydes, producing specific color changes.
- Interpretation: Indicates the presence of chemically reactive constituents which become more visible only after chemical derivatisation—this adds specificity and supports the compound class.

4. Interpretation and Significance:

- The presence of distinct bands at different Rf values and their specific colors under UV and visible light confirm the multicomponent nature of Kalingadi Arka.
- Repeated sample application (3, 6, and 9 μ l) ensures dose-dependent consistency in band intensity, supporting reproducibility.
- The Rf values serve as reference fingerprints for future quality control and batch-to-batch standardization of this formulation.
- The derivatisation further confirms chemical class identification which is crucial for pharmacological correlation.
- The HPTLC profile of Kalingadi Arka demonstrates the presence of multiple bioactive phytoconstituents. The developed chromatogram can be used as a standard fingerprint marker for this formulation. The clear and reproducible bands at Rf 0.67, 0.68, and 0.87 support the formulation's authenticity, stability, and quality. This analytical approach strengthens the scientific validation of classical Ayurvedic preparations in alignment with pharmacognostical standards.

DISCUSSION

The present study focuses on transforming the classical Ayurvedic preparation, Kalingadi Arka, into a convenient nasal spray and evaluating its analytical profile. In Ayurveda, the nasal route is given prime importance through Nasya karma because the nose acts as a gateway to the Urdhva Jatrugata region, allowing faster action and better absorption of medicines. Kalingadi Arka is traditionally used in Nasa rogas and is known for its Katu tikta rasa, Ushna virya and Kapha-Vata pacifying nature, which helps in reducing nasal blockage, inflammation and excessive discharge. By modifying this preparation into a spray form, the formulation becomes easier to use, more hygienic and capable of delivering a uniform dose, thereby improving patient comfort and compliance in routine clinical practice.

The analytical observations suggest that the modified formulation is well suited for nasal application. The preparation was clear, colorless and pleasant smelling, showing that the distillation process was efficient and that the volatile principles were retained. Its pH of 6.54 lies close to the natural pH of nasal mucosa,

reducing the chances of irritation. The low viscosity and near-water specific gravity help the spray to spread evenly over the nasal lining, allowing better contact with the absorption surface. Together, these features support faster onset of action and effective local as well as systemic effects, which are desirable in conditions like rhinitis, sinusitis and nasal congestion.

Chemical fingerprinting by HPTLC revealed that Kalingadi Arka nasal spray contains several biologically active constituents. The detected bands and peaks correspond to groups of compounds such as flavonoids, phenolics, terpenoids and volatile oils. These are well known for their anti-inflammatory, antimicrobial, antioxidant and decongestant actions. Their presence supports the traditional use of Kalingadi Arka in nasal disorders and also explains how the formulation may help in reducing infection, swelling and mucus accumulation. The identification of volatile and aromatic compounds further confirms that the Arka kalpana method is effective in capturing principles that are particularly useful for nasal delivery.

Densitometric scanning showed consistent and dose-dependent peaks, indicating good reproducibility of the preparation. This consistency is important when a classical medicine is converted into a modern dosage form, as it ensures uniform quality and therapeutic reliability. Overall, the integrated analytical findings show that Kalingadi Arka nasal spray is stable, safe, chemically rich and suitable for intranasal use. The modification of the classical Arka into a spray not only preserves its Ayurvedic pharmacological value but also enhances its practical usefulness by offering better safety, convenience, effectiveness and patient acceptance in the management of Nasa rogas.

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