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Original Article

Comprehensive Physico-chemical and HPTLC-Based Standardization of *Devdarvyadi Churna*: A Classical Ayurvedic Formulation

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ABSTRACT

Background: *Devdarvyadi Churna* is a classical Ayurvedic polyherbal formulation described by *Acharya Charaka* for the management of *Kaphaja Kasa* (cough of *Kapha* origin). It comprises *Devadaru, Haritaki, Musta, Pippali*, and *Vishva*, which possess documented *Kapha-Vata-shamak, dipana, pachana*, and *kasahara* properties. Despite its extensive traditional and clinical use in respiratory disorders, systematic scientific validation and standardization data remain limited. **Objectives:** The present study aimed to evaluate and standardize *Devdarvyadi Churna* using contemporary analytical techniques to substantiate its traditional therapeutic claims and establish quality control parameters. **Materials and Methods:** *Devdarvyadi Churna* was prepared according to classical references and standardized procedures. Organoleptic parameters were assessed, followed by physico-chemical analysis including loss on drying, ash values, pH, and extractive values as per the Ayurvedic Pharmacopoeia of India. Preliminary phytochemical screening was conducted to identify major bioactive groups. High-Performance Thin-Layer Chromatography (HPTLC) profiling of the methanolic extract was performed using silica gel 60 F254 plates, with detection at 254 nm and 366 nm to generate characteristic chromatographic fingerprints. **Results:** The formulation exhibited acceptable organoleptic and physico-chemical parameters, indicating good quality and stability. Phytochemical screening confirmed the presence of alkaloids, flavonoids, phenolics, tannins, terpenoids, and volatile oils. HPTLC analysis revealed reproducible chromatographic profiles with multiple well-resolved peaks, reflecting the polyherbal complexity of the formulation. **Conclusion:** The study establishes reliable standardization parameters and HPTLC fingerprints for *Devdarvyadi Churna*, scientifically supporting its traditional use in *Kaphaja Kasa* and enhancing quality assurance and reproducibility.

Keywords: *Devdarvyadi Churna*, HPTLC, *Kaphaja Kasa*, Phytochemical screening, Physico-chemical analysis, Standardization.

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INTRODUCTION

Devdarvyadi Churna is a classical Ayurvedic polyherbal formulation described by *Acharya Charaka* for the management of *Kaphaja Kasa* (cough of *Kapha* origin) (Agnivesha, 2018). The formulation comprises *Devadaru, Haritaki, Musta, Pippali*, and *Vishva*, each possessing well-documented *Kapha-Vata-shamaka, dipana, pachana*, and *kasahara* properties. Rooted in fundamental Ayurvedic principles, *Devdarvyadi Churna* exemplifies the concept of rational polyherbalism, wherein multiple botanicals are combined to achieve enhanced therapeutic efficacy through synergistic pharmacological action (Sharma, 2017).

Traditionally, the formulation has been prescribed in respiratory disorders such as *kasa, svasa*, and *ama*-associated *Kapha vikara*, owing to its expectorant, anti-inflammatory, bronchodilatory, and digestive properties. Phytochemical investigations of the individual ingredients have revealed the presence of alkaloids, phenolic compounds, flavonoids, tannins, terpenoids, and volatile oils, which are believed to collectively contribute to its therapeutic actions (Khandelwal, 2013). Experimental studies have indicated anti-inflammatory, antioxidant, antimicrobial, and antitussive activities, lending preliminary scientific support to its traditional usage (Kokate *et al.*, 2020).

However, despite extensive clinical use, systematic scientific validation and standardization data on *Devdarvyadi Churna* remain limited. Given the inherent complexity of polyherbal formulations, comprehensive analytical evaluation is essential to ensure quality, safety, batch-to-batch consistency, and reproducibility. Contemporary analytical approaches such as organoleptic evaluation, physicochemical analysis (including loss on drying, ash values, and extractive values), preliminary

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phytochemical screening, and High-Performance Thin-Layer Chromatography (HPTLC) play a pivotal role in the standardization process (Ministry of AYUSH, Government of India, 2001-2016). HPTLC profiling aids in establishing chemical fingerprints, detecting marker compounds, and strengthening quality control measures, thereby bridging traditional knowledge with modern analytical science (Sethi, 1996).

AIM AND OBJECTIVES

The present study aims to undertake a comprehensive analytical evaluation of *Devdarvyadi Churna* using contemporary scientific techniques to substantiate its traditional therapeutic claims in *Kaphaja Kasa* and to establish standardized quality control parameters.

The specific objectives of the study are:

1. To authenticate *Devdarvyadi Churna* through organoleptic evaluation and preliminary qualitative phytochemical screening.
2. To determine physicochemical parameters, including loss on drying, ash values, and extractive values, in order to ensure quality, purity, and batch-to-batch consistency.
3. To perform HPTLC profiling for the identification of characteristic phytoconstituents and to develop a standardized chromatographic fingerprint for quality assurance.

By accomplishing these objectives, the study aims to bridge traditional Ayurvedic knowledge with modern analytical validation, thereby enhancing scientific credibility, strengthening quality assurance, and promoting the wider acceptance of *Devdarvyadi Churna* in contemporary healthcare systems.

MATERIALS AND METHODS

Drug review

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चतुरो मधुना लेहान् कफकासहरान् भिषक्||१२१|| चरकसंहिता कासचिकित्सा 40/33

Stepwise Detailed Method for the Preparation of *Devdarvyadi Churna*

Collection and Authentication of Raw Drugs

1. **Selection of Ingredients:** Each herbal ingredient (4 kg) was selected based on classical Ayurvedic texts *Sharangdhara samhita* (Rao, 2013).
2. **Authentication:** All raw materials were authenticated as per the Ayurvedic Pharmacopoeia of India, ensuring correct identity, quality, and absence of contaminants (Table 1).

Cleaning and Processing of Raw Drugs

1. **Cleaning:** All raw herbal ingredients were thoroughly cleaned to remove extraneous matter such as dust, soil, and other physical impurities.
2. **Cutting and Crushing:** The dried raw materials were cut into small pieces and coarsely crushed to facilitate uniform powder preparation.

Preparation of *Devdarvyadi churna*

1. **Measurement:** A total quantity of 20 kg of raw drugs was taken, comprising 4 kg of each individual ingredient.
2. **Powder Process:** The coarsely crushed drugs subjected to pulverization using appropriate mechanical equipment to obtain a fine powder.
3. **Filtration:** The powdered material was passed through an 80# sieve to achieve uniform particle size and ensure homogeneity of the formulation.

Storage

1. **Container Selection:** Tablets were stored in sterilized, airtight plastic containers.
2. **Labelling:** Containers were labelled with the formulation name (*Devdarvyadi Churna*), batch number, date of manufacture, and storage instructions.
3. **Storage Conditions:** The containers were kept in a cool, dry place, protected from sunlight and moisture.

Quality Control and Testing

1. Organoleptic Characteristics.

➢Colour: Brown.

➢Odour: Bitter.

➢Consistency: Powder.

➢Taste: Bitter.

2. Physico-Chemical Parameters (Table 2).
3. Key Phytoconstituents (Table 3).
4. **Phytochemical Analysis:** HPTLC was carried out to identify and confirm the presence of key phytoconstituents, ensuring quality, consistency, and compliance with pharmacopeial standards.

High Performance Thin Layer chromatography

HPTLC Fingerprint Analysis Procedure for Methanol Extract of *Devadaryadi Churna*. The High-Performance Thin-Layer

Chromatography (HPTLC) fingerprinting for the methanolic extract of *Devadaryadi Churna* was performed as follows:

Sample Preparation

5 g of the sample was accurately weighed into a beaker, and 100 mL of methanol was added. The mixture was sonicated for 16 hr, after which the extract was filtered through standard filter paper, followed by filtration through a 0.45 µm membrane filter to obtain a clear solution.

Chromatography Setup

The filtered test solution was used for HPTLC analysis. Aliquots were applied as 6 mm wide bands on 10 × 10 cm TLC plates pre-coated with a 0.2 mm layer of silica gel 60 F254 (Merck), using a Linomat 5 sample applicator (CAMAG, Switzerland).

Chromatogram Development

The plates were developed in a CAMAG chamber pre-saturated with vapours of the mobile phase consisting of Toluene: Ethyl acetate: Acetic acid (3:2:0.5 v/v/v). The solvent front was run to a distance of 8.0 cm.

Detection and Documentation

Post-development, the HPTLC plates were air-dried at room temperature and subsequently scanned at 254 nm and 366 nm using a CAMAG TLC Scanner 3 equipped with win CATS 4 software (CAMAG, Switzerland). This enabled the detection, documentation, and generation of the HPTLC fingerprint profile of the methanolic extract of the formulation.

Figures 1 and 2 shows the HPTLC Chromatograms of *Devadaryadi Churna* at UV 254 nm and UV 366 nm respectively using Toluene: Ethyl acetate: Acetic acid (3:2:0.5 v/v/v) and gives the R_f values of the same.

RESULTS

The physicochemical parameters of *Devadarvyadi Churna* were found to be within the standard limits prescribed by the Ayurvedic Pharmacopoeia of India, indicating acceptable quality and consistency of the formulation. Additionally, microbial load analysis revealed values within permissible limits, confirming the safety of the formulation.

HPTLC profiling revealed distinct bioactive constituents at 254 nm and 366 nm, which remain to be further characterized and identified (Table 4).

Table 1: Ingredients of *Devdarvyadi Churna* with Their Botanical Identity.

Sl. No.	Name of the sample	Botanical Name	Family	Useful Part
1	*Devdaru*	*Cedrus deodara* Roxb.	Nyctaginaceae	Leaf, Bark, Heart wood (*Patra, Twak, Kashthasara*)
2.	*Sunthi* (Vishva)	*Zingiber officinale*	Zingiberaceae	Rhizome (*Kanda*)
3.	*Kanda*	*Terminalia chebula*	Combretaceae	Fruit (*Phala*)
4.	*Haritaki*	*Piper longum* L.	Menispermaceae	Fruit (*Phala*)
5.	*Phala*	*Cyperus rotundus* Linn.	Cyperaceae	Rhizome (*Kanda*)

Table 2: Physico-chemical and Pharmacopoeial Parameters of *Devdarvyadi Churna*.

Sl. No.	Parametre	Value	
1.	Loss on Drying at 110°C (%w/w)	9.9015%	
2.	Total Ash Value (%w/w)	7%	
3.	pH value	5.5	
4.	Acid insoluble ash (%w/w)	0.0245	
5.	Alcohol-Soluble Extract (%w/w)	32.4	
6.	Water-Soluble Extract (%w/w)	28.1	
7	Particle size distribution	Sieve size (mesh)	Percentage (%)
		10-20	100
		20-40	96
		40-60	95
		80-100	80
		100-120	36

Spot No.	5.0 µL		10.0 µL		15.0 µL	
	Rf value	Area%	Rf value	Area%	Rf value	Area%
1	0.228	15.55	0.244	12.52	0.2554	11.86
2	0.428	9.08	0.329	0.52	0.339	0.59
3	0.632	28.67	0.446	8.74	0.444	8.57
4	0.721	25.49	0.626	31.62	0.631	31.03
5	0.769	6.31	0.717	26.07	0.719	25.52
6	0.867	10.24	0.768	7.93	0.772	8.79
7	1.000	4.66	0.881	9.66	0.885	10.84
8			0.942	1.02	0.940	0.73
9			1.000	1.92	1.000	2.06

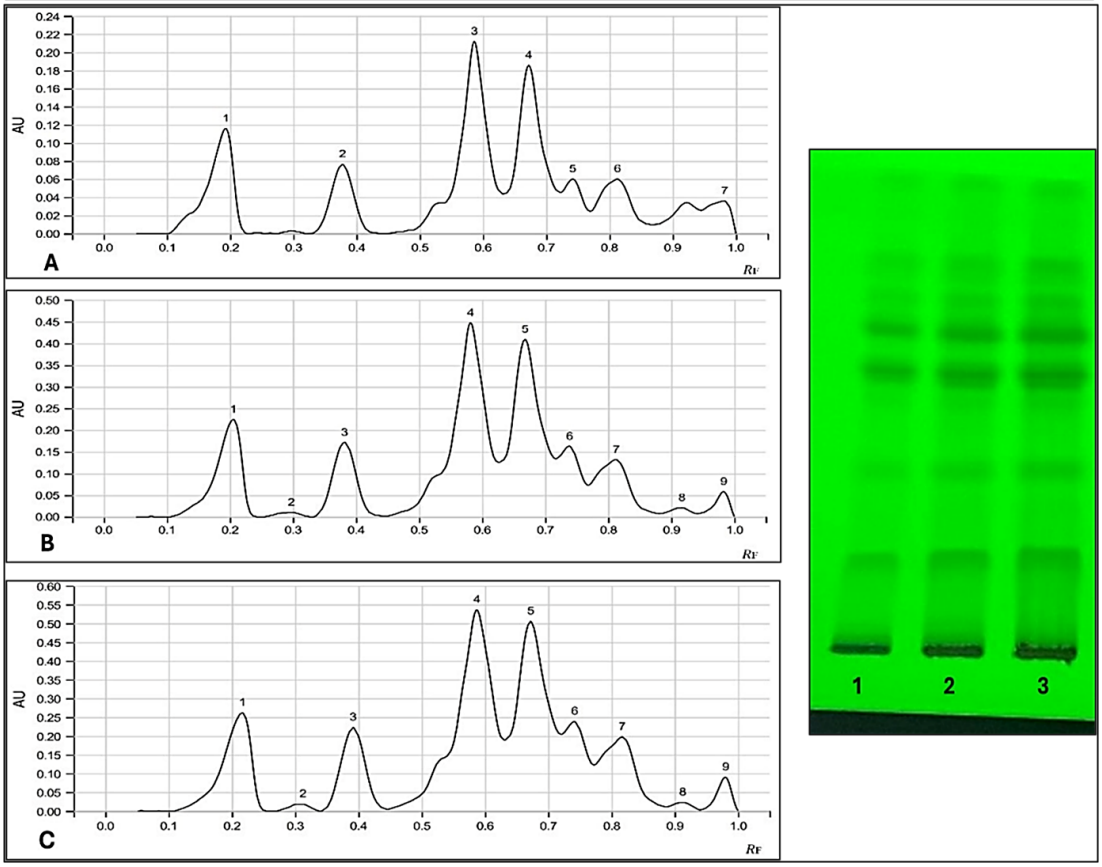

Figure 1: HPTLC fingerprint profile of the test formulation Rf values recorded at 254 nm, showing densitometric chromatograms (A-C) and corresponding HPTLC plate under UV light (1-3), where (A) 5.0 µL (Track 1), (B) 10.0 µL (Track 2), and (C) 15.0 µL (Track 3).

DISCUSSION

The present study was undertaken to generate comprehensive standardization and analytical data for *Devdarvyadi Churna*, a classical Ayurvedic formulation traditionally indicated in *Kaphaja Kasa*, by employing contemporary quality control and phytochemical profiling techniques. Given the increasing emphasis on evidence-based validation of classical formulations, such systematic evaluation is essential to substantiate traditional claims and ensure reproducibility, safety, and wider clinical acceptance.

Organoleptic evaluation of *Devdarvyadi Churna* revealed characteristic brown colour, bitter taste, and aromatic

Table 3: Key Phytoconstituents and Pharmacological Activities of Individual Ingredients of *Devadaryadi Churna*.

Sl. No.	Drug Name	Major Phytochemical Groups Detected	Probable Pharmacological Activities (Relevant to *Kaphaja Kasa*)
1	*Devadaru* (*Cedrus deodara*) (Kirtikar and Basu, 2006)	Terpenoids, Sesquiterpenes (cedrol), Flavonoids, Phenolics, Volatile oils.	Anti-inflammatory, Bronchodilator, Antimicrobial, Expectorant.
2	*Sunthi / vishva* (*Zingiber officinale*) (Mao *et al*., 2019)	Gingerols, Shogaols, Diarylheptanoids, Flavonoids, Volatile oils.	Antitussive, Anti-inflammatory, Mucolytic, Antioxidant, Digestive.
3	*Haritaki* (*Terminalia chebula*) (Ul Haq *et al*., 2013)	Tannins, Gallic acid, Chebulinic acid, Chebulagic acid, Phenolics.	Antioxidant, Anti-inflammatory, Expectorant, Immunomodulatory.
4	*Pippali* (*Piper longum*) (Yadav *et al*., 2023)	Alkaloids (piperine), Lignans, Flavonoids, Volatile oils.	Bronchodilator, Antitussive, Bioavailability enhancer, Anti-inflammatory.
5	*Musta* (*Cyperus rotundus*) (Peerzada *et al*., 2015)	Sesquiterpenes, Flavonoids, Alkaloids, Phenolics, Glycosides.	Anti-inflammatory, Antioxidant, Digestive, *Kapha-shamaka*.

Table 4: Phytoconstituents Identified via HPTLC (Based on R_f values) and Their Plant Sources.

R_f Range (Approx.)	Relative Area% (Intensity)	Probable Phytochemicals	Probable Plant Sources (from formulation)	Probable Pharmacological Activities
0.10-0.26	Low (6-13%)	Phenolic acids (gallic, ellagic), tannin fragments; polar glycosides.	*Terminalia chebula, Cyperus rotundus* (minor phenolics).	Antioxidant, antimicrobial, astringent; may reduce airway irritation.
0.56-0.66 (Major Peak)	High (≈ 35-40%)	Flavonoid glycosides, polyphenols.	*Cedrus deodara* (Wagner and Bladt, 1996; Harborne, 1998), *Terminalia chebula* (Saleem *et al*., 2002), *Zingiber officinale* (Ali *et al*., 2008).	Strong antioxidant, anti-inflammatory, broncho-protective.
0.63-0.77 (Secondary major peak)	Moderate-High (24-32%)	Diarylheptanoids (gingerols / shogaols-like), terpenoids, Alkaloids.	*Zingiber officinale* (Ali *et al*., 2008; Mashhadi *et al*., 2013), *Cedrus deodara, Piper longum*.	NF-κB inhibition, anti-inflammatory, mucolytic, bronchodilator.
0.83-0.94	Low-Moderate (5-12%)	Sesquiterpenes (cedrol), aromatics	*Cedrus deodara, Piper longum* (Singh *et al*., 2011; Mathela, 1994).	Anti-inflammatory, smooth muscle relaxation.
>0.94 (near solvent front)	Very low (1-3%)	Non-polar terpenoids		Anti-inflammatory, mild bronchodilator.

odour, which are consistent with the presence of *Tikta-Katu rasa*-dominant ingredients such as *Devadaru, Pippali, Sunthi*, and *Haritaki*. These attributes not only serve as preliminary quality indicators but also reflect the formulation's *Kapha-Vata-shamaka* and *kasahara* nature as described in classical texts.

Physicochemical parameters were found to be within acceptable limits prescribed by the Ayurvedic Pharmacopoeia of India, indicating good quality and stability of the formulation. The loss on drying value suggests low moisture content, which is essential for preventing microbial growth and ensuring shelf stability. Ash values indicate minimal inorganic and extraneous matter, reflecting the purity of raw materials and proper processing. The pH value (5.5) denotes a mildly acidic nature, which may facilitate better gastrointestinal tolerance and absorption. Adequate water- and alcohol-soluble extractive values signify the presence of a substantial amounts of bioactive constituents extractable in polar solvents, supporting the formulation's therapeutic potential.

Preliminary phytochemical screening confirmed the presence of alkaloids, flavonoids, phenolics, tannins, terpenoids, and volatile oils, collectively contributing to the formulation's pharmacological actions. These phytoconstituents are well documented for their anti-inflammatory, antioxidant, antimicrobial, antitussive, mucolytic, and bronchodilatory activities, which are highly relevant in the pathophysiology of *Kaphaja Kasa*. From an Ayurvedic perspective, these actions correlate with *Kapha samana, ama pachana, srotoshodhana*, and *vata anulomana* effects.

HPTLC fingerprint analysis provided a reproducible chromatographic profile at 254 nm and 366 nm, demonstrating the chemical complexity and synergistic nature of the formulation.

Multiple well-resolved peaks across different R_f ranges indicate the presence of diverse phytoconstituents derived from constituent drugs. The major peaks in the R_f range of 0.56-0.77 with high relative area percentages are suggestive of polyphenols, flavonoid glycosides, gingerol/shogaol-like compounds, and terpenoids, primarily attributable to *Zingiber officinale, Cedrus deodara, Piper longum*, and *Terminalia chebula*. These compounds are reported to exert NF-κB inhibition, antioxidant defense, smooth muscle relaxation, mucolytic, and broncho-protective effects, providing a plausible mechanistic basis for the formulation's efficacy in cough and allied respiratory disorders.

Lower and near-solvent-front R_f values correspond to polar phenolics and non-polar terpenoids, respectively, highlighting the broad polarity range of constituents extracted and detected. Such a multi-component profile supports the concept of rational polyherbalism, wherein different phytochemicals act on multiple targets, resulting in enhanced therapeutic efficacy and reduced adverse effects compared to single-drug therapy.

Spot No.	5.0 µL		10.0 µL		15.0 µL	
	Rf value	Area%	Rf value	Area%	Rf value	Area%
1	0.667	76.79	0.20	8.7	0.30	8.66
2	0.815	15.24	0.29	10.6	0.66	40.51
3	0.992	7.96	0.66	52.3	0.79	19.93
4			0.87	19.6	0.87	22.41
5			0.93	2.5	0.92	3.52
6			0.98	6.11	0.98	4.96

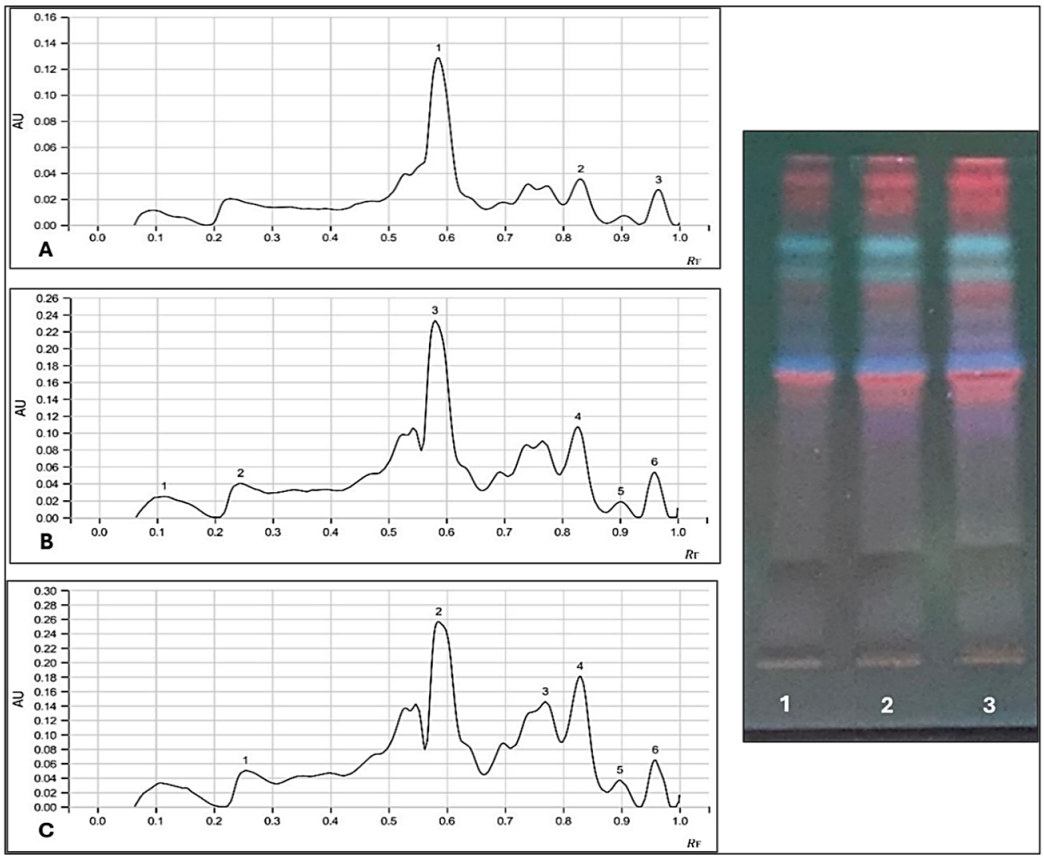

Figure 2: HPTLC fingerprint profile of the test formulation R_f values recorded at 366 nm, showing densitometric chromatograms (A-C) and corresponding HPTLC plate under UV light (1-3), where (A) 5.0 µL (Track 1), (B) 10.0 µL (Track 2), and (C) 15.0 µL (Track 3).

Overall, the findings of this study demonstrate that *Devdarvyadi Churna* conforms to acceptable physicochemical and phytochemical standards and exhibits a distinct, reproducible HPTLC fingerprint. These results scientifically reinforce its traditional use in *Kaphaja Kasa* and provide a robust analytical framework for quality control, batch-to-batch consistency, and future pharmacological or clinical investigations. The generated data can serve as a reference for routine standardization and may facilitate the integration of *Devdarvyadi Churna* into contemporary healthcare practice with greater confidence and credibility.

CONCLUSION

The present study establishes reliable physicochemical standards and HPTLC fingerprint profiles for *Devdarvyadi Churna*, confirming its quality, consistency, and phytochemical integrity. The detection of key bioactive compounds supports its traditional therapeutic use in *Kaphaja Kasa* and related respiratory disorders. These findings provide a scientific basis for standardization, quality control, and future clinical validation, strengthening the formulation's credibility in evidence-based Ayurvedic practice.

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Nill.

ABBREVIATIONS

API: Ayurvedic Pharmacopoeia of India; **LOD:** Loss on Drying; **HPTLC:** High-Performance Thin-Layer Chromatography; **TLC:** Thin-Layer Chromatography; **R_f:** Retardation factor; **UV:** Ultraviolet; **% w/w:** Percentage weight by weight; **v/v/v**: Volume by volume by volume; **kg:** Kilogram; **µL:** Microlitre; **µm:** Micrometer; **cm:** Centimeter; **min:** Minutes; **sec:** Seconds; **nm:** Nanometer; **CAMAG:** Company for Analytical Measuring Systems (Chromatography equipment manufacturer).

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

FINANCIAL DISCLOSURE

No and refined the content, taking full responsibility for the final publication.

AUTHOR CONTRIBUTION STATEMENT

All authors contributed to the concept and design of the study, acquisition of data, and analysis and interpretation of data. Corresponding Author took primary responsibility for drafting the manuscript and revising it critically for important intellectual content. Finally, all authors reviewed and approved the final version of the manuscript to be published and agree to be accountable for all aspects of the work.

ETHICAL STATEMENT

This study is an *in vitro* analytical evaluation of a classical Ayurvedic formulation and did not involve human participants or animal subjects; therefore, ethical approval was not required.

STATISTICAL ANALYSIS

All experimental analyses were performed in triplicate, and results are expressed as mean±Standard Deviation (SD). Descriptive statistical methods were applied to evaluate organoleptic, physicochemical, and HPTLC data to ensure consistency, reproducibility, and reliability of the analytical parameters.

DATA AVAILABILITY STATEMENT

All data collected, including recordings of measurements, are properly stored physically or electronically as appropriate. They are stored without personal identifiers with the corresponding author who can make them available under appropriate circumstances.

SUMMARY

The present study focuses on the comprehensive scientific standardization of *Devdarvyadi Churna*, a classical Ayurvedic polyherbal formulation traditionally indicated for the management of *Kaphaja Kasa* and allied respiratory disorders. The formulation was prepared strictly according to classical Ayurvedic references and subjected to systematic evaluation using organoleptic, physicochemical, phytochemical, and High-Performance Thin-Layer Chromatography (HPTLC) analyses to establish quality control parameters and analytical fingerprints.

Organoleptic evaluation revealed characteristic brown colour, bitter taste, and aromatic odour, consistent with the formulation's classical attributes. Physicochemical analysis demonstrated acceptable values for loss on drying (9.90%), total ash (7%), acid-insoluble ash (0.0245%), pH (5.5), and extractive values, indicating good quality, purity, and batch-to-batch consistency. Particle size distribution further confirmed uniformity and suitability of the powdered formulation. Preliminary phytochemical screening confirmed the presence of bioactive constituents such as alkaloids, flavonoids, phenolics, tannins, terpenoids, and volatile oils, which are pharmacologically relevant to the management of cough and *Kapha*-dominant respiratory conditions.

HPTLC fingerprinting of the methanolic extract was performed using silica gel 60 F254 plates with a mobile phase of Toluene: Ethyl acetate: Acetic acid (3:2:0.5 v/v/v). Chromatographic evaluation at 254 nm and 366 nm revealed multiple well-resolved peaks with reproducible R_f values, reflecting the polyherbal complexity of the formulation. Major peaks corresponded to probable polyphenols, flavonoid glycosides, gingerol/shogaol-like compounds, sesquiterpenes, and alkaloids, attributable to

constituent drugs such as *Cedrus deodara, Zingiber officinale, Terminalia chebula*, and *Piper longum*. These phytoconstituents are known to exert antioxidant, anti-inflammatory, antitussive, mucolytic, bronchodilatory, and broncho-protective effects.

Overall, the study establishes reliable physicochemical standards and a reproducible HPTLC fingerprint profile for *Devdarvyadi Churna*, scientifically validating its traditional therapeutic use in *Kaphaja Kasa*. The generated data provide a robust analytical framework for quality assurance, batch consistency, and future pharmacological or clinical investigations, thereby supporting the integration of this classical formulation into evidence-based Ayurvedic practice.

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