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Pharmacokinetic and Pharmacodynamic Insights into Vaitarana Basti: An HPTLC-Based Interpretation with Clinical Validation

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Abstract

Vaitarana Basti is a classical medicated enema indicated in Amavata (rheumatoid arthritis) and other Vata-Kapha dominated disorders, yet its behavior in terms of modern pharmacokinetics and pharmacodynamics has remained largely theoretical. In the present work, a methanolic extract of Vaitarana Basti (start and end samples) was subjected to high-performance thin-layer chromatography (HPTLC) on silica gel 60 F_{254} plates, with densitometric scanning at 254 nm and 366 nm. Distinct Rf bands were observed in both UV ranges, which were tentatively correlated with phenolic acids, flavonoids, lignans, coumarins, sterols and fatty acid fractions derived mainly from *Tamarindus indica* pulp and *Sesamum indicum* oil [1][2][3][4].

On the basis of published pharmacology of these phytochemical classes and available experimental data on medicated enemas, a composite picture emerges: phenolic and flavonoid components likely undergo partial systemic absorption through the rectal mucosa, while lipophilic lignans and fatty acids contribute to local mucosal protection, modulation of inflammatory mediators and improved penetration of co-constituents [5][6][7][8]. These findings offer a mechanistic bridge between traditional Vaitarana Basti indications and contemporary concepts of drug disposition and tissue-level action. Clinical validation was demonstrated through a case of seropositive rheumatoid arthritis showing 69.7% reduction in CRP levels and 50% reduction in pain scores following 8-day Karma Basti protocol [9].

Introduction

Vaitarana Basti is described in classical Ayurvedic texts as a Tīkṣhṇa (penetrating), Uṣhṇa (hot) and Vāta-Kaphashamaka (Vata-Kapha pacifying) therapeutic enema, particularly employed in Amavata classically equated with rheumatoid arthritis-like conditions and chronic painful disorders of the spine and

lower limbs [10][11]. Clinical experience and limited modern trials suggest that such bastis provide significant relief in pain, stiffness and functional disability, yet the question "how does it work in modern pharmacological terms?" is still largely open [9][12].

HPTLC fingerprinting has emerged as a robust tool to chemically characterize complex herbal formulations and to serve as a quality-assurance marker [13][14][15]. When such fingerprints are interpreted together with known pharmacology of phytoconstituents and emerging data on basti pharmacokinetics, they can provide a plausible model of the formulation's pharmacodynamic and pharmacokinetic behavior [7][8][16]. The present study attempts precisely this: to move from bands on a plate to a coherent explanation of how Vaitarana Basti may act at the rectal mucosa, in the circulation and finally at target tissues, supported by clinical evidence from a documented Amavata case.

2. Materials and Methods

2.1 Sample Preparation and Track Assignment

Methanolic extracts of the Vaitarana Basti formulation were prepared from start phase and end phase samples. Four tracks were analysed as follows:

Track	Sample Description	Volume (µL)
1	Vaitarana Basti (start)	5.0
2	Vaitarana Basti (start)	10.0
3	Vaitarana Basti (end)	5.0
4	Vaitarana Basti (end)	10.0

Table 1: Track assignment for HPTLC analysis

2.2 Chromatographic Conditions

Parameter	Specification
Stationary Phase	Merck HPTLC Silica gel 60 F_{254}
Plate Format	100 × 100 mm
Application Device	CAMAG Linomat 5 (SN 280008)
Sample Solvent	Methanol

Application Position	Y: 8.0 mm
Track Distance	22.4 mm
Dosage Speed	150 nL/s
Pre-dosage Volume	0.20 µL
Mobile Phase	n-hexane:diethyl ether:glacial acetic acid (8:2:1 v/v/v)
Development Chamber	Twin-trough chamber (TTC 10×10 cm)
Saturation Time	20 minutes
Migration Distance	80 mm
Drying Condition	Room temperature, 5 minutes

Table 2: Chromatographic conditions for HPTLC analysis

2.3 Detection and Data Analysis

Parameter	**Scan 1 (254 nm)**	**Scan 2 (366 nm)**
Scanner	CAMAG TLC Scanner 4 (SN 271118)	CAMAG TLC Scanner 4 (SN 271118)
Mode	Absorbance	Fluorescence
Lamp	Deuterium and Tungsten	Mercury
Filter	NA	K400
Slit Dimension	6 × 0.45 mm micro	6 × 0.45 mm micro
Scanning Speed	100 mm/s	100 mm/s
Data Resolution	100 µm/step	100 µm/step

Table 3: Detection parameters for densitometric scanning

Data integration was performed using visionCATS software (version 3.2.23095.1) with Gauss legacy integration, Savitzky-Golay smoothing (window 7), and lowest slope baseline correction. Rf ranges and major peaks were interpreted with reference to standard phytochemical atlases and reports on tamarind and sesame extracts [1][2][3][4], allowing tentative assignment of bands to broad phytochemical classes. No attempt was

made to claim definitive structural identification; rather, the bands were treated as fingerprint markers anchored in probable classes like phenolic acids, flavonoids, lignans, coumarins, sterols and fatty acids.

2.4 Clinical Case Reference

A 28-year-old female patient with seropositive rheumatoid arthritis (Amavata) received 8-day Karma Basti protocol (5 Anuvasana Basti + 3 Niruha Basti) with adjuvant paraffin wax therapy. Pre- and post-treatment assessments included Visual Analog Scale (VAS), Disease Activity Score-28 (DAS-28), joint-specific symptom scores, range of motion (ROM), and inflammatory markers (CRP, RF). This case serves as clinical validation of the proposed pharmacokinetic-pharmacodynamic model derived from HPTLC data [9].

3. Results

3.1 HPTLC Fingerprint Profile

The methanolic extract showed consistent bands in both start and end samples, indicating that core phytochemical groups remain present throughout the Basti preparation and administration window.

3.2 Peak Data at 254 nm (Absorbance Mode)

Track	Sample	Volume (µL)	Peak No.	Rf Max	Area (%)
1	Start	5	1	0.282	44.57
1	Start	5	2	0.546	55.43
2	Start	10	1	0.321	100.00
3	End	5	1	0.235	100.00
4	End	10	1	0.068	10.10
4	End	10	2	0.233	51.32
4	End	10	3	0.333	38.57

Table 4: Peak profile at 254 nm wavelength

3.3 Peak Data at 366 nm (Fluorescence Mode)

Track	Sample	Volume (µL)	Peak No.	Rf Max	Area (%)
1	Start	5	1	0.042	100.00
2	Start	10	1	0.047	63.58

2	Start	10	2	0.068	24.98
2	Start	10	3	0.119	3.80
2	Start	10	4	0.454	7.64
3	End	5	1	0.057	88.24
3	End	5	2	0.189	4.65
3	End	5	3	0.406	4.60
3	End	5	4	0.736	2.50
4	End	10	1	0.064	100.00

Table 5: Peak profile at 366 nm wavelength

3.4 Phytochemical Interpretation of Rf Ranges

Rf Range	Detection	Probable Class	Source	Pharmacological Activity
0.03–0.07	366 nm fluor.	Phenolic acids	*T. indica* pulp	Antioxidant, anti-inflammatory
0.06–0.10	366 nm fluor.	Flavonoids	*S. indicum*	Anti-inflammatory, hepatoprotective
0.20–0.28	254 nm abs.	Lignans (sesamin)	Sesame oil	Antioxidant, anti-atherogenic
0.30–0.35	254 nm abs.	Coumarins	Tamarind pulp	Smooth muscle relaxant
0.43–0.47	366 nm fluor.	Sterol derivatives	Sesame oil	Anti-inflammatory, lipid lowering
0.50–0.55	254 nm abs.	Non-polar lipids	Sesame oil	Lubricant, Vātahara oleation
0.70–0.75	366 nm fluor.	Fatty acids	Taila component	Anti-inflammatory, mucosal protective

Table 6: Phytochemical interpretation of Rf ranges and probable bioactivities

The comparative tracks at 254 nm and 366 nm show that certain bands—notably around Rf 0.23–0.33 and 0.04–0.07—persist from start to end, suggesting that both polar phenolics and moderately lipophilic constituents survive the formulation process and remain available at the time of rectal administration.

3.5 Clinical Case Outcomes (Summary)

3.5.1 Patient Demographics

- Age: 28 years
- Gender: Female
- Diagnosis: Seropositive Amavata (Rheumatoid Arthritis)
- RF: 150 IU/mL (Normal <20)
- CRP (Baseline): 18.34 mg/L (Normal <6)
- Treatment Duration: 8 days (31/01/2026 to 07/02/2026)

3.5.2 Vaitarana Basti Administration Schedule

Day	Type	Time	Session
1	Anuvasana	2:30 PM	Evening
2	Niruha	10:00 AM	Morning
3	Anuvasana	2:50 PM	Evening
4	Niruha	9:40 AM	Morning
5	Anuvasana	2:10 PM	Evening
6	Niruha	10:00 AM	Morning
7	Anuvasana	2:05 PM	Evening
8	Anuvasana	3:00 PM	Evening

Table 7: Vaitarana Basti administration schedule (Karma Basti protocol)

3.5.3 Primary Clinical Outcomes

Parameter	Before Treatment	After Treatment	Improvement (%)
VAS Score	6/10	3/10	50.0
DAS-28 Score	5.92	4.61	22.1
CRP (mg/L)	18.34	5.56	69.7

Table 8: Clinical outcome scores showing moderate improvement

3.5.4 Joint-Specific Assessment

Symptom	Rt Knee BT	Lt Knee BT	Rt Knee AT	Lt Knee AT
Sandhi Shula (Pain)	4	4	2	2
Sandhi Shotha (Swelling)	2	2	1	1

Sparsha asahatva (Tenderness)	1	1	0	0
Sandhi Graha (Stiffness)	3	3	1	1
Total Score	**10**	**10**	**4**	**4**
Improvement (%)	**—**	**—**	**60**	**60**

Table 9: Bilateral knee joint assessment (before and after treatment)

Symptom	**Rt Elbow BT**	**Lt Elbow BT**	**Rt Elbow AT**	**Lt Elbow AT**
Sandhi Shula (Pain)	3	3	1	1
Sandhi Shotha (Swelling)	1	1	1	0
Sparsha asahatva (Tenderness)	0	0	0	0
Sandhi Graha (Stiffness)	1	1	0	0
Total Score	**5**	**5**	**2**	**1**
Improvement (%)	**—**	**—**	**60**	**80**

Table 10: Bilateral elbow joint assessment (before and after treatment)

3.5.5 Range of Motion Improvement

Joint	**Movement**	**Rt BT**	**Lt BT**	**Rt AT**	**Lt AT**
Knee	Extension	10°	10°	0°	0°
Knee	Flexion	10–110°	10–110°	0–120°	0–120°
Elbow	Extension	20°	10°	10°	0°
Elbow	Flexion	20–130°	10–130°	10–130°	0–130°

Table 11: Range of motion comparison showing functional improvement

3.5.6 Inflammatory Marker Changes

Investigation	**Baseline**	**Post-Treatment**	**Change**	**Change (%)**
CRP (mg/L)	18.34	5.56	-12.78	-69.7

Table 12: Inflammatory marker changes demonstrating significant anti-inflammatory effect

The reduction in C-reactive protein from 18.34 mg/L to 5.56 mg/L (near-normal range <6 mg/L) demonstrates significant anti-inflammatory effect of the treatment protocol, providing clinical validation for the proposed mechanism of action derived from HPTLC phytochemical profiling [9].

4. Discussion

4.1 Linking Fingerprint to Pharmacodynamics

4.1.1 Anti-inflammatory and Antioxidant Actions

Tamarind phenolic acids and flavonoids have been reported to inhibit cyclooxygenase-2 expression and 5-lipoxygenase pathways, with downstream reduction in prostaglandin and leukotriene-mediated inflammation [2][4][5]. Luteolin-like flavonoids and sesame lignans (sesamin, sesamol) also possess well-documented antioxidant and anti-inflammatory properties, including suppression of NF-κB activation and modulation of cytokine production [3][6].

Clinical Correlation: The 69.7% reduction in CRP levels (18.34 → 5.56 mg/L) and 50% reduction in VAS pain scores (6/10 → 3/10) in the clinical case directly support this proposed anti-inflammatory mechanism [9].

4.1.2 Analgesic and Smooth-Muscle Modulation

Coumarin-like compounds, as indicated in the 0.30–0.35 Rf band, are associated with smooth-muscle relaxant and mild analgesic actions in several plant species [2][4]. Together with the warm, penetrating, Tīkṣhṇa quality attributed to Vaitarana Basti in classical texts.

4.1.3 Lipid-Mediated Mucosal Protection and Drug Carriage

Sesame oil-derived lignans, sterols and long-chain fatty acids (Rf 0.20–0.28, 0.43–0.47, 0.50–0.75) form a lipophilic matrix around the polar phytoconstituents [3][6].

4.1.4 Ayurvedic-Modern Convergence

From an Ayurvedic lens, the combined properties of tamarind and sesame oil in Vaitarana Basti are described as Laghu (light), Rukṣha (dry), Uṣhṇa (hot) and Tīkṣhṇa (penetrating), with dominant Vata-Kaphashamaka action [10][11]. When translated into modern mechanisms, these qualities mirror:

1. **Laghu-Rukṣa:** Reduced oedema and exudation via anti-inflammatory and astringent phenolics.
2. **Uṣhṇa-Tīkṣhṇa:** Enhanced perfusion and penetration at the mucosal surface, paralleling improved absorption of phenolic acids and flavonoids through the rectal mucosa.

In this way, the HPTLC fingerprint provides a chemical underpinning for classical guṇa-based descriptions.

4.2 Pharmacokinetic Considerations of Vaitarana Basti

4.2.1 Rectal Absorption of Phytochemicals

Experimental work on Lekhana Basti has already shown that gallic acid, used as a marker, appears measurably in systemic circulation following basti administration, with higher serum levels and area under the curve when an appropriate adjuvant is used [7][8][16]. This directly supports the assumption that at least a fraction of low-molecular-weight phenolic acids in medicated enemas are absorbed via the rectal and colonic mucosa.

Given that the Vaitarana Basti fingerprint demonstrates a low-Rf fluorescent band consistent with gallic-acid-type phenolics (0.03–0.07 at 366 nm), it is reasonable to infer a similar absorption pattern for these constituents.

4.2.2 Local versus Systemic Disposition

Studies on enema drug delivery have highlighted that enema composition especially tonicity and presence of lipids strongly influences whether the dose remains local or becomes systemic [7]. Mildly hypotonic or near-isotonic enemas favour high tissue levels with controlled systemic exposure, whereas strongly hypertonic vehicles can provoke epithelial damage and brisk systemic absorption.

Vaitarana Basti, as formulated with jaggery, saindhava (rock salt) and sesame oil in an acidic but not extremely hypertonic medium, likely behaves as a moderately hypotonic to near-isotonic vehicle once equilibrated with rectal fluid.

4.2.3 Role of Lipophilic Fractions

Lignans, sterols and long-chain fatty acids, prominent in the fingerprint's mid- and high-Rf zones, are expected to display slower and more limited systemic absorption by the rectal route.

4.3 Integrated Pharmacodynamic-Pharmacokinetic Model of Vaitarana Basti

Bringing these strands together, the following working model can be articulated for Vaitarana Basti:

1. Immediately after administration, the acidic, phenolic-rich aqueous phase spreads over rectal and distal colonic mucosa, where low-molecular-weight phenolic acids and flavonoids begin to diffuse across the epithelium.
2. The sesame oil-based lipid phase coats the mucosa, reduces friction and mechanical irritation, and creates a microenvironment that increases membrane fluidity and potentially opens paracellular routes for polar compounds.
3. Locally, high tissue levels of phenolics, flavonoids and coumarin-like compounds which is present in Tamarind, modulate mucosal immunity, reduce production of pro-inflammatory mediators and contribute to smooth-muscle relaxation, thereby easing pelvic and abdominal symptoms often concomitant with Amavata.
4. Over repeated basti sessions, sesame lignans and sterols contribute background hypolipidemic and endothelial-protective actions, while the overall reduction in oxidative stress may down-tune systemic inflammatory load, offering a rational basis for the sustained improvement reported in clinical practice.

Clinical Validation: The 8-day Karma Basti protocol in the reference case (5 Anuvasana + 3 Niruha Bastis) resulted in progressive improvement: mid-treatment VAS 4/10 (Day 4), final VAS 3/10 (Day 8), knee joint symptom reduction 60%, elbow joint symptom reduction 60-80%, and CRP normalization from 18.34 to 5.56 mg/L[9]. This temporal pattern of improvement supports the proposed biphasic pharmacokinetic model with early phenolic absorption and sustained lipophilic depot effects.

From an Ayurvedic standpoint, this integrated model re-expresses the traditional claims of Āmapācana (Āma digestion), Srotoshodhana (channel cleansing) and Vāta-Kaphashamana (Vata-Kapha pacification) in language that is translatable to pharmacology and

physiology without diluting the essence of the classical description [10][11].

5. Conclusion

The HPTLC fingerprint of Vaitarana Basti reveals a coherent phytochemical architecture dominated by phenolic acids, flavonoids, lignans, coumarins, sterols and long-chain fatty acids derived largely from tamarind pulp and sesame oil. Interpreted in the light of contemporary data on rectal drug delivery and basti pharmacokinetics, these bands point towards a formulation that achieves both local mucosal and systemic anti-inflammatory, antioxidant, analgesic and endothelial-protective effects through a biphasic absorption pattern [1][2][3][4][5][6][7][8].

Clinical validation through a documented Amavata case demonstrated 69.7% reduction in CRP levels, 50% reduction in pain scores, and 60-80% improvement in joint symptoms following 8-day Karma Basti protocol, providing real-world evidence supporting the proposed pharmacokinetic-pharmacodynamic model [9]. Such an integrated view not only honours the classical Ayurvedic understanding of Vaitarana Basti but also offers a scientifically intelligible framework which can be tested and refined by future experimental and clinical studies.

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Conflicts of Interest

The authors declare no conflicts of interest related to this study.

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Author Contributions

- Dr. Akshay Kumar: Study design, HPTLC analysis, case management, data collection, manuscript preparation
- Dr. Divya B: Treatment supervision, manuscript review, project guidance

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