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Analytical and Formulative Approaches to Doshaghna Churna: Development of a Modified Patch and Validation by HPTLC and FTIR

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Abstract

Doshaghna Lepa is classically mentioned as *Shothahara Lepa (Punarnava, Devdaru, Sunthi, Sigru & Sarshapa)* in *Sarngadhara SaChita,* by *Acharya Sarangadhara*. The present study aims to develop modified *Doshaghna herbal patch* and scientifically evaluate the phytochemical constituents of *Doshaghna Churna* and *Doshaghna* extract using advanced instrumental techniques such as Fourier-transform infrared (FTIR) spectroscopy and High-Performance Thin Layer Chromatography (HPTLC). FTIR analysis confirmed the presence of multiple bioactive functional groups including hydroxyl, carbonyl, and aromatic compounds, indicating the presence of flavonoids, tannins, alkaloids, and glycosides. HPTLC analysis at 254 nm and 366 nm revealed reproducible chemical fingerprints with significant peaks and consistent Rf values, validating batch-to-batch uniformity and phytochemical richness. These results align with the known pharmacological actions of the ingredients, including anti-inflammatory, analgesic, and detoxifying effects, thereby scientifically supporting its clinical application in managing Amavata.

Key words : *Doshaghna Churna*, Modified herbal patch, FTIR, HPTLC, *Ayurveda,* phytochemical analysis, *Amavata.*

D*oshaghna Lepa* is classically mentioned as *Shothhara Lepa* (anti-inflammatory lepa) in *Sharangadhara SaChita*, by *Acharya Sarangadhara*[15,16]. In the text, it is described in the context of external applications for reducing *Sotha* (inflammation or swelling). The formulation is traditionally indicated for conditions caused by vitiation of *Tridosha* and is aimed at alleviating pain and local inflammation.

Doshaghna lepa, a polyherbal blend composed of *Punarnava, Devdaru, Sunthi, Sigru,* and *Sarshapa*. Each of these botanicals is known for its anti-inflammatory, antioxidant, and circulatory-stimulating properties, making the formulation effective in pacifying aggravated doshas and restoring physiological balance. However, traditional powdered formulations often face challenges in dosing precision, patient compliance, and bioavailability.

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To overcome these limitations, transdermal drug delivery systems—particularly herbal patches—have gained attention. Herbal patches offer controlled and sustained release. They are non-invasive, easy to apply, and reduce dosing frequency, thereby improving patient adherence and minimizing systemic side effects. Moreover, they allow for localized delivery, which is especially beneficial in inflammatory conditions affecting joints and muscles.

The process of standardisation involves comparing the qualitative and quantitative characteristics of herbs to recognised or controlled criteria and parameters.[10,23] Ensuring the quality and consistency of herbal formulations is critical for their therapeutic success. This necessitates the use of advanced analytical techniques such as Fourier Transform Infrared Spectroscopy (FTIR) and High-Performance Thin Layer Chromatography (HPTLC). FTIR provides insights into the functional groups present in the extract, confirming the presence of bioactive compounds like flavonoids, terpenoids, and glycosides.

High-performance thin layer chromatography (HPTLC) is one of the sophisticated instrumental methods for qualitative and quantitative analysis of plants and herbal remedies[17,18]. Procedures for developing analytical methods and validating them are essential to the search for new medications and pharma-ceuticals.[22]

By integrating traditional *Ayurvedic* wisdom with modern pharmaceutical technology, the research seeks to establish a scientifically validated herbal anti-inflammatory therapy with enhanced delivery and therapeutic potential.

Table-1. Ingredients of Doshaghna Lepa (Alternative Shothahara lepa Formulation)

Sanskrit Name	Botanical Name	Part used	Rasa/Guna/Karma	Therapeutic Role
Punarnava[1,8]	*Boerhavia diffusa* L.	*Panchanga*	*Tikta, Kashaya; Mutrala, Shothahara*	Anti-inflammatory, diuretic
Devadaru[14]	*Cedrus deodara* (Roxb.) G. Don.	*Heart wood/ Inner wood*	*Tikta, Laghu, Ushna; Vata-Kaphahara*	Anti-edematous, anti-arthritic
Shunthi[2,11]	*Zingiber officinale* Roscoe (dry)	*Rhizome*	*Katu, Ushna, Laghu; Deepana, Pachana*	Digestive, anti-inflammatory
Shigru[3,6]	*Moringa oleifera* Lam.	*Seed*	*Katu, Tikta; Ushna; Kaphahara, Vedanashamak*	Muscle relaxant, anti-inflammatory
Sarshapa[4,20]	*Brassica campestris* L. (mustard)	*Seed*	*Katu, Ushna; Tikshna; Kapha-Vatahara*	Rubefacient, analgesic, deep tissue stimulant

Aim & objective :

This study aims to formulate a modified *Doshaghna Churna*-based herbal patch, evaluate its physicochemical properties, and authenticate its extract using FTIR and HPTLC.

Sample Preparation: Raw materials were procured from local vendors and authenticated botanically in department of *dravyaguna,* Parul ayurveda institute, Parul university, Vadodara. As per the standards of Ayurvedic Pharmacopia of India, *Doshaghna Churna* was prepared by grinding the dried ingredients into fine powder. The powdered drug, sieved through 80-mesh sieve.

Herbal patch preparation :

Doshaghna patch was prepared according to IP Standards or API standards (volume 7 & 8).

Extract Preparation :

The coarsely powdered *churna* was individually extracted using methanolic and hydroalcoholic solvents via Soxhlet apparatus for 6–8 hours. This ensured efficient extraction of active phytoconstituents. The herbal extract was concentrated under reduced pressure and blended with a 12–15% guar gum powder base to form a gummy paste. Prepared gummy paste was evenly spread on sterile cotton cloths in thin layers with partial drying in between. The patches were dried at room temperature (40^{o}C), yielding flexible, non-sticky, and skin-friendly herbal patches. Patch was stored in moisture-resistant pouches.

Table-2. Extract of *Doshaghna churna*

Drug Name	Type Of Extract
Punarnava	Methyl alcoholic extract
Devdaru	Hydroalcoholic
Sunthi	Tincture (ethyl alcohol)
Sarshapa	Tincture
Shigru	Hydroalcoholic

Analytical Test :

Pharmacognostic evaluation of the fine powder and extract of final product was done in Pharmacognosy Lab of Parul Ayurved institute, Parul university, Vadodara.

Organoleptic study : Powdered sample of *Doshaghna churna* and extract of *Doshaghna churna* was evaluated for its organoleptic characters including colour odour and consistency.

Table-3. Organoleptic Characterstics of Drugs

Sample	Doshaghna Churna	Doshaghna Extract
Color	Brownish cream	Brown
Odour	Characteristic	Characteristic
Consistency	Solid	semisolid

Table-4. Physico-Chemical parameters of Doshaghna churna and Doshaghna churna extract

	Sample	Doshaghna Churna	Doshaghna Extract
S.No.	Parameter	Values	
1.	Loss on Drying at 110 c(%w/w)	5	58
2.	Total Ash Value(%w/w)	3.80	0.21
3.	Acid Insoluble Ash(%w/w)	0.50	0
4.	Water Soluble Extractive(%w/w)	19.30	12.50
5.	Alcohol Soluble Extractive(%w/w)	7	39
6.	PH Value (10 % Aqs)	6	7.2
7.	Bulk density		-
	Tap density	0.36	
	10 taps	0.43	
	20 taps	0.45	
	50 taps	0.47	
8.	Mesh analysis		-
	10-20# (%w/w)	94	
	20-40# (%w/w)	71	
	40-60# (%w/w)	46	
	80# (%w/w)	28	
	120# (%w/w)	0	
9.	Angle of Repose	0.85	-

FTIR Analysis[7]

Fourier-transform infrared (FTIR) spectroscopy was carried out in centre of research for development (CD4D) Parul university, vadodara. It was done to detect the presence of various functional groups. The extract was mixed with spectroscopic grade KBr and pressed into a pellet. The FTIR spectra were recorded in the range of 4000–400 cm^- The peaks were analyzed to identify chemical bonds and associated bioactive groups.

HPTLC Analysis :

HPTLC was used to generate the phytochemical fingerprint. It was done in centre of research for development (CD4D) Parul university, Vadodara.

For the preparation of the test solution, 5 g of the sample was accurately weighed into a beaker, extracted with 100 mL of methanol, sonicated for 15 minutes, and filtered using simple filter paper, with the clear filtrate taken as the test solution for HPTLC fingerprinting.

The chromatographic study was performed on MERCK HPTLC silica gel 60 F254 aluminium sheets as the stationary phase using a CAMAG Linomat 5 (S/N: 280008) applicator. Sample bands were applied at a start position of 15 mm from the plate base with a development distance of 80 mm, an application volume of 10 µL, and a track separation of 21.4 mm. Development was carried out in a CAMAG TLC twin trough chamber saturated for 30 minutes, employing toluene:chloroform:methanol (6:3:1 v/v/v) as the mobile phase. Plates were observed under UV light at 254 nm and 366 nm, followed by derivatization in a CAMAG dip tank for approximately 1 minute. Finally, the plates were dried on a TLC plate heater preheated at 100 ± 5 °C for 3 minutes.

Observation :

FTIR Observation : The FTIR analysis revealed the following major absorption bands:

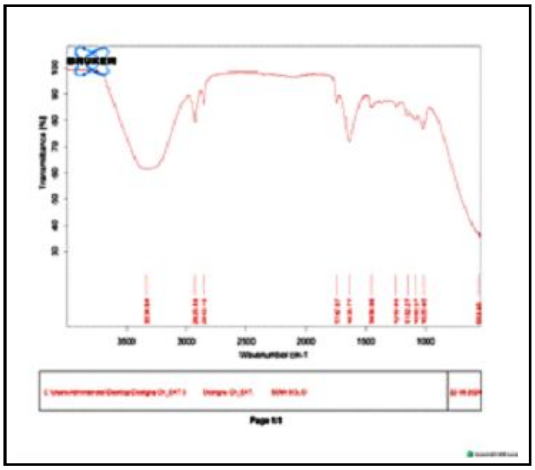
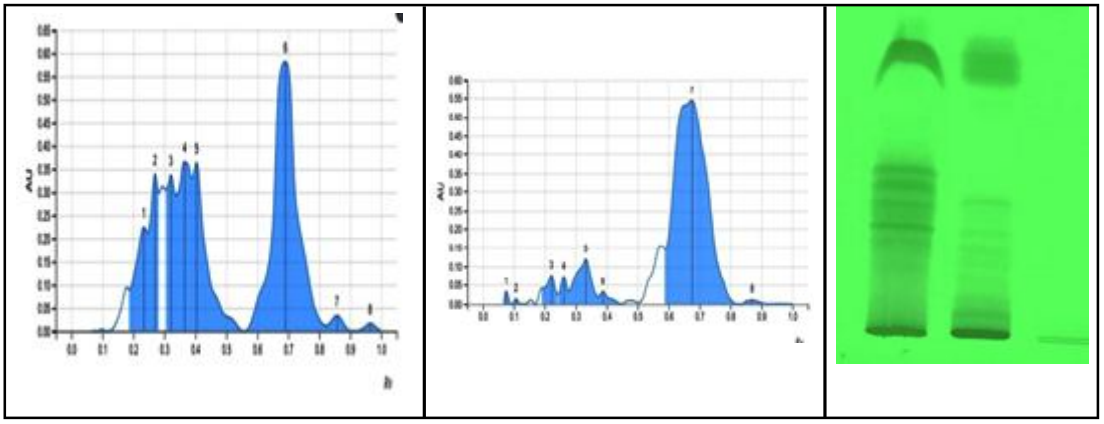


Fig. 1. FTIR OF Doshaghna churna Extract

Table-5. FTIR interpretation

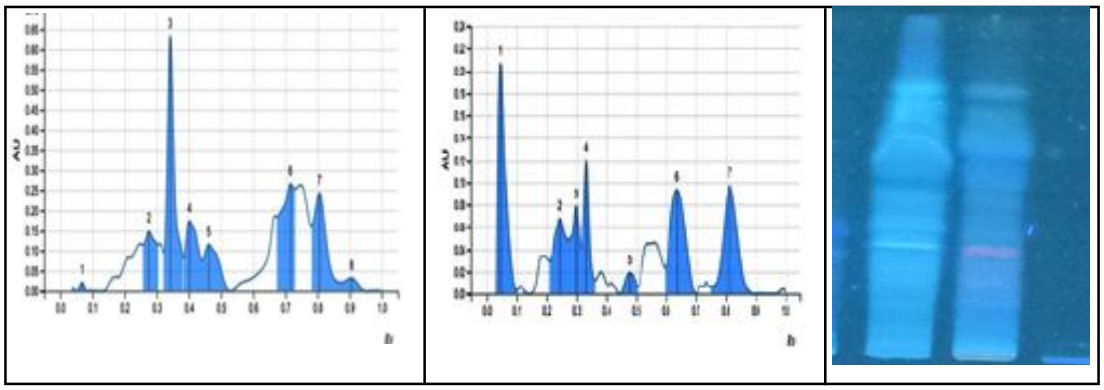
Wavenumber (cm^-1)	Functional Group[9]
~3400	O–H stretch (phenols, alcohols)
~2920 – 2850	C–H stretch (alkanes)
~1740 – 1700	C=O stretch (esters, acids)
~1630 – 1600	C=C aromatic stretch
~1250 – 1000	C–O stretch

HPTLC Observation :



Track - 1 Track - 2

Figure 2. HPTLC Chromatograph @366 nm of Track-1 and Track-2



Track - 1 Track - 2

Figure 3. HPTLC Chromatograph @366 nm of Track-1 and Track-2

Track-1=*Doshaghna churna*

Track-2= *Doshaghna extract*

Doshaghna churna @254 nm

Peak	Start		Max		End		Area	
	R_F	H	R_F	H	R_F	H	R_F	H
1	0.186	0.0898	0.233	0.2242	0.186	0.0898	0.233	0.2242
2	0.244	0.2136	0.269	0.3393	0.244	0.2136	0.269	0.3393
3	0.304	0.3054	0.321	0.3369	0.304	0.3054	0.321	0.3369
4	0.338	0.2933	0.365	0.3654	0.338	0.2933	0.365	0.3654
5	0.389	0.3301	0.404	0.3636	0.389	0.3301	0.404	0.3636
6	0.560	0.0000	0.690	0.5816	0.560	0.0000	0.690	0.5816
7	0.821	0.0112	0.857	0.0334	0.821	0.0112	0.857	0.0334
8	0.924	0.0000	0.964	0.0162	0.924	0.0000	0.964	0.0162

Doshaghna churna @366 nm

Peak	Start		Max		End		Area	
	R_F	H	R_F	H	R_F	H	R_F	H
1	0.067	0.0000	0.075	0.0322	0.067	0.0000	0.075	0.0322
2	0.093	0.0000	0.107	0.0132	0.093	0.0000	0.107	0.0132
3	0.189	0.0402	0.221	0.0761	0.189	0.0402	0.221	0.0761

4	0.242	0.0249	0.261	0.0731	0.242	0.0249	0.261	0.0731
5	0.278	0.0334	0.332	0.1189	0.278	0.0334	0.332	0.1189
6	0.372	0.0194	0.388	0.0320	0.372	0.0194	0.388	0.0320
7	0.588	0.1461	0.675	0.5440	0.588	0.1461	0.675	0.5440
8	0.829	0.0002	0.869	0.0109	0.829	0.0002	0.869	0.0109

Doshaghna extract @254 nm

Peak#	Start		Max		End		Area	
	R_F	H	R_F	H	R_F	H	R_F	H
1	0.050	0.0000	0.068	0.0201	0.050	0.0000	0.068	0.0201
2	0.256	0.1143	0.275	0.1485	0.256	0.1143	0.275	0.1485
3	0.321	0.0942	0.342	0.6318	0.321	0.0942	0.342	0.6318
4	0.383	0.0828	0.401	0.1726	0.383	0.0828	0.401	0.1726
5	0.440	0.0764	0.461	0.1148	0.440	0.0764	0.461	0.1148
6	0.674	0.1839	0.715	0.2658	0.674	0.1839	0.715	0.2658
7	0.781	0.1601	0.806	0.2421	0.781	0.1601	0.806	0.2421
8	0.874	0.0197	0.906	0.0316	0.874	0.0197	0.906	0.0316

Doshaghna extract @366 nm

Peak	Start		Max		End		Area	
	*R*F	H	*R*F	H	*R*F	H	*R*F	H
1	0.036	0.0000	0.049	0.2064	0.036	0.0000	0.049	0.2064
2	0.208	0.0292	0.247	0.0679	0.208	0.0292	0.247	0.0679
3	0.272	0.0484	0.299	0.0786	0.272	0.0484	0.299	0.0786
4	0.314	0.0418	0.336	0.1199	0.314	0.0418	0.336	0.1199
5	0.449	0.0000	0.479	0.0192	0.449	0.0000	0.479	0.0192
6	0.596	0.0233	0.639	0.0937	0.596	0.0233	0.639	0.0937
7	0.749	0.0064	0.815	0.0971	0.749	0.0064	0.815	0.0971

The modified *Doshaghna herbal patch* was successfully formulated using a hydroalcoholic extract of *Doshaghna Churna* and guar gum as a binder. The patch exhibited favorable physical properties—flexibility, non-stickiness, and uniformity—suitable for transdermal delivery.

Organoleptic and physicochemical evaluations confirmed the quality of both *churna* and extract, with acceptable moisture content, ash values, and extractive yields. The extract showed higher alcohol solubility (39%) and a slightly alkaline pH (7.2), supporting its stability and suitability for topical use.

FTIR analysis revealed the presence of functional groups corresponding to flavonoids, tannins, glycosides, and organic acids, which are known for their anti-inflammatory, antioxidant, and rejuvenative effects.

HPTLC fingerprinting demonstrated reproducible and well-resolved peaks at both 254 nm and 366 nm. Major Rf values ranged from 0.244 to 0.690, indicating the presence of flavonoids, polyphenols, alkaloids, and terpenoids. These peaks were consistent between the churna and its extract, ensuring batch-to-batch uniformity and validating its therapeutic potential in managing Amavata.

The successful formulation of a modified *Doshaghna* herbal patch using a hydroalcoholic extract and guar gum offers an effective transdermal delivery system for managing *Amavata*. The patch ensures localized, sustained drug release, improving patient compliance and therapeutic efficacy. Physicochemical tests confirmed the quality and stability of the formulation, with high alcohol-soluble extractive values and suitable pH for topical use.

FTIR analysis validated the presence of functional groups such as hydroxyl, carbonyl, and glycosidic bonds—indicative of flavonoids, tannins, and polyphenols—supporting the formulation's antioxidant, anti-inflammatory, and detoxifying actions.

HPTLC analysis of *Doshaghna Churna* and its herbal patch extract demonstrated multiple bioactive constituents supporting their classical *Shothahara* and *Vedanasthapana* properties. In the *churna,* major peaks at Rf 0.321 (38.82%) and 0.560 (25.73%) corresponded to flavonoid derivatives[21] and polyphenols/ terpenoids, indicating anti-inflammatory, antioxidant, and *Aamapachana* effects beneficial for *Amavata*. Additional peaks for flavonoids, alkaloids[13], saponins[5], sterols, and phenolics[19] reflected analgesic, immunomodulatory, and strengthening actions.

The herbal patch showed a dominant peak at Rf 0.588 (60.41%) for terpenoids and polyphenols. Minor peaks for flavonoids, phenolic glycosides, volatile oils, and simple sugars indicated detoxifying, *Srotoshodhana,* and anti-arthritic properties. Together, the profiles validate the synergistic anti-inflammatory and Analgesic role of *Doshaghna Churna* and its patch in inflammatory joint disorders.

The current study successfully characterizes the chemical constituents of Doshaghna Churna using FTIR and HPTLC methodologies. The findings support the traditional Ayurvedic understanding of the formulation's utility in treating Sotha (inflammation) by highlighting the presence of compounds with anti-inflammatory, analgesic and detoxifying actions. The reproducibility of Rf peaks in HPTLC affirms its reliability as a fingerprinting and quality control tool. Such integrative scientific approaches enhance the credibility and acceptance of Ayurvedic medicines in global healthcare.

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