International Journal of Pharmaceutics and Drug Analysis

Content Available at www.ijpda.org ISSN: 2348:8948

# ANALYTICAL FINGERPRINTING OF THE SIDDHA POLYHERBAL REMEDY LAVANGADHI VADAGAM (LV) USING FTIR, TLC/HPTLC AND ICP-OES –A QUALITY CONTROL APPROACH

**S FAHMIDHA[1], K NALINA SARASWATHI[2], J JERIS AGNES[3]**

*[1&3] PG scholar, Department of Gunapadam (Siddha Pharmacology), Government Siddha medical college, Chennai – 106, Tamil Nadu, India.*

*[2] Lecturer, Department of Gunapadam (Siddha Pharmacology), Government Siddha medical college, Chennai – 106, Tamil Nadu, India.*

Received: 21.03.2026 Revised: 16.04.2026 Accepted: 27.05.2026

**ABSTRACT**

*Siddha* polyherbal formulations, rooted in traditional medicine, offer promising holistic management due to their synergistic bioactive constituents. However, standardization and quality control remain critical challenges for their wider acceptance. The present study focuses on the analytical fingerprinting of a *Siddha* polyherbal remedy *Lavangadhi Vadagam* (LV) using advanced instrumental techniques, namely Fourier Transform Infrared Spectroscopy (FTIR), High Performance Thin Layer Chromatography (HPTLC), and Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). FTIR analysis was employed to identify functional groups and characterize major phytochemical classes present in the formulation. HPTLC profiling provided a comprehensive chromatographic fingerprint, enabling the detection and comparison of key bioactive compounds. ICP-OES analysis was conducted and to assess the presence of heavy metals, ensuring safety and compliance with pharmacopeial standards. The integration of these analytical techniques establishes a robust quality control framework for the *Siddha* formulation LV.

***Keywords***: *Lavangadhi Vadagam (LV), Siddha, Instrumental analysis, HPTLC, FT-IR, ICP-OES*



***CORRESPONDING AUTHOR**

S Fahmidha

DOI: https://doi.org/10.47957/ijpda.v14i2.728

**PRODUCED AND PUBLISHED BY**

South Asian Academic Publications

## INTRODUCTION

The *Siddha* system of medicine is one of the popular traditional holistic health care systems of south India which comprises 32 forms of internal medicine. One among them is "*Vadagam*" which is correlated with Lozenges in modern medical system. The drug *Lavangadhi Vadagam* (LV) is known to cure indications like *Neeradaippu, Kalladaippu, Soothagavayu, Yeppam, Kandhal, Varatchi* as per the *Siddha* classical text *"Aaviyalikkum Amudhamurai Surukkam*".Despite its extensive traditional use, scientific validation and quality standardization have become increasingly important in the modern healthcare system. In addition, concerns regarding adulteration, contamination, and heavy metal toxicity necessitate the implementation of reliable analytical techniques to ensure the safety, efficacy, and reproducibility of traditional medicines. Therefore, the present investigation was undertaken to scientifically validate and standardize the *Siddha* polyherbal formulation LV using FTIR, HPTLC, and ICP-OES analytical technique to establish a reliable phytochemical and elemental fingerprint profile that can support the quality control, authenticity, safety evaluation, and wider acceptance of *Siddha* formulations in contemporary healthcare and pharmaceutical research.

## MATERIALS AND METHODS

### Drug Profile [1]

Drug name: *LavangadhiVadagam*(LV)
Dosage: *Kottaipaakkalavu* (6.022g)
Route: Oral Administration
Indications:*Neeradaippu*,*Kalladaippu, Soothagavayu, Yeppam, Vayu, Soolai, Kandhal, Varatchi.*

Table 01: Ingredients of LV

| S.NO | TAMIL NAME | BOTANICAL NAME | QUANTITY | PARTS USED |
|---|---|---|---|---|
| 1. | *Lavangam* | *Syzygiumaromaticum* | 100 varagan (420g) | DriedFlower bud |
| 2. | *Sirunagapoo* | *Mesuaferrea* | 100varagan (420g) | DriedFlower bud |
| 3. | *Vilamichuver* | *Coleus vettiveroides* | 100varagan (420g) | Dries Root |
| 4. | *Chukku* | *Zingiberofficinale* | 100varagan (420g) | Dried Rhizome |
| 5. | *Milagu* | *Piper nigrum* | 100varagan (420g) | Dried Fruit |
| 6. | *Thippili* | *Piper longum* | 100varagan (420g) | Dried Fruit |
| 7. | *Vellam* | *Saccharumofficinarum* | 120 varagan (504g) | Jaggery |

## COLLECTION OF RAW DRUGS

All the above ingredients were bought from an authentic country drug store.

## IDENTIFICATION AND AUTHENTICATION

All the drugs were identified and authenticated by Botanist and Gunapadam experts of Government *Siddha* Medical College, Arumbakkam, Chennai.The identified product Samples were maintained in the PG Gunapadam laboratory for future references.

## PURIFICATION OF THE DRUG

Purification process was made according to the procedures mentioned in the classical *Siddha* literature 2 (*Sarakkugalin Suthi Sei Muraigal).*

## METHOD OF PREPARATION OF *LAVANGADHIVADAGAM*

- The above drugs are taken dried, finely powdered and subjected to *vasthirakayam.*
- Jaggery was added to it and mixed.
- Then the mixture was purified by *pittaviyal* method.
- Then the mixture in the muslin doth will be cooled.
- Finally the mixture rolled into pills of the size of *kottaipaaku* (6.022g)

## ANALYTICAL INSTRUMENTATION TECHNIQUES - METHODOLOGY

**Sample Preparation for TLC** One gram sample was sonicated in 10 ml of ethanol for 15 minutes and then filtered. This solution was used for TLC.

### TLC/HPTLC Methodology

Applied 15, 20 µl of sample extract on TLC plate using Camag's ATS4 applicator and developed by the Mobile phase: Toluene: Ethyl acetate: Acetic acid (9:1:0.5, v/v) up to 8 cm distance. After development, the plate was photo documented using Camag's TLC Visualizer under UV 254 nm and UV 366 nm. Scanned the plate using Camag's Scanner 4 at UV 254 nm (D 2 lamp/Absorption mode) finger print profiles of the extract were documented. Then the plate was dipped in vanillin-sulphuric acid reagent followed by heating at 105 o C till development of coloured spots. The plate was then photo documented in white light and scanned at 520nm (W lamp/Absorption mode)

### FTIR METHODOLOGY [3 & 4]

Fourier Transform Infrared (FTIR) analysis was carried out to identify the functional groups present in the sample following standard procedures reported in similar studies. The sample was dried, finely powdered, and a small quantity was mixed with potassium bromide (KBr) and compressed into a thin pellet (or analyzed directly using ATR mode). The spectrum was recorded using an FTIR spectrophotometer over the range of 4000–400 $cm^{-1}$ at a resolution of about 4 $cm^{-1}$ with multiple scans to ensure accuracy. A background spectrum was obtained prior to analysis. The resulting absorption peaks were interpreted based on characteristic wave numbers corresponding to different functional groups such as hydroxyl, carbonyl, alkane, alkene, and amine groups, and the obtained spectral data were compared with standard references to determine the chemical constituents present in the sample.

### ICP-OES METHODOLOGY [5]

The heavy metals in the sample were analyzed using Inductively Coupled Plasma–Optical Emission Spectrometry (ICP-OES) following AOAC Official Methods of Analysis (22nd Ed., 2023). Approximately 0.5–1.0 g of the sample was accurately weighed and subjected to acid digestion using concentrated nitric acid and hydrogen peroxide in a microwave digestion system until a clear solution was obtained. The digested sample was cooled, diluted to a known volume with deionized water, and filtered if necessary. Calibration standards were prepared from multi-element standard solutions, and a blank was used for baseline correction. The prepared solutions were introduced into the ICP-OES instrument, where elements such as arsenic (As), cadmium (Cd), mercury (Hg), and lead (Pb) were quantified based on their characteristic emission wavelengths. Quality control measures including blanks and standard checks were employed to ensure accuracy. Results were expressed in mg/kg, and values below the limit of quantification were reported as BLQ, with limits of quantification set

at 2.0 mg/kg for As, 0.1 mg/kg for Cd, 1.0 mg/kg for Pb, and 0.5 mg/kg for Hg.

## RESULTS

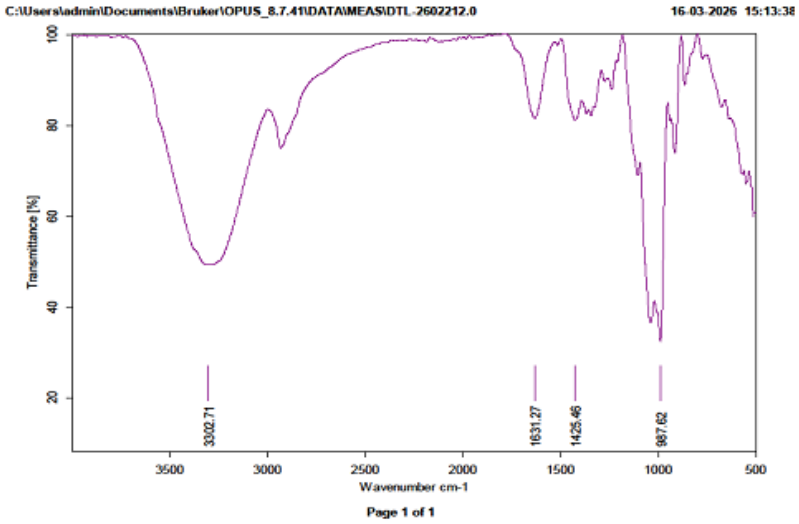
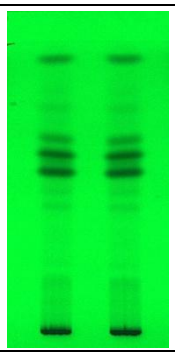
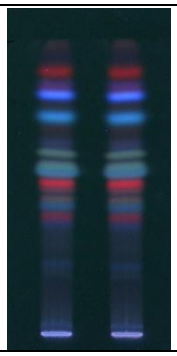
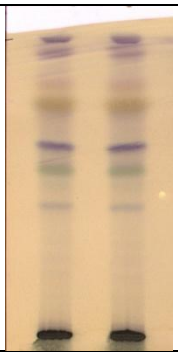



Figure 01: FTIR peak spectrum of LV

### FTIR INTERPRETATION

Table 01: FTIR spectral peaks and their corresponding functional groups with indications in the formulation

| S. NO. | WAVENUMBER ($CM^{-1}$) | FUNCTIONAL GROUP | INDICATION |
|---|---|---|---|
| 1 | 3302.71 | O–H stretching | Indicates the presence of hydroxyl (–OH) groups, adsorbed moisture, alcohols, phenols, or hydrated inorganic constituents. Suggests hydrogen-bonded hydroxyl groups commonly found in herbo-mineral formulations. |
| 2 | 1631.27 | C=O stretching / H–O–H bending | Indicates carbonyl-containing compounds such as amides or ketones and may also represent bending vibrations of bound water molecules. Suggests the presence of organic residues or proteinaceous materials. |
| 3 | 1425.46 | C–H bending / Carbonate vibration | Suggests aliphatic C–H groups or carbonate ions. Indicates carbonate-containing mineral phases and organic constituents within the formulation. |
| 4 | 987.62 | C–O stretching / Si–O / $PO_4$ vibration | Indicates C–O functional groups and inorganic components such as silicates, phosphates, or metal–oxygen bonds. Suggests the presence of mineral oxides or phosphate-containing structures. |

| UV 254 nm | | UV 366 nm | | Derivatized | |
|---|---|---|---|---|---|
| $R_f$ value | Color | $R_f$ value | Color | $R_f$ value | Color |
| 0.18 | Green | 0.23 | Blue | 0.44 | Blue |

| | | | | | |
|---|---|---|---|---|---|
| 0.23 | Green | 0.36 | Blue | 0.55 | Green |
| 0.44 | Green | 0.40 | Red | 0.64 | Blue |
| 0.48 | Green | 0.42 | Blue | 0.76 | Yellow |
| 0.55 | Green | 0.51 | Red | 0.85 | Pink |
| 0.61 | Green | 0.55 | Green | 0.98 | Purple |
| 0.67 | Green | 0.56 | Green | | |
| 0.78 | Green | 0.60 | Green | | |
| 0.93 | Green | 0.73 | Blue | | |
| | | 0.80 | Blue | | |
| | | 0.88 | Red | | |

Figure 02: TLC Photo documentation of LV

**TLC INTERPRETATION:**

The TLC profile of the drug revealed the presence of multiple phytochemical constituents with different polarities and fluorescence characteristics. Under UV 254 nm, several green quenching spots were observed, indicating UV-active compounds. At UV 366 nm, blue, red, and green fluorescent bands confirmed the presence of diverse fluorescent constituents, while derivatization produced distinct blue, green, yellow, pink, and purple bands, suggesting chemically varied metabolites. Prominent spots observed at Rf values around 0.40, 0.51, 0.85, and 0.98 indicate the possible presence of major flavonoid, phenolic, or terpenoid-type compounds. Overall, the TLC fingerprint demonstrates successful separation and confirms the complex phytochemical nature of the drug sample.

**At UV 254 nm**

The chromatogram showed several green fluorescent bands with different Rf values ranging from **0.18 to 0.93**, indicating the presence of compounds with conjugated double bonds and aromatic structures.

**Observed major bands**

Table 02: TLC Interpretation at UV 254nm

| RF VALUE | OBSERVATION | INTERPRETATION |
|---|---|---|
| 0.18–0.23 | Green bands | Polar phytoconstituents such as phenolics or glycosides |
| 0.44–0.67 | Multiple intense bands | Presence of flavonoids, tannins, or alkaloidal fractions |
| 0.78–0.93 | Distinct upper bands | Less polar volatile or resinous compounds |

**At UV 366 nm**

Under long-wave UV, blue, red, and green fluorescent bands were observed at Rf values from **0.23 to 0.88**

**Key observations**

Table 03: TLC Interpretation at UV 366nm

| RF VALUE | FLUORESCENCE | POSSIBLE INDICATION |
|---|---|---|
| 0.23, 0.36, 0.42 | Blue | Coumarins, phenolics, flavonoids |
| 0.40, 0.51, 0.88 | Red | Polyphenolic or highly conjugated compounds |
| 0.55–0.60 | Green | Terpenoids or chlorophyll-related compounds |

**Post-Derivatization Profile**

After derivatization, colored bands appeared at Rf values between 0.44 and 0.98, including blue, green, yellow, pink, and purple zones.

Table 04: TLC Interpretation at Post derivatization

| RF VALUE | COLOR | INTERPRETATION |
|---|---|---|
| 0.44–0.64 | Blue/Green | Phenolic and flavonoid compounds |
| 0.76 | Yellow | Terpenoids or essential oil components |



CODEN (USA): IJPDBY

| | | |
|---|---|---|
| 0.85 | Pink | Alkaloidal constituents |
| 0.98 | Purple | Highly non-polar compounds/resins |

Derivatization enhances visualization of phytochemical groups, suggesting the formulation contains a broad spectrum of secondary metabolites.

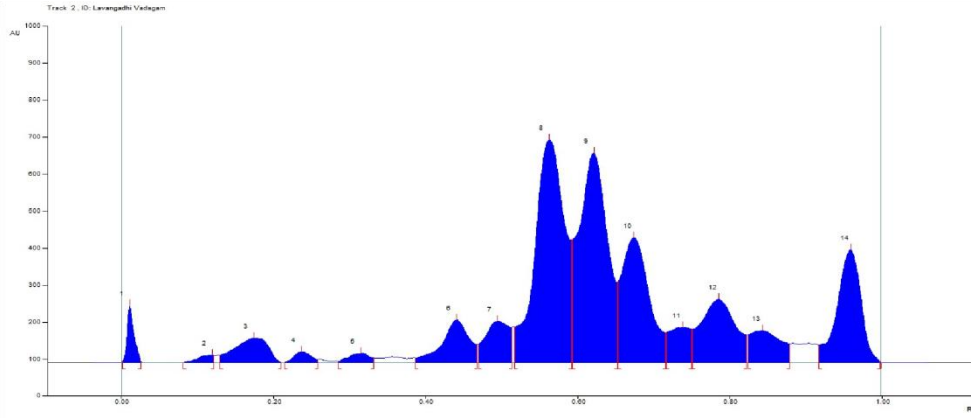


Figure 03: HPTLC Finger print profile at UV 254 nm

Track 2, ID: Lavangadhi Vadagam

| Peak | Start Position | Start Height | Max Position | Max Height | Max % | End Position | End Height | Area | Area % |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00 Rf | 5.7 AU | 0.01 Rf | 154.9 AU | 5.76 % | 0.03 Rf | 2.0 AU | 1297.1 AU | 1.46 % |
| 2 | 0.08 Rf | 0.7 AU | 0.12 Rf | 20.0 AU | 0.74 % | 0.12 Rf | 19.6 AU | 383.3 AU | 0.43 % |
| 3 | 0.13 Rf | 20.6 AU | 0.17 Rf | 66.8 AU | 2.48 % | 0.21 Rf | 0.2 AU | 2796.8 AU | 3.14 % |
| 4 | 0.21 Rf | 0.6 AU | 0.24 Rf | 28.7 AU | 1.07 % | 0.26 Rf | 7.6 AU | 620.0 AU | 0.70 % |
| 5 | 0.29 Rf | 3.8 AU | 0.31 Rf | 24.9 AU | 0.93 % | 0.33 Rf | 13.2 AU | 670.5 AU | 0.75 % |
| 6 | 0.39 Rf | 12.4 AU | 0.44 Rf | 115.4 AU | 4.29 % | 0.47 Rf | 49.2 AU | 3897.4 AU | 4.37 % |
| 7 | 0.47 Rf | 49.7 AU | 0.50 Rf | 112.3 AU | 4.18 % | 0.51 Rf | 95.8 AU | 3369.7 AU | 3.78 % |
| 8 | 0.52 Rf | 96.0 AU | 0.56 Rf | 602.3 AU | 22.41 % | 0.59 Rf | 32.2 AU | 22292.8 AU | 25.01 % |
| 9 | 0.59 Rf | 333.1 AU | 0.62 Rf | 566.3 AU | 21.07 % | 0.65 Rf | 16.7 AU | 19916.8 AU | 22.35 % |
| 10 | 0.65 Rf | 218.0 AU | 0.67 Rf | 338.4 AU | 12.59 % | 0.72 Rf | 81.4 AU | 11563.9 AU | 12.97 % |
| 11 | 0.72 Rf | 81.9 AU | 0.74 Rf | 95.4 AU | 3.55 % | 0.75 Rf | 91.1 AU | 2542.4 AU | 2.85 % |
| 12 | 0.75 Rf | 90.8 AU | 0.79 Rf | 171.1 AU | 6.36 % | 0.82 Rf | 74.5 AU | 7389.8 AU | 8.29 % |
| 13 | 0.82 Rf | 75.0 AU | 0.84 Rf | 86.4 AU | 3.21 % | 0.88 Rf | 50.6 AU | 3345.5 AU | 3.75 % |
| 14 | 0.92 Rf | 48.1 AU | 0.96 Rf | 304.9 AU | 11.34 % | 1.00 Rf | 1.7 AU | 9043.8 AU | 10.15 % |

Figure 04: HPTLC Peak table at UV 254nm

**HPTLC Profile at 254 nm**

The densitogram revealed multiple peaks, confirming the presence of several constituents in the formulation.

**Major peaks observed**

Table 05: HPTLC Interpretation at UV 254nm

| Rf | AREA % | INTERPRETATION |
|---|---|---|
| 0.52 | 25.01% | Major bioactive constituent |
| 0.65 | 12.97% | Significant phytochemical fraction |
| 0.93 | 16.15% | Non-polar major constituent |
| 0.47 | 3.78% | Moderate constituent |

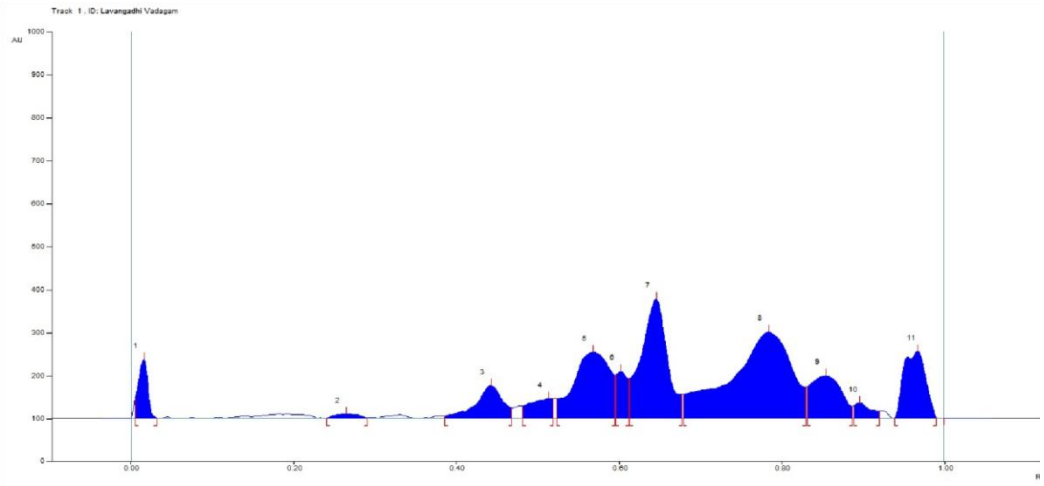


Figure 05: HPTLC Finger print profile at 520 nm

Track 1, ID: Lavangadhi Vadagam

| Peak | Start Position | Start Height | Max Position | Max Height | Max % | End Position | End Height | Area | Area % |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00 Rf | 47.0 AU | 0.02 Rf | 137.0 AU | 10.48 % | 0.03 Rf | 0.6 AU | 1523.1 AU | 3.43 % |
| 2 | 0.24 Rf | 0.8 AU | 0.26 Rf | 10.8 AU | 0.82 % | 0.29 Rf | 0.6 AU | 290.4 AU | 0.65 % |
| 3 | 0.39 Rf | 5.8 AU | 0.44 Rf | 77.0 AU | 5.89 % | 0.47 Rf | 24.4 AU | 2406.0 AU | 5.43 % |
| 4 | 0.48 Rf | 28.7 AU | 0.51 Rf | 46.1 AU | 3.53 % | 0.52 Rf | 45.1 AU | 1262.8 AU | 2.85 % |
| 5 | 0.52 Rf | 46.0 AU | 0.57 Rf | 155.1 AU | 11.87 % | 0.60 Rf | 00.5 AU | 6496.0 AU | 14.65 % |
| 6 | 0.60 Rf | 101.0 AU | 0.60 Rf | 109.6 AU | 8.39 % | 0.61 Rf | 92.3 AU | 1434.5 AU | 3.23 % |
| 7 | 0.61 Rf | 93.1 AU | 0.65 Rf | 277.8 AU | 21.26 % | 0.68 Rf | 55.3 AU | 8404.5 AU | 18.95 % |
| 8 | 0.68 Rf | 55.4 AU | 0.78 Rf | 201.4 AU | 15.41 % | 0.83 Rf | 73.4 AU | 14207.7 AU | 32.04 % |
| 9 | 0.83 Rf | 73.9 AU | 0.85 Rf | 99.4 AU | 7.61 % | 0.89 Rf | 27.7 AU | 3604.4 AU | 8.13 % |
| 10 | 0.89 Rf | 28.4 AU | 0.90 Rf | 36.5 AU | 2.79 % | 0.92 Rf | 16.4 AU | 694.6 AU | 1.57 % |
| 11 | 0.94 Rf | 0.2 AU | 0.97 Rf | 156.1 AU | 11.95 % | 0.99 Rf | 3.0 AU | 4020.2 AU | 9.07 % |

Figure 06: HPTLC Peak table at UV 520nm

**HPTLC PROFILE AT 520 NM**

The densitometric scan at 520 nm also showed characteristic peaks.

**Major peaks**

Table 06: HPTLC Interpretation at UV 520nm

| Rf | AREA % | INTERPRETATION |
|---|---|---|
| 0.78 | 32.04% | Predominant compound |
| 0.61 | 18.95% | Major secondary metabolite |
| 0.52 | 14.65% | Important phytochemical constituent |
| 0.94 | 9.07% | Less polar compound |

**HEAVY METAL ANALYSIS**

Table 07: Heavy metal report of LV

| S.NO | DRUG RECEIVED | ELEMENT | RESULTS (MG [KG]) |
|---|---|---|---|
| 1. | ***LavangadhiVadagam*** | Arsenic( As) | BLQ |
| 2. | | Cadmium (Cd) | BLQ |
| 3. | | Mercury (Hg) | BLQ |
| 4. | | Lead (Pb) | BLQ |

BLQ: Below Limit of Quantification



CODEN (USA): IJPDBY

## DISCUSSION

The FTIR spectrum indicates the coexistence of both organic and inorganic constituents **in** the sample. The broad hydroxyl peak at 3302.71 $cm^{-1}$, confirms the presence of hydrogen-bonded compounds and adsorbed moisture, while the bands around 1631 $cm^{-1}$ and 1425 $cm^{-1}$ suggest organic functional groups and carbonate-related vibrations. The intense band near 987 $cm^{-1}$ indicates mineral-associated bonds such as phosphate, silicate, or metal–oxygen linkages, supporting the presence of stabilized inorganic constituents. The TLC fingerprint profile of the drug LV demonstrates the presence of multiple phytochemical constituents with good separation under different visualization conditions (UV 254 nm, UV 366 nm, and post-derivatization). The chromatographic profile indicates a chemically complex herbal formulation containing several bioactive compounds. The HPTLC densitogram recorded at UV 254 nm revealed the presence of multiple phytochemical constituents with varying concentrations and polarities. The chromatographic profile showed several well-resolved peaks distributed across the Rf range, indicating a chemically complex herbal formulation. Among the detected peaks, the major constituents were observed at Rf 0.56and Rf 0.62, showing the highest peak area percentages of approximately 25.01% and 22.35%, respectively. These peaks represent the dominant UV-active compounds present in the formulation. Another significant peak was observed at Rf 0.67with an area percentage of about 12.97%, followed by peaks at Rf 0.79 and Rf 0.96, indicating moderately abundant constituents. The presence of peaks at lower Rf values suggests relativelypolar compounds, whereas peaks at higher Rf values correspond to less polar constituents. The strong absorption at UV 254 nm indicates the presence of conjugated or aromatic compounds such as flavonoids, phenolics, tannins, or alkaloidal constituents.The overall densitometric pattern can serve as a reference fingerprint for indicating the presence of diverse bioactive compounds such as flavonoids, phenolics, alkaloids, and terpenoid constituents. The reproducible fingerprint profile confirms the identity, purity, and phytochemical complexity of the formulation LV.Heavy metal analysis shows that the drug LV is free of the contamination of toxic metals like Lead, Cadmium, Arsenic and Mercury as they are below the detectable quantity.

## CONCLUSION

The present study scientifically validated the *Siddha* polyherbal formulation LV through comprehensive analytical fingerprinting using FTIR, HPTLC, and ICP-OES techniques. FTIR analysis confirmed the presence of important functional groups such as hydroxyl, carboxyl, C-O bending, and C-H stretching vibrations, indicating the occurrence of biologically active phytoconstituents. HPTLC profiling demonstrated the presence of major secondary metabolites including flavonoids, phenolics, terpenoids, and alkaloids, which are known for their antioxidant, anti-inflammatory, antimicrobial, diuretic, and protective pharmacological properties. ICP-OES analysis further established the safety profile of the formulation by confirming that toxic heavy metals such as cadmium (Cd), arsenic (As), mercury (Hg), and lead (Pb) were below detectable limits.The generated analytical fingerprint profile provides a valuable scientific basis for the authentication, standardization, and quality control of the Siddha formulation. These findings support the traditional therapeutic claims of the drug and enhance its reliability, reproducibility, and acceptability in evidence-based traditional medicine research. The identified phytochemical constituents may contribute to the therapeutic efficacy of the formulation in the management of Siddha indications such as Neeradaipu (urinary tract infections), Kalladaipu (urinary calculi/stones), Soothaga Vayu (PCOS-related disorders), Vayu disorders, Kandhal, and Varatchi. The presence of phenolics and flavonoids may help reduce oxidative stress and inflammation, while alkaloids and terpenoids may contribute to antimicrobial, analgesic, diuretic, and metabolic regulatory activities associated with these conditions, thus supporting the traditional therapeutic claims of the drug LV and enhance its reliability, reproducibility, and acceptability in evidence-based traditional medicine research. Furthermore, the analytical data revealed in this study can serve as a reference standard for future pharmacological, toxicological, phytochemical isolation and clinical studies on the formulation LV. The established fingerprint profile may also facilitate batch-to-batch consistency, formulation validation, and development of standardized *Siddha* herbal products for wider clinical and pharmaceutical applications. Thus, the study contributes significantly toward bridging traditional *Siddha* knowledge with modern scientific validation and promotes the global acceptance of *Siddha*medicine in integrative healthcare research.

## FUNDING

None

## INFORM CONSENT

Not Applicable

## INFORM CONSENT

Not Applicable

## AUTHOR CONTRIBUTION

All are contributed equally

## REFERENCES

1. Pathinen Siddhar. *Aaviyalikkum Amudha Murai Surukkam (Aathmarakshamirtham Vaiththiya*

*Saarasangiragam)*. Pazhani: Pazhani Thandaayudhabani Swami Thirukovil Siddha Maruthuva Nool Veliyeetu Kuzhu; 1975. p. 553.
2. Aanandhan A, editor. *Sarakkugalin Suthi Sei Muraigal*. Chennai: Department of Indian Medicine and Homeopathy; 2008.
3. Joseph J, Jeeva S. GC-MS and FT-IR analysis of a coastal medicinal plant *Hyptis suaveolens* (L.) Poit. *J Coast Life Med*. 2016;4(5):380-389.
4. Yang Y, Zhao Y, Zuo Z, Zhang J, Shi Y, Wang Y. Investigation of a medicinal plant for hepatic diseases with secoiridoids using HPLC and FT-IR. *Molecules*. 2020;25(5):1219.
5. AOAC International. *Official Methods of Analysis of AOAC International*. 22nd ed. Vol. 1. Rockville (MD): AOAC International; 2023. Chapter 9.2.39, p. 51-54.