Research Article

FTIR Characterization of Siddha Polyherbal Formulation Samsakra Chooranam

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ABSTRACT

Objective: To characterize the Siddha formulation Samsakra Chooranam.

Materials and Methods: The Siddha formulation Samsakra Chooranam was prepared according to the Siddha literature Pathartha Guna Vilakkam (Moola Varkkam) and analyzed using FTIR spectroscopy.

Results: FTIR characterization revealed the presence of various functional groups and phytoconstituents such as phenols, alcohols, flavonoids, terpenoids, and glycosides in Samsakra Chooranam. This study provides a basis for the pharmaceutical analysis of Samsakra Chooranam, and the role of its phytoconstituents in anti-urolithiasis activity may be further explored through safety and efficacy studies.

Conclusion: The FTIR instrumental analysis of Samsakra Chooranam demonstrated the presence of several functional groups through characteristic stretching vibrations and absorption bands, which may contribute to its pharmacological activity. Further studies are required to validate its efficacy and therapeutic potency.

Keywords: FTIR, Siddha drug, Herbal compound, Functional groups.

INTRODUCTION

Fourier Transform Infrared Spectroscopy (FTIR) is a powerful and widely employed analytical technique used for the identification and characterization of chemical constituents in complex samples. FTIR can be used to find the structure of unknown compositions as well as the intensity of absorption of spectra related to molecular composition or chemical group content.[1,5] It operates on the principle of infrared radiation absorption by molecular bonds, producing a characteristic spectral pattern that serves as a molecular fingerprint of functional groups. Owing to its rapid, non-destructive, and highly sensitive nature, FTIR has gained significant importance in the analysis of herbal and traditional formulations.

The Siddha system of medicine, one of the oldest traditional systems of medicine, is extensively practiced in South India and is founded on the equilibrium of the three fundamental humors: Vali (Vatham), Azhal (Pitham), and Iyyam (Kabam). Siddha formulations are primarily composed of plant-based materials, along with minerals and metals, which contain a wide range of bioactive compounds responsible for their therapeutic efficacy.

In recent years, there has been increasing emphasis on the scientific validation and standardization of traditional medicines. In this context, FTIR spectroscopy serves as a valuable analytical tool for identification of functional groups and phytoconstituents present in Siddha formulations. It facilitates the detection of key bioactive compounds such as phenols, flavonoids, terpenoids, and glycosides, which are known to contribute to various pharmacological activities such as antioxidant, anti-urolithiasis and diuretic activity. The presence of Coriandrum sativum which has a huge part in the formulation further supports its therapeutic potential, as it was documented for its antioxidant activity.[3,4]

Furthermore, FTIR plays a crucial role in quality control, ensuring batch-to-batch consistency, and detecting possible adulteration or impurity in herbal preparations. The integration of FTIR with traditional Siddha knowledge not only enhances the understanding of the chemical basis of these formulations but also strengthens their scientific credibility and global acceptance. Thus, FTIR analysis represents an important step toward bridging traditional wisdom with modern analytical science.

MATERIALS AND METHODS

Drug Reference: Pathartha Guna Vilakkam (Moola Varkam)

Authentication:

The raw materials mentioned in table:1 were authenticated by the Postgraduate department of Gunapadam, Government Siddha Medical College, Palayamkottai, Tirunelveli.

Purification and process of preparation:

The ingredients of the trial drug were collected, authenticated, and cleaned to remove impurities such as dust and foreign particles. Each ingredient was then dried in shade to preserve its active constituents. The dried materials were powdered and sieved using a cloth to obtain a fine, uniform powder. Then the chooranam was stored in an airtight container, protected from moisture and light, to maintain its stability and potency until further analysis.

Drug Ingredients:[2]

Table 1: Ingredients of Samsakra Chooranam

S. No	Tamil vernacular name	Botanical name	Quantity
1.	Seeragam	*Cuminum cyminum*	1 palam (35 g)
2.	Adhimadhuram	*Glycyrrhiza glabra*	1 palam (35 g)
3.	Kirambu	*Syzygium aromaticum*	1 palam (35 g)
4.	Karunjeeragam	*Nigella sativa*	1 palam (35 g)
5.	Sannalavangappattai	*Cinnamomum verum*	1 palam (35 g)
6.	Sadhakuppai	*Anethum graveolens*	1 palam (35 g)
7.	Kothumalli vidhai	*Coriandrum sativum*	6 palam (210 g)
8.	Seenakarkandu	*Saccharum officinarum*	12 palam (420 g)

Table 2: FT-IR peak table

Approx. Peak / Region (cm^{-1})	Probable Functional Group(s)	Interpretation
~3400–3200	O–H stretching / N–H stretching	Broad weak band indicating hydroxyl containing compounds such as phenols, alcohols, and possibly amine-bearing constituents
~2950–2850	C–H stretching	Sharp aliphatic stretching bands of methyl and methylene groups, suggesting terpenoids, fatty components, or hydrocarbon chains
~1700–1600	C=O stretching / C=C stretching / amide-related vibration	May indicate carbonyl-containing phytochemicals, aromatic unsaturation, or flavonoid-associated structural motifs
~1450–1350	C–H bending	Aliphatic deformation bands from CH_2 and CH_3 groups
~1250–1000	C–O stretching / C–N stretching	Indicative of ethers, alcohols, phenolic constituents, glycosides, and carbohydrate related components
~1100–900	C–O–C / glycosidic linkage region	Strong absorptions in this region support the presence of polysaccharides, glycosides, and oxygenated herbal metabolites
~800–500	Fingerprint region	Complex skeletal vibrations suggesting substituted aromatic rings and other characteristic plant-derived molecular features

Human dose: 3g

FTIR spectrum analysis

The sample was processed using the Bruker Alpha-E FTIR spectrometer with an ATR (Attenuated Total Reflectance) module.

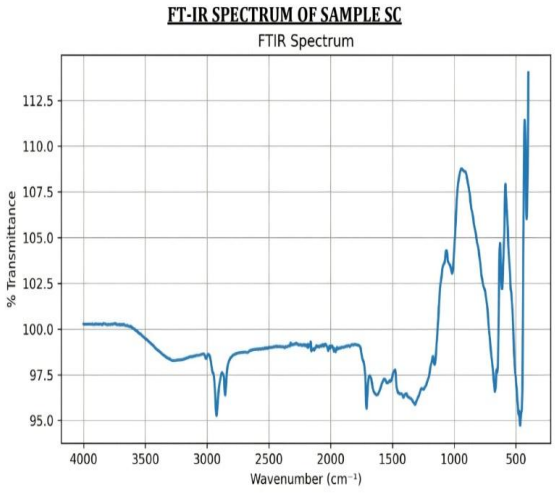

Figure 1: FT-IR spectrum of sample SC (SC-Samsakra Chooranam)

The sample was positioned on the crystal platform with proper alignment, keeping the anvil in the upright position. Proper contact between the sample and the crystal was ensured prior to the exposure to IR radiation. Spectral measurements were obtained at the desired wavelength, and the corresponding absorption peaks/waves were recorded with their respective wavenumbers for further interpretation. OPUS version 7 software was used for functional group analysis. Signal detection was carried out using a DTGS detector. Baseline correction was adjusted as required.

RESULT

The results of FTIR data interpretation of Samsakra Chooranam have been shown in figure 1 and tabulated in table 2.

DISCUSSION

The FTIR spectrum of the sample Samsakra Chooranam indicates the presence of several functional groups that are commonly associated with bioactive phytochemicals, suggesting its potential role in the prevention and management of urolithiasis.

The broad peak observed in the region of ~3400–3200 cm^{-1} can be attributed to O–H and N–H stretching vibrations. This points to the presence of hydroxyl-containing compounds such as phenols and alcohols, along with possible amine groups. These compounds are widely recognized for their antioxidant properties, which may help reduce oxidative stress—a key contributor to renal epithelial damage and the initiation of stone formation.

The peaks around ~2950–2850 cm^{-1} correspond to aliphatic C–H stretching, indicating methyl and methylene groups. This suggests the presence of compounds like terpenoids and fatty constituents. Terpenoids, in particular, have been reported to exhibit anti-urolithiasis effects by reducing crystal aggregation and enhancing urine output, thereby lowering the likelihood of stone development.

In the ~1700–1600 cm^{-1} region, the observed bands are indicative of C=O stretching, C=C stretching, and possible amide groups. These features suggest the presence of carbonyl compounds and flavonoids. Flavonoids are especially important due to their ability to inhibit calcium oxalate crystallization, which is the predominant form of kidney stones.

The region between ~1450–1350 cm^{-1} shows C–H bending vibrations, supporting the presence of aliphatic chains and structural components of organic molecules. These may contribute to the overall stability and biological activity of the phytochemicals present in the sample.

The absorption bands in the ~1250–1000 cm^{-1} range correspond to C–O and C–N stretching vibrations, indicating the presence of alcohols, ethers, phenolic compounds, and glycosides. These compounds may play a role in preventing stone formation by interacting with calcium ions, thereby inhibiting crystal nucleation and growth.

Similarly, the strong peaks in the ~1100–900 cm^{-1} region suggest C–O–C and glycosidic linkages, pointing toward the presence of polysaccharides and glycosides. These substances are known to provide protective effects on renal tissues and may reduce the adhesion of crystals to the epithelial lining of the urinary tract.

Finally, the fingerprint region (~800–500 cm^{-1}) exhibits complex patterns that are characteristic of substituted aromatic rings and various plant-derived metabolites. This further supports the presence of diverse bioactive compounds that may collectively contribute to anti-urolithiasis activity.

CONCLUSION

The FTIR analysis of Samsakra Chooranam reveals the presence of diverse phytoconstituents such as phenols, flavonoids, terpenoids, and glycosides. These compounds are known for their antioxidant, anti-inflammatory, and diuretic properties, which are important in the management of urolithiasis. Oxidative stress, inflammation, and crystal aggregation play key roles in stone formation. The presence of hydroxyl and carbonyl groups suggests the existence of compounds that may help reduce oxidative damage, while glycosidic and other phytoconstituents may contribute to the prevention of crystal growth and the promotion of urinary flow. Overall, the findings support the traditional use of Samsakra Chooranam in Siddha medicine and suggest that it may help prevent stone formation and promote urinary health through its multi-targeted bioactive effects.

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