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# Comprehensive Characterisation of the Siddha Herbo-mineral Formulation *Seethamsa Rasam* using XRD and FTIR Techniques

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## ABSTRACT

**Background:** Siddha medicine, a traditional system of healing, has been practiced for centuries, “*Seethamsa Rasam*” is a herbo-mineral formulation prepared according to the process found in Siddha literature *Anuboga vaithiya navaneedham*. Traditionally the chosen formulation has been prescribed for the management of *Seedha suram* (Fever), *Soolai* (Throbbing pain), *Vaadha paandu* (Anaemia), *Kaamalai* (Jaundice), *Suvasakaasam* (Bronchial asthma), *Udhara noigal* (Blood related disorders), *Katti* (Tumour), *Magodharam* (Acitis) and *Yaanaikaal vaatham* (Filariasis). **Objective:** This study aims to characterize the chemical composition of “*Seethamsa Rasam*” using XRD and FTIR analysis, thereby bridging traditional knowledge with modern medicine. **Method:** The formulation was prepared as per the literature and then subjected to quantitative analysis with XRD and FTIR. **Findings:** The XRD analysis showed the presence of Arsenic (II) sulfide (AsS) and the FTIR analysis showed the presence of hydroxyl, carboxylic acids, amines, aromatic compounds, hydrocarbons, and carbonyl groups. **Novelty:** This study provides a novel-insights into the chemical characterization of “*Seethamsa Rasam*,” highlighting its potential anti-pyretic, analgesic and anti-inflammatory properties. The findings encourage further pharmacological research into this traditional medicine.

**Key Words** *Seethamsa Rasam, XRD, FTIR, Siddha medicine, Internal medicine*

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## INTRODUCTION

Siddha medicine is one of the oldest traditional systems of medicine originating in southern India, with root believed to trace back thousands of years. Siddha is a holistic health system addressing physical, psychological, social and spiritual well-being<sup>1</sup>.

Herbal remedies, minerals, and animal products are used in treatment. The internal medicines are classified into 32 types in this system, one among them is *maathirai* which has half-life of one year. *Maathirai* is prepared by grinding raw materials with

some leaf extract or decoction and made into small sized pills<sup>2</sup>. *Seethamsa Rasam*, a herbo mineral formulation, is used for many years in Siddha system of medicine has been indicated for *Seedha suram* (Fever), *Soolai* (Throbbing pain), *Vaadha paandu* (Anaemia), *Kaamalai* (Jaundice), *Suvasakaasam* (Bronchial asthma), *Udhara noigal* (Blood related disorders), *Katti* (Tumour), *Magodharam* (Acitis) and *Yaanaikaal vaatham* (Filariasis)<sup>3</sup>. The therapeutic potential of a formulation is determined by its composition. In this study, characterization carried

## RESEARCH ARTICLE

out using XRD and FTIR, which are analytical techniques employed to identify and evaluate the chemical makeup of the formulation<sup>4</sup>. XRD helps in analyzing the crystalline structure and structural properties, while FTIR is used to determine the functional groups and molecular structure of the drug. These techniques play a key role in standardizing traditional medicines by providing reliable data on their composition, purity and stability<sup>5</sup>. This approach not only validates the traditional knowledge of siddha medicine but also improves the credibility and quality assurance of SR as a promising therapeutic agent for various diseases.

**Table 1** Ingredients of *Seethamsa Rasam*

S. No	The vernacular name of the ingredients	Botanical name/Chemical name	Quantity
1.	Purified <i>Thalagam</i>	Yellow arsenic trisulphide	35gm
2.	Purified <i>Manosilai</i>	Red orpiment	35gm
3.	Purified <i>Nervaalam</i>	<i>Croton tiglium</i>	35gm
4.	Purified <i>Chukku</i>	<i>Zingiber officinale</i>	70gm
5.	Purified <i>Milagu</i>	<i>Piper nigrum</i>	70gm
6.	Purified <i>Thipilli</i>	<i>Piper longum</i>	70gm

### Preparation of *Vepampattai* decoction

One part of bark of *Azadirachta indica* (*Vepampattai*) is added to four part of water and prepared as decoction.

### Purification of *Thalagam*

Yellow Arsenic trisulphide was placed in between lime stone and palm toddy is poured into it. This process is repeated for 10 times<sup>2</sup>.

### Purification of *Manosilai*

Red orpiment is purified by boiling with lemon juice<sup>2,3</sup>.

### Purification of *Nervaalam* (*Croton tiglium*):

Cow dung mixed with water was placed in a mud pot. The outer skin of *Croton tiglium* was removed, and the seeds were tied with a cloth and hung within the pot without touching the base of

## MATERIALS AND METHODS

### Selection of the test drugs

The test drug “*Seethamsa Rasam*” is one of the herbo mineral formulations for fever, throbbing pain and filariasis indicated in the Siddha literature “*Anuboga vaithya navaneetham-part 6*” written by Hakeem B.M.Abdullah Sahib Pg No. 132<sup>3</sup>.

### Collection of Raw drugs

The raw drug was procured from a reputed shop, in Chennai and authenticated by the “Faculty, Department of *Gunapadam*, National Institute of Siddha, Chennai”.

The procured raw drugs are listed in Table 1,

the pot. The mixture was burnt for half an hour until one-third of the content was reduced. The seeds were taken out and washed thoroughly with water. The cotyledons were removed, and the seeds were tied in a cloth and hung within the pot containing cow milk, then boiled until one-third of the content was reduced. The seeds were taken out and washed thoroughly with water, dried under sunlight, and fried with ghee<sup>6</sup>.

### Preparation of *Thalaga kattu*

Purified Yellow Arsenic trisulphide was placed in a vessel filled with a litre of neem oil and burnt in low flame until the oil was reduced to half<sup>3</sup>.

### Preparation of *Seethamsa Rasam*

Purified raw materials were powdered separately and mixed and grounded with *Vepampattai*

## RESEARCH ARTICLE

decoction for 12 hours. It is The tablet was made into *kundrimani* sized (130 mg) pills and dried under shade<sup>3</sup>.

- **Dose:** 1 – 2 tablets
- **Adjuvant/Vehicle:** Honey
- **Route of administration:** Oral
- **Indications:** *Seedha suram* (Fever), *Soolai* (Throbbing pain), *Vaadha paandu* (Anaemia), *Kaamalai* (Jaundice), *Suvasakaasam* (Bronchial asthma), *Udhara noigal* (Blood related disorders), *Katti* (Tumour), *Magodharam* (Acitis) and *Yaanaikaal vaatham* (Filariasis)<sup>7</sup>.
- **Reference:** *Anuboga vaithya navaneetham*-part 6 authored by Hakeem B.M.Abdullah Sahib, Pg No. 132.

### Instrumental analysis of SR

#### XRD analysis

X-ray diffraction (XRD) data were obtained using an Aeris Analytical diffractometer (Netherlands). The diffractometer was configured with Ni-filtered copper radiation and employed a Bragg-Brentano geometry. A thin layer of fine powder sample was placed on silicon zero background holders. The diffraction pattern was recorded over  $2\theta$  range of 10-9- degrees at a scanning rate of 4 degrees per second, utilizing  $\text{CuK}\alpha$  radiation with a wavelength of 1.5418 Å<sup>8</sup>.

#### FTIR Analysis

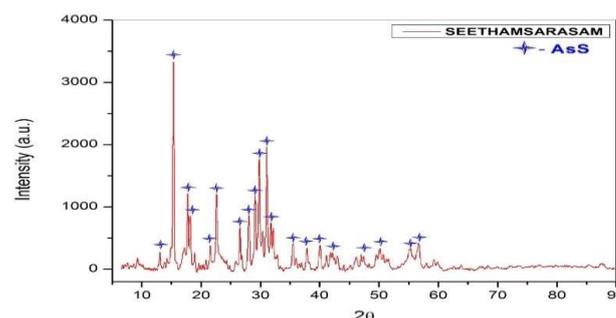
The FTIR analysis was conducted using a Bruker Alpha-E spectrometer equipped with an Attenuated Total Reflectance (ATR) module. The sample was carefully positioned on the crystal platform, ensuring proper alignment and contact

with the crystal before IR radiation exposure. The spectra were measured at the desired wavelength, and the corresponding peaks were recorded. The data was then analyzed using OPUS version 7 software to identify functional groups. The signal detection was processed through a DTGS (Deuterated Triglycine Sulfate) detector, and baseline correction was performed according to the requirements<sup>9</sup>.

## RESULTS

### XRD analysis

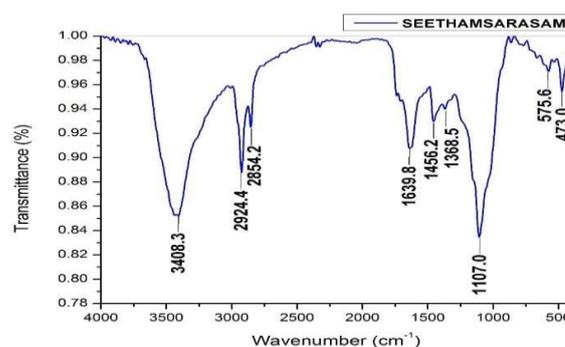
The XRD results for SR are illustrated in Figure 1.



**Figure 1** XRD Analysis of SR

### FTIR analysis

The FTIR analysis results for SR are shown in Figure 2, highlighting the peak values, while the corresponding functional groups are listed in Table 2.



**Figure 2** FTIR Analysis of SR

**RESEARCH ARTICLE****Table 2** Interpretation of FTIR Peaks obtained for the analysis of SR

Peak Number	Range (cm <sup>-1</sup> )	Functional Group
1.	3408.3	Indicates the surface bound water molecule (O-H)
2.	2924.4	Represent C-H vibration
3.	2854.2	Represent C-O vibration
4.	1639.8	Indicates the surface bound water molecule (O-H)
5.	1456.2	Represent the deformational vibration of =C-H
6.	1368.8	Represent the deformational vibration of =C-H
7.	1107	Represent the C-O vibration
8.	575.6	Indicates As-S vibration
9.	473	Indicates As-S vibration

**DISCUSSION**

X-ray diffraction analysis (XRD) is a non-destructive method that offers comprehensive insights into a material's crystallographic structure, chemical composition and physical properties<sup>8</sup>. The XRD data reveals a highly crystalline structure characterized by seven distinct peaks. The most prominent peak, occurring at  $28.59^{\circ}2\theta$  with a d-spacing of  $3.119 \text{ \AA}$  and 100% relative intensity, indicates the presence of a dominant phase featuring well-ordered atomic planes. Additional peaks at  $40.75^{\circ}2\theta$  and  $50.39^{\circ}2\theta$  exhibit significant intensities of 54.53% and 16.28% respectively, suggesting the existence of secondary phases or supplementary crystalline planes within the structure. The narrow Full Width at Half Maximum (FWHM) values observed across the peaks signify good crystallinity, although minor broadening implies the presence of small crystallites or slight structural disorder in certain regions. The d-spacing values, which range from 1.28 to  $3.31 \text{ \AA}$ , indicate a mixture of closely packed and more open planes, pointing to a complex material with diverse atomic arrangements. This suggests a well-defined crystalline structure comprising multiple phases. The major peaks correspond to Arsenic sulfide. The strong alignment between the observed data and reference codes

indicates that the sample contains Arsenic sulfide being more prevalent. This formulation is a testament to the alchemy of traditional medicine, where precise preparation methods and carefully chosen ingredients create the foundation for synergistic transformations. While the direct formation of Arsenic sulfide (AsS) may not be immediately apparent, traditional processes often involve gradual chemical evolution. The interaction between metals, minerals, and herbs in this mixture could yield unique complex salt formation under specific conditions such as controlled maturation or environmental exposure. AsS is used for treating inflammation, skin diseases, ulcers, joint pain, convulsions and schistosomiasis. Some research also points to its anti-cancer potential, particularly in the treatment of acute promyelocytic leukemia (APL) and other cancers, due to its ability to induce cell death in cancerous cells. AsS the principal component of realgar used in traditional Chinese medicine, has demonstrated significant anti-cancer activity both in vitro and in vivo. Researchers have shown that AsS inhibits proliferation and induces apoptosis in a range of solid tumor cell lines, including gastric cancer, melanoma, pancreatic carcinoma and hepatocellular carcinoma<sup>10</sup>.

## RESEARCH ARTICLE

The FT-IR spectrum analysis indicates the presence of alcohols suggesting the existence of hydroxyl (-OH) groups, which are often associated with solubility in water and can participate in hydrogen bonding, enhancing biological activity<sup>11,12</sup>. The FTIR analysis of SR indicates the presence of O-H vibrations can indicate the presence of water molecules bound to a surface. C-H vibrations are associated with the presence of carbon-hydrogen bonds, which are common in many organic molecules. C-O vibrations are associated with the presence of carbon-oxygen bonds, which are found in various functional groups such as alcohols, ethers, and carbonyl compounds. The presence of carbonyl groups (C=O), which are characteristic of ketones, aldehydes, or esters, adds another layer of complexity to the sample. Carbonyl compounds are often associated with varied reactivity, playing pivotal roles in organic synthesis and exhibiting unique biological activities<sup>13</sup>. For instance, esters are commonly used in pharmaceuticals and fragrances, highlighting their importance in both medicinal chemistry and sensory applications<sup>14</sup>. The deformational vibration of =C-H is associated with the presence of alkene or alkyne groups. As-S vibrations are associated with the presence of arsenic-sulfur bonds, which are found in certain compounds. Overall, these functional groups reveal a complicated chemical composition. The complexity of SR indicates potential biological activities such as anti-oxidant, anti-inflammatory and anti-pyretic effects. These properties align with its traditional use in treating conditions like *Seedha suram* (Fever), *Soolai* (Throbbing pain), *Vaadha paandu* (Anaemia), *Kaamalai* (Jaundice), *Suvasakaasam* (Bronchial asthma), *Udhara noigal* (Blood related disorders), *Katti* (Tumour), *Magodharam* (Acitis) and *Yaanaikaal vaatham* (Filariasis).

X-ray diffraction and FT-IR analysis reveal a complex material comprising the crystalline structure of Arsenic sulfide (AsS), alongside various functional groups. These include hydroxyl, alkyl, alkoxy or alcohol, and alkene groups. This diverse chemical composition suggests potential biological activities, such as antioxidant, anti-pyretic, and anti-inflammatory effects. Seethamsa Rasam is a similar formulation which is studied for FT-IR analysis and showed the presence of organic and inorganic groups.

## CONCLUSION

This study marks a significant milestone in the scientific validation of Seethamsa Rasam through the use of cutting-edge analytical methods such as XRD and FTIR. These techniques provide a distinct fingerprint of the formulation, laying the groundwork for future in-vitro and in-vivo research. The innovative aspect of this research lies in its attempt to bridge the divide between traditional knowledge and modern science. By doing so, it contributes to a robust foundation for the global acceptance of Siddha medicines.

## Abbreviations

**SR:** *Seethamsa Rasam*; **XRD:** X-Ray Diffraction; **FTIR:** Fourier Transform Infrared Spectroscopy; **ATR:** Attenuated Total Reflectance; **FWHM:** Full Width at Half Maximum.

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**RESEARCH ARTICLE**

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**RESEARCH ARTICLE**

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