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INSTRUMENTAL ANALYSIS OF SIDDHA POLYHERBAL FORMULATION - *SAARANAI MOOLI KUZHAMBU*

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ABSTRACT

Saaranai Mooli Kuzhambu (SMK) is a polyherbal formulation described in classical *Siddha* literature for *Paandu Noi* (Anemia). Standardizing *Siddha* polyherbal formulation is necessary to ensure the quality of medicines for their safe usage.The study aims to standardize the SMK by modern instrumental analytical techniques such as Scanning Electron Microscopy (SEM), Fourier Transform Infra-Red Spectroscopy (FTIR), and ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometry). The SMK had been prepared as per the reference text *"Pathinen Siddharkal Vaithiya Sillaraik Kovai Part II"* and screened for particle size, identification of functional groups, and detection of heavy metal contamination. SEM analysis was carried out at IIT-Madras, Chennai. The SEM analysis of the sample showed the presence of nano-and micro particles. The FT-IR spectroscopy and ICP-OES were performed at CCRAS, Chennai. FT-IR has revealed the presence of functional groups like alcohol, carbonyl, amines, and Ethers. ICP-OES indicated that heavy metals such as arsenic, cadmium, mercury, and lead are detected below the limit of quantification. This study shows how modern standardization methods can improve the reliability and acceptance of polyherbal formulations at the global level.The results show that SMK is preferably nontoxic when used at the recommended dose.

Keywords: *Saaranai Mooli Kuzhambu,Siddha, Instrumental analysis, Polyherbal formulation.*

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INTRODUCTION

The *Siddha* system of medicine is one of the ancient health practices serving humankind to fight against disease and to lead a healthy life. Standardization of siddha formulations is important to ensure quality and therapeutic effectiveness. It involves a comprehensive quality assurance process covering every stage of the formulation process, from the selection of raw materials to prepare the final product and its evaluation. This present study aims to standardize a *Siddha* polyherbal formulation known as *SaaranaiMooli Kuzhambu* (SMK), which is described in the classical *Siddha*text, *"Pathinen Siddharkal Vaithiya Sillaraik Kovai-Part II"*[1]. In *Siddha* medicine, *Kuzhambu* is an important semi-solid formulation known for its thick, paste-like consistency. The preparation involves grinding the ingredients, mixing them with suitable liquids, and heating until a thick consistency is achieved. *Saaranai MooliKuzhambu* is indicated for anemia.Anemia is a blood disorder characterized by insufficient, dysfunctional, or low levels of red blood cells/hemoglobin, limiting oxygen delivery to body tissues.As of early 2026, Anemia remains a severe public health challenge in India, with prevalence rates exceeding 50% among women of reproductive age, adolescents, and children. In this research, the formulation was evaluated and standardized using modern analytical methods such as SEM, FT-IR, and ICP-OES. The results validate the claims mentioned in traditional Siddha texts.

MATERIALS AND METHODS

Selection of a drug

The drug SMK was selected from the classical *siddha* literature, *"Pathinen Siddharkal Vaithiya Sillaraik Kovai Part II"*. The ingredients of *Saaranai Mooli Kuzhambu* (SMK) are listed in table 01.

Collection of the drugs

The plant *Saaranai(Trianthema portulacastrum)* was collected from in and around Chennai, Tamil Nadu. The other ingredients were collected from reputed country drug store in Broadway Chennai. Goat's milk was collected from the street milk man from a cattle herd.

Identification and Authentication

All the ingredients of SMK were identified and authenticated by the faculty and expert members of the *Gunapadam* (Siddha Pharmacology) department, Government Siddha Medical College, Arumbakkam, Chennai - 600106. Specimen samples for *Saaranai ver* and *Thippili* were stored with respective register numbers in the postgraduate pharmacology department for future reference.

Table 01: Ingredients of SMK

S.NO	TAMIL NAME	BOTANICAL NAME	PARTS USED	QUANTITY
1	*Saaranai*	*Trianthema portulacastrum*	Root	2 *palam* (70 g)
2	*Thippili*	*Piperlongum*	Fruit	6 *palam* (210 g)
3	*Inji saaru (Juice of Ginger)*	*Zingiber officinale*	Rhizome	QS
4	*Vellaattu paal (Goat's milk)*	*Capra hircus*	Milk	QS

Figure 01: Ingredients of SMK

Purification of ingredients and preparation of *Saaranai Mooli Kuzhambu* (SMK)

The purification process was performed as per the methods described in the classical Siddha text *Sarakku Suthi Muraigal* [2] and *Siddha* Materia Medica *(Gunapadam Mooligai Vaguppu)* [3]. The root of *Saaranai* was collected and thoroughly cleaned before being cut into small pieces. These pieces were then boiled in goat's milk for a sufficient duration to ensure proper processing. After boiling, the root was removed and allowed to dry completely. After complete drying of the root, it was finely powdered by using an iron mortar with a pestle. Long pepper is also purified as per the text and ground well into fine powder. Both the powders were mixed thoroughly to achieve a uniform mixture. Subsequently, ginger juice was gradually incorporated into the mixture, and it was processed well until a semi-solid consistency resembling kuzhambu was obtained.

Storage of the drug

The prepared test drug was stored in a clean airtight container. It was labelled as "*Saaranai Mooli Kuzhambu*" (SMK). The *Kuzhambu* was examined repeatedly to avoid any fungal growth.

Drug profile

Form of the medicine - Kuzhambu

Route of administration –Oral Route

Dose –1*Kazhanju* (5.1 g)

Shelf life - 5 years

Indication - *Gunmam, Soolai, Vaadham, Kuththulaichal, Paandu*.

Instrumental analysis- Methodology

Scanning electron microscopy (SEM)

Scanning electron microscopy (SEM), which is also recognized as SEM analysis or SEM technique, has been used worldwide in many disciplines. It can be regarded as an effective method in the analysis of organic and inorganic materials on a nanometer to micrometer (μm) scale.SEM works at a high magnification,reaching 300,000x and even 1000000 (in some modern models) in producing images very precisely of a wide range of materials [4].

SEM analysis was done at IIT Madras, Chennai. Scanning Electron Microscopy (SEM) was used to analyze the particle size and surface morphology of SMK with a Zeiss Gemini 560 Field Emission SEM. Before analysis, the samples were prepared in a suitable size so they could fit inside the SEM chamber. A small quantity of each sample was gently placed onto double-sided carbon tape and fixed onto aluminum stubs for SEM observation. This setup helps produce clear secondary electron images. To improve image quality, the samples were coated with a thin layer of gold inside a vacuum chamber under controlled conditions. This gold coating helps make the sample surface conductive, which enhances the clarity and resolution of the SEM images. The coated samples were then used for capturing and recording the SEM micrographs.

Fourier transforms infrared spectroscopy (FT-IR)

FT-IR spectra were performed at CCRAS, Chennai. FTIR helps in identifying functional groups and determining the composition of a sample quickly and accurately. The drug sample of 1.5±0.02 mg was mixed with potassium bromide (100 mg) in the agate mortar. FT-IR spectra were collected by a Perkin-Elmer FT-IR Spectrometer (Norwald, CT, USA) equipped with a deuterated triglycine sulfate detector. Before the analysis, the instrument was preheated for 30 min under 65% relative humidity. Each spectrum was scanned in the absorbance in a range from 4000 to 400 cm^{-1} [5]. The obtained FT-IR spectrum was used to identify the functional groups and characteristic

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absorption bands present in the formulation. This analysis helps in understanding the chemical constituents of the trial drug. The recorded spectra are presented in the corresponding figures.

ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometry)

ICPOES analysis was carried out at CCRAS, Chennai. Inductively Coupled Plasma Optical Emission spectroscopy (ICP-OES) is a powerful analytical technique used to determine the elemental composition of various samples. It uses a high-temperature argon plasma, typically from 8,000 to 10,000 K, to excite atoms in a sample, causing them to emit light at specific wavelengths that are measured to identify and quantify elements. 0.5g of SMK is measured and then dissolved in a decomposition vessel with nitric acid into a 10 mL solution. Partial spectral profile and analysis were done. ICP-OES is widely used in environmental testing to monitor water, soil, and air for heavy metals and pollutants, in industrial quality control to verify material composition in metals, geochemical samples, and throughout the battery lifecycle, and in pharmaceuticals and food safety to ensure products meet strict regulatory limits for elemental impurities and contamination.

RESULT AND DISCUSSION

SEM results of SMK

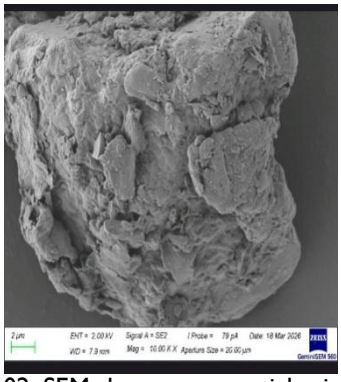

Figure 02: SEM shows nanoparticles in SMK

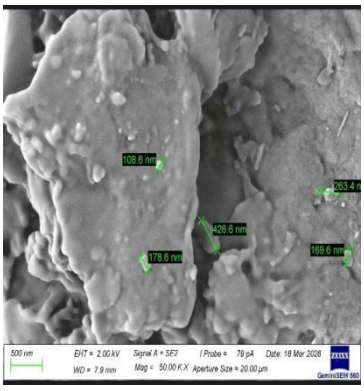

Figure 03: SEM shows nanoparticles in SMK

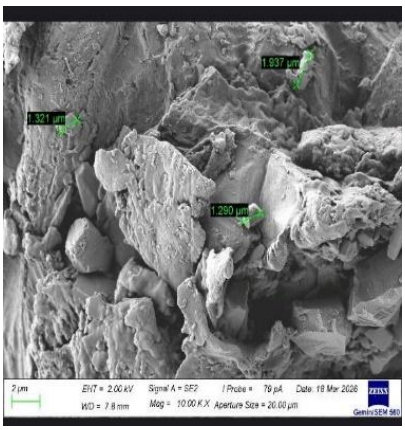

Figure 04: SEM shows nanoparticles in SMK

Figure 05: SEM images of SMK

SEM results of SMK

The above SEM studies (Fig), the morphology of SMK reveals irregularly shaped, non-uniform particles forming large, clustered masses. At lower magnification (10.00 KX), the particles appear as coarse, flaky, and plate-like structures with rough surfaces, while at higher magnification (50.00 KX), finer granular features and small protrusions are observed on the particle surfaces. The measured particle sizes at the microscale range from approximately 1.29 µm to 1.93 µm, whereas at higher magnification, smaller features in the nanometer range (about 108.6 nm to 426.6 nm) are evident.

FT-IR ANALYSIS GRAPH OF SMK

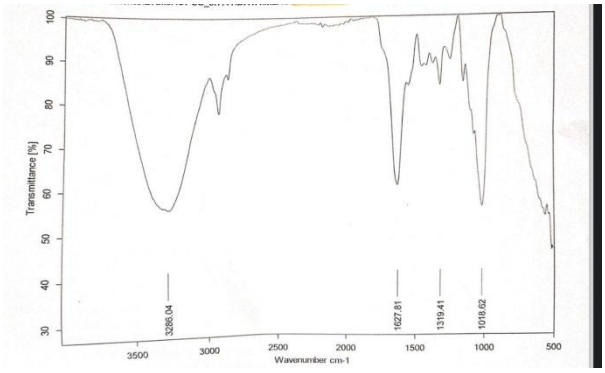

Figure 06: SMK has the following functional groups

Table 02: Interpretation of FT-IR spectrum

Wave number (cm-1)	Vibration Mode	Functional group
3286.04	O-H Stretching	Alcohol
1627.81	C=O stretching	Carbonyl
1319.41	C-N stretching	Amines
1018.62	C-O stretch	Ether

In the FT-IR spectra analysis, this SMK sample exhibits the peak values (table) at the wave number of 3286.04, 1627.81, 1319.41, 1018.62, having O-H stretch, C=O stretch, C-N bending, and C-O stretch. This indicates the presence of some organic functional groups such as hydroxyl carbonyl, amine, and Ether. The prevalence of O-H and C=O functional groups confirms a rich polyphenolic content, and phenols possess high antioxidant properties.

ICP-OES (INDUCTIVELY COUPLED PLASMA OPTICAL EMISSION SPECTROMETRY)

Table 03: ICP-OES results of SMK

S.no	Elements	Results
1	Arsenic (As)	BLQ
2	Cadmium (Cd)	BLQ
3	Mercury (Hg)	1.92
4	Lead (Pb)	2.405

Interpretation

The analysis of heavy metals in the drug SMK revealed that Arsenic, Cadmium, Mercury, and Lead were below the limit of quantification (BLQ).This indicates that their levels are extremely low and within the WHO permissible limits. These results indicate that the drug SMK meets safety standards with respect to heavy metal content and is considered safe for preclinical use.

CONCLUSION

The results show that SMK is preferably nontoxic when used at the recommended dose. The standardization of the drug was carried out using different tests such as heavy metal analysis, functional group analysis, elemental analysis, and particle size measurement using ICP-OES, FTIR, and SEM. ICP-OES analysis showed that the levels of heavy metals in SMK were within safe limits. This confirms that the drug is safe for use and does not contain toxic elements. The FTIR analysis of SMK showed characteristic peaks corresponding to organic functional groups such as alcohol, carbonyl, amine, and ethers. The results indicate that SMK contains a complex mixture of organic constituents, which may contribute to its efficacy, stability, and safety. SEM analysis revealed that SMK consists of micro- and nano-sized particles. The small particle size may enhance absorption, improve bioavailability, and support effective therapeutic action at low doses without inducing toxicity.

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CONFLICT OF INTEREST

The authors declared that there is no conflict of interest.

ABBREVIATIONS

SMK - *Saaranai Mooli Kuzhambu*, SEM - Scanning Electron Microscope, FTIR - Fourier Transform Infrared Spectroscopy, ICPOES - Inductively Coupled Plasma Optical Emission Spectrometer.

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