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QUALITATIVE AND QUANTITATIVE ANALYTICAL SCREENING OF *SIDDHA* POLYHERBAL FORMULATION "*INJI PODI*" THROUGH INSTRUMENTAL TECHNIQUES

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ABSTRACT

Siddha system of medicine is a traditional system originated from ancient Tamilagam in south India. According to Siddha, 4448 disease classifications are mentioned. ThamaragaNoi (coronary heart disease) is one among the disease. Various medicines are available for ThamaragaNoi in Siddha. One kind of medicine is Inji Podi (IP). Standardization of Siddha formulation is mandatory to assess the quality of the medicines for their safe and discriminate use. The aim of the study was to standardize the IP by modern instrumental analytical techniques such as FTIR, SEM and ICP-OES. SEM analysis was carried out at IIT madras that shows the presence of micro and nano particlesin IP for a better bioavailability of the drug. FTIR and ICP-OES was carried out at CCRAS, Chennai. FTIR analysis confirms the presence ofalcohols/phenols, aliphatic chains, and carbonyl-containing compounds. ICP-OES analysis indicates that the heavy metals such as Mercury, Arsenic, Lead and Cadmium are present as Below Detectable Limit. Based on the results, Inji Podi is safe, preferably non-toxic to humans for its therapeutic dose.

Keywords: *Inji Podi, ThamaragaNoi, Instrumental analysis, Siddha medicine.*

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INTRODUCTION

Siddha system of medicine is a traditional system of medicine originated from ancient *Tamilagam* in south India. *Siddhars* are the premier scholars of this system from ancient times. Though alchemy is the special treasure of *Siddhars*, they advocated various formulations and treatment modalities for notorious ailments. Enumerable varieties of herbs, minerals, and animal products have been mentioned for therapeutic purposes. As we all know earlier, *Siddha* system of medicine is known to be effective in the treatment of chronic diseases as well as non-communicable diseases such as *Suvaasanoigal (respiratory ailments) Vaatha noigal* (Rheumatic diseases)*Thamaraganoigal* etc, According to Siddha, 4448 disease classifications were mentioned. *Thamaraga Noi* (coronary heart disease) is one among the disease [1]. The prevalence rate of cor. The prevalence of coronary heart disease (CHD) in India varies widely, with studies reporting 2.5–12.6% in urban populations and 1.4–4.6% in rural populations, showing a higher burden in urban areas and a rising trend nationwide [2]. Coronary heart disease is a condition characterized by the narrowing or blockage of the coronary arteries, usually caused by atherosclerosis, leading to a reduced blood supply to the heart muscle (myocardium) [3]. Antiplatelet agents are widely used which directly inhibit platelet aggregation. *Inji Podi* (IP) is one of the *Siddha* polyherbal formulations indicated for *Thamaraganoi* [4]. To meet the modern scientific and regulatory standards, analytical techniques are integrated into the traditional practices to screen herbal drugs. Standardization of *Siddha* formulation is mandatory to assess the quality of the drugs for treatment procedures. The aim of the study was to standardize the IP by modern instrumental analytical techniques such as FTIR, SEM and ICP-OES.

MATERIALS AND METHODS

Selection of Drug

The formulation *Inji Podi* (IP) is taken for analytical study, mentioned in the *Siddha*literature *TheraiyarTharu.*

Collection of the drug

The ingredients used to prepare the drug *Inji Podi*were purchased from the reputed *Siddha* raw drug store, at Chennai, Tamil Nadu.

Identification and Authentication of the drug

All the drug were Identified and Authenticated by *Gunapadam* experts, Government Siddha Medical College, *Arumbakkam*, Chennai-600106.Sample of all the ingredients was labelled with respective register numbers and kept in the *Gunapadam* laboratory for future reference.

Purification of the drug

Purification of all the drugs was done as per classical *Siddha* literature *Sarkkugalin SuthiSei Muraigal* [5].

Table 01: Ingredients of *Inji Podi*

S.No	VERNACULAR NAME	BOTANICAL NAME	USEDPART	QUANTITY
1	*Inji*	*Zingiberofficinale*	Rhizome	10 grams
2	*Kadugu*	*Brassicajuncea*	Seed	20 grams
3	*Seeragam*	*Cuminumcyminum*	Driedfruit	20 grams
4	*Omam*	*Carumcopticum*	Fruit	20 grams
5	*Kottam*	*Costusspeciosus*	Rhizome	20 grams
6	*Chukku*	*Zingiberofficinale*	Rhizome	20 grams
7	*Milagu*	*Pipernigrum*	Fruit	20 grams
8	*Thippili*	*Piperlongum*	Fruit	20 grams
9	*Kungumapoo*	*Crocus sativus*	Driedstigma	20 grams
10	*Chittrarathai*	*Alpiniaofficinaurum*	Rhizome	20 grams
11	*Perungayam*	*Ferulaasafoetida*	Driedlatex	20 grams
12	*Adhimadhuram*	*Glycyrrhizaglabra*	Root	20 grams
13	*Musumusukkai*	*Mukiamaderasapatna*	Leaves	QS
14	*Moare*	*Cow's buttermilk*		QS

METHOD OF PREPARATION

Ginger was skin peeled and shredded into pieces. *Musumusukkai* juice was taken from their leaves and the peeled ginger piece was soaked in *Musumusukkai* juice. It was dried and ground into fine powder. All the other ingredients were soaked in *Pallaiaadu* (Goat) buttermilk and then dried. They were ground into fine powder and mixed with the ginger powder that was prepared earlier. All the powders were mixed well and sieved to get a fine*chooranam.* This *chooranam* was processed by *Pittaviyal* method, dried well and stored in air tight container.

DRUG PROFILE

Form of medicine :*Chooranam*
Route of Administration: Oral route
Duration: Two times a day after food
Shelf life: 3 Months Indication: *Maaradaippu, Pakkasoolai, Maandham,Kaalvali Seriyamai, Irummal, Suram, Eelai, Uppusam*

SOPHISTICATED INSTRUMENTAL ANALYSIS- METHODOLOGY

SCANNING ELECTRON MICROSCOPE (SEM)

The sample formulation was gently ground into fine powder and affixed onto aluminium stubs using conductive carbon adhesive tape. To ensure adequate conductivity and minimize charging effects, the samples were sputter-coated with a thin layer of gold under vacuum. Subsequent Scanning Electron Microscopy (SEM) analysis was conducted using a Zeiss Gemini 560 Field Emission SEM operated at an accelerating voltage of 10 kV, enabling detailed assessment of particle size distribution, surface morphology, and microstructural features at varying magnifications.

FOURIER TRANSFORM INFRA RED SPECTROSCOPY (FT-IR)

Fourier Transform Infrared Spectroscopy, also known as FTIR Analysis or FTIR Spectroscopy, is an analytical technique used to identify organic, polymeric, and, in some cases, inorganic materials. The FTIR analysis method uses infrared light to scan test samples and observe chemical properties**.**About2 mg of the sample was mixed with 100 mg potassium bromide (FT-IR Grade) and then compressed to prepare a salt-disc (3 mm diameter). The disc was immediately kept in the sample holder and FT-IR spectra were recorded in the range of absorption between 400 and 4000 cm-1. All investigations were carried out with a Shimadzu FT-IR spectrometer [6].

HEAVY METAL ANALYSIS INDUCTIVELY COUPLED PLASMA OPTICAL EMISSION SPECTROMETRY (ICP-OES)

ICP, abbreviation for Inductively Coupled Plasma, is one method of optical emission spectrometry. When plasma energy is given to an analysis sample from outside, the component elements (atoms) is excited. When the excited atoms return to low energy position, emission rays (spectrum rays) are released and the emission rays that correspond to the photon wavelength are measured.0.5g of Inji Podi is measured and then dissolved in a decomposition vessel with nitric acid into 10ml solution. Partial spectral profile and analysis were done. ICP optical emission

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spectrometry is now highly rated as a multipurpose analysis technique. It is well regarded as an environmental measurement technique, along with atomic absorption spectrometry and ICP mass spectrometry, and its use is expected to expand even further in the future [7.]

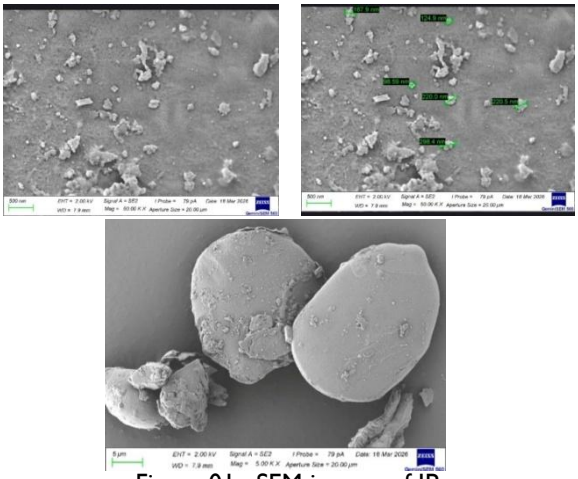

Figure 01: SEM images of IP

RESULTS

SEM IMAGES AND FINDINGS

INTERPRETATION:

The scanning electron microscopy (SEM) analysis reveals that the sample exhibits a heterogeneous and polydisperse particulate morphology with features spanning both micro- and nanoscale dimensions. Atlower magnification, the presence of micron-sized particles (~1–5 µm) is evident, while higher magnification images confirm the distribution of nanoparticles in the range of ~100–300 nm. These nanosized particles are frequently observed adhering to the surface of larger particles, forming a hierarchical (core–satellite) structure.

Table 02: FTIR analysis of IP

Wavenumber (cm^{-1})	Functional Group	Vibrational Mode	Interpretation
3283.83	O–H / N–H	Stretching (broad)	Hydroxyl groups (alcohols, phenols) / amines; moisture
2923.76	C–H (aliphatic)	Stretching	Alkane chains (–CH_2, –CH_3 groups)
1632.17	C=O / C=C / H–O–H	Stretching /bending	Carbonyl (amide/ketone), aromatic C=C, or water bending
1449.36	C–H (CH_2/CH_3)	Bending (scissoring)	Aliphatic group confirmation
1007.28	C–O / Si–O / Metal–O	Stretching	Alcohols,etherspolysaccharides or metal–oxygen bonds
Wavenumber (cm^{-1})	**Functional Group**	**Vibrational Mode**	**Interpretation**

FTIR SPECTRA GRAPH

INTERPRETATION

FTIR analysis confirms the presence of key functional groups including O–H, C–H, C=O, and C–O, indicating a heterogeneous composition with both organic and inorganic characteristics. The observed functional groups suggest the presence of alcohols/phenols, aliphatic chains, and carbonyl-containing compounds, along with possible metal–oxygen interactions, supporting the complex nature of the sample.

HEAVY METAL ANALYSIS (ICP-OES)

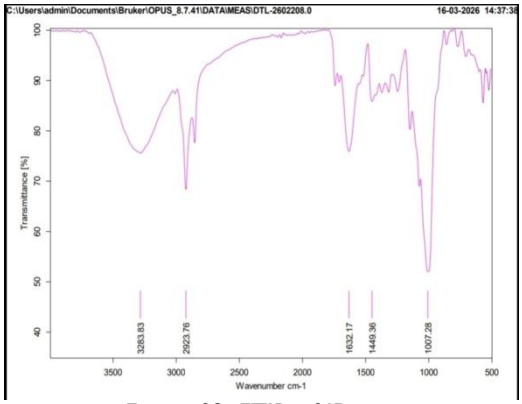

Figure 02: FTIR of IP

Table 03: Heavy metal analysis of IP

S.NO	DRUG	ELEMENT	RESULT
1	INJI PODI	Arsenic (As)	BLQ
2		Cadmium (Cd)	BLQ
3		Mercury (Hg)	BLQ
4		Lead (Pb)	1.755

BLQ – Below Limit of Quantification

Limit of Quantification – As (2.0mg/kg), Cd (0.1mg/kg), Pb (1.0mg/kg), Hg (0.5mg/kg)

DISCUSSION

The present study employed various modern techniques to categorize and standardize the *Siddha* polyherbal formulation *InjiPodi* (IP). Each instrumental method provided complementary data supporting the formulation's chemical complexity, structural characteristics and safety profile.

Scanning Electron Microscope (SEM) reveals that the sample is heterogenous in nature with micro and nanoscale dimensions. Atlower magnification, the presence of micron-sized particles (~1–5 µm) is evident, while higher magnification images confirm the distribution of nanoparticles in the range of ~100–300 nm.

Fourier Transform Infrared (FTIR) confirms the key functional groups including
O–H, C–H, C=O, and C–O and the presenceof alcohols/phenols, aliphatic chains, and carbonyl-containing compounds, along with possible metal–oxygen interactions, supporting the complex nature of the sample.
Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) analysis confirmed the absence of toxic heavy metal contamination. Lead was detected at 1.755ppm, which is well below the permissible limit (10 ppm), while arsenic, cadmium, and mercury were below detectable levels (BDL). This ensures that the formulation is safe for internal administration and adheres to regulatory safety standards.
Overall, the analysis of SEM, FTIR, and ICP-OES confirms that *Inji Podi* (IP) is a chemically complex, structurally diverse and safe polyherbal formulation. The presence of bioactive functional groups, combined with favourable particle size distribution and minimal heavy metal contamination, supports its potential efficacy and safety for internal administration.

CONCLUSION

This study concludes that the sample *Inji Podi*was prepared and purified under standard guidelines, confirming its quality. Standardization of drug is an important step in the drug development process. The standardization of the drug is carried by chemical characterization with Heavy metal analysis, functional group analysis and determination of particle size by ICP-OES, FTIR and SEM respectively. Based on the findings the polyherbalformulation*Inji Podi*has potential efficacy and safety for internal administration. Further preclinical and clinical evaluations are necessary to support its therapeutic use.

ETHICAL APPROVAL

Approved

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CONFLICT OF INTEREST

No conflict of interest

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None

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