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PHARMACEUTICO-ANALYTICAL STUDY OF SWARNAVANGA WITH SPECIAL REFERENCE TO CHEMICAL CHARACTERIZATION

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ABSTRACT

Swarnavanga is a classical Kupipakwa Kalpa described in various Rasashastra texts, indicated predominantly in prameha and kapha medorogas. Despite of its long-standing therapeutic use, systematic pharmaceutico-analytical documentation using classical and modern parameters remains limited. Hence this study was designed to prepare Swarnavanga as per classical reference, analyse physicochemical properties and characterize its chemical composition through modern analytical instruments. Swarnavanga was prepared by kupipakwa method as described in Rasa Tarangini. Classical Siddhi Lakshanas of Swarnavanga were achieved. Analytical results confirmed low moisture content, acidic pH, high ash value and formation of complex tin and mercury based crystalline phases. XRD analysis indicated a multiphase inorganic compound, validating classical transformation of ingredients through kupipakwa samskara. This study established a reproducible pharmaceutico-analytical profile of Swarnavanga, supporting its classical indications, providing a scientific basis for quality control and further pharmacological exploration.

KEYWORDS: Swarnavanga, Kupipakwa Rasayana, Pharmaceutico-analytical study

INTRODUCTION

Rasoushadhi's have gained importance because of their quicker action, lesser dosage and tastelessness[1]. Medicines prepared from *Murcchita Parada* are classified into *Kharaleeya Rasayana, Parpati Rasayana, Pottali Rasayana, and Kupipakwa Rasayana. Formulations prepared using Paradadi kajjali and is subjected to Kramagni paka in kachakupi are known as Kupipakwa Rasayana. Formulations such as Rasasindhūra*, Rasa Karpura, *Asthamurthy Rasayana, Mallasindhūra, Sameerapannaga Rasa* and *Swarṇavanga* are few therapeutically potent and widely used formulations prepared by this method.

Swarnavanga is a Sagandha, Talastha, Bahirdhuma Kupipakwa Kalpa *explained in Rasa Tarantini* contains *ingredients like Vanga, Parada, Gandhaka and Navasadara. It is* indicated in diseases caused by *Kapha dosha*. It has actions like *Pramehahara, Medohara, Shukrakara, Vrushya and*

Rasayana[2]and derives its name from the characteristic golden yellow colour of the final product. The absence of chemical characterisation represents a significant research gap. Present study addresses said lacunae through comprehensive pharmaceutical and analytical methodology, thereby establishing the foundational evidence necessary for contemporary clinical application and further research advancement.

AIMS AND OBJECTIVES

AIM

Pharmaceutico-Analytical Study of Swarnavanga.

OBJECTIVES

-Preparation of Swarnavanga by Kupipakva method as per classics.

-Analytical Study of Swarnavanga.

MATERIALS AND METHODS

Study Design and Phases:

This comprehensive investigation was structured into two phases:

Phase-I-Pharmaceutical Study: This includes classical preparation of Swarnavanga including raw material authentication, individualized shodhana procedures, and final formulation synthesis via Kupipakwa methodology.

Phase-II-Analytical Study: Multidimensional characterization encompassing. organoleptic assessment, physicochemical parameters and instrumental analysis.

Pharmaceutical Study:

Raw materials were procured from M/S Dorle and sons, Kolhapur and authenticated by expert faculty at the Central Research Facility, BVVS Ayurveda College and Hospital, Bagalkot. All pharmaceutical procedures were executed at BVVS Ayurveda Pharmacy, Bagalkot.

Shodhana of *Parada* was carried as per the Rasendra Sara Sangraha. Parada along with equal quantity of *haridra* is triturated in *khalwa* along with kumari Swarasa. After 3 hours of trituration, the mixture had turned greyish yellow colour. This kalka was dried, and poured in *tiryaka patana yantra* and subjected for *shodhana*[3]. *Shodhana* of *gandhaka* was carried out as per the Rasa Ratna Samucchaya by dhalana method in godugdha.[4]. Vanga shodhana was carried out as per Rasa Tarangini by dhalana[5] method in churnodaka through Pithara yantra. Navasadara shodhana was carried out per Rasa Tarangini. Navasadara was dissolved in water and filtered. Filtrate was subjected for heating over mandagni. Shuddha Navasadara left at the base of vessel was collected.[6]

Parada vanga pishthi was prepared, washed using *nimbu swarasa* and *saindhava lavana.* Later this *pisthi* was triturated with *shuddha gandhaka* and *shodhita navasadara*. Thus

prepared kajjali was filled in kachakupi and subjected for kramagni paka[7]. Heating was initiated with *Mandagni*, maintained for 3 hours and gradually intensified to *Madhyama agni* to *teevragni*. Temperature was maintained for 6 hours each. After completion of heating, the apparatus was allowed for *swangasheeta.* After *swangasheeta, kupi* was carefully broken and shining golden coloured *talastha* product was collected and stored in air tight glass container. Temperature & observation during *Swarnavanga Nirmana* was shown in table no 1.

Table No-1: Showing temperature & observation during *Swarnavanga Nirmana*

Date	Time	Temp	Observation
28/02/2025	8:30 AM	40^0C	Started Heating
	8:35 AM	45^0C	-
	8:45 AM	60^0C	-
	8:55 AM	123^0C	Sand started heating
	9:00 AM	168^0C	-
	9:30 AM	221^0C	-
	10:00 AM	280^0C	White fumes of *Navasadara* were observed
	10:30 AM	311^0C	White fumes of *Navasadar*a were observed
	10:50 AM	330^0C	White fumes & odor of *Navasadara* were appreciated
	11:00 AM	335^0C	Dense White fumes & odor of *Navasadara* were appreciated
	11:30 AM	330^0C	*Gandhaka* fumes were observed
	12:00 PM	402^0C	*Gandhaka* fumes were observed
	1:30 PM	430^0C	Odour of *Gandhaka* was appreciated
	2:00 PM	488^0C	Odour of *Gandhaka* was appreciated
	2:30 PM	502^0C	Kajjali started melting
	3:00 PM	530^0C	Dense *Gandhaka* fumes were observed
	3:30 PM	540^0C	Dense *Gandhaka* fumes were observed
	4:00 PM	572^0C	Gandhaka adhered at mouth of kupi
	4:30 PM	580^0C	Gandhaka adhered at mouth of kupi
	5:00 PM	600^0C	While Tapta Shalaka sanchalana, dense fumes and Gandhaka odour was appreciated
	5:30 PM	628^0C	dense yellow fumes +

	6:00 PM	630^{0}C	dense yellow fumes +
	6:30 PM	700^{0}C	dense yellow fumes +
	7:00 PM	702^{0}C	dense yellow fumes +
	7:30 PM	700^{0}C	dense yellow fumes +
	8:00 PM	710^{0}C	Copper coin test negative, dense yellow fumes +
	9:00 PM	720^{0}C	Yellow Fumes reduced
	10:00 PM	720^{0}C	Hg floating was seen inside kupi
	10:30 PM	750^{0}C	Red hot base, golden yellow product was seen, copper coin test +
	11:00 PM	750^{0}C	Heating was Stopped, allowed for Swangasheeta

Analytical Study:

Analytical studies like organoleptic studies, physico-chemical analysis was carried out at HSK College of Pharmacy, Bagalkot. Instrumental analysis was carried out at accredited laboratory i.e. Jeevan Rekha Laboratories, Sambhaji Nagar (Aurangabad), Maharashtra.

Table No 2: Showing Organoleptic Characters of Swarnavanga

Characteristic	Observations
Sparsha (Touch)	Sponge-like, extremely soft, smooth texture with very fine particles
Roopa (Color)	Shining golden color with light-yellow shade
Rasa (Taste)	Nis wadu (no distinctive taste upon tongue contact)
Gandha (Odor)	Non-specific, mild, without offensive properties

Table No 3: Physico-Chemical Analysis of Swarnavanga.

Parameter	Method
Moisture Content	Loss on drying at 105°C for 3 hours
Total Ash	Incineration at 450°C until constant weight
Acid Insoluble Ash	Ash dissolved in dilute HCl; insoluble residue weighed
Water Soluble Ash	Ash dissolved in distilled water; soluble portion weighed
pH Value	pH meter in aqueous suspension (1% w/v)

Instrumental Analysis:

X-Ray Diffractometer studies:

XRD analysis was performed using an X-ray diffractometer.

Table No 4: XRD Analysis result of *Swarnavanga*

Compound	Composition	Crystal Shape	2theta	D Spacing	Intensity %
Mercury Chlorat	$HgCl_2O_4$	Unknown	18.710 30.28 3.41	5.50 43.5 23.5	65.3

e			32838.371	952.7083	
Mercury Tin Phosphide	$HgSnP_4$	Orthorhombic	12.56916.30334.034	8.1715 6.3084 3.0564	21.346.618.6
Tin Fluoride Sulfate	$Sn(SO_3F)_4$	Unknown	13.28814.06321.863	7.7310 7.3072 4.7168	34.841.629.1
AmmoniumTin Chloride Hydrate	$NH_4SnCl_3H_2O$	Unknown	14.36717.21628.060	7.1532 5.9762 3.6897	81.933.635.4
Sodium Tin Phosphide	Na_5P_3Sn	Monoclinic	14.64420.12132.541	7.0188 5.1206 3.1927	52.654.529.9
Potassium Tin Chloride Acetate	$C_6H_6Cl_3KO_6Sn$	Monoclinic	15.91630.35533.758	6.4609 3.4165 3.0807	67.943.519.3

The XRD pattern demonstrates a multiphase crystalline system comprising mercury- and tin-based salts, hydrates, and phosphides. The mixture's complexity indicates complete phase transformation. Identified compounds were shown in the table no 4.

XRF Analysis

The elemental profile confirms integration of all major components. The relatively low concentration of mercury compared to tin indicates the formation of organometallic complexes rather than simple physical mixing.

Fourier-Transform Infrared Spectroscopy (FTIR) Analysis.

The spectroscopic data confirms successful integration of metallic, sulphur-based constituents. The absence of peaks characteristic of toxic free mercury or sulphur indicates complete complexation into stable organometallic form like medicine.

Particle Size Estimation:

Particle size distribution was determined using laser diffraction particle size analyzer.

Table No 5: Particle size result of Swarnavanga

1.	Field Scanned	05
2.	Total Particle Count	115688
3.	Number of single Particle	106038
4.	Number of Agglomerates	9645
Single Particle	d10	10% particles are below 0.71 microns
	d50	50% particles are below 1.23 microns
	d90	90% particles are below 2.00 microns
Agglomerate	d10	10% particles are below 1.33 microns
	d50	50% particles are below 2.40 microns
	d90	90% particles are below 3.79 microns

OBSERVATIONS & RESULTS

Pharmaceutical results:

Table No 6: Showing results of pharmaceutical study.

Procedure	Initial Quantity (gm)	Obtained Quantity (gm)	Loss (gm)	Loss (%) / Yield (%)
Parada Shodhana	500 gm	478 gm	22 gm	4.4% loss
Gandhaka Shodhana	450 gm	405 gm	45 gm	10% loss
Vanga Shodhana	200 gm	189 gm	11 gm	5.5% loss
Navasadara Shodhana	100 gm	95 gm	5 gm	5% loss
Parada Vanga Pishthi Nirmana	350 gm	325 gm	25 gm	7.14% loss
Swarnavanga Kajjali Nirmana	6?80 gm	652 gm	28 gm	4.12% loss
Swarnavanga Kupipakwa Nirmana	240 gm	97.38 gm	—	40.5% yield

Analytical results:

Table No 7: Test of Perfectness of Kajjali:

Test	Observations and Results
Nischandratva	The Kajjali was observed in bright sunlight. It was not having any luster – Negative
Rekhapurnata	The Kajjali was rubbed in between index finger and thumb. It penetrates the furrows of the fingers – Positive
Vaaritaratva	A small amount of Kajjali was carefully sprinkled over the surface of a beaker contained a stagnant water. It was found that total portion of kajjali was floating on the water surface – Positive
Unam	A small amount of Kajjali was carefully sprinkled in beaker full of water and a grain is placed on the floating matter. It was found that the grain was floating on the water surface – Positive

Table No 8: Physicochemical Analysis

Parameter	Result
Moisture Content	0.4% w/w
Total Ash	16.5% w/w
Acid Insoluble Ash	14.5% w/w
Water Soluble Ash	14.5% w/w
pH Value	3.8

Instrumental Analysis results:

The XRD profile indicates the presence of multiple mercury and tin containing phases. This suggests complex multiphase crystalline mixture rather than a single pure compound. Key identified compounds were Mercury Chlorate, Mercury Tin Phosphide, Tin Fluoride Sulfate, Ammonium, Tin, Chloride Hydrate, Sodium Tin Phosphide and Potassium Tin Chloride Acetate.

Elemental profile by XRF confirms integration of all major components. The relatively low concentration of mercury compared to tin indicates the formation of

organometallic complexes rather than simple physical mixing.

The FTIR indicates the presence of various functional groups that supports the integration of metallic, sulfur based and ammonium constituents within an organic herbal matrix. Broad absorption bands observed between 3300–3900 cm^{-1} indicate the presence of ammonium (NH_4^+) and hydroxyl groups, which can be attributed to Navasadara (ammonium chloride) and residual moisture or herbal components used during processing. Bands in the region of 1374–1654 cm^{-1} suggest the presence of organic and amide functional groups, reflecting the contribution of herbal media. Additionally, peaks observed between 1684–2342 cm^{-1} indicate metal–ligand interactions, supporting the formation of mercury- and tin-based complexes during the processing of Parada and Vanga in the Kupipakwa method. Single particle size: <2 µm (mean 0.8-1.5 µm) - Agglomerate size: 3.79 µm average - Distribution: Log-normal pattern indicating natural crystalline aggregation - Particle size confirms Sukṣhmata of compound which is required for optimal bioavailability.

DISCUSSION

The present pharmaceutico-analytical study was undertaken to evaluate Swarnavanga systematically through the combined lens of Rasashastra and contemporary analytical science. The shodhana processes employed for parada, gandhaka, vanga, and navasadara produced consistent reductions in weight, reflecting removal of physical impurities, volatile fractions and undesirable reactive components. These findings align with shodhana concept which enhances safety rather than merely a purification step. Attainment of classical kajjali Siddhi Lakṣhaṇa like absence of metallic lustre, fineness etc indicates effective particle size reduction and uniform integration of ingredients. The kupipakwa procedure carried out under graded heating (Kramāgni) resulted in the formation of talastha Swarnavanga with characteristic golden yellow colour, as described in classical texts. The observed yield of 40.50% is within acceptable limits for sulfur and ammonium containing kupipakwa kalpas.

Physicochemical analysis revealed low moisture content, indicating enhanced stability. The acidic pH of the formulation may support better dispersion and absorption, particularly relevant in kapha-dominant metabolic disorders. Elevated ash values confirm the inorganic nature of Swarnavanga.

X-Ray Diffraction study confirmed multiphase crystalline structures**,** comprising mercury and tin based derivatives. This transformation aligns with the stage of

Murcchana and *Bandhana* of *Parada*, where mercury's unstable and toxic nature is converted into stable, therapeutically useful form. XRF elemental profiling further confirmed integration of constituent elements with mercury present in comparatively lower proportions, indicating its participation in stable complex formation rather than persistence as a free element.

FTIR analysis revealed functional groups related to ammonium, hydroxyl and organic residues from processing media along with evidence of metal ligand interactions. These spectral features support the formation of stable mercury and tin based complexes, confirming that Swarnavanga is a chemically integrated organometallic formulation rather than a simple physical mixture. Particle size analysis revealed that the majority of particles were below 2 µm fulfilling the classical requirement of *Sūkṣhmatva*. Such micro sized particles have reduced particle size and enhanced surface area, which is necessary for faster absorption and better therapeutic activity.

CONCLUSION

The present study successfully establishes a comprehensive pharmaceutico-analytical profile of Swarnavanga prepared by classical Kupipakwa kramagni paka method. Pharmaceutical processing resulted in a stable, micro sized, multiphase inorganic formulation, as confirmed by physicochemical parameters and advanced instrumental analyses including XRD, XRF, FTIR and particle size estimation.

The findings clearly demonstrate that Swarnavanga is a chemically transformed organometallic complex rather than a crude metallic preparation, validating its classical safety claims. Integration of traditional siddhi lakṣaṇas with modern analytical evidence provides a robust framework for standardization, quality assurance, and regulatory acceptance of this formulation.

Overall, this study bridges classical Rasashastra concepts with contemporary scientific validation, reinforcing the relevance of Swarnavanga in evidence-based Ayurveda practice and laying a strong foundation for further pharmacological and clinical investigations.

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Fig 1: Representation of Swarnavanga Nirmana; time duration and temperature

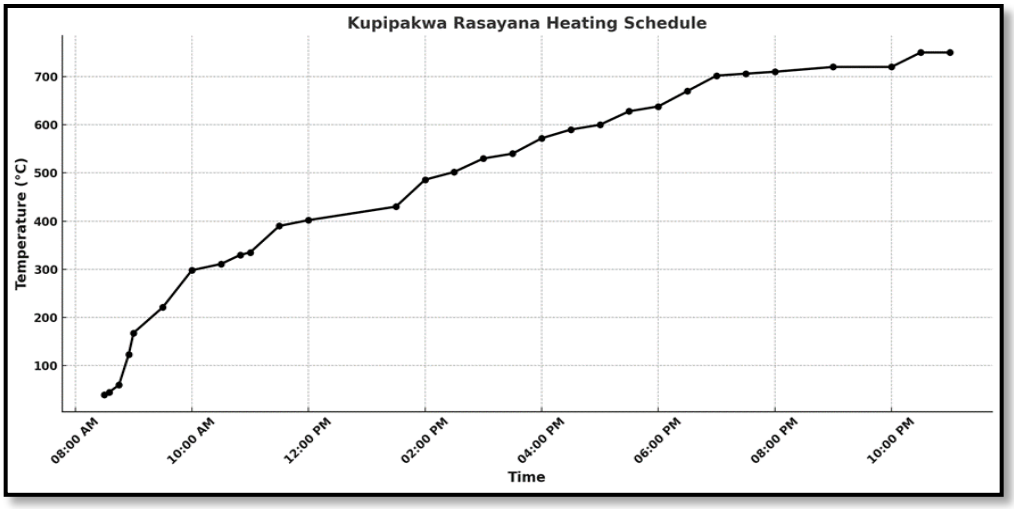
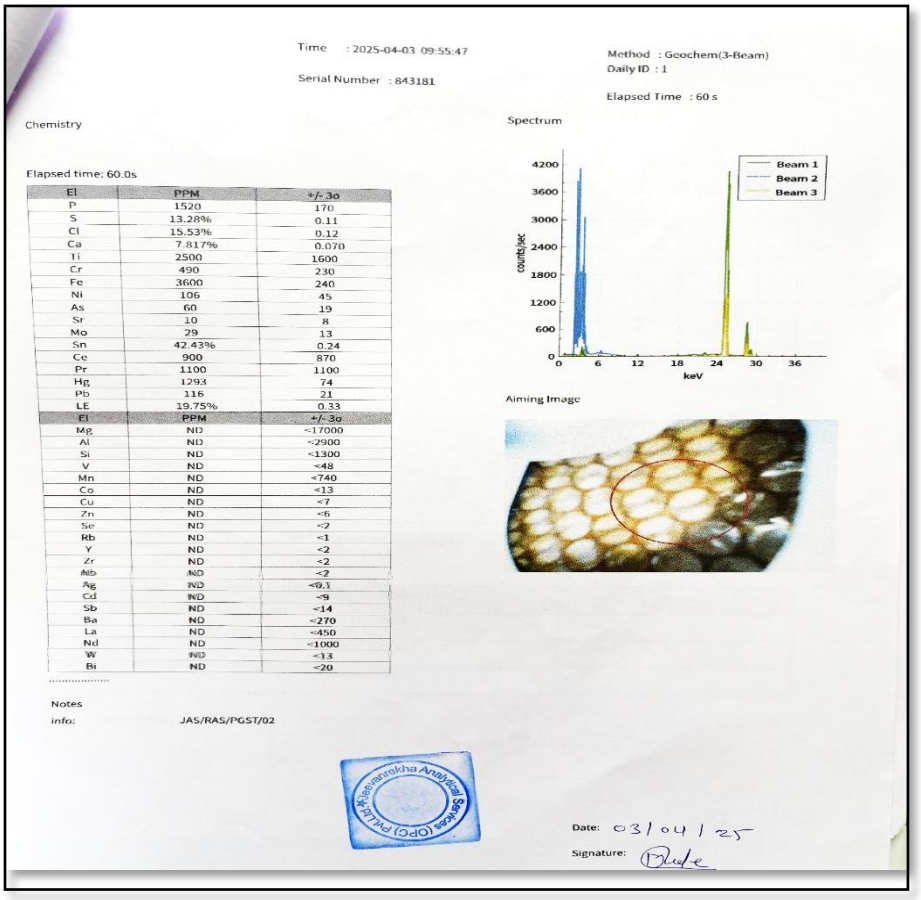


Fig 2: XRD Analysis



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Method : Geochem(3-Beam)
Daily ID : 1

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Chemistry

Elapsed time: 60.0s

El	PPM	+/- 3σ
P	1520	170
S	13.28%	0.11
Cl	15.53%	0.12
Ca	7.817%	0.070
Ti	2500	1600
Cr	490	230
Fe	3600	240
Ni	106	45
As	60	19
Sr	10	8
Mo	29	13
Sn	42.43%	0.24
Ce	900	870
Pr	1100	1100
Hg	1293	74
Pb	116	21
LE	19.75%	0.33
El	PPM	+/- 3σ
Mg	ND	<17000
Al	ND	<2900
Si	ND	<1300
V	ND	<48
Mn	ND	<740
Co	ND	<13
Cu	ND	<7
Zn	ND	<6
Se	ND	<2
Rb	ND	<1
Y	ND	<2
Zr	ND	<2
Nb	ND	<2
Ag	ND	<9.1
Cd	ND	<9
Sb	ND	<14
Ba	ND	<270
La	ND	<450
Nd	ND	<1000
W	ND	<13
Bi	ND	<20

Spectrum

Aiming Image

Notes

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Date: 03/04/25

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Fig 3: XRF Analysis

Peak Number	Wave number (cm^{-1})	Intensity
1	1095.08644	0.44768
2	1374.93039	0.41946
3	1399.47811	0.41811
4	1419.11628	0.41967
5	1437.11794	0.41965
6	1474.75777	0.41567
7	1491.12291	0.41336
8	1507.48806	0.42293
9	1522.21669	0.41416
10	1540.21834	0.41693
11	1617.13452	0.43638
12	1636.77269	0.41065
13	1654.77435	0.40832
14	1634.23161	0.40221
15	1700.59675	0.39878
16	1718.59841	0.39581
17	1751.32870	0.38806
18	1772.60338	0.38715
19	1792.24155	0.38321
20	1829.8818	0.37516
21	1844.61001	0.37294
22	1869.15773	0.36732
23	1991.89631	0.30656
24	2112.99837	0.33657
25	2342.11038	0.35661
26	2373.20415	0.35358
27	3307.65385	0.33925
28	3525.31025	0.3284
29	3567.85963	0.32149
30	3589.13431	0.31852
31	3630.04717	0.31729
32	3649.68534	0.31555
33	3677.50609	0.31215
34	3690.59820	0.31269
35	3713.50940	0.31096
36	3780.60649	0.31084
37	3801.88118	0.31169
38	3821.51935	0.31160
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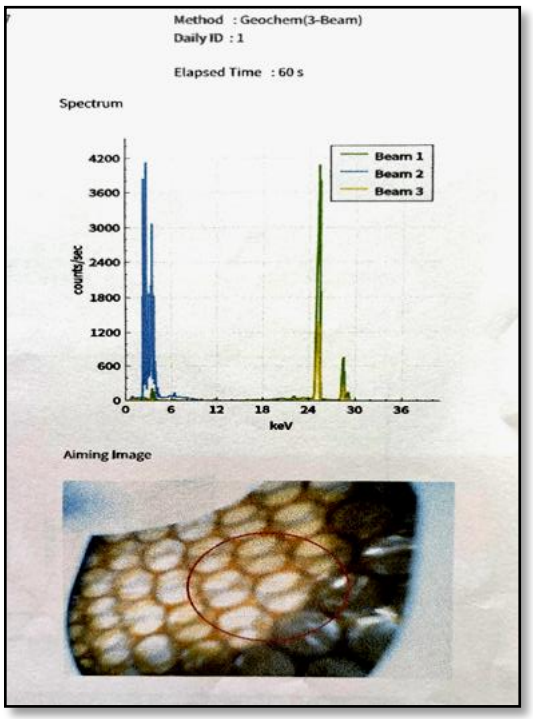

Fig 4: FTIR analysis

Group Frequency (cm^{-1})	Wave Number (cm^{-1})	Intensity	Functional Group and Type of Vibration	Interpretation / Remarks	Active Constituents	Source (Origin)
1000–1200	1095	Medium	C–O or S=O stretching	Could represent sulfate, sulfide or organo-metal bonds	Gandhaka, Navasadara	Sulfur-rich or organosulfur
1300-1500	1374–1437	Medium	NO_3^- / CH_3 bend	Ammonium and organic residues	NH_4^+ (Navasadara), Herbal residues	Herbal + Ammonium
1600–1700	1474–1540	Medium	N–O stretching / Amide II	Proteinaceous / Nitrogenous compounds	NH_4Cl / Herbal binders	Navasadara + Herbs
1600–1680	1617–1654	Medium	C=C stretching / Amide I	Unsaturated organics	organics	Milk and ghee used for shodhan of Gandhak
1650–1750	1684–1772	Weak	C=O stretching / Sn–O or Sn–S modes	Organotin vibrations / binder residues	Vanga (Sn)	Tin oxides/sulfides
1800–2300	1792–1869	Weak	Metal-ligand overtones	Weak bonds of Hg–S, Sn–O possibly	Parada, Gandhaka, Vanga	Metallurgical processing
1800–2500	1991–2342	Weak	Organometallic / metal-halide interactions	Possibly Hg–S and Sn–Cl complexes	Parada (Hg), Vanga (Sn)	Mineral-metal complexation
3300–3600	3307–3567	Medium	N–H symmetric/asymmetric stretching	Clear presence of ammonium ion NH_4^+	Navasadara	Ammonium chloride
3600–3900	3630–3903	Medium	O–H / N–H stretch	Moisture or OH/NH interactions,	NH_4Cl, Herbs	Hygroscopic content or

Swarnavanga