



Research Article

PHARMACEUTICAL PROCESSING AND ANALYTICAL EVALUATION OF VANGA BHASMA

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ABSTRACT

Rasashastra, a specialised branch of Ayurveda dealing with metals and minerals, employs specialised pharmaceutical procedures to transform raw metals into safe and therapeutically effective formulations. The present study aimed to standardise the preparation of *Vanga Bhasma* through classical procedures of *Samanya Shodhana*, *Vishesha Shodhana*, *Jarana* and *Marana*, and to evaluate its physicochemical and advanced analytical characteristics. The prepared *Vanga Bhasma* was assessed using classical *Bhasma Pariksha*, physiochemical parameters, and instrumental analysis like XRD, XRF, SEM, SEM-EDS. The formulation satisfied all classical quality parameters and exhibited low moisture content, high ash value and good physiochemical stability. XRD confirmed the formation of crystalline tin oxide, while XRF identified tin as the predominant element. SEM revealed fine agglomerated particles with an average particle size of 2.12nm, EDS confirmed the presence of tin and oxygen. The study scientifically validates the classical pharmaceutical processing and establishes the quality, standardization, and analytical profile off *Vanga Bhasma*.

INTRODUCTION

Rasashastra, the ancient alchemist from the Vedic era, studies mercury, metals, and minerals. Its knowledge is vital to understand herbo-mineral formulations and their therapeutic actions. The therapeutic potency of *Rasa Dravyas* depends largely on their proper processing. Ayurvedic texts describe several preparatory procedures for the preparation of *Vanga Bhasma*; however, the process fundamentally comprises sequential stages- *Shodhana* (*Samanya* and *Vishesha*), *Jarana* and *Marana*. The preparation begins with *Shodhana* process by the classical *Dhalana* method, which is intended to eliminate *Dravya Mala*^[1], and improve the suitability of the *Vanga* for subsequent processing, followed by *Jarana*, a process specifically employed for low melting point metals to convert the molten metal into a fine powder suitable for *Marana* aided by repeated *Bhavana*, and *Putapaka*, produce a stable, bio-assimilable *Vanga Bhasma*.

In *Sanskrit* terminology, *Lauha* originates from the root *Lohkarshan*, signifying a substance procured from a mineral by means of extraction.^[2] The categorization of *Lauha* in *Rasa Ratna Samuchaya* classical text includes *Sudha Lauha*, *Puti Lauha*, and *Mishra Lauha*.^[3] Among the *Puti Lauha*, *Vanga* was historically esteemed by ancient physicians and documented under the term '*Trapu*' in classical literature.^[4,5] *Trapu* is distinguished by its low melting point, allowing it to liquefy readily when exposed to fire.

Recent advances in materials science and nanotechnology have enabled the scientific validation of classical *Rasashastra* preparations. Modern analytical techniques such as X-ray diffraction (XRD), X-ray fluorescence (XRF), Scanning electron microscopy (SEM), and energy-dispersive spectroscopy (EDS) have demonstrated that properly prepared *Bhasma* undergo significant physiochemical transformation, reduction in particle size to the nanometre range, and the formation of stable mineral complexes.

Although several studies have explored the processing of *Vanga*, there remains a need for a systematic observational-based study to examine the effects of the physical and organoleptic

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transformations- that accompany *Samanya*, *Vishesha Shodhana*, *Jarana* and *Marana* in a single continuous pharmaceutical study and for correlating these classical observations with modern instrumental analysis of the finished *Bhasma*. The present work was carried out to fulfil the following aims and objectives

AIM

To evaluate the purification, incineration and calcination of raw *Vanga* through *Samanya Shodhana*, *Vishesha Shodhana*, *Jarana* and *Marana* and to assess the role in enhancing its safety and therapeutic suitability of *Vanga*, with special reference to classical texts, supported by physiochemical and instrumental characterisation of the *Vanga Bhasma*.

Objectives of the Study

- To perform the *Samanya Shodhana* of *Vanga* as described in classical textbook.
- To conduct the *Vishesha Shodhana* of *Vanga* using specific media and methods mentioned in the *Rasa Tarangini* classical textbook.
- To carry out *Vanga Jarana* as per classical texts.
- To perform *Vanga marana* by the Classical puta method and obtain *Vanga bhasma* as per classical texts.
- To observe and compare the organoleptic characters and physical changes occurring at each stage of processing.
- To characterise the finished *Vanga Bhasma* using XRD, physiochemical analysis, XRF, SEM and SEM-EDS.

MATERIALS AND METHODS

Place & Duration of Study: The necessary procedures for raw materials processing and preparation were conducted in the pharmacy section of the Rasashastra and Bhaishajya Kalpana department at *Patanjali Bhartiya Ayurvedigyan Evam Anusandhan Sansthan*, Haridwar. The present study was carried out in the year of 2025.

Procurement of Raw Materials

Table 1: Quantity of liquid media used per quenching cycle for 400gm of *Vanga*

Liquid Media	Quantity used						
	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
<i>Taila</i>	500ml	250ml	250ml	250ml	250ml	250ml	250ml
<i>Takra</i>	300ml	400ml	400ml	400ml	400ml	400ml	400ml
<i>Gomutra</i>	550ml	550ml	550ml	550ml	550ml	550ml	550ml
<i>Kanji</i>	450ml	450ml	450ml	450ml	450ml	450ml	450ml
<i>Kulattha Kwatha</i>	500ml	500ml	500ml	500ml	500ml	500ml	500ml

Raw *Vanga*, Dry *Haridra*, *Tandula*, *Kulattha dal*, *Mulaka*, *Tila Taila*, *Godadhi* was purchased from an authentic source. *Gomutra* was collected from local *Goshala* in Haridwar. Fresh *Ghrithkumari*, *Apamarga Panchanga*, *Nirgundi* leaves were collected from the herbal garden of *Patanjali Bhartiya Ayurvedigyan evam Anusandhan Sansthan*, Haridwar.

Media Used

- **For *Samanya Shodhana Dravyas*:** *Tila Taila*, *Takra*, *Gomutra*, *Kanji*, and *Kulattha Kwatha*.
- **For *Vishesha Shodhana Dravyas*:** *Nirgundi Patra Svarasa* and *Haridra Churna*.
- ***Jarana Dravya*:** *Apamarga Panchanga Churna*

Equipment's used: *Louha Darvi patra* (iron vessel), *Pithara Yantra*, LPG gas stove, measuring jar, spatula, weighing machine, thermocouple, stainless-steel vessel, *Khalwa Yantra*, sieves, *Louha patra*, *Chullika*, *Sharawa*, *Multani mitti*, markin cloth, *Laghu puta* pit, and *Upale* cow- dung cakes.

Pharmaceutical processing

Steps involved in the preparation of *Vanga Bhasma*

- *Samanya Shodhana* of *Vanga*
- *Vishesha Shodhana* of *Vanga*
- *Jarana* of *Vanga*
- *Marana* of *Vanga*

Samanya Shodhana of *Vanga*^[6]

Method: 400gm of raw *Vanga* measured and heated over *Madhyam Agni* (moderate flame) until melted. Owing to its low melting point, it melts quickly and uniformly. The molten metal was then poured in a *Pithara Yantra* using *Dhalana* method, followed by successive quenching in different liquid media *Taila*, *Takra*, *Gomutra*, *Kanji* and *Kulattha Kwatha*. Each quenching was repeated for 7 times. After quenching, the *Vanga* was collected, washed with hot water, and dried. The process was repeated seven times with fresh media, and weight was recorded after each cycle.

OBSERVATIONS**Table 2: Physical changes observed in *Vanga* after quenching in each medium**

Media	Changes in <i>Vanga</i>
<i>Til Taila</i>	Silvery-gray irregular flattened disc with dark oxidized patches and bubbled, cracked surface in one piece.
<i>Takra</i>	Bright silvery irregular metallic lump with dark patches and rough, jagged, bubbled textures and clustered fragments. After 7 quenches in <i>Til Taila</i> , quenching in <i>Takra</i> produced yellow particles that later turned blackish, and bounced with sound.
<i>Gomutra</i>	Bright silvery white with a shiny metallic luster. Irregular, jagged and fragmented appearance with sharp edges, rough surface, and some darker oxidized patches scattered throughout.
<i>Kanji</i>	Silvery-white with a strong metallic shine. Forms an irregular, uneven lump with a rough, porous surface and scattered dark patches. Surface shows small projections and solidified molten patterns.
<i>Kulattha Kwatha</i>	Silvery-white with a dull metallic shine. It is irregular and fragmented, showing elongated, needle-like pieces mixed with rough, porous lumps and some slightly darkened or oxidized areas, and can be easily bent.

Result**Table 3: Result of *Samanaya Shodhita Vanga***

Media used	Quantity used	pH of media	Time taken to melt	Wt. before <i>Shodhana</i>	Wt. after <i>Shodhana</i>
<i>Til Taila</i>	2000ml	7	3-6min	400gm	388gm
<i>Takra</i>	3000ml	6	4-6min	388gm	356gm
<i>Gomutra</i>	4000ml	7	5-6min	356gm	351gm
<i>Kanji</i>	3000ml	4	5-6min	351gm	344gm
<i>Kulattha Kwatha</i>	4000ml	7	5-6min	344gm	340gm
Wt. of <i>Ashuddha Vanga</i>	Wt. of <i>Shuddha Vanga</i>	Average time taken to melt	Total Liquid media quantity	Wt. loss in gm	Wt. loss %
400gm	340gm	3-6min	16L	60gm	15%

***Vishesha Shodhana of Vanga*^[7]**

Method: Numerous *Vishesha Shodhana* procedures are mentioned in classical texts, this study specifically carried out as per reference described in the classical text *Rasatarangini*. Fresh *Nirgundi* leaves were collected, trimmed, washed thoroughly and triturated in a *Khalwa Yantra*, the *Swarasa* was expressed by squeezing the paste through muslin cloth into a stainless-steel vessel, mixed with 1/16th part of *Haridra Churna* as *Prakshepa Dravya*. The molten *Samanya Shodhita Vanga* was poured into this prepared liquid medium and quenched in a *Pithara Yantra* using the *Dhalana* method and quenched three times which facilitates the removal of specific impurities that remain even after *Samanya Shodhana*.

Table 4: Quantity of media used for 340 gm of *Samanya Shodhita Vanga*

Media with <i>Prakshepa Dravya</i>	Quantity used		
	1 st	2 nd	3 rd
<i>Nirgundi patra Svarasa</i>	500ml	500ml	500ml
<i>Haridra Churna</i>	31gm	31gm	31gm

Observation**Table 5: Observation parameters of Vishesha Shodhita Vanga**

Parameter	Observation	Inference
Odour	Characteristic <i>Nirgundi Swarasa</i>	Proper quenching
Medium colour	Olive green to dark olive green with <i>Haridra</i> precipitation	Impurity extraction
<i>Vanga</i> appearance	Lustre reduced, greenish colour	Surface reaction
Particle change	Separation observed	Disintegration
Final	Lustre restored with black patches	Partial purification

Result**Table 6: Result of Vanga Vishesha Shodhana**

Liquid Media	Average time to melt	Media Quantity	Wt. before Shodhana	Wt. after Shodhana	Wt. loss	Loss %
<i>Nirgundi Swarasa + Haridra Churna</i>	5-7 min	1500ml	340gm	333gm	7gm	2%

Precautions

- Precautions from injuries and smoke of media was taken.
- Liquid media must be taken fresh before each quenching
- Immediate quenching of hot molten *Vanga* in the specified liquid media is essential to prevent sticking to the *Darvi Yantra*.

Vanga Jarana^[8]

Method: Collected *Apamarga Panchanga* was washed, sun-dried, powdered and sieved through a No.40 mesh to obtain a coarse powder. *Shuddha Vanga* was melted in an iron pan over a *Chullika* and a small quantity of *Apamarga Churna* were added repeatedly to the molten *vanga*, with vigorous rubbing performing using

the base of an iron ladle after each addition. This was continued until the *Vanga* was converted into a powder form and lost its metallic shine. The powder was gathered at the center of the pan, covered with a *Sharawa*, and subjected to intense heat until both the *Sharawa* and the powder becomes red hot (*Angara varna*). The *Sharawa* was lifted and heating discontinued once the characteristic red-hot color was attained, after which the material was allowed to cool naturally. The *Jarita Vanga* was collected and weighed on the following day, and *Vanga Prakshalana* was subsequently carried out to separate residual particles and neutralize the pH.

Observation**Table 7: Parameters observed during Vanga Jarana**

Parameters	Observation	Inference
Melting Stage	Smoke with burning odour of <i>Haridra</i> & <i>Nirgundi</i> : black residues visible	Presence of residual media and volatilisation
Addition of <i>Apamarga Churna</i>	Initial burning with Smoke, which ceased after mixing	Indicates proper incorporation
Method of addition	Added in small portions after smoke cessation	Ensures uniform mixing and conversion
Conversion process	Gradual transformation of molten <i>Vanga</i> into powder	Effective <i>Jarana</i> achieved
Quantity Adequacy	Additional <i>Churna</i> required	Initial quantity insufficient for complete conversion

Result**Table 8: Result of Vanga Jarana**

Wt. of Shodhita Vanga	Wt. of Apamarga Churna	Duration	Wt. of Jarita Vanga	Wt. loss in %	Wt. of Vanga after Prakshalan	Wt. Loss in %	Colour of Vanga
333gm	400gm	7 hours	310gm	7%	301gm	3%	Ivory-white

Precautions

1. The heat should be gradually increased during the procedure and maintained at a *Madhyama Agni* (moderate level). Well-dried *Apamarga Panchanga Churna* should be used.
2. At the conclusion of the procedure, maximum heat was applied until the base of the vessel became red hot and no loose molten metal particles were observed.
3. The number of media to be added at each stage should correspond to the quantity of *Vanga*, and the next portion should be added only after the fumes have subsided.

Vanga Marana^[9]

Method: The *Ghrithkumari* leaves were washed, and their spiny margins and tips were trimmed. The mucilaginous pulp was scooped out, and the green portions were removed. Only the clear pulp was used for levigation. The extracted pulp was whisked thoroughly prior to use to facilitate mixing during levigation. *Jarita Vanga* was transferred to a *Khalwa Yantra*, and *Kumari Swarasa* was added gradually as the *Bhavana Dravya* until the material became fully moistened. Continuous trituration was performed until

Subhavita Lakshana appeared, yielding a homogeneous thick paste suitable for pellets formation. The levigated mass was shaped into small, uniformly sized *Chakrika* (pellets) and sun-dried on a plastic sheet. The dried *Chakrika's* were arranged in a single layer within a *Sharawa* to ensure uniform heating covered with another *Sharawa*, sealed with Markin cloth coated with *Multani Mitti* to form a *Sharawa Samputa* and allowed to dry completely and then subjected to heating (*Putapaka*) in a *Laghu Puta*. Four *Upalas* were ignited using matchsticks, with paper used to facilitate the ignition. Two-thirds of the pit were first filled with *Upalas*. Two ignited *Upala* was placed over them, after which the *Sharawa Samputa* was positioned in the pit. The remaining one-third of the pit was then filled with *Upalas*, and two ignited *Upalas* were placed over the top layer to ensure proper heating. After the completion of *Putapaka*, it was left undisturbed for *Swangasheeta* (self-cooling). The *Samputa* was opened the following day, and the material was collected and triturated in a *Khalva Yantra*. The process was carried out a total of 15 times.

Observation**Table 9: Parameters showing observation of Vanga Bhasma formation**

Parameter		Observation	
<i>Bhavana</i> characteristics		Smooth texture, faster absorption, homogeneity and loss of grittiness observed.	
Duration of <i>Mardana</i>		Achieving <i>Subhavita Lakshana</i> shortened from 5 to 2 hours, confirming improved surface area and faster impregnation of the <i>Kumari Swarasa</i> .	
<i>Chakrika</i> weight	<i>Chakrika</i> shape	Initially 13-14gm, decreased to 10-11gm after <i>Putapaka</i> . Size: 2.5-3.5cm.	Round, flat disc and uniform thickness for proper heating.
Heating pattern of <i>Putapaka</i>	Temperature	10-12hours heating followed by 5-6hours <i>Swangasheeta</i> .	Maximum- 630°C, maintained at 350-400°C for several hours.
<i>Bhasma</i> Characteristics	<i>Bhasma Pariksha</i>	Gradual improvement- softer, lighter, finer, brittle and more homogenous.	<i>Rekhapurna</i> achieved first, followed by <i>Varitara</i> in later <i>Putapaka</i> .

Result**Table 10: Result showing Vanga Bhasma**

No. of Puta	Wt. of Vanga in gm	Quantity of Bhavana Dravya in ml	No. of Vanyopalas used	Max Temp. reached	Wt. after Puta in gm	Chakrika	
						Color	Consistency
1.	250gm	70ml	17	550°C	247gm	Dull white	Firm
7.	247gm	70ml	12	500°C	247gm	White	Soft
8.	247gm	70ml	26	630°C	245gm	Greyish-white	Hard
14.	239gm	50ml	17	545°C	235gm	Ivory-white	Soft
16.	232gm	50ml	12	486°C	230gm	Ivory-white	Soft

Precautions

- A sufficient quantity of *Bhavana Dravya* should be used to fully soak the *Vanga Bhasma*.
- The *Bhavana* process should continue until proper *Subhavita Lakshanas* appear, ensuring finer particle formation.
- The *Chakrika* should be uniform and homogeneous in size and shape (as previously described) to ensure proper and even heat exposure, and they should be thoroughly sun-dried before further processing.
- The *Kapad-mitti* sealing of the *Sharava Samputa* should be carried out uniformly, ensuring that no bubbling or overlapping occurs, and it should be thoroughly sun-dried prior to use.
- The process should be carried out under *Laghu Puta* conditions, as excessive temperature may result in increased hardness of the material and the development of an undesirable colour.

Samanaya Shodhana and Vishesha Shodhana of Vanga

Image 1
Raw Vanga



Image 2
Tila Taila & Raw Vanga



Image 3
Takra & Vanga



Image 4
Gomutra & Vanga



Image 5
Kanji & Vanga

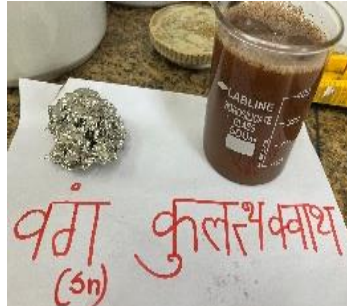


Image 6
Kulattha Kwatha & Vanga



Image 7
Molten Vanga

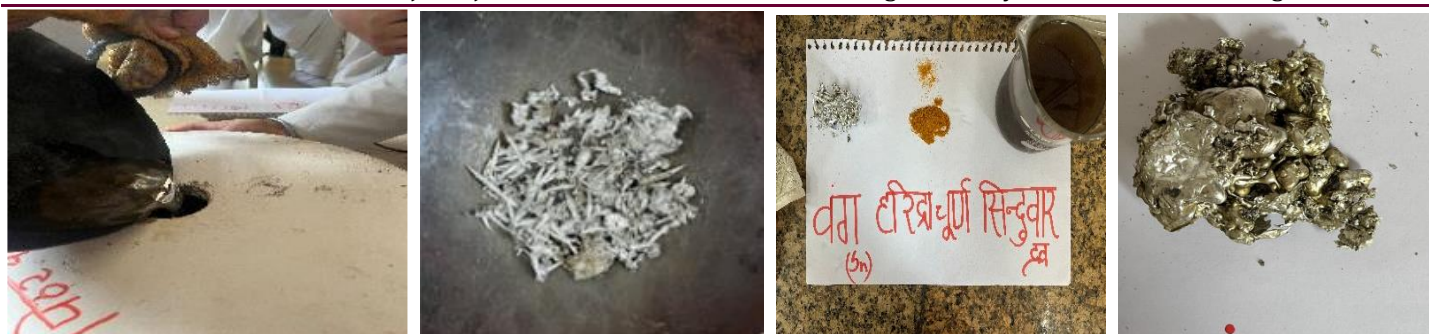


Image 8 Poured in a <i>Pithara Yantra</i>	Image 9 <i>Samanaya Shodhita Vanga</i>	Image 10 <i>Nirgundi patra Swarasa with Haridra Churna</i>	Image 11 <i>Vishesha Shodhita Vanga</i>
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Vanga Jarana



Image 12 <i>Vanga & Apamarga Churna</i>	Image 13 <i>Vanga in a Louha Patra</i>	Image 14 <i>Churna added in molten Vanga</i>	Image 15 Temp. while procedure
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Image 16 Conversion in Powder form	Image 17 Covered with a <i>Sharawa</i>	Image 18 <i>Jarita Vanga</i>	Image 19 <i>Vanga Prakshalana</i>	Image 20 Neutralize pH
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Vanga Marana



Image 21 <i>Jarita Vanga and Ghritakumari</i>	Image 22 <i>Bhavama</i>	Image 23 <i>Chakrika</i>	Image 24 <i>Chakrika's placed in Sharawa</i>
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Image 25
Sharawa Samputa



Image 26
**Sharawa arranged in
Laghu Puta**



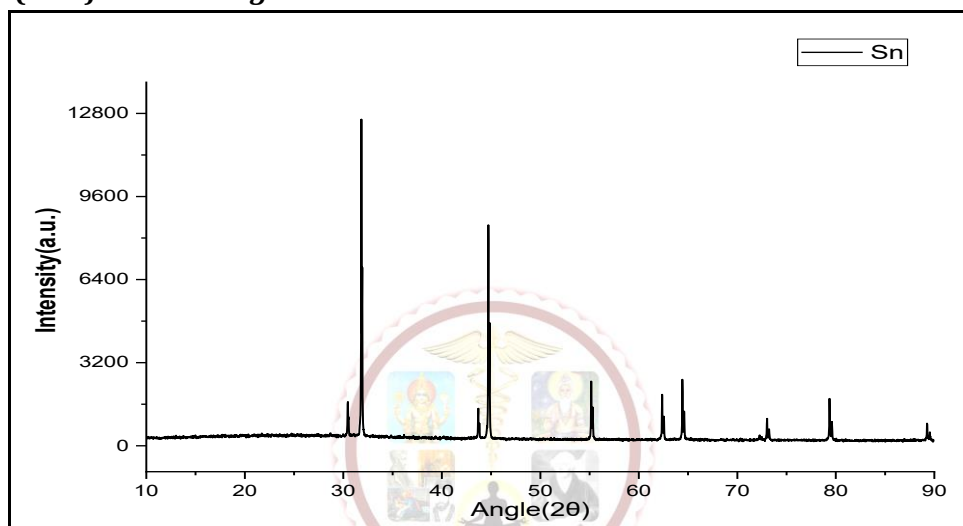
Image 27
Laghu Puta



Image 28
**Chakrika's after 16th
puta**

Analytical Characterisation of *Vanga Bhasma*

X-Ray Diffraction (XRD) of Raw *Vanga*



The XRD pattern recorded for raw *Vanga* showed sharp, high-intensity peaks at 2-theta values of 30.5, 31.82, 43.7, 44.84, 55.2 and 62.38 degrees, corresponding to the crystalline phase of white metallic tin (Sn).

Table 11: Classical Organoleptic and *Bhasma Pariksha* parameters of *Vanga Bhasma*

Parameters	<i>Vanga Bhasma</i>
<i>Roop</i> (Colour)	Soft, Ivory-White
<i>Nischandrika</i>	Positive
<i>Rekhapurnatva</i>	Present
<i>Varitara</i>	Present
<i>Unama</i>	Present
<i>Rasa</i> (taste)	Tasteless
<i>Sparsha</i> (touch)	Fine powder
<i>Gandha</i> (tmell)	Odourless



Image 29
Nischandrika



Image 30
Varitara



Image 31
Rekhapurnatva



Image 32
Unama

Table 12: Physiochemical Parameters of Vanga Bhasma

S.No.	Parameter	Units	Vanga Bhasma
1.	pH. (1% aqueous solution)	-	7.75
2.	Loss on drying at 105°C	%w/w	0.06
3.	Total ash	%w/w	91.68
4.	Sulphated ash	%w/w	87.19
5.	Acid insoluble ash	%w/w	69.54
6.	Water insoluble ash	%w/w	97.06
7.	Alcohol soluble extractive value	%w/w	0.85

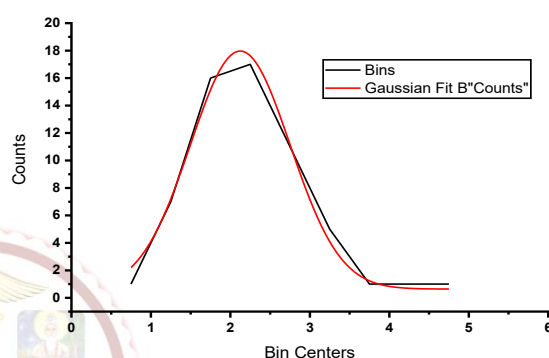
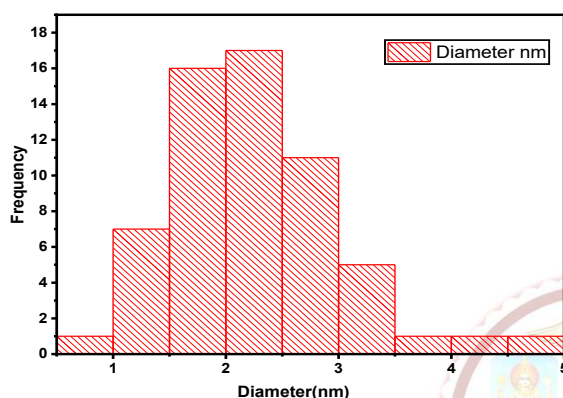
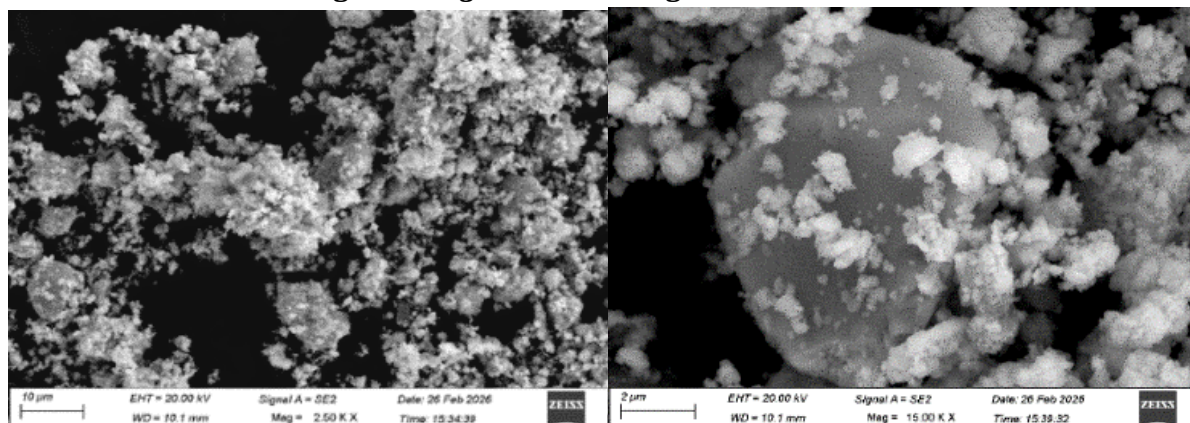
X-Ray Fluorescence (XRF) Elemental Analysis of Vanga Bhasma

Table 13: Value of element in Vanga Bhasma

Compound	Unit	Vanga Bhasma
Mg	Mass%	0.3465
Al	Mass%	0.2622
Si	Mass%	0.8313
P	Mass%	0.0895
S	Mass%	0.0568
Cl	Mass%	0.3244
K	Mass%	0.1054
Ca	Mass%	0.000
Fe	Mass%	0.5865
Cu	Mass%	0.1196
Kr	Mass%	0.4445
Sn	Mass%	96.8333

Scanning Electron Microscopy (SEM) of *Vanga Bhasma*

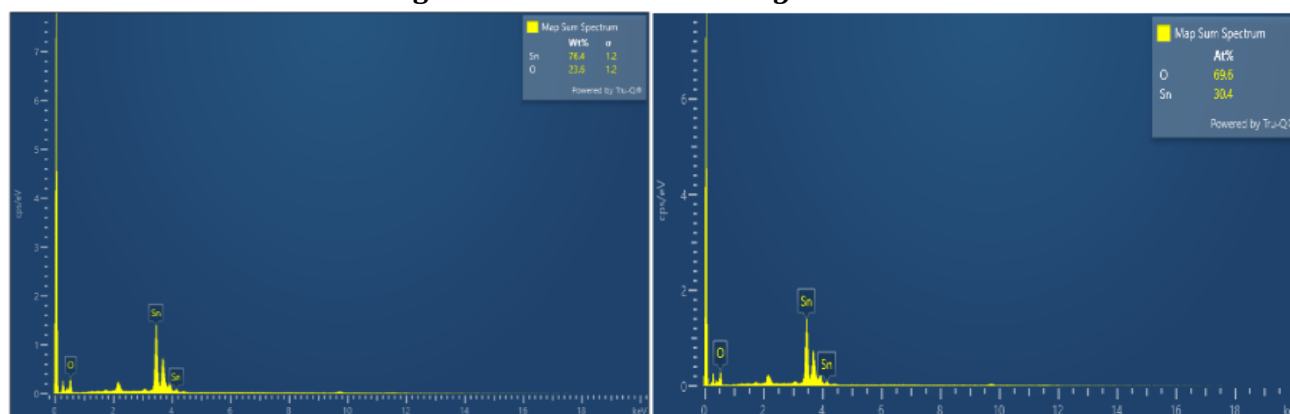
Figure: *Vanga Bhasma* image from SEM scan



SEM data analysed using ImageJ software. Average diameter was calculated by plotting its Histogram and Gaussian distribution function. The Data was plotted in origin software. Average diameter or particle size of *Vanga Bhasma* is 2.12nm. The image reveals irregular, agglomerated micron-sized particles confirming moderate uniformity with limited polydispersity.

SEM-EDS Elemental Spectrum of *Vanga Bhasma*

Figure: EDS Elemental of *Vanga Bhasma*



The elemental mapping shows a uniform distribution of Tin (Sn) and Oxygen (O), confirming excellent Compositional Homogeneity with no phase Separation. Sharp EDS peaks and a near 2:1 atomic ratio indicates high purity and successful conversion to stable Tin Dioxide (SnO_2), ensuring consistent microstructural integrity.

DISCUSSION

The present study traces the complete pharmaceutical transformation of raw *Vanga* from bulk metal to a finished, classically validated *Bhasma*,

and situates the observations made at each stage within the broader rationale of *Rasashastra*. During *Shodhana*, the *Pithara Yantra* used for quenching with

a deep base and a concave upper lid, a design that minimises spillage of molten metal had to be poured into the *Pithara Yantra* without any delay, since even brief hesitation allowed the metal to begin solidifying before it could be properly quenched, compromising the uniformity of the resulting product.

Within *Samanya Shodhana*, the maximum weight loss was observed in *Takra*, followed by other liquid media as the sharp temperature difference between the hot molten *Vanga* and the cold *Takra* caused splashing during quenching, resulting in loss of material. It is always ensured that the quantity of liquid used is greater than the metal, allowing complete and effective quenching of the material. Repeated cycles of heating and rapid cooling disturb the balance between compression and tension, making the metal more brittle, less hard, and finer in particle size.

After *Samanya* as well as *Vishesha Shodhana*, the colour and shape of *Vanga* also show noticeable changes. This process serves as the initial step in the conversion of metal into nanoparticles. The subsequent stages of *Jarana* and *Marana* that prepares it for further pharmaceutical processing. *Jarana* converted the ductile, quenched metal into a friable, oxidised powder through repeated trituration with *Apamarga Panchanga Churna* and controlled thermal exposure, while the fifteenth cycle of *Bhavana* and *Puti* undertaken during *Marana* produced a progressive refinement in colour, texture and particle fineness, culminating in a *Bhasma* that satisfied all the classical parameters- *Rekhaupurna*, *Varitara*, *Unama* and *Nishchandratva*- used to confirm completion of *Marana*.

The instrumental data obtained in this study lend strong support to the classical process outcomes. XRD of raw material confirmed a well-crystallised metallic in phase to processing.

The physiochemical analysis showed an alkaline pH 7.75, very low LOD 0.06%w/w confirming stability and negligible moisture content, High Total Ash 91.68%w/w, Acid insoluble ash 69.54%w/w, Sulphated ash 87.19%w/w, Water insoluble ash 97.06%w/w, reflected the predominance of a stable inorganic matrix formed after repeated *Marana*. The low alcohol soluble extractive value 0.85%w/w suggested the effective removal of organic residues, resulting in a chemically stable inorganic preparation. XRF analyses of the finished *Bhasma* demonstrate a predominantly tin-based composition (96.83mass%Sn) with negligible calcareous or extraneous contamination.

SEM-EDS spectral and elemental mapping data further confirmed that the present in the *Bhasma*

exists in an oxide form, with a near 2:1 atomic ratio of oxygen to tin consistent with stable Tin dioxide phase, and an average particle size (2.12nm) reflecting the extensive particle size reduction achieved through the sequential mechanical and thermal processing of *Shodhana*, *Jarana* and *Marana*.

Taken together, these findings indicate that the classical procedure functions, in modern pharmaceutical terms, as a systematic route for converting bulk metallic tin into a chemically stable, compositionally homogenous, nano-structured oxide formation suitable for therapeutic administration.

CONCLUSION

The *Samanya Shodhana*, *Vishesha Shodhana*, *Jarana* and *Marana* of *Vanga* carried out in this study following the classical reference, produced characteristic, reproducible and stage-wise changes in the colour, lustre, texture, particle size and weight of the metal, culminating in a *Vanga Bhasma* that fulfilled all classical *Bhasma Pariksha* criteria. Instrumental Characterisation by XRD, physiochemical analysis, XRF, SEM and SEM-EDS corroborated this classical observation, confirming successful conversion of metallic tin into a predominantly oxide- phase, nanometric, compositionally homogenous, formulation essentially free of extraneous contamination. The study thereby demonstrates, through an integrated classical and modern analytical approach that the traditional multistage processing of *Vanga* is scientifically consistent and reproducible method for rendering this *Puti Louha* safe and pharmaceutically suitable for therapeutic use, and underscores the value of combining Ayurvedic pharmaceutical methodology with contemporary instrumental analysis.

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