COMPREHENSIVE PHYSICOCHEMICAL ANALYSIS OF VANGA BHASMA

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Abstract

Vanga Bhasma, an important Ayurvedic formulation, is known for its therapeutic properties. Despite its extensive therapeutic application, scientific validation of its safety, efficacy, and standardization remains limited. Researchers are increasingly focusing on conducting rigorous studies to better understand its mechanisms of action and potential benefits. This validation could pave the way for wider acceptance and use of Vanga Bhasma in current medicinal practices. This study presents a comprehensive physicochemical analysis of Vanga Bhasma using classical Ayurvedic methods alongside modern analytical techniques. The preparation process was documented, and the final product was analyzed. The bhasma was characterized by organoleptic properties, pH, loss on drying, ash value, and particle size analysis. Advanced instrumental techniques such as X-ray diffraction (XRD), scanning electron microscopy- energy dispersive X-ray (SEM-EDX), and Fourier-transform infrared spectroscopy (FTIR) were employed to assess the structural, elemental, and functional group characteristics of the final product. The results indicated the presence of nanosized particles with uniform morphology and the absence of free metal, suggesting a complete transformation of the metal. This physicochemical evaluation not only confirms the classical parameters for bhasma but also supports the standardization and quality control of Vanga Bhasma, contributing to its scientific validation and safe therapeutic use

Key words : Vanga bhasma ,Bhasma pareeksha Organoleptic tests , XRD,SEM-EDAX,FTIR, ,particle size

Introduction

Vanga Bhasma, an important Ayurvedic formulation, is primarily derived from Vanga(tin), a metal known for its therapeutic properties. In Ayurvedic medicine, Bhasmas are the preparations created by subjecting a metal or mineral to a complex process of shodhana (purification) and marana (incineration), which transforms the substance into a fine, bioavailable powder.

The significance of Vanga Bhasma lies in its use to manage various health conditions, including reproductive disorders, diabetes, arthritis, and nervous system ailments. It possesses Rasayana

(rejuvenating), Vrishya (aphrodisiac), and shleshma roga nashaka, obesity curing properties.[1] However, despite its widespread use in Ayurvedic practice, scientific data on the precise composition, efficacy, and safety of Vanga Bhasma remains limited.

Vanga Bhasma must be studied critically in order to comprehend its physicochemical properties, identify the active constituents, and establish its pharmacological actions. This study typically involves techniques classical and modern physiochemical tests, instrumental tests such as XRD, SEM-EDAX, FTIR and particle size

In this analytical exploration of Vanga Bhasma, the focus will be on its physico - chemical profile, that ensure its therapeutic potency. The results from such studies are crucial for validating the claims of Vanga Bhasma's health benefits and determining its place in modern medical practices.

Aims and Objectives:

1.) To comprehend Vanga bhasma's ancient and modern physicochemical effects.

2.) To ascertain Vanga bhasma's qualitative and quantitative characteristics using FTIR, SEM-EDAX, and XRD as instrumental tests.

3) To determine the Vanga Bhasma particle size

A.) Preparation of vanga bhasma: -

1. Shodhana: Vanga's samanya shodhana is done by dhalana method in tila taila, takra, kanji, aranala, and kulattha kwatha for seven times[2]. Vishesha shodhana is accomplished by dhalana in haridrayukta nirgundi swarasa[3].

2. Jarana: Vanga jarana is carried out with 1/4th part of yavakuta apamarga panchanga choorna.[4]

3. Marana: Bhasmikarana is conducted by applying bhavana with kumari swarasa and subsequently subjecting it to varaha puta. A total of ten varaha puta are administered to achieve bhasma siddhi lakshana.[5]

B.) PHYSICO CHEMICAL ANALYSIS

1.) CLASSICAL PARAMETERS

Bhasma pareeksha- Classical physico – chemical analysis [6]

a) **Rekha Poornata**: This technique involves rubbing Vanga Bhasma between the thumb and index finger; if it gets into the finger creases, it's referred to as rekhapoornata.

b) **Varitrata**: A test tube filled with water is carefully filled with finely powdered vanga Bhasma; if the Bhasma floats on the water, the varitarata parameter has been satisfied.

c) **Uttama**: If the rice grain floats like Hamsa after being spread on water with Vanga Bhasma, then Mrta Vanga was regarded as Uttama.

d) Niruttha Pareeksha:

Materials: Vanga Bhasma: 2 gm , Pure silver: 2gm

Crucible: 01

Procedure: -Two grams of pure silver and two grams of vanga Bhasma were placed in a crucible and heated to teevragni in a furnace that had an electric blower attached. For ten minutes, heat was applied. The crucible's contents were then removed and poured onto a surface that was clean. Silver was dipped in water, wiped with a cloth, and weighed once it had cooled.

II). MODERN PARAMETERS

A.) PHYSICAL TESTS

1. ORGANOLEPTIC CHARACTERS

Table.01: Showing Organoleptic characters of vanga bhasma

Physical test	Vanga Bhasma
Colour	White
Odour	Characteristic
Touch	Amorphous
Taste	Tasteless
Appearance	Fine powder

2. DETERMINATION OF PH VALUE.[7]

Materials: Vanga Bhasma 2g, pH meter, distilled water, beakers

Preparation of buffer solutions: Dissolve one tablet of pH 4, 7, and 9.2 in 100 ml of distilled water.

Method: One milliliter of the sample was taken, mixed thoroughly with distilled water to make ten milliliters, and then filtered. The experiment was conducted using the filtrate. The device was turned on. The pH meter was allowed to warm up for 30 minutes. First, the pH 4 solution was added, and then, using the knob, the pH was changed to 4.02 for room temperature (30°C). After adding the pH 7 solution, the knob on the pH meter was turned to 7. Without turning the knob, added the pH 9.2 solution and measured the pH. A reading was then recorded after the sample solution was added. The average reading was calculated after the test was administered four times.

3) DETERMINATION OF ASH VALUE [8]

Materials:Silica crucible,Electronic weighing machine, Electric furnace. Vanga bhasma-2 gms

Procedure: Two grams of vanga bhasma were taken, placed in the silica crucible, and ignited for an hour at 450 degrees Celsius in an electric furnace. The crucible was subsequently removed from the furnace, allowed to cool, and weighed. The ash value was computed by weighing the ash after it had cooled.

4. DETERMINATION OF ACID INSOLUBLE ASH [9]

Material:Silica crucible, Burner,Whatman filter paper, electronic weighing machine, dil. HCl - 25 ml,Conical flask.Vanga bhasma—2 gms

Method: 25 ml of diluted HCl was used to digest 2 gm of vanga bhasma for 5 minutes. The mixture was then filtered through Whatman paper and rinsed with water. After being placed in a crucible, the residue was dried, ignited, cooled, and weighed.

5) DETERMINATION OF WATER SOLUBLE ASH [10]

Material:

- Burner,
- Whatman filter Paper,
- Electronic weighing machine,
- Water
- Vanga bhasma -2gms

Method:

25 milliliters of water were used to boil the ash for five minutes. The insoluble material was then gathered in filter paper, cleaned with hot water, and ignited for fifteen minutes at a temperature no higher than 450 degrees Celsius. The water-soluble ash was determined by subtracting the weight of the insoluble material from the weight of the ash. In relation to the air-dried medication, the percentage of water-soluble ash was computed.

6) DETERMINATION OF LOSS ON DRYING AT 110^0C [11]

Materials:

- Silica crucible,
- Electronic weighing machine,
- Hot air oven
- Vanga bhasma -1gm

Method:

A silica crucible containing 1g of vanga bhasma was precisely weighed and heated to 110^0C for three hours in a hot air oven. Weighed again, the weight difference was determined.

B.) CHEMICAL TESTS:

Determination tin, iron and calcium were done by volumetric analysis

C.) INSTRUMENTAL TESTS: -

1.) X-RAY DIFFRACTION [12]

Materials:

- Vanga Bhasma - 1gm
- XRD analyzer.

Method: 1g of the specimen was taken. The material was finely powdered. Using the sample holder, vanga bhasma was put through for reading

2). SEM-EDAX.[13]

Materials include:

• A scanning electron microscope (SEM) equipped with an ED x-ray detector, which gathers and examines fluorescent x-rays from the sample in conjunction with an analyzer, beam source, and pulse processor.

• VB: 1gm.

Method: After that, the samples were put on a slide designed specifically for SEM. The components were scanned after this slide was put in a SEM analyzer.

The display image is taken for the sample. Three distinct regions have been chosen from a single image, and the mass percentage of the elements present in each area has been examined. The mean of these three percentages is then calculated as the

total percentage of the element present in the sample for accuracy.

3.) **FOURIER TRANSFORM INFRARED SPECTROMETRY** [14]

Sample –Vanga Bhasma: 1 gram. preparation of KBr Pellets: Pulverize the solid sample to a fine powder and combine it with powdered potassium bromide (KBr). Using a hydraulic press, compress the mixture into a thin, transparent pellet.
Setup of the instrument: -The FTIR spectrometer has a detector, a sample compartment, an infrared light source, and a computer for collecting and processing data.

Method: -The process involves placing the prepared sample in a sample compartment, allowing infrared light to pass through it and measuring the wavelengths that the sample absorbs. A plot of absorbance (or transmittance) against wavenumber (or frequency) is the resultant spectrum. Determine which peaks in the spectrum correspond to particular chemical bonds or functional groups that are present in the sample. To identify the sample or ascertain its composition, compare the spectrum to known spectra of reference compounds.

4.) PARTICLE SIZE ANALVSIS[15] :

Material: Zeta Potential Analyzer, 3 Samples of Vanga Bhasma – 0.5gm each, distilled water

Method: Two milliliters of distilled water were added to 0.5 grams of the sample in a curette to create a solution, which was subsequently kept in the Zeta Potential Analyzer. The time scale of movement of the scatterers (particles) can be inferred from the particle size distribution found within a specific range of light intensity fluctuations.

Results

Classical tests for VB:

a. Varitaratva: Positive b. Rekha poorna: Positive
c. Unnama: Positive d. Niruttha: Positive

Modern physical and chemical analysis of vanga bhasma

Table02: showing results Modern physical and chemical analysis of vanga bhasma

PARAMETERS	RESULTS
Color	White
Odour	Characteristic
Taste	Tasteless
Touch	Amorphous
Appearance	Fine powder
pH	7.1
Loss On Drying	0.53%
Total ash	99.098%
Acid Insoluble Ash	2.45%
Water Soluble Ash	2.90
Tin	68.35%
Total Iron	1.50%
Ferrous	1.35%
Ferric	0.15%
Calcium	0.71%

Instrumental tests

XRD of Vanga Bhasma

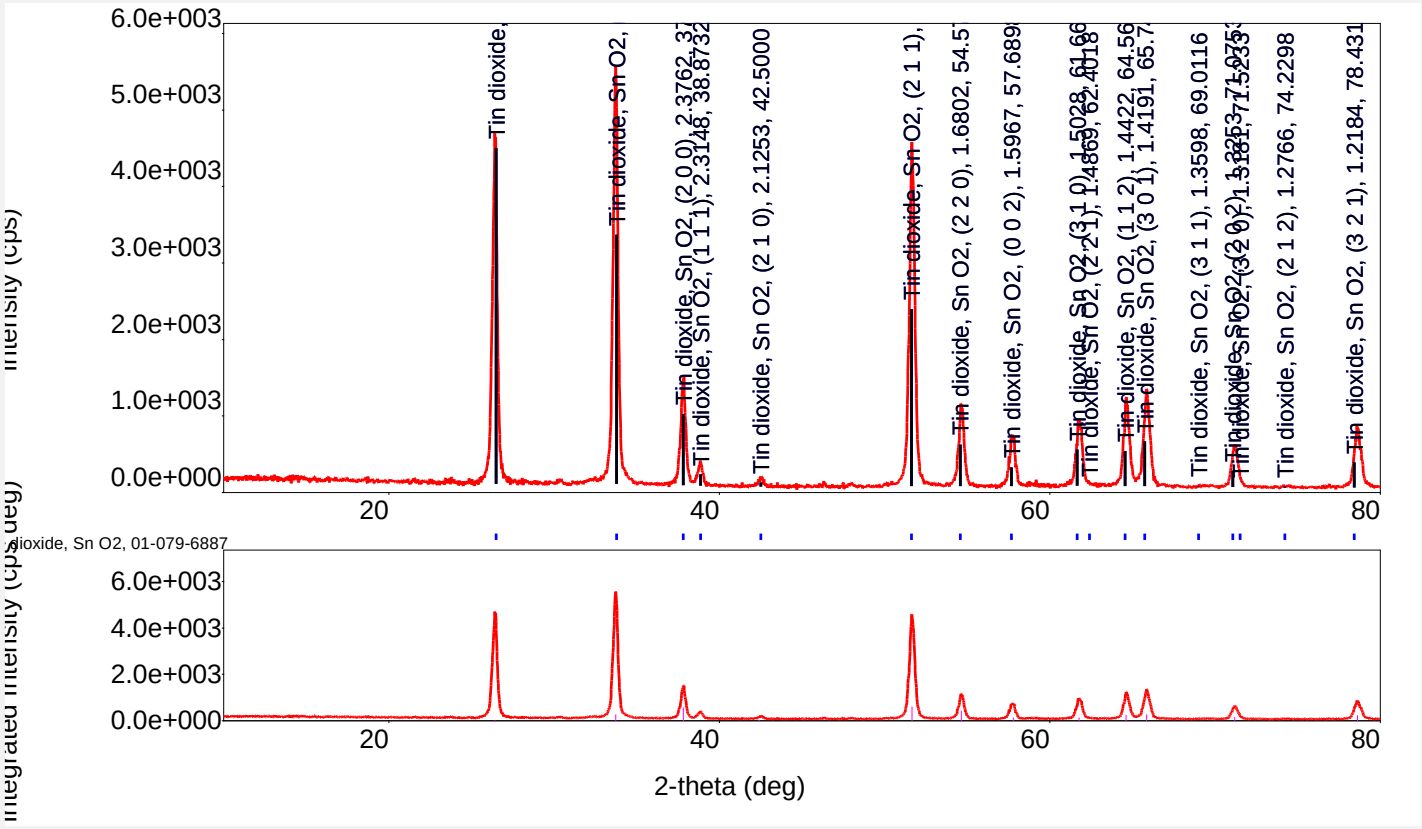


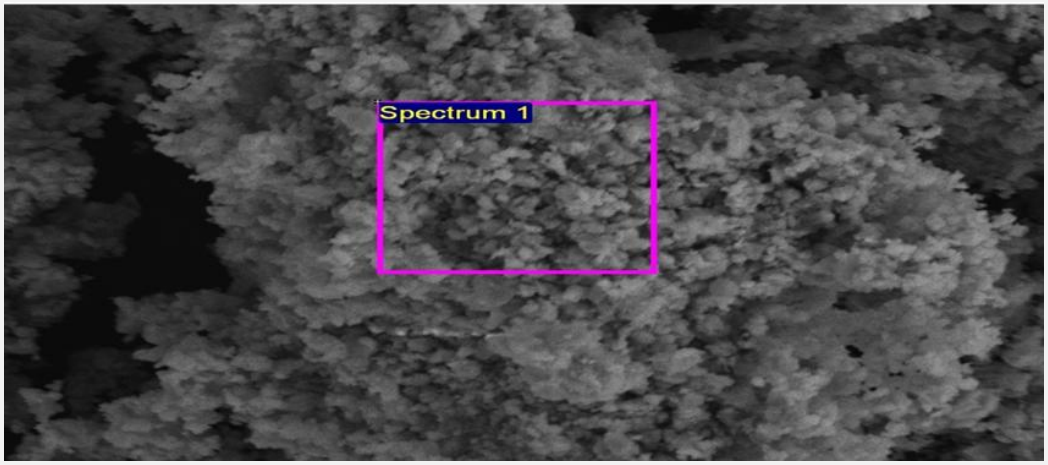
Table 2.a: Displaying Vanga bhasma's Crystal Structure, Chemical Composition, and D-Space Value

Parameters	**D-space**	
Peaks identified by XRD	2.65591 1.67843 1.50064 1.4412 1.41686	3.3709 2.65591
Name	Tin Dioxide	Potassium tin oxide
Composition	SnO2	K2Sn2O3.
Crystal system	Tetragonal	Cubic
Total No. Of Peaks Found	13	13

SEM-EDAX

Table.03: Displaying SEM-EDAX of Vanga Bhasma

Elements	Weight%	Atomic %		Weight%	Atomic %	Mean
C	0.9	0.40		0.9	0.56	0.9
O	25.9	55.30		24.9	55.00	25.4
Mg	0.19	0.21		0.2	0.32	0.195
Fe	1.3	0.24		1.6	0.43	1.45
K	0.9	0.31		0.8	0.23	0.85
Ca	0.8	0.79		0.9	0.65	0.85
N	0.1	1.30		0.09	0.98	0.095
Sn	69.91	41.45		70.61	41.83	70.26



FTIR OF VANGA

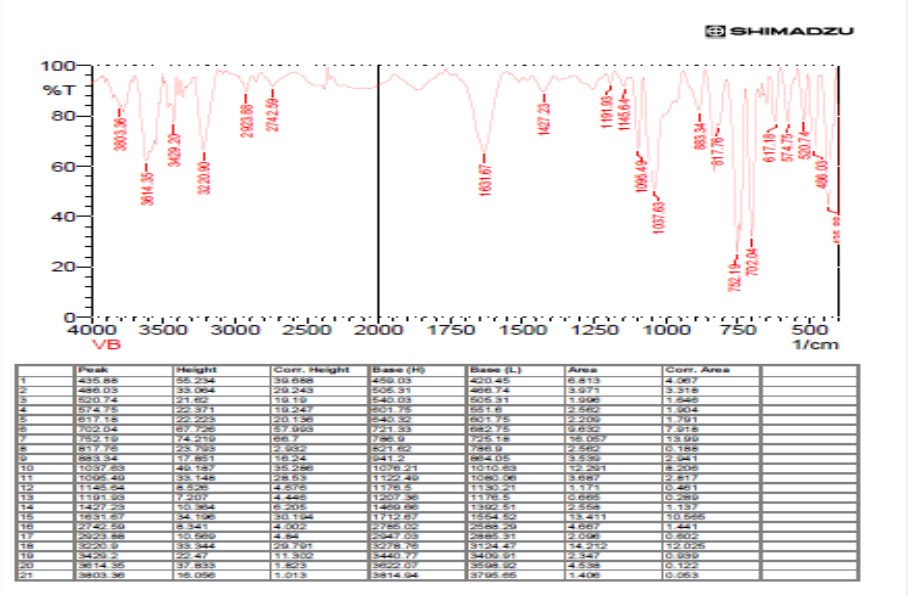


Table. 04: Displaying FT-IR Observations of Vanga bhasma

Sample Peak Frequency Cm^{-1}	Standard Peaks Frequency Cm^{-1}	Specific Type Of Bond	Bond	Functional Group
702.04	700–610	Strong ,broad	–C≡C–H: C–H bend	Alkynes
752.19	900–675	Strong	C–H "oop"	Aromatics
817.76	850–550	Medium	C–Cl stretch	alkyl halides
883.34	900–675	Strong	C–H "oop"	Aromatics
1037.63 1095.49 1145.64	1250–1020	Medium	C–N stretch	aliphatic amines
1427.23	1500–1400	Medium	C–C stretch (in–ring)	Aromatics
1631.67	1650–1580	Medium	C–C stretch (in–ring)	Aromatics
2742.59	2830–2695	Medium	H–C=O: C–H stretch	Aldehydes
2923.88	3000–2850	Medium	C–H stretch	Alkanes
3220.9 3429.2	3330–3270 s	strong, narrow,	C–H: C–H stretch	Alkynes(terminal)
3614.35	3640–3610	Strong ,sharp	O–H stretch	hydroxyl alcohols, phenols

PARTICLE SIZE

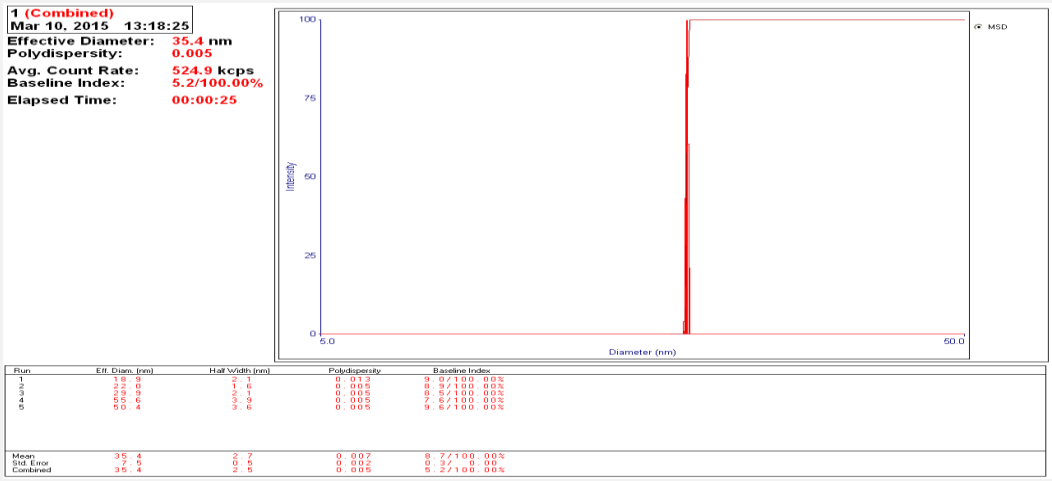


Table.05: Displaying Particle Size of Vanga Bhasma.

Sample	Particle Size	
	Half width diameter	Effective diameter
VB	Mean diameter- 2.7nm Std error-0.5 nm Combined- 2.5nm	Mean diameter- 35.4nm Std error- 7.6 nm Combined-35.4 nm

DISCUSSION[16]

Ancient Parameters:

Rekhapurnata determines microfineness. Varitara had a positive value, meaning it is easily absorbed, due to its extremely low density, which prevents it from breaking the surface tension of water. The Varitara test indirectly reveals the bhasma's smaller particle size. In Unama Pariksha bhasma can float on the water's surface without losing its surface tension because of its large surface area and extremely small particle size. Its capacity to float on water and carry a grain of rice is proof of this.In Nirutha pareeksha Silver's weight remained unchanged, indicates absence of free metal

Modern parameters:

The PH of 7.1 for vanga bhasma suggests that it is not particularly alkaline. The small intestine absorbs weak bases more readily. Because of this feature, Vanga bhasma is a good choice for people looking for a mineral supplement that is easy on their digestive tract. Furthermore, the bioavailability of its advantageous components may be improved by its balanced pH. The pharmacopeial standards are met by the 99.098% total ash of VB, providing information about the bhasma's quality and purity. As per the standards, a considerable portion of the drug dissolves in the acidic medium of the stomach. The medication's potential for silicate contamination is also eliminated.

Loss on drying at 110°C: This physical test determines the sample's average moisture content and, consequently, its shelf life. In order to preserve the drug's effectiveness, a low moisture content denotes improved stability and a longer shelf life. Manufacturers must perform comprehensive moisture content assessments because of this stability, which guarantees that the active ingredients will continue to be effective over time. Understanding these characteristics can also help with handling and storing the product correctly, which will ultimately benefit consumers by increasing dependability and safety. According to the current study, VB has a loss on drying of 0.53% at 110°C. As a result, it can be claimed that VB has the least amount of moisture absorption. and the fewest opportunities for bacterial and fungal growth. Because the drug has less hygroscopic activity, it is less likely to get contaminated.

Chemical Parameters:

The presence of iron and calcium in the sample is because of the use of iron vessels and media used for the preparation of the Bhasma.

Instrumental tests

XRD

VB compared with standard SnO_2: Strong, intense peaks in the Vanga bhasma align with tin dioxide standards.This suggests that vanga bhasma has similar structural properties to SnO_2, which

could indicate its potential utility in various applications, including electronics and catalysis. Further analysis is needed to explore the implications of these findings in practical uses.

VB compared with standard $K_2Sn_2O_3$: The Vanga bhasma's few intense peaks align with potassium tin oxide standards. This correlation suggests that vanga bhasma also possesses properties similar to potassium dioxide that could enhance its performance in specific applications.

SEM EDX:

Accurate elemental identification and quantitative compositional data are revealed by the SEM EDX study.

Vanga bhasma contains the following major elements: Sn, O, Fe, and C; minor elements include C, Mg, K, Ca, Mn, and N.

Tin: From raw to bhasma, the percentage of tin drops by 27.96%. The oxidation reaction, which results in the addition of oxygen molecules and lowers the percentage of tin, is explained by this reduction. Oxygen: The proportion of oxygen has significantly increased. This demonstrates that Bhasma is in the oxide state. Tin is subjected to an oxidation reaction during processing, which results in the addition of oxygen molecules to create tin dioxide.

Aloe vera has been found to contain high concentrations of K, Ca, Mg, P, Cu, and Fe. Mg, K, S, Ca, Al, and N are present in trace amounts in Apamarga. Since these materials used in the Shodhana, Bhavana, and Jarana are enhanced with these elements, the existence of additional minor elements such as Ca, K, Al, Mg, and Mn can therefore be justified.

FTIR

Alkyl halides, alkynes, aromatics, alkyl halides, amines, phenols, hydroxyl alcohols, alkanes, alkynes. and aldehydes are the functional groups found in Vanga Bhasma. Because Kulatha, Godugdha, and Kumari are abundant protein sources, they may contain amines, the primary functional group of all proteins. In addition, amines are a functional group found in urea and uric acid, which are the components of gomutra. Carbohydrates have functional groups called alcohols and aldehydes. Kumari is rich in monosaccharides and polysaccharides.

Particle Size

The dissolution rate is significantly influenced by the particle size. Drugs dissolve more quickly when their surface area is greater and their particle size is smaller. When a drug is transported by blood and lymph from the GI tract to the site of action, its particle size is crucial. A smaller particle size allows for a larger surface area, enhancing the drug's ability to interact with solvents and facilitating faster absorption into the bloodstream. Consequently, optimizing particle size can lead to improved therapeutic efficacy and faster onset of

action for medications. Molecules have a much higher chance of penetrating cell membranes due to the significantly larger absorptive area that is available to them. Drug bioavailability will rise as a result of precise drug delivery brought about by particle size reduction.

CONCLUSION:

All of the traditional Bhasma pareekshas were passed by the prepared Vanga Bhasma, demonstrating a traditional standard procedure and final product (Bhasma). This guarantees both its safety and effectiveness when used medicinally. Furthermore, the consistent quality of Vanga Bhasma underscores the importance of adhering to traditional preparation methods in Ayurvedic practices.

Modern parameters like total ash, pH, and acid-soluble ash indicate the purity of the sample and the possibility of better absorption in the stomach and intestine. Modern parameters like total ash, pH, and acid-soluble ash indicate the purity of the sample and the possibility of better absorption in the stomach and intestine. These factors are crucial for determining the overall quality and efficacy of dietary supplements and pharmaceuticals. By analyzing these parameters, manufacturers can ensure that their products meet safety standards and provide the desired health benefits.

The percentages of tin, iron, and calcium in Vanga bhasma, prepared by this method, are within pharmacopoeia standards. Phase identification of vanga Bhasma by XRD reveals that tin oxide (SnO_2) is the major phase with a tetragonal structure. This structural integrity is crucial for ensuring the efficacy of the preparation. Vanga Bhasma's SEM-EDAX results revealed Sn-70.26%. C, Mg, K, Ca, Mn, and N are minor elements of O, Fe, and C. Numerous functional groups are found in the herbal compounds used for the Shodhana and Marana, according to FTIR analysis.

These findings show the importance of analytical techniques in validating the quality and effectiveness of Ayurvedic formulations. By employing such methodologies, researchers can better understand the complex interactions of herbal components and their potential therapeutic benefits.

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