Vanga Bhasma And Its XRD Analysis

Dr. Rudramma Hiremath
Dr.C.B.Jha
Dr.K.K.Narang

ABSTRACT

Bhasmas are potent Ayurvedic medicaments, biologically active and powerful healing preparations in all aspects. Properly prepared Bhasmas have not reported any serious untoward effects in clinical practice. Vanga Bhasma is an effective Ayurvedic medicine, among various Bhasmas which are classically explained and advised specially in genitourinary disorders. XRD peaks of Vanga Bhasma are identified to be as Tin dioxide (SnO_2).

Key words: *Vanga, Shodhana, Dhalana, Jarana, Marana, Vanga Bhasma, XRD of Vanga Bhasma.*

INTRODUCTION

Bhasmas (herometalic preparation) are complex compound forms of metals or minerals obtained by repeated incineration with herbal extracts. These are administered orally in small amount with suitable vehicle to make them biocompatible. A small quantity of *Bhasma* can be used for wide range of therapeutics. In classical Rasa *shastra* texts various types of *Bhasma* and their indications are described in detail. For *Vanga* also different methods by using herbal, mineral and animal origin drugs are described.

A number of modern technologies are used to know the material characterization of *Bhasmas*. Among them XRD analysis is one of the important technique by which compounds of material and free metals etc can be detected. So in this scientific era it is very essential to determine changes in the material by *Shodhana* (purification), *Marana* (incineration) procedures. By this, one can say authentically the transformation of material in to a compound or orally administrable form.

MATERIALS AND METHOD

Vanga and associated materials are used for the preparation of *Bhasma*. Methods adopted are *Dhalana* (a process where molten tin is poured into specific liquids), *Jarana* (roasting purified tin with *Apamarga* (Achyranthes asper Linn.) *panchanga* (whole parts) in open atmosphere), *Marana* (triturating roasted tin with *Kumari* (Aloe vera Linn.) and heating in furnace) and the references are followed as per classical Rasa Shastra texts[1,2,3].

Shodhana of Vanga: *Samanya Shodhana*[2] (general purification) was done by adopting *Dhalana* process using *Churnodaka* (lime water) for seven times. *Vishesha Shodhana* (specific purification)[1] was done by using *Nirgundi*[4](Vitex nigundo Linn.) decoction mixed *Haridra* (Curcuma longa Linn., Turmeric) powder[4] for three times.

Marana of Vanga: *Marana* procedure was carried out by following *Jarana* process and *Puta* (heating media) process. *Jarana* process was done by heating and rubbing *Shodhita* (purified) *Vanga* along with *Apamarga panchanga* in open atmosphere. *Jarita* (roasted) *Vanga* was triturated with *Kumari* (Aloe vera)[4] juice and incinerated using electric muffle furnace at temperature 600° C maintained for an hour. This was repeated for six times to obtain *Vanga Bhasma* (incinerated tin) with all desired characteristics mentioned in classical literature[5].

X-RAY DIFFRACTION ANALYSIS:

XRD analysis of *Shodhana* samples.

After *Samanya Shodhana* and *Vishesha Shodhana* the obtained product was major quantity of *Vanga* only. XRD peaks of these samples correspond to untransformed tin metal. This was evidenced by presence of strongest Sn peak.

Table 1

Showing 2 θ (°) value of three strongest peaks of Samanya and Vishesha Shodhita Vanga.

Vanga	2 θ (°) value
Raw Vanga	31.921, 44.820, 30.522
Samanya Shodhana	32.061, 30.681, 44.941
Vishesha Shodhana	32.061, 44.921, 30.698

XRD analysis of *Jarana* and *Marana* samples.

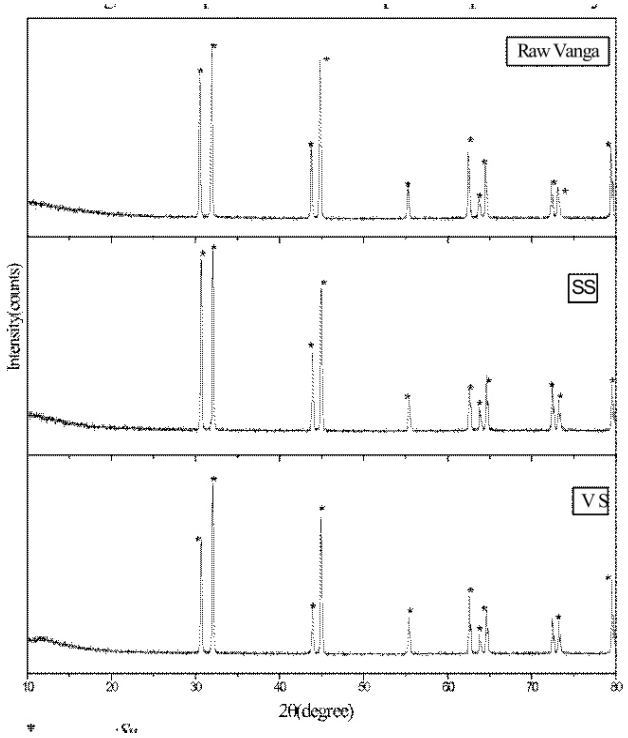
In *Vanga Jarana* sample, the XRD peaks were identified to be as SnO_2 (tin dioxide) and Sn (tin) and $K_2Sn_2O_3$ (potassium tin oxide). The strong peak corresponds to tin dioxide, few weak peaks correspond to unreduced metallic tin and potassium tin oxide peak is very low in intensity.

In XRD of *Vanga Bhasma* sample, the strongest peaks identified to be are SnO_2 (tin dioxide), with a small peak of $K_2Sn_2O_3$ which was followed from *Jarana* process.

CTN No.5373,Plot No.2,2nd Main Road,4th Cross,Basava Colony,Nehru nagar P/O,Bauxite road,Belgaum-590010,Karnataka. Phone No-09480539098 Email:dr_rrhiremath@yahoo.co.in

Graph 1

Graph showing the XRD peaks of *Vanga, Samanya Shodhita and Vishesha Shodhita Vanga*



*: Sn
Raw *Vanga*: Initial material
SS: *Samanya Shodhita Vanga* Using *Churnodaka*
VS: *Vishesha shodhita Vanga* Using *Nirgundi* decoction mixed with *Haridra* powder

Table 2

Showing the two theta (2θ) value of different compounds of *Jarana* process

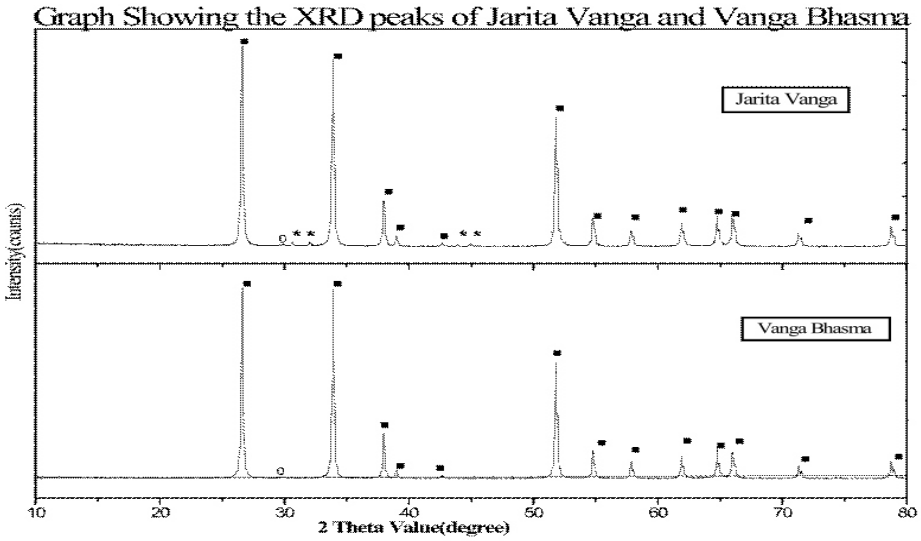
Study	*Jarana* sample (~2θ value)		
	SnO_2	Sn	$K_2Sn_2O_3$
Jarita Vanga	26.618,	30.675	29.922

Table 3

Showing the two theta value of SnO_2 of *Vanga Bhasma* sample.

Product	2θ value of SnO_2
Jarita Vanga	26.618, 33.900, 51.800
Vanga Bhasma	26.619, 33.900, 51.800

Graph 2



• : SnO_2
* : Sn
0 : K_2SnO_3

Jarita vanga : Jarana done with Apamarga
VI sample : Marana with Kumari

Table 4

Showing Particle size of *Jarita Vanga* and *Vanga Bhasma.*

Sample Name	Particle size at maximum peak (nm)
Jarita Vanga	12-47
Vanga Bhasma	53

Particle size analysis:

Particle size analysis was done by using Scherer's equation between maximum to minimum intensity peak.

OBSERVATION AND DISCUSSION:

***Samanya Shodhana of Vanga* (General Purification of Tin)**

Vanga (Tin) was melted at 232°C and poured into lime water. After cooling, it was collected and the same process was repeated for seven times. On seventh pouring some amount of *Vanga* was converted into solid, brittle, bright, silvery colour along with fine particles. Molten *Vanga* on pouring in *Churnodaka* produced loud blasting sound. Greyish slag was seen along with tin. *Vanga* melts at 232° C but the duration of Melting was extended after every *Dhalana* process.

On heating, the Sn-Sn bonds get energized and when plunged into lime water get broken into smaller fragments by reacting with water in which lime is present, resulting in probably, free Sn radicals. These free radicals react further with water producing SnOH (Tin hydroxide). Similarly this type of heating and quenching in lime water, a large amount of slag formed and floats on water or seen floating over molten tin, ultimately converting to $Sn(OH)_4$ floating on surface. This compound, $Sn(OH)_4$ (Tin Tetra hydroxide) may react with $Ca(OH)_2$ (calcium hydroxide) in lime water at high temperature. This compound formation depends on concentration of $Ca(OH)_2$ in Lime water.

Since elemental tin is present along with the hydroxides from the very beginning, there is every likely hood of reactions of lower tin hydroxides like Sn (OH), $Sn(OH)_2$, Sn $(OH)_3$, Sn $(OH)_4$ with lime (calcium oxide, CaO), forming lower stannite.

Since, the XRD analysis of *Samanya Shodhita Vanga* shows the peaks of tin metal (Sn). Their might be transformation of tin into compounds but due to its very small quantity that might not be detected in XRD. These compounds may be present extremely small amounts in slag floating on tin metal. These stannites may therefore cause Loss of products. Due to lime water treatment there seems to be no impurity.

***Vishesha Shodhana of Vanga*: (Special Purification of Tin)**

Tin purified by the general method was heated to melt more than temperature 232° C on electric heater and poured in to *Nirgundi* decoction mixed with *Haridra* powder. The same process was repeated for three times using fresh liquid.

Tin purified by the general method turns to slight yellowish green color, shiny, brittle along with fine particles at the end of special purification process. Turmeric powder adhered to tin catches fire during heating, forms carbonaceous material and floats over molten tin. Molten *Vanga* when comes in contact of liquid produces loud blasting sound. Melting duration of *Vanga* was extended on every *Dhalana* procedure due to presence of carbonaceous material.

The constituents of *Nirgundi patra* (leaves)[6] are a glycoside 2'-p-hydroxybenzoylmussaenoisdic acid two blycosidic iridoids viz nishindaside and negundoside, 5,3'- dihydroxy-7,8,4', and 5,3' dihydroxyy-6,7,4'-trimethosyflavononones, two flavonoids viz. 5-hydroxy-3,6,7,3'4-pentamethosyflavone and 3,5' dihydroxy 3,4'6,7 tetramethoxyflavonol.

Chemical Constituents of *Haridra*[6] are the major chemical constituents are curcuminoids (approx 6%) the yellow colouring principles of which curcumin constitutes 50-60%. essential oil (2-7 %) with high content of bisabolane derivatives. The minor components include desmethoxycurcumin, bidesmehtoxycurcumin, dihydrocurcumin, phytosterols, fatty acids, polysacharides.

The active components in these chemicals containing groups such as COOH- (carboxylic acid group), -OH- (phenolic group) may behave as acids and deprotonate to react with tin at high temperature.

When molten tin is added to decoction of *Nirgundi* mixed with *Haridra* powder, free metal particles of tin were generated during heating may react with water to give, Sn $(OH)_2$, Sn $(OH)_3$, Sn $(OH)_4$ compounds. Further these compounds may react with organic chemicals containing COOH- (carboxylic acid group), -OH- (phenolic group) present in *Nirgundi* decoction or *Haridra* powder, but due to their very small quantity that might not be detected in XRD. So the XRD analysis of the *Vishesha Shodhita Vanga* shows the peaks of Tin metal (Sn).

Procedure of *Jarana* (Roasting):

The *Vishesha Shodhita Vanga* was taken in an iron pan, heated between at the temperature 600°C - 700°C. *Apamarga panchanga* coarse powder is added little by little and rubbed with back of ladle with pressure. The process continued till it turned to powder form completely. This is known as *Jarita Vanga* (roasted tin).

When *Apamarga* is added to molten *Vanga*, immediately it burns and becomes carbon. While rubbing molten *Vanga* along with *Apamarga*, initially the whole material was changed into black powder form, later its colour turned to black Grey colour. When Jarana process finished, the whole material was turned to whitish grey powder, known as *Jarita Vanga*.

Since the plant chemicals added to *Vishesha Shodhita Vanga* were reacted with *Apamarga.* One fourth quantity of *Apamarga* was used up to 8-10 hrs heating at 600 ° C -700° C. All the organic matter was expected to burn out. The reactive components of Achyranthes aspera helped in further disintegrating of tin particles into tin compounds in open air/ atmosphere. These tin compounds may be finally converted into SnO_2 (tin dioxide), potassium stannite and potassium stannate.

Because potash is the main constituent of Achyranthes aspera[4, 6] which would give potassium oxide (alkali) at high temperature. Formation of tin compounds depends upon the amount or concentration of potassium oxide which reacts with tin during *Jarana* process. The final products may be SnO_2 (tin dioxide), potassium stannite/ potassium stannate. $K_2Sn_2O_2$ (potassium tin oxide), K_2SnO_2 (potassium stannite), $K_2Sn_2O_3$ (potassium stannite), K_2SnO_3 (potassium stannate), Sn (Free metal/ tin).

But on examining the XRD spectra of *Jarita Vanga*, we find that SnO_2 is the main product. Only 2-3 very weak peaks related to tin (Sn) are seen. Besides one very weak peak corresponding to $K_2Sn_2O_3$ is observed.

Procedure of *Marana* (Incineration):

Jarita Vanga (Roasted Tin) was triturated with *Kumari* (Aloe vera) juice till it turned to semi solid form. Pellets were made, dried and kept in furnace at 600° C maintained for one hour. The same process was repeated for six times to get *Bhasma* as described in Ayurvedic classics. The colour of product turned to white after second heating. After fifth *Puta* the *Bhasma* passed the Ayurvedic test, *Sukshma* (minute), *Niswadu* (tasteless), *Rekhapurnata* (the particles of *Vanga Bhasma* should enter into furrows of fingers) as well as partially *Varitara* (*Vanga Bhasma* particles should float on the surface of water) test. After sixth *Puta Varitara* test was also observed in the *Bhasma.*

The constituents of Aloe vera[6] are - Hydroxyanthraquinone-barbaloin (a mixture of aloin A & B, the diastereoisomeric 10 C glucoside of aloe- emodin anthrone), γ - hydroxyaloin isomers. Other constituents include aloe emodin, chrysophanol, chromone derivatives- aloeresin B with its p-coumaryl derivatives oleoresin A and C and the aglycone aloesone, pH 4.5, Water- 99-99.5 %, Solid materials- Vitamins, Minerals, Enzymes, Sugars, phenolic compounds, Lignin, Saponins, sterols, amino acids, salicylic acids.

The reactions between tin compounds in Aloe vera are speculated as SnO_2, $K_2Sn_2O_2$, K_2SnO_2, $K_2Sn_2O_3$, K_2SnO_3.

The XRD spectra of *Vanga Bhasma* shows that all peaks identified are SnO_2 (tin dioxide) compound and very weak

Table 5

Showing the three strongest XRD peaks of *Vanga Bhasma*

1st Strongest Peak 2θvalue	2nd Strongest Peak 2θ value	3rd Strongest Peak 2θ value
26.619	33.901	51.800

peak identified is $K_2Sn_2O_3$. Weak peak of Tin (Sn) which was Seen in XRD of *Jarita Vanga* sample was not seen in *Vanga Bhasma.*

CONCLUSION:

Metallic preparations offered many advantages over plant drugs by virtue of their stability over a long period, lower doses, easy storability and sustained availability. In the *Samanya and Vishesha Shodhita* samples of *Vanga,* two theta values of XRD peaks shows the untransformed tin metal (Sn). Significant structural or chemical changes may not occur during *Shodhana* (Purification) process. The presence of trace level extraneous element in *Vanga Bhasma* is due to the medium in which they are prepared and that probably help in enhancing its potency. *Apamarga (Achyranthes aspera)* is rich in potash reacts with tin forms compound. Tin will oxidize quickly when treated with alkali in presence of heat and open atmosphere.

Jarana (Roasting) process also capable to disintegrate *Vanga* and helps for the formation of compound. This process which is pre stage of *Marana* (Incineration) suggests that, the compound or product obtained by heating and processing *Vanga* with *Apamarga* leads to a mixture of SnO_2 (tin dioxide), Sn (tin), $K_2Sn_2O_3$ (potassium tin dioxide) seen in XRD analysis.

Vanga Bhasma formed by processing *Jarita Vanga* with Kumari (Aloe vera) gives the compounds SnO_2 (tin dioxide), $K_2Sn_2O_3$(potassium tin dioxide).

The free metallic tin which was seen in *Jarita* sample was completely turned into compound form during *Marana* procedure when *Jarita Vanga* was treated with Aloe vera at 600° C. Hence it was not seen in XRD analysis of *Vanga Bhasma* sample.

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