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SEM-EDAX Analysis of *Jarita Vanga* and *Vanga Bhasma*

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ABSTRACT

Use of *Vanga Bhasma* can traced back from ancient era. Detailed description regarding the procedure is available in various Rasagranthas. *Jarana* is a special technique mentioned in recent *Rasa* treatises for *Puti Lohas* which is an intermediate stage between *Shodhana* and *Marana*. In this study, after performing both *Samanya* and *Vishesha Shodhana*, *Vanga* was subjected to *Jarana* using *Ashwatha Twak* as per the reference of Rasa Tarangini followed by *Prakshalana* to remove its alkaline nature. Later *Vanga* was subjected to *Putapaka* using *Bhavana Dravya* as *Kumari Swarasa*. Organoleptic and Elemental constitutions of both *Jarita Vanga* and *Vanga Bhasma* where analysed to see the differences and to observe the changes due to *Samanya Shodhana* and *Vishesha Shodhana*.

Key words: *Samanya Shodhana, Vishesha Shodhana Vanga Jarana, Vanga Bhasma, SEM-EDAX.*

INTRODUCTION

References of *Vanga* can be traced back from the ancient literature; Vedas. Even though Brihatryis mentioned the therapeutic use of *Vanga*; detail knowledge of preparation of *Vanga* can be found in Rasagranthas. *Vanga* is one among the *Puti Lohas* among classification of *Dhatu*. Here *Puti* indicated the obnoxious odour. Unlike other metals, these set of metals possess low melting point and there is an intermediate procedure called *Jarana* in between *Shodhana* and *Marana*. Through high heating procedure; in this procedure *Vanga* will change from its metallic nature completely in to powder form making *Marana* easier. *Vanga* will be losing it metallic characters both physically and chemically. Physical changes can be assessed through Organoleptic tests where as chemical changes can be assessed through instrumental analysis (SEM-EDS, XRD, FTIR etc.).

Since both the *Jarita Vanga* and *Vanga Bhasma* are in powder form it becomes a need to find the differences. State of the metal has to be assessed to analyse the safety levels and here this study has been conducted to analyse and to compare the physical and chemical changes of *Jarita Vanga* and *Vanga Bhasma*.

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AIMS AND OBJECTIVES

1. To identify genuine sample of *Vanga*
2. To subject *Vanga* for *Samanya Shodhana* and *Vishesha Shodhana*
3. To subject *Vanga* for *Jarana*
4. To subject *Jarita Vanga* for *Marana*
5. To compare *Jarita Vanga* and *Vanga Bhasma* Analytically using SEM-EDAX

MATERIALS AND METHODS

The raw material of *Vanga* was collected from Amrit Kesari Deppo, Bengaluru and examined for *Grahya Lakshana.* Other ingredients like Tila *Taila, Kulatha,*

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Haridra, Gomutra, Ashwatha Twak were collected from local market. *Takra, Kanji, Kulatha Kwatha, Nirgundi Swarasa* and *Vanga Bhasma* were prepared in teaching pharmacy of Sri Sri College of Ayurvedic Science and Research, Bangalore. SEM-EDAX analysis was carried out in CIF innovation (MAHE-MIT).

Preparation of *Vanga Bhasma*

Preparation of *Vanga Bhasma* can be listed in three stages i.e.

a) *Shodhana* - *Samanya* and *Vishesha*

b) *Jarana* and *Prakshalana*

c) *Marana*

SHODHANA

Samanya Shodhana[1]

Materials

Vessels, *Darvi, Pithara Yantra,* Spoon, weighing scale, measuring jar

Method

Asuddha Vanga is taken in a *Darvi* and heated. When it's completely melted, poured into *Kanji* through *Pithara Yantra.* After cooling down *Vanga* is collected from *Kanji*, dried and weighed. This process is repeated for 3 times in each of *Kanji* (Sour gruel), *Takra* (Butter milk), *Kulatha Kwatha* (Decoction of horse gram), *Gomutra* (Cow's Urine) and *Tila Taila* respectively.

Vishesha Shodhana[2]

Materials

Vessels, *Darvi, Pithara Yantra,* Spoon, weighing scale, measuring jar.

Method

Samanya Shodhita Vanga is taken in a *Darvi* and heated. When it's completely melted, poured into *Haridrayukta Nirgundi Swarasa* through *Pithara Yantra*. After cooling down *Vanga* is collected from media, dried and weighed. This process is repeated for 3 times.

Vanga Jarana[3]

Materials

Kadahi, Gas stove, Weighing machine, Sharava, Ladle, Pyrometer

Method

Shudha Vanga is taken in a *Kadahi* and heated till it melted. *Ashwatha Twak Churna* which is properly dried was added little by little to the melted *Vanga* along with continuous stirring. Stirring was continued till all the metal converted in to powder form. All these powders were collected to the centre of the *Kadahi* and covered with a *Sharava*. *Teevragni* was given continuously till it became red hot. In between; *Sharava* lifted and checked for the colour of the *Vanga*. When all the metallic particles were converted into powder form; heating was stopped and allowed to self-cool. Later, its collected and weighed.

Prakshalana[4]

Jarita Vanga samples were washed in water to remove *Ksharatwa*.

Procedure: *Jarita Vanga* samples were kept in 4 parts of water and left overnight.

Next day morning water portion decanted, and this procedure was repeated until it becomes neutral in pH. Decanted water was collected and checked for pH changes.

MARANA[5]

Materials

Weighing machine, Measuring jar, Sharava, Kora cloth, Multan mitti, Pyrometer

Method

Jarita Vanga was taken in a porcelain *Khalwa* and 70 ml of *Kumari Swarasa* was added and *Mardana* was done till it became a thick paste which is suitable for making *Chakrika*. After preparing *Chakrika* it was dried well and weighed. *Chakrika* was kept in *Sharava* and *Sandhibandhana* was done and kept for drying. After complete drying, it was subjected to *Laghuputa*. In the pit, 2/3rd *Vanopala* was filled and then *Sharava*

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Samputa kept over that. Later, remaining 1/3rd *Vanopala* was filled and ignited using little *Karpura*. After complete burning, allowed to cool and next day when it cooled completely; taken out to collect *Vanga*. Collected *Vanga* was weighed and this procedure was repeated till *Bhasma Lakshana* appeared.

Observation and Results

Table 1: Total weight of *Vanga* taken for *Shodhana*

1.	Total *Vanga* taken before *Samanya Shodhana*	800 g
2.	Total *Vanga* after *Samanya Shodhana*	660g
3.	Total weight loss	140g
4.	Weight loss in percentage during *Shodhana*	17.5%
5.	Total quantity of *Vanga* remaining after *Shodhana* in %	82.5 %

Table 2: Showing changes in *Vanga* and liquid media after *Samanya Shodhana*

SN	Media	Changes in *Vanga*	Changes in media
1.	*Kanji*	On melting, coloured layer and black charred particles appeared on top of melted *Vanga*. A sudden sound was heard while pouring melted *Vanga* to *Kanji.* *Vanga* became a hard mass.	Foul smell was emitted during heating. Splashing sound produced during quenching. It was spilling out while quenching. While melting black soot like substances appeared on the surface.
2.	*Takra*	Layer appeared on top while liquifying Sudden sound was heard while quenching	Foul smell felt during melting and quenching. Supernatant layer of Media became black in colour.
3.	*Kulatha Kwatha*	*Puti Gandha* felt with less intensity Black soot appeared on top during melting which was removed. Brownish layer formed after *Dhalana* After washing also little bit brownish layer of kwatha still remained.	Loud and sudden cracking sound Black particles seen on top.
4.	*Gomutra*	After *Dhalana* *Vanga* became very clean thorny and bright. Cracking sound was observed. *Puti* Gandha while heating.	Fumes and froth were observed during quenching. Colour of media unchanged. Spilling out, of media observed during quenching.
5.	*Tila Taila*	In between darvi containing *Vanga* caught fire during 2nd and 3rd time of melting. Not much *Puti Gandha* was observed except burnt smell when it caught fire. Unlike other media, *Vanga* obtained was smooth mass with blunt ends.	No cracking sound no splashing out while quenching. Took longer time to cool.
6.	*Kanji*	On melting, coloured layer and black charred particles appeared on top of melted *Vanga*. A sudden sound was heard while pouring melted *Vanga* to *Kanji*. *Vanga* became a hard mass.	Foul smell was emitted during heating. Splashing sound produced during quenching. It was spilling out while quenching. While melting black soot like substances appeared on the surface.
7.	*Takra*	Layer appeared on top while liquifying Sudden sound was heard while	Foul smell felt during melting and quenching. Supernatant layer of Media became black in

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		quenching	colour.

Temperature of media

Table 3: *Vanga* - temperature and pH of the media

SN	Media	Temperature		pH of media
		Before	After	
1.	Kanji			3.35
2.	Takra	26	43	4/3.99
3.	Kulatha kwatha	38	54	5.91
4.	Gomutra	28	35	9.22
5.	Tila taila	26	48	-

Vishesha Shodhana

- Smell of *Nirgundi Swarasa* appreciated during *Nirvapa*.
- Colour of the media changed to darker.
- *Vanga* became more brittle with sharp edges.
- More smaller particles observed after *Shodhana*.
- It was little hard to extract and to clean *Vanga* from the media.
- Shining reduced.

Table 4: Showing results of weight of *Vanga* before and after *Vishesha Shodhana*

Quantity of *Vanga* taken for *Vishesha Shodhana*	402 gm
Quantity of *Vanga* obtained after *Vishesha Shodhana*	385 gm
Total weight loss	17 gm
Weight loss in percentage	4.22%
Quantity of *Vanga* obtained after *Vishesha Shodhana*	95.78%

Jarana

Vanga became completely liquified after 3 min of heating. After addition of *Ashwatha Churna*, initially all *Churna* became black and burnt. Later, after 20 minutes it started to turn in to grey and then to greyish white. When *Churna* was added it burnt and emitted smoke, which got ceased after some time. *Vanga* remained separate from burnt *Churna* initially and later it turned to smaller particle. *Vanga* was slowly losing it mobility. After 1hr 6 min *Vanga* completely turned in to grey *Churna*. After 22 min of subjecting to *Tivragni*, it started becoming red hot. After 4 hr 10 min of tivragni it completely became red hot.

- Quantity of *Shodhita Vanga* taken for *Jarana* : 385 gm
- Quantity obtained after *Jarana* : 442 gm
- Weight gain in percentage after *Jarana* in % : 1.5%

Precautions

- Only dried *Ashwatha Twak Churna* should be used.
- *Ashwatha Churna* should be added little by little. Once a part of *Churna* added, next part should be added only after cessation of fumes.
- Better to use a ladle of long handle and mask to escape from fumes.
- While adding *Churna* try to maintain *Madhyamagni*.
- *Tivragni* should be started only when all the *Vanga* particles and *Churna* mixed and turned completely in to powder. No metallic particle should be visible.
- Maximum heat should be provided for *Tivragni* till the bottom of the vessel visibly turn red.

Prakshalana

Table 5: Showing pH of *Vanga* after each wash

SN	No. of washing	pH
1.	After 1st wash	11.80
2.	After 3rd wash	9.13
3.	After 5th wash	7

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Marana

Table 6: Showing observations during *Marana*

No. of Puta	Quantity of *Vanga* (gm)	Q. of *Kumari Swarasa* (ml)	Weight of *Chakrika* (gm)	After Puta (gm)	Loss (gm)/ Gain
1.	221	70	235	213	7
2.	213	65	205	207	6
3.	207	60	225	206	1
4.	206	60	238	204	2
5.	204	60	207	205	1(Gain)
6.	205	60	228	201	4
7.	201	60	221	196	5
8.	196	60	205	190	6
9.	190	60	200	183	7
10.	183	60	192	169	14
11.	169	60	185	163	5
12.	163	50	185	159	4
13.	159	50	168	156	3
14.	156	40	165	147	9
15.	147	40	171	143	4

Table 7: Showing organoleptic characters during *Marana*

SN	Touch	Colour	Taste	*Varitara*	*Unnama*
1.	Rough	Greyish white	Slight Alkaline	-	-
2.	Rough	Greyish white	Slight Alkaline	-	-
3.	Rough	Greyish white	Slight Alkaline	-	-
4.	Rough	Dull white	Tasteless	-	-
5.	Softer	Dull white	Tasteless	-	-
6.	Softer	Dull white	Tasteless	-	-
7.	Softer	Dull white	Tasteless	-	-
8.	Soft	Dull white	Tasteless	-	-
9.	Soft	Dull white	Tasteless	-	-
10.	Soft	White	Tasteless	-	-
11.	Soft	White	Tasteless	-	-
12.	Soft	White	Tasteless	-	-
13.	Soft	White	Tasteless	-	-
14.	Fine	White	Tasteless	_	_
15.	Very Fine	White	Tasteless	+	+

Quantity taken for *Putapaka* : 220 gm

Quantity obtained : 143 gm

Percentage of loss : 35%

ANALYTICAL RESULTS

Figure 1: SEM-EDAX Elemental Constitution of *Jarita Vanga*

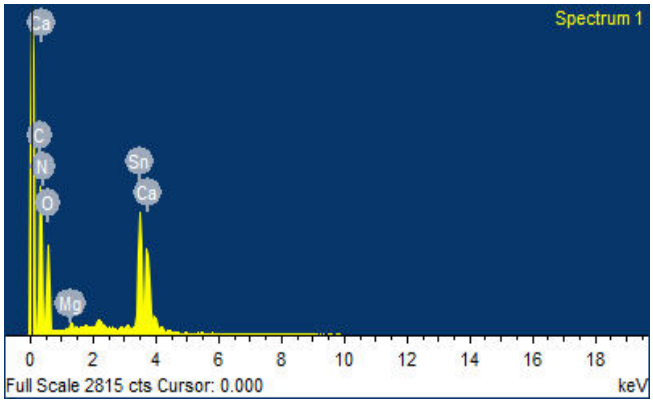

Table 8: SEM-EDAX - Elemental Constitution of *Jarita Vanga*

Element	Weight %	Atomic %
C K	11.58	26.09
N K	1.11	2.14

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O K	33.77	57.13
Mg K	0.50	0.56
Si K	0.31	0.30
Ca K	3.93	2.65
Sn L	48.80	11.13

Figure 2: SEM-EDAX Elemental Constitution of *Vanga Bhasma*

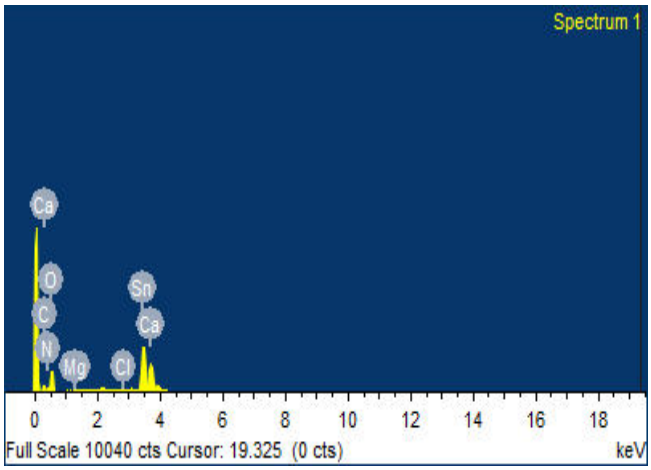


Table 9: SEM-EDAX-Elemental Constitution of *Vanga Bhasma*

Element	Weight %	Atomic %
C K	7.41	18.21
N K	1.32	2.79
O K	33.75	62.28
Mg K	0.43	0.52
Si K	0.42	0.44
Ca K	3.40	2.50
Sn L	53.27	13.25

Images of *Vanga Shodhana* and *Marana*

Melting of Vanga

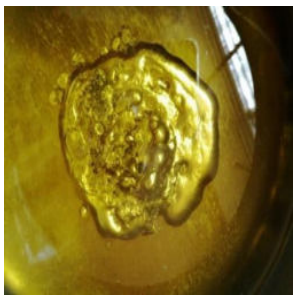
Dhalana

After Shodhana

After Dhalana in takra

After Dhalana in kulatha kwatha

After Dhalana in gomutra



After Dhalana in Tila taila

Nirgundi Swarasa and Haridra Churna

After Dhalana

Vanga and Ashwatha

Vanga getting red-hot

After Jarana Twak Churna

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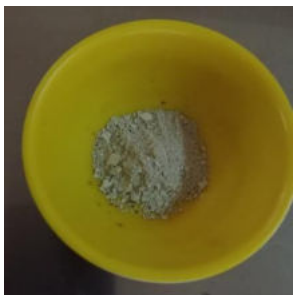
Prakshalana

Vanga and Kumari Swarasa

Chakrika

Marana

After 1st puta



Vanga Bhasma

Rekhapurnata

Varitara and Unnama

DISCUSSION

Vanga is one among *Dhatu Varga* which possess low melting point. *Shodhana* is the procedure which removes impurities from substances and reduces particles size. It can even attribute new qualities to the metal and makes *Marana* easier. Here *Vanga* has underwent both *Samanya* and *Vishesha Shodhana* through which hardness has reduced to an extent. In *Samanya Shodhana* due to repeated heating and quenching in acidic and alkaline media has increased the brittleness of *Vanga*. More over lot of impurities came out during liquefaction which were mixed with *Vanga* and invisible earlier. Especially after Dhalana in Gomutra *Vanga* became So clear and brittle. Maximum of impurities could be removed by *Samanya Shodhana*.

Table 10: *Vanga* - Media pH evaluation and properties

SN	Media	pH	Character	Properties - pH evaluation
1.	*Kanji*	3	Acidic	It is *Tikshna, Samghata-Bhedana* and *Shaithilikaran* May causes softening and breaking of the material
2.	*Takra*	4	Acidic	Similar as *Kanji*
3.	*Kulatha Kwatha*	5.6	Acidic	*Ashmari Bhedana* property Can cause breakdown the particles easily
4.	*Gomutra*	9.22	Alkaline	*Dahana* and *Pachana* properties. So, it may cause worn-out of the material, Can eradicate unwanted substances.
5.	*Tila Taila*			*Sukshma* and *Ashukari* by these Easy break down of material as it can enter into minute spaces of the substance and quicker action due to *Ashukaritwa*.

Through *Vishesha Shodhana* through *Haridrayukta Nirgundi Swarasa*, left out impurities were removed. *Vanga* became more brittle and more small particles were observed.

Jarana is an intermediate stage between *Shodhana* and *Marana*. Here *Ashwatha Twak Churna* was used for *Jarana*. *Vanga* was turned completely in to powder form and was greyish white in colour.

Vanga was heated continuously in a temperature ranging from 450˚C - 550˚C because of which Molecular bonds might have loosened. *Ahwatha Twak Churna* which was added little by little might have

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entered the intermolecular space and due to continues heat; and pressure from ladle may have led to breakage of the bonds and converted in to greyish-white powder.

On the next stage *Vanga* was covered with a *Sharava* and heated continuously till it attains red-hot. This created a closed space concentrating maximum of the temperature toward *Vanga*. Through this controlled combustion, *Vanga* was turned in to greyish white ash. Because of the open heating earlier, *Vanga* was reacting to environmental Oxygen due to which analytical reports showed maximum Oxygen content.

As *Jarita Vanga* was highly alkaline in nature (pH-11.80) it was subjected to *Prakshalana*. After 5th *Prakshalana* pH turned neutral. *Marana* has changed the greyish-white powder in to white colour might be because further heating took place. After 15th puta, *Vanga* passes *Rekhapurna, Varitara* and *Unnama Parikshas* indicating *Laghuta* of the product. After analysis, Oxygen content was maximum (62.28%) in *Vanga Bhasma.* Where as in *Jarita Vanga* oxygen content was less than *Vanga Bhasma*. Percentage of Sn was more in *Vanga Bhasma* (13.25%) and in *Jarana* it was (11.13%). Carbon content in *Vanga Bhasma* was more (18.21%) compared to *Jarita Vanga* (11.58%) indicating more organic content in *Bhasma*. *Jarita Vanga* shows presence of Ca (3.93%) might be because of *Ashwatha Twak Churna* added in equal quantity for *Jarana*.

Conclusion

By means of organoleptic examination no metallic particles were visible in both *Jarita Vanga* and *Vanga Bhasma*. Later was smooth and soft compared to former. *Jarita Vanga* didn't pass the *Varitara* and *Unnama Bhasma Pariksha* where as *Vanga Bhasma* passed *Rekhapurna*. *Varitara* and *Unnama Parikshas* which indicates lightness of the product. Even though the metal was transferred to completely powdered form, it was not passing the *Bhasma Pariksha*. Through instrumental analysis, we can assess that *Vanga* is in oxide form and absence of any heavy metal which is safe for ingestion. percentage of Sn present in *Bhasma* sample was higher than *Jarita Vanga* sample. Ca content was noted in both the samples. It might because of the use of *Ashwatha Twak Churna* extensively during *Jarana*. Carbon content was noted and is higher in *Vanga Bhasma* samples indicating organic contents. Mg content was observed in *Vanga Bhasma*; might be because of the use of *Kumari* in *Putapaka*. When a herbo-mineral mixture is incinerated in closed vessels, the nano-oxide particles will be converted in to a more favourable oxidation form for human consumption.[6-8]

On gross Analysis of data obtained through organoleptic and instrumental aids; it can be said that *Vanga Bhasma* seems to be safer to consume and was passing all the *Bhasma Parikshas*. *Jarita Vanga* on the other hand was powdered completely during *Teevragnipaka* and still *Guru* compared to *Bhasma*. It was not completely passed *Rekhapurna*, *Varitara* and *Unnama Parikshas*. Whereas *Bhasma* was very soft in touch so can be taken for therapeutic purposes.

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