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Pharmaceutico - Analytical Study of Vimala Bhasma

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ABSTRACT

Background - Pharmacopoeia of Ayurveda comprises of drugs derived not only from herbs but also from metals, minerals and animal products. Rasa Shastra an Indian alchemy, is a branch of Ayurveda dealing with therapeutic utilization of metals and minerals.

Vimala is one among the maharasa, which has a prime importance in both dhatuvada and dehavada. Bhasmeekarana is a process by which a bio-incompatible substance is made biocompatible by certain samskaras. Evolution of bhasma kalpana took place by virtue of its easy absorption, assimilation and quick action with higher therapeutic efficacy by lower dosage.

In the context of vimala, acharayas have explained the bhasmeekarana of vimala by puta method, which posses the wide range of therapeutic actions like vrushya, atirasayana and indicated in many diseases like prameha, arsha, yakshma, pandu etc

Materials and Methods: Vimala, Haratala, Gandhaka selected as per grahya lakshana and subjected to Shodhana. In the preparation of Vimala Bhasma, Shodhita Haratala & Shodhita Gandhaka are mixed with Vimala. Bhavana with Jambeera swarasa should be done and Subjected to Gajaputa. Analytical study: Analytical study of Vimala Bhasma was carried out with classical and modern parameters. The present study pharmaceutico – analytical study of vimala bhasma was conducted to see the changes in vimala when subjected to various analytical procedures before and after Marana

Results: Yield of Vimala Bhasma is 73.6% . It was also analysed by using modern instrumental analysis like XRD, EDX SEM and particle analysis, NPST.

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KEYWORDS: *Vimala bhasma, Iron pyrite, Shodana, Marana*

INTRODUCTION

Ayurveda is a highly evolved and codified system of life and health science based on its own unique original concepts and fundamental principles. The Ayurvedic drugs may be herbal, mineral, metals, herbomineral, gems, precious stone, animal.

Rasashastra has laid much more importance on '*Rasayana* concept of *Ayurveda.* This concept was found during the time of *Samhita* and number of Herbs were possessing *Rasayana* properties. But, in the period of *Nagarjuna,* number of metals, minerals, gems, few poisons drugs were recognized to possess these properties. On the other hand, Rejuvenation and disease cure, gave rise to the non-mercurial preparations like *Ayaskrti, Pisti, Bhasma* etc. But in the due course of time *Bhasma* got developed in both the aspects ie. with and without the use of *parada* in *Bhasma* preparation. Further progress of the concept of *Ayaskriti* led to the well developed form of *Bhasma.*

Initially, *Bhasma* was revolved only around metals but later it was applied to minerals too. It got popular day by day due to its unique assimilatory organometallic constitution.

By keeping in mind, all the related factors, it has been decided to work on Vimala[1] which is one among the maharasa, which has a prime importance in both dhatuvada and dehavada. *Vimala Bhasma*[2] is rare, unique mineral preparation prepared by Puta method. It is used as substitutes of *Makshika.* The product

obtained by this process is having the main action of *Rasayana* as well as *Vajeekarana*. It is indicated especially in *Pandu, Kamala. Yakshma, Grahani, Dhatugata jwara etc.*

METHODOLOGY

Reference – Ayurveda Prakasha

Equipments - Khalva yantra, mrutika sharava, weighing machine, cora cloth, pyrometer, spoons, cowdungs, mud pot, brush.

Preparation of Vimala Bhasma –

1. Raw materials were collected after authoritative and identification through grahya lakshana.
2. Gandhaka Shodhana was carried out by kurmaputa method.[3]
3. Haratala Shodhana was carried out by kushmanda swarsa by swedana method.[4]
4. Vimala Shodhana was carried in vasa swarasa by swedana method.[5]
5. Vimala bhasma was carried by nimbu swarasa as bhavana dravya and subjected to 15 gajaputa.[2]

Dose – 3 ratti

Anupana – Gritha

Indication – twak roga, prameha, pandu, dhatugata jwara, kamala, yakshma, kasa, swasa, shotha.

RESULTS

Pharmaceutical Results:

Table no 01: Showing results of Gandhaka Shodhana

Batch no.	Weight of *Gandhaka* before *shodhana*	Weight of *Gandhaka* after *shodhana*	Loss	Yield %
Batch I	500gms	468gms	32gms	
	468gms	447gms	21gms	
	447gms	426gms	21gms	85%
Batch II	500gms	473gms	27gms	
	473gms	444gms	45gms	
	444gms	410gms	34gms	82%
Batch III	500gms	486gms	14gms	
	486gms	440gms	46gms	
	440gms	410gms	30gms	82%

Table no 02: Showing results of Haratala Shodhana

Quantity of *Haratala* taken	Quantity of *Haratala* obtained	Loss	Yield %
1000gms	995gms	05gms	99.5%

Table no 03: Showing results of Vimala Shodhana

Quantity of *Vimala* taken	Quantity of Vimala obtained	Loss	Yield %
1450gms	1416gms	34gms	97%

Table No.04: Showing results of *Vimala Marana*

Puta No.	Drugs used and its quantity	Peak temp. (^{0}C)	Weight of Chakrika	
			before	after
1st puta	*Vimala:* 1416gms *Shodhita Gandhaka*: 177gms *Shodhita Haratla* :177gms *Nimbu swarasa:*350ml	834^{0}C	1840gms	1332gms
2nd puta	*Vimala:* 1332gms *Shodhita Gandhaka*: 166gms *Shodhita Haratla* :166gms *Nimbu swarasa:*600ml	740^{0}C	1736gms	1358 gms
3rd puta	*Vimala:* 1358gms *Shodhita Gandhaka*: 169gms *Shodhita Haratla*: 169gms *Nimbu swarasa* 550ml	850^{0}C	1786 gms	1402 gms
4th puta	*Vimala:* 1402gms *Shodhita Gandhaka*:175gms *Shodhita Haratla*: 175gms *Nimbu swarasa* 550ml	752^{0}C	1867 gms	1390 gms

5th puta	*Vimala:* 1390gms *Shodhita Gandhaka*: 173gms *Shodhita Haratla*: 173gms *Nimbu swarasa* 610ml	710^{0}C	1835 gms	1416 gms
6th puta	*Vimala:* 1416gms *Shodhita Gandhaka*: 177gms *Shodhita Haratla* :177gms *Nimbu swarasa* 550ml	437^{0}C	1851 gms	1400 gms
7th puta	*Vimala:* 1400gms *Shodhita Gandhaka*: 175gms *Shodhita Haratla*: 175gms *Nimbu swarasa* 550ml	780^{0}C	1877.5 gms	1363 gms
8th puta	*Vimala:* 1363gms *Shodhita Gandhaka*: 173.3gms *Shodhita Haratla*: 173.3gms *Nimbu swarasa* 560ml	900^{0}C	1864.5 gms	1276 gms
9th puta	*Vimala:* 1276gms *Shodhita Gandhaka*: 159.5gms *Shodhita Haratla* :159.5 gms *Nimbu swarasa* 700ml	789^{0}C	1560 gms	1363 gms
10th puta	*Vimala:*1363gms *Shodhita Gandhaka*: 173.3gms *Shodhita Haratla* :173.3gms *Nimbu swarasa* 700ml	715^{0}C	1489 gms	1282gms
11th puta	*Vimala:* 1282gms *Nimbu swarasa* 600ml	865^{0}C	1475 gms	1197 gms
12th puta	*Vimala:* 1197gms *Nimbu swarasa* 520ml	700^{0}C	1325 gms	1168 gms
13th puta	*Vimala:* 1168gms *Nimbu swarasa* 480ml	820^{0}C	1364 gms	1080 gms
14th puta	*Vimala:*1080gms *Nimbu swarasa* 450ml	662^{0}C	1380gms	1044 gms
15th puta	*Vimala:* 1044gms *Nimbu swarasa* 380ml	700^{0}C	1199 gms	1043 gms

Table No.05: Showing results of *Vimala Marana*

Quantity of *Vimala* taken for *Marana*	Quantity of *Vimala* obtained after 15 puta	Loss	Yield %
1416gms	1043gms	373gms	73.6%

Table No.06: Showing organoleptic characters of Vimala Bhasma during Marana

	Color	Taste	Odour	Touch	Lusture
2nd puta	Black	Metallic	Metallic with mild sulphur	Smooth	Present
5th puta	Black	Metallic	Metallic with mild sulphur	Smooth	Prsent
10th puta	Reddish brown	Tasteless	Odourless	Smooth	Absent
15th puta	Reddish brown	Tasteless	Odourless	Smooth	Absent

Table No.07: Showing Classical parameters of *Vimala Bhasma* during *Marana*

	Rekha purnata	*Varitartva*	*Nishchandratva*	*Unnama*
2nd puta	Negative	Negative	Negative	Negative
5th puta	Negative	Negative	Negative	Negative
10th puta	Positive	Negative	Positive	Negative
11th puta	Positive	Partially Positive	Positive	Partially Positive
15th puta	Positive	Positive	Positive	Positive

ANALYTICAL STUDY RESULTS

PHYSICAL TEST

Table No.08: Showing organoleptic characters of Vimala bhasma

Physical test	*Vimala bhasma*
Colour	Reddish brown
Odour	Odourless
Taste	Tasteless
Touch	Fine
Appearance	powder

Table No.09: Showing results of p^H, Ash value, Acid insoluble ash, Water soluble ash and loss on drying at 105^0C.

Parameters	*Vimala bhasma*
P^H Value	9.8
Ash Value	85%
Acid Insoluble Ash	26%
Water Soluble Ash	8%
Loss on drying at 105^0C	0.38%

MICROBIAL LIMIT TEST

A. Total fungal count

Table No.10: showing results of Total fungal count

Sl. no	Samples	Dilutions	Colony forming Units/ml
01	*Vimala bhasma*	Direct	3CFU/ML

Limits - < 10CFU/ML

B. Total bacterial count

Table No.11: Showing results of Total bacterial count

Sl. no	Samples	Dilutions	Colony Forming Units/ml
01	*Vimala bhasma*	Direct	2CFU/ML

Limits - < 10CFU/ML

CHEMICAL TESTS

1. X-RAY DIFFRACTION STUDY

Table No.12: Showing XRD report of *Vimala bhasma*

2-Theta	d	Intensity
24.104(5)	3.6891(8)	4736(154)
26.48(3)	3.363(3)	338(41)
26.588(5)	3.3499(6)	1397(84)
29.83(2)	2.993(2)	418(46)
33.110(3)	2.7034(2)	16299(285)
35.581(2)	2.52114(17)	11709(242)
39.197(13)	2.2965(7)	300(39)
40.814(5)	2.2091(3)	3426(131)
43.43(3)	2.0817(13)	294(38)
49.421(4)	1.84265(15)	4879(156)
54.023(3)	1.69607(8)	6226(176)
57.576(12)	1.5996(3)	1155(76)
62.398(5)	1.48703(10)	3648(135)
63.944(6)	1.45476(12)	3505(132)
69.552(10)	1.35053(17)	334(41)
71.74(5)	1.3147(7)	158(28)
71.921(9)	1.31175(15)	1007(71)
75.452(8)	1.25889(11)	644(57)
77.697(13)	1.22803(17)	289(38)
80.66(3)	1.1902(3)	408(45)

2. SCANNING ELECTRON MICROSCOPY (EDX) STUDY.

Table No.13: Showing SEM EDS result of *Vimala bhasma*

Sample/ Element	O		C		Fe		Mg	
	Wt. %	Atomic %	Wt. %	Atomic %	Wt. %	Atomic %	Wt. %	Atomic %
Vimala bhasma	28.3	50.0	6.12	14.4	60.0	30.3	0.48	0.55

Sample/ Element	Al		Si		K		Ca	
	Wt. %	Atomic %	Wt. %	Atomic %	Wt. %	Atomic %	Wt. %	Atomic %
Vimala bhasma	1.06	1.11	2.47	2.49	0.89	0.64	0.60	0.43

3. PARTICLE SIZE ANALYSIS:

Table No.14: Showing results Parcticle size analysis of *Vimala bhasma*

Sample	Mean diameter(nm)
Vimala bhasma	1167.4 nm

4. FTIR ANALYSIS:

Table No. 15: Showing results of FTIR of *Vimala bhasma*

Sample peaks Cm^{-1}	Bond	Functional groups
3400.97	O-H (stretching)	phenols
2142.39	-SCN	Thiocyanate
1036.77	CN (stretching)	Primary amine
572.16	C-I stretch	aliphatic iodo compounds
563.46	C-I stretch	aliphatic iodo compounds
554.91	C-I stretch	aliphatic iodo compounds
481.9	S-S stretch	Aryl disulfides
473.29	S-S stretch	Aryl disulfides

5. NPST -

Table No.16: Showing Observations during NPST

Sample	I phase(0-5min)	II Phase(5-20min)	III Phase (20 min-1hrs)
Vimala bhasma	Dark blue coloured central spot with irregular margins. Colour of Intermediate area was light blue. Slight greenish Periphery	Dark blue coloured central spot with irregular margins. Colour of Intermediate area was light blue. Slight greenish Periphery	Dark blue coloured central spot with irregular margins. Colour of Intermediate area was light blue with whitish ring Slight greenish Periphery.

DISCUSSION

Vimala shodhana –

- *Vasa swarasa* was used for *Vimala Shodhana* by *Swedana* method.
- The color of *Vimala churna* after *swedana* was slight brighter than before. There was 34 gms of weight loss in this procedure, which might be due to the foreign particles and there may be a possibility of weight loss while washing with hot water.

Gandhaka Shodhana –

Gandhaka Shodhana was done by Kurmaputa method, using milk as a media.

Melting of Gandhaka:

- Sulphur can melt at two different temperatures
- If heated rapidly, it melts at 112.80C
- But if heated slowly it will melt only at 118.60C
- In this case Sulphur is melted by steady rise of temperature i.e., by the second way. At this temperature, sulphur melts to form a light-yellow liquid. At this point the S8 molecules are separating. In this form the atoms are covalently bonded (sharing electrons with one another) to form rings of eight. These rings slide easily over one another but can't connect or tangle, which is why the liquid is not viscous. When this light-yellow molten sulphur is poured into milk it solidifies as crystalline sulphur.

Godugdha as a media

- Guru – snigdha guna and sheeta veerya of godughdha pacifies the Teekshna, Ushnaguna of Gandhaka.
- The organic sulphur present in the protein of milk might have a role in increasing bioavailability of inorganic sulphur.
- Immersing the Molten Sulphur in to milk may cause, higher porosity, lower mechanical strength, and increase in the crystal size of Sulphur.
- Since raw milk is the commonly recommended antidote for poisoning, it might help in neutralizing the sulphur poisoning.
- Shuddha Gandhaka was brittle and shiny, may be due to the change in crystalline structure while passing through the stage of melting.
- The impurities like mud or any other material gets separated on the cloth as these impurities do not melt or change at this temperature.

***Haratala shodhana* by *Swedana*:**

- Leaching of arsenic in aqueous media: as it is well known fact that Arsenic partially leaches in water upon heating, may release Arsine gas, even humidity also helps the phenomenon.
- It is known that solubility of Arsenic trisulphide increases in sulphide solutions and more in alkaline sulphide solutions. Released Arsine gas may form several organo-arsenic compounds with liquid media, thus reducing arsenic content.
- Arsenic dissolution increases in sulphide solutions and due to the formation of H_2S gas while heating, sulphide solution of several trace elements, sulphurous acid in traces may get formed thus facilitating further leaching of Arsenic in to the liquid media for *Swedana.*

***Vimala Marana*:**

- In the present study the Marana procedure adopted was from Ayurveda Prakasha reference. Here *Vimala* mixed with 1/8th Part of Shodhita Haratala and1/8th part of Shodhita *Gandhaka*, after Jambeera Swarasa *Bhavana*, chakrikas are prepared, kept in Sharava sam*puta* and Gaja*puta puta* was given.
- Shoditha *Haratala* and Shoditha *Gandhaka* are selected as *maraka dravyas*. The probable reason for selecting dual drugs as *maraka dravyas* could be:

These medias helps to reduce the *Kathinata* of the *dhatu.* Corrosive nature of *Haratala* will helps to fastening of reaction as well as particle size reduction. As it has the *Yogavahi* property it helps to breakdown the molecules into very small.

- As both of them contains Sulphur which helps to change metal into Sulphide and other compound form & also it make the final *bhasma* product therapeutically more effective.
- In present study, Shodhita *Haratala* and Shodhita Gandhaka were added initial 10 gaja *puta*s in the preparation of V.B, but stopped for remaining 5 *puta*s. Because of by adding extra gandaka and haratala to *vimala*, they will convert the *Vimala* into ferrous Sulphide & ferrous Oxide. Hence the Colour of *bhasma* will changes to Black colour. So, to get proper colour to *Bhasma* by taking expert opinion addition was stopped.
- Iron when ignited with extra sulphur, sulphides are formed which predominantly are black in colour. (FeS, Cu2 S, CuS – Black). *Puta* without *Gandhaka* along with organic minerals in *Nimbu swarasa* aids in oxidation leading to formation of reddish colour.
- Sulphur act as better media in particle size reduction.

DISCUSSION ON ANALYTICAL STUDY

pH value

The pH value of *vimala bhasma* is 9.8.The alkalinity of drug indicates the site of absorption and action of drug. Alkaline environment in which the major component of drug exists in unionized form, facilitates their absorption in intestine.

Total Ash Value:

Vimala bhasma was evaluated for ash value and it was found 85%**.** which indicates the presence of inorganic residues such as phosphates, carbonates and silicates present in herbal drugs. This may be due to the addition of trace elements during the process of *bhavana.*

Acid insoluble ash

Vimala bhasma was evaluated for acid insoluable ash and it was found to be 26%

It signifies that a considerable amount of drug is soluble in the acidic media of stomach.

Water soluble ash

Vimala bhasma was evaluated for water soluable ash and it was found to be 8%

As the values are least and indicates that water is not soluble media for it.

Loss on drying at 110^0c

Vimala bhasma was evaluated for loss on drying and it was found to be 0.38%

Hence it can be stated that all have very less amount of moisture content and very rare chance of bacterial and fungal growth.

Microbial Limit Test:

Total fungal count of *Vimala bhasma* is 3CFU/ML which is within limit i.e less than 10CFU/ML.

Total bacteria count of *Vimala bhasma* is 2CFU/ML which is within limit i.e less than 10CFU/ML

XRD

The XRD findings of *Vimala Bhasma* are almost similar to JCPDF standards which indicates that there is no change in chemical constituents and their form during the process of *bhavana* except for that it adds on the organic constituents in the product.

SEM EDX

Elements found in *Vimala Bhasma* are O, C, Fe, Mg, Al, Si, K, Ca in the percentage of 28.3, 6.12, 60.0, 0.48, 1.06, 2.47, 0.89 and 0.60 respectively. This shows that Iron is in greater proportion and the elements may be in the form of oxides and sulphides.

FTIR:

The obtained peaks of the *Vimala Bhasma* were compared with the standard peaks. It showed the presence of different functional groups like phenols, Thiocyanate, Primary amine, aliphatic iodo compounds.

This shows the presence of organic compounds in the drug.

Particle size Analysis (by ZetaPals method):

- Mean Particle size of *Vimala Bhasma* is 1167.4 nm
- The particle size has an important influence on dissolution rate. Smaller the drug particle size larger the surface area, leads to faster dissolution.
- Particle size reduction will result in precise drug delivery and there by increasing the bio availability of the drug.
- It can be inferred that the repeated *Bhavana*(trituration) and *Puta* (Incineration) aided in reducing the particle size of the samples.

N.P.S.T.:

- N.P.S.T is a modification of circular paper chromatography. N.P.S test gives a clear differentiation of individual products in a group and also product can be identified by its classical name not by the chemical name.
- The continual chemical reactions taking place gradually between 2 chemical substances on static media at fraction of second and also after certain interval of time are easily detected by their distinct colour changes and the pattern of spot.
- NPST of Vimala Bhasma in 3rd phase showed dark blue colored central spot with irregular margins. Colour of Intermediate area was light blue with whitish ring Slight greenish Periphery.

CONCLUSION

- *Vimala bhasma* – ferrous oxide or ferrous sulphide, having properties like *vrishya, atirasayana*. And indicated in *twak gata roga, vrana, dhatugata jwara, shotha, pandu, prameha, aruchi, shula, kamala, yakshma*. Shodhana and Marana is an essential step before usage, which will modify the raw drugs into safe, bio-active, therapeutic form.

- Physical tests showed Vimala Bhasma is reddish brown in colour with pH of 9.8.
- NPST of Vimala Bhasma in 3rd phase showed dark blue colored central spot with irregular margins. Colour of Intermediate area was light blue with whitish ring Slight greenish Periphery.
- Elements found in *Vimala Bhasma* are O, C, Fe, Mg, Al, Si, K, Ca in the percentage of 28.3, 6.12, 60.0, 0.48, 1.06, 2.47, 0.89 and 0.60 respectively.
- The XRD findings of *Vimala Bhasma* are almost similar to JCPDF standards.
- The obtained peaks of the *Vimala Bhasma* were compared with the standard peaks. It showed the presence of different functional groups like phenols, Thiocyanate, Primary amine, aliphatic iodo compounds.
- Mean Particle size of *Vimala Bhasma* is 1167.4 nm

Further experimental and clinical studies are needed to prove the effect of Vimala Bhasma on different diseases in which it has been indicated

FIGURES

FIG. NO. 06
RAW VIMALA

FIG. NO. 07
SWEDANA IN VASA SWARASAA

FIG. NO.08
VIMALA AFTER SHODHANA

FIG. NO. 09
ASHODHITA GANDAKA

FIG. NO. 10
KURMAPUTA FOR GANDHAKA SHODHANA

FIG. NO. 11
SHODHITA GANDHAKA

FIG. NO. 12
ASHODITA HARATALA

FIG. NO. 13
SWEDANA IN KUSHMANDA

FIG. NO. 14
SHODHITA HARATLA

FIG. NO. 15
VIMALA + GANDAHAKA + HARATALA

FIG. NO. 16
CHAKRIKA NIRMANA

FIG. NO. 17
SHARAVA SAMPUTA

FIG. NO. 18
GAJA PUTA

FIG. NO. 19
CHAKRIKA AFTER 1ST PUTA

FIG. NO. 20
CHAKRIKA AFTER 10TH PUTA

FIG. NO. 21
CHAKRIKA AFTER 15TH PUTA

FIG. NO. 22
VIMALA BHASMA

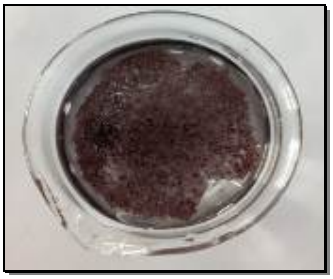

FIG. NO. 23
VARITARATVA

FIG. NO. 24
UNNAMA

FIG. NO. 25
REKHAPURNATVA

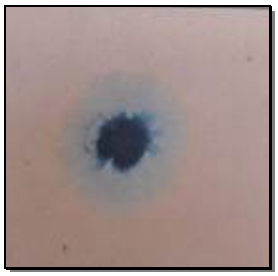

FIG. NO. 26
VB AFTER 5 MIN

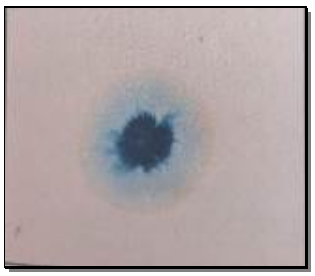

FIG. NO. 27
VB AFTER 20 MIN

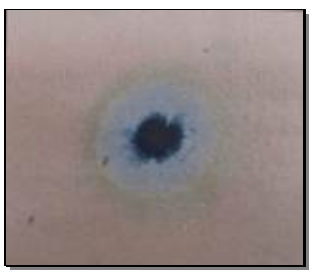

FIG. NO. 28
VB AFTER 20 HRS

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[6] Acharya Shree Vaagbhata. Rasa Ratna Samuchchayah: with Siddhiprada Hindi commentary by Prof. Siddhinandan Mishra. Varanasi: Chaukhambha Orientalia; 2019, 5th chapter, Lohavarga, Verse 53, 243pp.