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ORIGINAL RESEARCH ARTICLE

Analytical Assessment of Rajata Bhasma

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ABSTRACT

Rajata (Silver) Bhasma is prepared and analyzed on various parameters; 99.56% pure Silver was subjected to samanya and vishesha shodhana with lemon juice, it was converted to tiny pieces and triturated along with equal quantity of Hingulottha Parada and lemon juice for 6 hrs. The coarse powder was then triturated with Shuddha Gandhakato obtain Kajjali. Rajata Kajjali was subjected to Kupipaka in Valukayantra in the quantity of 250 gm in each Kupi. A total 4 samples were prepared, after self-cooling the bottom material was subjected to Putapaka procedure for the preparation of Rajata Bhasma. Each sample was triturated with half a quantity of Shuddha Gandhaka and Kumari Swarasa, used as Bhavana Dravya. The lumped material obtained was converted into Chakrika and subjected to the Puta (Heating System) in the E.M.F. (Electric Muffle Furnace). Appropriate temperature for the preparation of Rajata Bhasma was 500 – 550^{O} C. For every Puta, the same procedure was repeated upto the desirable characteristics of the Rajata Bhasma. In each sample required the number of Puta varied i.e. 17 Puta, 12 Puta, 11 Puta and 9 Puta. All the samples were jet black in color though slightly lustrous particles were also observed. Atomic Emission Spectroscopy with Inductively Coupled Plasma (AESICP) was conducted with AESICP of Rajata Bhasma 17 Puti, 73.594% silver was found, while sulphur was present at 17.246% which may be in sulphide form of silver. Quantity of iron, copper and platinum was 0.43585%, 0.29944% and 0.0014752% respectively.

Key words: Rajata Bhasma, Gandhaka, Parada, AESICP.

INTRODUCTION

Bhasma Kalpana is a unique part of Ayurvedic Rasashastra. It is a method of converting metals into metallic Bhasma. Metallic Bhasmas are well known for its quick effectiveness, smaller dose and a long shelf life. However if these bhasmas are not well prepared and analyzed they can be toxic to human body. Therefore Bhasma Pariksha is given in Ayurveda to confirm the well prepared metallic Bhasma, but in this era we need to analyze the Bhasmas on modern parameters too to make it acceptable globally. So in this study prepared Rajata (Silver) Bhasma is analyzed on various parameters i.e. ayuvedic parameters including Namburi Phased Spot Test, physical and chemical parameters and some modern parameters like, particle size distribution and A.E.S.I.C.P. (Automic Emission Spectroscopy and Inductively Coupled Plasma). Results indicate that the advanced modern parameters are really the necessity to understand the Bhasma scientifically.

Rajata Bhasma – Ayurvedic Parameters – Physico Chemical Parameters – Particle Size Distribution – Automic Emission Spectroscopy with Inductively Coupled Plasma.

Ayurveda has clearly defined the analytical techniques collectively called Bhasma Pariksha. Further Bhasma Pariksha is divided into following sub methods dependent of the requirement. (**Table 1**) Most of the Ayurvedic methods for Analysis are qualitative and subjective. It is a myth that metallic Bhasma is an oxide of a particular metal.

Thus, the Analytical presentation of Ayurvedic metallic Bhasma on the basis of modern parameters has become the need of time as it allows us to study the quality, potency and assists in negating toxicity, thus allowing the study to

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achieve worldwide acceptance.The study is an attempt made w.s.r. to Rajata Bhasma.

MATERIALS AND METHODS

Preparation of Rajata Bhasma:

Samanya Shodhana for The: Samanya Shodhana of Rajata was escaped though 99.56% pure Silver could be obtained from the market and it was in the form of thick rode.

Vishesha Shodhana: Thick silver rode was converted into folia (Kantakavedhipatra) of 32 Gauze. It was in the form of 2" X 4" pieces and subjected to 7 times Nirvapa in Lemon Juice.

Marana: Kupipakwa method was adopted to obtain Rajata Sindura as a byproduct and Parada and Gandhaka were used as a media.

Pishti formation: For the above result, Shodhita Rajata was converted into tiny piece and Triturated along with equal quantity of Hingulottha Parada and lemon juice for 6 hrs. Due to the minimum quantity of Parada it was converted to a lustrous steel gray colored coarse powder instead of Pisti.

Kajjali Formation: The above obtained coarse powder was then triturated with Shuddha Gandhaka (equal quantity to Rajata) for 6 hrs. and then Kumari Swarasa was added as per requirement and trituration was done for another 12 hrs.

Kupipaka: Prepared Rajata Kajjali was subjected to Kupipaka in Valukayantra in the quantity of 250 gm in each Kupi. A total 4 samples were prepared with this method. After self-cooling of Kupi, material obtained from the neck of the bottle was collected as Rajata Sindura while bottom material of the material was subjected to the Rajata Bhasma for further procedure.

Putapaka: Material obtained from the bottom of the Kupi was subjected to the Putapaka procedure for the preparation of Rajata Bhasma. For that, each sample was triturated with half a quantity of Shuddha Gandhaka and Kumari Swarasa, which were used as Bhavana Dravya. The lumped material obtained was converted into Chakrika and subjected to the Puta (Heating System) in the E.M.F. (Electric Muffle Furnace).

Appropriate temperature for the preparation of Rajata Bhasma was $500 - 550^{O}$ C. For every Puta, the same procedure was repeated upto the desirable characteristics of the Rajata Bhasma. In each sample required the number of Puta varied i.e. 17 Puta, 12 Puta, 11 Puta and 9 Puta. All the samples were jet black in color though slightly lustrous particles were also observed.

Analytical Study of Rajata Bhasma:

2 samples were selected for the Analysis of the Rajata Bhasma. They were 17 Puti Rajata Bhasma – R.B. (A), 9 Puti Rajata Bhasma – R.B. (B)

Ayurvedic Parameters opted: Organoleptic Test**,** Apunarbhava Test**,** Niruttha Test**,** NPS (Namburi Phased Spot) Test

Physico-chemical Parameters Opted: Loss On Drying, Ash Value**,** Acid Insoluble Ash, Carbon Disulphide Extract, Estimation of Silver Content (Manual Method),Estimation of Mercury Content (Manual Method),Presence of free Ag (Manual Method)

Modern Advanced Parameters Opted: Particle Size Distribution, Atomic Emission Spectroscopy with Inductively Coupled Plasma (A.E.S. I.C.P.) for R.B. (A)

RESULTS

Under ayurvedic parameters, organoleptic parameters have been checked (**Table 2**). Apunarbhava test for Rajata Bhasma has been carried out (**Table 3**). Niruttha test for Rajata Bhasma has been carried out (**Table 4**). NPS (Namburi phased spot) test of Rajata Bhasmahas been carried out (**Fig 1**)[5] This method was developed by Dr. Namburi Hanumantha Rao in 1970 which was accepted and propagated by C.C.R.A.S.

Physico-chemical parameters of Rajata Bhasma (**Table 5**), Estimation of Silver Content (**Table 6**), Mercury Content (**Table 7**), Presence of free Ag by manual method has also been checked by manual method: The free Ag in [R. B. (A)] sample was checked by manual method. That is 1 g of R. B. (A) was taken into sodium metabyte sulphide solutions (25 g in 100 ml distilled water) and shaked for half an hour but even after one hour the shining which was present in the Bhasma could not be disappeared which indicated there is no free Ag in the sample.

In modern advanced parameters particle size distribution had been carried out (**Fig 2 & Table 8**), Atomic Emission Spectroscopy with Inductively coupled plasma: The sample of Rajata Bhasma [R. B. (A)] was analyzed for different element content while atomic emission spectroscopy through inductively coupled plasma (AESICP) method and the result of analysis has been presented in tabular format (**Table 9**).

DISCUSSION

Organoleptic test of both samples of Rajata Bhasma was conducted (Table 2). Both samples passed through Shabda, Sparsha, Rasa and Gandha Pariksha, while in case of Rupa a slight

shining was observed. Due to which, attention must be given to the Nischandratva test of Rajata Bhasma. The references[6] regarding Rajata Bhasma are silver leaves are mixed with twice the weight of cinnabar, heated in the subliming apparatus called Urdhvapatan Yantra. This process is repeated 14 times and the resulting compound is a fine grayish black powder with minute shining while particles intermixed with it.

A sample of Raupya Bhasma obtained from the Kalpataru Ayurveda Works, Calcutta was subjected to analysis; In appearance it was grayish black amorphous powder with admixture of very small particles.

The presumption regards to the shining of Rajata Bhasma is that it may be the natural shining of the prepared compound; Or molecule a compound reflecting with light at a certain angle. Further studies are required to conclude the Nischandratva test for Rajata Bhasma. Above tests represent complete conversion of metal into needed compound, have no coarse particles on touch and are micro-fined jet black in colour.

The Bhasma passed the Rekhapurnata and Varitara tests indicate the fineness and Laghuta. Rajata Bhasma also passed the Unam test, which indicates that more surface area and fineness not piercing the surface tension of water even after loading it with rice grains. Bhasma was tasteless and odorless, these are the characteristics of well-prepared Bhasma as given in classics, which may indicate that there are no reacting compounds with Saliva producing definite test, may be action of Bhasma doesn't start at oral level.

Apunarbhava test was conducted and there was no revival of any metallic lumps which indicates the stable form of Bhasma that could not be converted into metallic form at the temperature of its formation (Table 3).

The samples of Bhasma passed the Niruttha test and there was no change in the weight of silver leaf indicating stable form of Bhasma without any reacting substance at the temperature of its formation (Table 4).

In modern chemistry the technique of spot test or chromatography is widely used. Unlike the conventional method of spot test, with NPS technique the spot is not rejected immediately after reading and noting the chemical reaction. This is a method to study or to detect continual chemical reactions that takes place gradually between two chemical substances on static media at every second or at a fraction of a second. In these trial and error methods, the author has come up with certain reagents and some chemical papers that produced specific pattern of spots with specific Bhasma and Sindura. These spots help in identifying the Bhasma and Sindura. Photographs of both the samples of NPS Test of Rajata Bhasma matched with the reference book written by Dr. Namburi and there is slight variation in both samples which indicate that there might be some definite changes on the basis of the number of Puta. NPS indicates the presence of metal as well as the process adopted for the preparation. On that basis, NPS test shows the importance in identifying the Bhasma.

In loss on drying: It is 0.675% in R. B. (B) and 0.465% in R. B. (A) which indicates its moisture content, which is more in R. B. (B) and). There might be some role of Puta with regards to decrease in the moisture content. Ash Value was found 88.38% in R. B. (B), while in R. B. (A) i.e.88.10. (Table – 4) There was no difference in value of ash in the samples R. B. (A) and R. B. (B). The ash value indicating that some percentage of Bhasma is still present in each sample which could not be burnt to ash reducing the weight of Bhasma. Though most of the percentage of the Bhasma was in ash form. Acid Insoluble Ash was found 83.03% in R. B. (A) while in R. B. (B) i.e.79.67% (Table 4).

As per the findings of this acid insoluble ash, bio-availability of R. B. (A) is more in comparison to other samples. Carbon Disulphide Soluble Extract was nil in both sample R. B. (A) and R. B. (B), which indicates that there is no free sulphur present in the compounds. Estimation of Silver Content of R. B. (A) and R. B. (B) were done (Table 5). It shows R. B. (A) at 70.26% and R. B. (B) was 68.72% indicating there is no loss in the percentage of Silver with the increase in Puta.
Estimation of Mercury Content of R. B. (A), R. B. (B) was done (Table 6). It showed that in R. B. (A) and R. B. (B) the mercury content was found nil, which indicates that mercury might have a specific role to facilitate the metal for the formation of Bhasma. Presence of free Ag Because of lustrous particles in the Bhasma there was the doubt of the presence of free Ag but by adopting manual method free Ag could not be found. But for the confirmation advanced technique is required. The lustrous particles available might be due the natural shining of any of the compounds present in the Bhasma or the molecule of that particular compound might

reflect with light which could be the reason for the luster in the bhasma.

Particle size distribution (Table 8) of two samples of Rajata Bhasma [R. B. (A) and R. B. (B)] were analyzed. In R. B. (A) 17 Puta were given and [R. B. (B)] 9 Puta were given. The result shows that 100% of particles are below 90 μm in R. B. (A) and 100% of particles were below 105μm in R. B. (B), whereas R. B. (A) and R. B. (B) had 50% particles below 15.50 μm.

It showed that 50% particles of both samples were below the 15.50 μm. The lacuna of instrumentation detects the complete regular spherical particles. If the size of the particle is small, but not completely spherical, it is not detected under the lower limit of the particle size, but it will pass by the upper limit of the particle size. Due to this lacuna, it may also be possible that more than 50% particles are below the 7.50μm to 13.00μm.

The second most important thing in particle size analysis is with the concentration optimum solution. In R. B. (A) concentration optimum is 25.37% while in R. B. (B) concentration optimum is 24.14%. It may also play a major role in the distribution of particle size. An effort must be made with a maximum concentrated solution which will fulfill the aim behind particle size analysis of an Ayurvedic Bhasma.

Atomic Emission Spectroscopy with Inductively Coupled Plasma (AESICP): Elemental analysis was conducted with AESICP of R. B. (A) and R. S. (D) samples (Table No. 9). In R. B. (A), 73.594% silver was found, while sulphur was present at 17.246% which may be in sulphide form of silver. Quantity of iron, copper and platinum was 0.43585%, 0.29944% and 0.0014752% respectively. These three elements may be present due to the use of Kumari Swarasa as a Bhavana Dravya. 0.012% mercury was present in the sample, while Zn, Pb and Cd were present at 0.3651%, 0.0075966% and 0.0003144% respectively. Presence of these three elements in Rajata Bhasma was either due to the usage of Kumari Swarasa as Bhavana Dravya or these were impurities which may be readily present in raw silver and could not be removed through the whole process, but it must be noted here, that the quantity of all these elements are below the permissible limits.

Table 1: Methods of Bhasma Pariksha

Measuring Particle size & density	Absence of free metal	Chemical changes in metals
Rekhapurnata	Apunarbhava	Ishta Gandha-Varna
Varitara	Niruttha	Gatarasatva
Unama		
Apunarbhava		
Niruttha		
Nischandratva		

Table 2: Organoleptic parameters of Rajata Bhasma

Parameter	R. B. (A)	R. B. (B)
Shabda	No metallic sound when crushed between teeth	No metallic sound when crushed between teeth
Sparsha	No coarse particles by touch	No coarse particles by touch
Rupa	Black	Black
Susnigdham	Oleated in consistency	Oleated in consistency
Nischandratvam	Slightly lustrous particles observed	Slightly lustrous particles observed
Rekhapurnata	Fills the space between finger lines	Fills the space between finger lines
Varitarata	Floats on surface of water	Floats on surface of water
Unama	Grains of rice float on the Bhasma floating on water	Grains of rice float on the Bhasma floating on water
Rasa	Tasteless	Tasteless
Gandha	No specific	No specific

Table 3: Apunarbhave Test of Rajata Bhasma

Samples	Weight of Bhasma taken	Weight of Mitra Ppanchaka taken	Final Bhasma observations
R.B. (A)		10 g	No metallic luster and lumps
R.B. (B)	2 g	10 g	No metallic luster and lumps

Table 4: Niruttha test of Rajata Bhasma

Sample	Wt. of Bhasma taken	Wt. of silver taken	Final wt. of Bhasma	Final wt. of silver leaf
R.B. (A)	1 g	0.5 g	1 g	0.5 g
R.B. (B)	1 g	0.5 g	1 g	0.5 g

Table 5: Physico-chemical parameters [1-4]**:**

Tests	R.B. (A)	R.B. (B)
Loss on drying	0.465%	0.675%
Ash value	88.10%	88.38%
Acid insoluble ash	83.03%	79.67%
Carbon disulphide extract	Nil	Nil

Table 6: Showing the silver content

Sample	% of silver
R. B. (A)	70.26
R. B. (B)	68.72

Table 7: Showing the percentage of Hg in the samples

Sample	% of silver
R. B. (A)	Nil
R. B. (B)	Nil

Table 8: Particle size distribution

Sample	VMD in μm)	X10 (in μm)	X16 (in μm)	X50 (in μm)	X84 (in μm)	X90 (in μm)	X99 (in μm)
R.B. (A)	18.40	2.43	3.60	13.22	35.00	42.40	71.47
R.B. (B)	21.00	02.26	03.32	14.59	40.70	40.08	85.66

VMD= Volumetric Mean Diameter; C_Opt = 25.37% in R. B. (A); C_Opt = 24.14% in R. B. (B)

Table 9: Data of AESICP analysis of R. B. (A)

Elements	Rajata Bhasma (A) % W/W
Silver (Ag)	73.594
Mercury (Hg)	0.012064
Sulphur (S)	17.246
Iron (Fe)	0.43585
Copper (Cu)	0.29944
Cadmimum (Cd)	0.0003144
Lead (Pb)	0.0075966
Platinum (Pt)	0.0014752
Zinc (Zn)	0.03651

Fig 1: NPS (Namburi phased spot) test of Rajata Bhasmahas been carried out

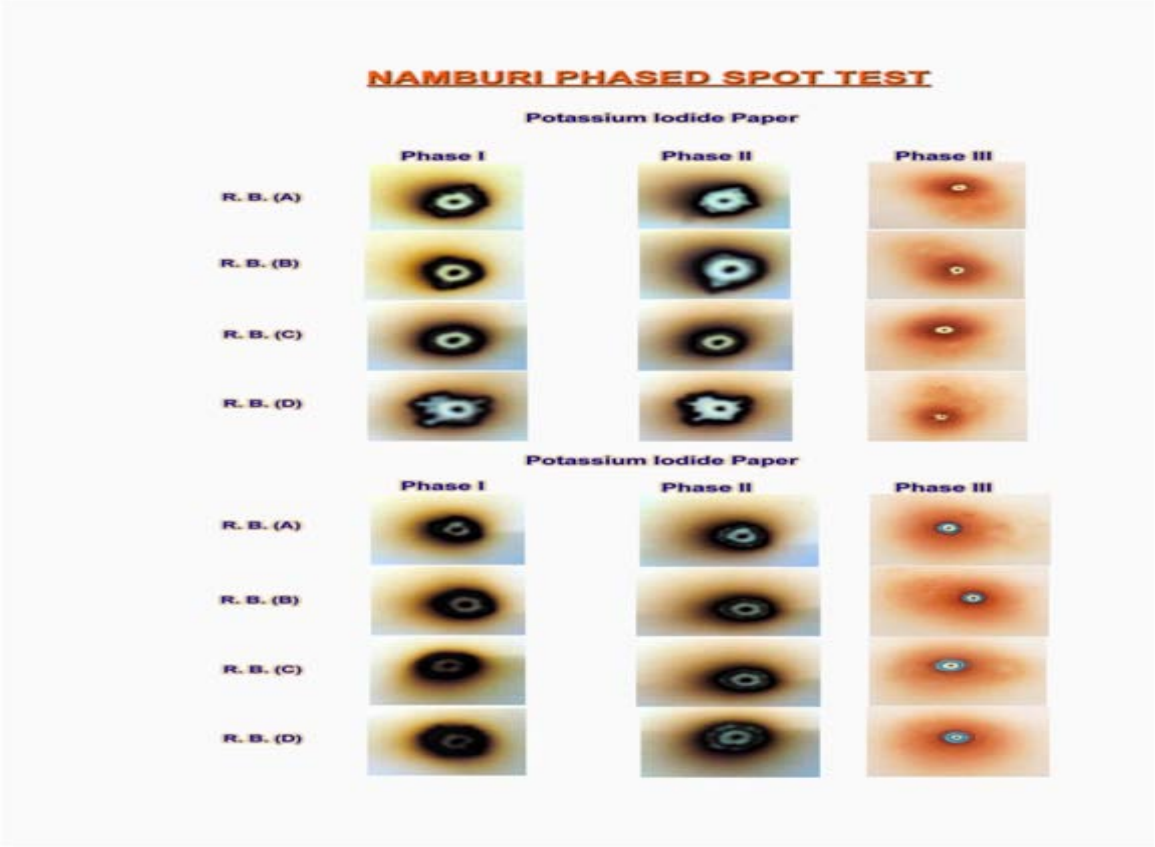
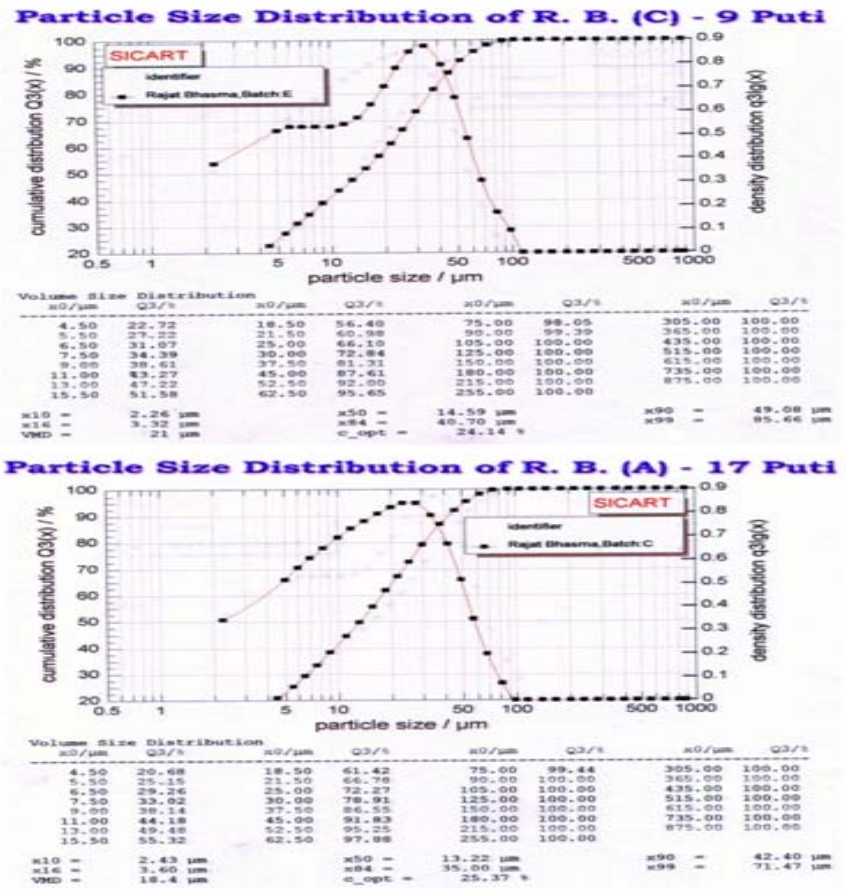


Fig 2: Particle size distribution of Rajata Bhasma



CONCLUSION

Absence of free Ag by manual method indicates that Chandratva in the Bhasma might be the natural shining of any compounds present in the Bhasma**.** The various trace elements found in Rajata Bhasma were iron, copper, lead, cadmium apart from silver (73.59%w/w) and sulphur (17.24%w/w). But quantities of these trace elements were below the permissible limits.

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