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Research Article

SEM-EDX ANALYSIS OF *ABHRAKA BHASMA* PREPARED ACCORDING TO *RASA RATNA SAMMUCHCHAYA*

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ABSTRACT

Bhasmas are the most frequently used medicines in the field of Ayurveda as it tends to act fast when compared to other modes of medication. It works on the principle of nanoparticle assimilation, which provides higher bioavailability due its higher surface area and lesser particle size. This invention was made back in ancient days, which proves that during those ages there were faster methods of medical aids for a disease proving to be fatal. *Abhraka* is one of the main drugs used in Ayurveda mainly in the form of a *Bhasma*. It is abundantly used in single / compound forms for diseases like cold, cough, diabetes, anemia, asthma, etc. For a *Bhasma* to act significantly without side-effects it has to be properly rendered to purifactory procedures and Incineration at optimum temperature. This article basically deals with *Samanya Shodana*, *Dhanyabhraka nirmana* and *Marana* of *Abhraka* followed by its analysis by SEM-EDX which proved that there was reduction in some of the elements present in the drug after giving successive *Putas*, till the formation of a *Bhasma*. The atomic percentage of oxygen increased when *Bhasma* was formed, hence suggesting it to be in oxide form. There was absence of heavy metals after giving *Puta* according to the classical reference. Microscopic images of the *Churna* and *Bhasma* could be analysed and the particle size of *Bhasma* could be analysed which was 580.2 nm.

KEYWORDS: *Abhraka bhasma*, SEM-EDX analysis, *Rasa Ratna Sammuchchaya.*

INTRODUCTION

SEM-EDAX is one of the most useful innovative tools used in today's era in defining a nanoparticle. It has gained popularity as it distinguishes particles present in the specimen by finding out its elements, imagining the particle and isolating the particle size. This works on the basis of electron emission which is beamed at high frequency which hits the sample thereby leading to either absorption, reflection or release of secondary electrons all of which will contribute in knowing the surface structure, composition and type of sample dealt with by knowing the percentage of electron analysed by the secondary and backscattered electron detector which send the final information to the TV scanner. In Ayurveda, *Bhasmas* are considered to be a nanoparticle which is substantiated by the tests like *Rekhapurna*, *Vartiara* and *Unama*. Hence, this can also be proved significantly by using highly sophisticated instruments like SEM, which can even determine the purity, composition and the size determination of a particle. *Bhasmas* are profoundly used in the field of medical practise as it gives a significant result thereby proving it to be the need of the hour. In today's era, faster healing is what catches the eye and *Rasaushadis* prove to make it happen. *Bhasmas* are considered as a nanoparticle which proves it to be readily bio-available thereby helping the molecule to hence enter a cell easily and show rapid onset of action. For preparation of *Bhasmas* in large scale it has to undergo proper processing before consumption. *Abhraka Bhasma* though in raw form proves to be highly toxic, if it is improperly processed it turns out to be poisonous even after following the procedures. Hence *Shodana* and *Marana* have to be done precisely with utmost care to avoid adverse drug reaction/ complications. If systematically processed, it turns out to be like nectar and can cure almost anything at its will. In this article *Abhraka Shodana, Dhanyabhraka Nirmana* and *Marana* followed by analysis of the product is dealt in detail.

MATERIALS AND METHODS

This involves the following procedures

a) *Samanya Shodana* of *Abhraka*[1]
b) Preparation of *Dhanyabhraka*[2]
c) *Marana* of *Abhraka*[3]

a) *Samanya Shodana* of *Abhraka*

Name of practical: *Abhraka Samanya shodana*

Reference: R.R.S 2/16-17

Apparatus used: Stove, Tongs, Steel vessel, Milk, Cloth, Pyrometer etc.

Ingredients: *Ashuddha Abhraka*: 700gm, *Milk*: 6lts

Procedure

- 600 grams of *Abhraka* was taken.
- A steel vessel with required quantity of milk is taken and kept ready.
- *Abhraka* was then kept directly on fire, till it became red hot.
- It was then rotated over the fire with metal tongs so as to give equal exposure of heat on all the sides.
- When *Abhraka* became completely red hot in colour, they were plunged quickly into the milk with the help of metal tongs.
- Later, *Abhraka* was separated by filtering it through a sieve and the pieces of *Abhraka* were collected and again subjected for the next process of *Nirvapa*.
- Temperature of *Abhraka* was noted by using a Pyrometer.
- This procedure was repeated for 7 times.

Table 1: Tabular representation of observations seen during *Abhraka shodana*

No.of *Nirvapas*	Changes seen in *Abhraka*	Changes in milk	Quantity obtained
1	1) Lustre increased (+) 2) Color -Blackish 3) Dense fumes (+)	1) Milk produced hissing sound. 2) Color of milk, Brownish. 3) Temperature of milk increased and it split.	694 gm
2	1) Increased Lustre(++) 2) Color-Blackish 3) Dense fumes(++) 4) Brittle (+)	1) Milk produced hissing sound. 2) Color of milk- Brownish Black tinge. 3) Milk split and had pieces of *Abhraka*, at the base of vessel.	693.2 gm
3	1) Increased lustre (+++) 2) Color-Blackish 3) Dense fumes(+++) 4) Brittle(+++)	1) Milk produced hissing sound. 2) Color of milk- Brownish black tinge. 3) Milk split and had pieces of *Abhraka* at the base of vessel.	692.4gm
4	1) Increased lustre (++++) 2) Brittle (++++) 3) *Abhraka* on heating got easily red hot (+)	1) Milk produced hissing sound. 2) Color of milk- Brownish grey tinge. 3) Milk split and had pieces of *Abhraka*, at the base of vessel.	692.0 gm
5	1)Increased 2)lustre(+++++) 3)Brittle (+++++) 4)*Abhraka* on heating got easily red hot(++)	1) Milk produced hissing sound. 2) Color of milk- Brownish grey tinge. 3) Milk split and had pieces of *Abhraka,* at the base of vessel.	391.9 gm
6	1) Lustrous(++++++) 2) Brittle (++++++) 3) *Abhraka* on heating got easily red hot(+++)	1) Milk produced hissing sound. 2) Color of milk- Brownish grey tinge. 3) Milk split and had pieces of *Abhraka,* at the base of vessel.	690.6gm
7	1) Very lustrous(+++++++) 2) Brittle (+++++++) 3) *Abhraka* on heating got easily red hot(++++)	1) Milk produced hissing sound. 2) Color of milk- Brownish grey tinge. 3) Milk split and had pieces of *Abhraka,* at the base of vessel.	690.2gm

(+.....: Indicates increasing property/Indicates improvement in the quality)

Precautions

- *Abhraka* has to be heated until red hot by exposing all sides of it.
- Care has to be taken while doing the heating process.
- During the process of *Nirvapa*, the milk tends to split at each step and has to be changed with fresh one.
- After the completion of the process, *Abhraka* tends to be slimy and hence has to be washed with hot water repeatedly to avoid fungus to grow over its surface.

Result:

- Weight of *Abhraka* after *Samanya Shodana*: 690.2g

b) Preparation of *Dhanyabhraka*

Name of practical: Preparation of *Dhayabhraka*

Reference: R.R.S 2/21

Instruments: Steel vessel, *Kanji*, Bandage cloth, Steel spatula, Gloves.

Ingredients:

Shuddha Abhraka - 1 part (690.2 gm)

Shaali-1/4th part (172.55 gm)

Kanji- Q.S

Procedure

- *Shodita Abhraka* is taken in a tray and 1/4th quantity of *Shaali* is added to it.
- Both are mixed thoroughly manually by hands.
- A piece of bandage cloth was spread on a table and then the mixture of *Shaali* and *Abhraka* was put over the cloth.
- Later all the corners of the cloth are converged together and made in the form of a *Pottali*, which was then tied tightly.
- Required amount of *Kanji* was taken in a steel vessel and the *Pottali* was then dipped in it completely and it was tied over a steel spatula, which was then balanced over the steel vessel.
- *Potalli* was kept in the *Kanji* for 3 days i.e. 72 hours, undisturbed.
- When there was reduction in the level of *Kanji*, more *Kanji* was added so as to keep *Pottali* immersed in it.
- After 3 days the *Pottali* was removed from the steel vessel and kept in an enamel tray.
- Later a large steel vessel containing water was taken; *Pottali* was dipped in it and rubbed between palms protected by gloves.
- Every time when the colour of water changed to black, the water was decanted slowly and fresh water was added and the process was continued.
- This process was continued till complete *Dhanyabhraka* was obtained.
- The vessel was kept stable overnight.
- The next day morning, the upper clear water in the vessel was decanted carefully.
- Residue present in the vessel was collected and allowed to dry.
- A lustrous black coloured coarse powder of *Dhanyabhraka* was obtained.

Observations

- There was a blackish layer formed over the surface of *Kanji*.
- Kanji tends to stink at the end of 3 days.
- After rubbing the *Pottali* in between the palms in the media, there was fine sediments present at the base of the vessel.
- The sediments were very fine and lustrous black in color.

Precautions

- Care has to be taken while rubbing the *Potalli* between the palms, as the sharp surface of the *Shaali* tends to cut the fingers.
- Gloves can be used for rubbing, as a precaution.
- *Kanji* has to be filled repeatedly if in case its quantity reduces, i.e., *Potalli* has to be completely immersed within the *Kanji*.
- Decantation has to be done carefully, to prevent wastage.

Results

Duration of *Mardana* for complete extraction: 3 hrs

Weight of *Dhanyabhraka*: 679.5gm

c) *Abhraka Marana*

Name of practical: *Marana* of *Abhraka*

Reference: R.R.S

Equipments: *Sharavas*, *Khalva yantra*, steel plates, Pyrometer etc

Ingredients

1) *Dhanyabhraka*: 1part
2) *Eranda patra swarasa* (liquid extract of leaves of Ricinus communis):Q.S
3) *Guda (Jaggery):* 1part
4) *Vata Patra* (leaves of *Ficus begenlansis*)

Procedure

- *Dhanyabhraka* was first weighed.
- The *Swarasa* of *Eranda patra* (fresh liquid extract of leaves of *Ricinus communis*) was prepared by chopping the fresh leaves and steaming it in a cooker with water.

- Later, the *Swarasa* was extracted from the leaves using *Khora* cloth.
- Jaggery was then weighed and all the three drugs were put together in a *Khalva* and triturated for 5 hours
- After which *Chakrikas* where prepared and placed over steel plate and let to dry.
- After the *Chakrikas* dried, they were weighed.
- The *Vata Patras* was placed both above and below the *Sharava* and later the *Cakrikas* were placed over it carefully.
- Then the *Sharava* was sealed properly.
- Sealing was done using *Khora* cloth and *Multani mitti*.
- 5 layers of *Sandhibandana* were done systematically.
- Later, *Sharavas* was subjected for *Puta*.
- With the help of pyrometer the temperature was recorded.
- After 24 hours the next day, once the *Sharavas* are self cooled they were opened carefully.
- The obtained *Abhraka* was then observed and weighed.

Table 2: Tabular representation of observations seen in *Abhraka* after each *Puta*

No.of *Puta*	Observation	Yield (grams)
1	1) Color: Black with a peacockish tinge at some places. 2) Form: Very Hard 3) *Chandrika:* (++++++++)	656.1 gm
2	1) Color: Black with a peacockish tinge at some places. 2) Form: Very Hard 3) *Chandrika:* (++++++++)	647.5 gm
3	1) Color: Black 2) Form: Very Hard 3*) Chandrika:* (++++++++)	632.0 gm
4	1) Color: Black 2) Form: Hard 3*) Chandrika:* (++++++++)	629.4 gm
5	1) Color: Black 2) Form: Hard 3) *Candrika:* (++++++)	625.3 gm
6	1) Color: Black 2) Form: Hard 3) *Candrika:* (++++++)	622.9 gm
7	1) Color: Black 2) Form: Hard 3) *Chandrika:* (+++++)	622.5 gm
8	1) Color: Black 2) Form: Hard 3) *Chandrika::* (++++)	621.3 gm
9	1) Color: Black 2) Form: Hard 3) *Chandrika:* (+++)	620.2 gm
10	1) Color: Black with a slight brownish tinge(+) 2) Form: Hard 3) *Chandrika:* (+++)	615.1 gm
11	1) Color: Black with a brownish tinge (++) 2) Form: Hard 3) *Chandrika:* (+++)	614.7 gm

12	1) Color: Black with brownish tinge (++) 2) Form: Hard 3) *Chandrika:* (++)	614.1 gm
13	1) Color: Black with more brown tinge (+++) 2) Form: Hard 3) *Chandrika:* (+)	612.4 gm
14	1) Color: Black with more brown tinge (+++) 2) Form: Hard 3) *Chandrika:* (+)	610.0 gm
15	1)Color: Black with more brown tinge (+++) 2) Form: Hard 3) *Chandrika:* (+)	609.5 gm
16	1) Color: Black with more brown tinge (+++) 2) Form: Hard 3) *Chandrika:* (+)	607.1 gm
17	1) Color: Black with more brown tinge (+++) 2) Form: Hard 3) *Chandrika:* Absent	606.3 gm
18	1) Color: Black with more brown tinge (+++) 2) Form: Slighty Hard 3) *Chandrika::* Absent	605.7 gm
19	1) Color: Black with more brown tinge (+++) 2) Form: Slightly hard 3) *Chandrika:* Absent	604.2 gm
20	1) Color: Black with more brown tinge (+++) 2) Form: Coarse powder 3) *Chandrika:* Absent	604.0 gm
21	1) Color: Black with more brown tinge (+++) 2) Form: Coarse powder 3) *Chandrika:* Absent	603.9 gm
22	1) Color: Black with more brown tinge (++++) 2) Form: Coarse powder 3) *Chandrika:* Absent	603.0 gm
23	1) Color: Black with more brown tinge (++++) 2) Form: Coarse powder 3) *Chandrika:* Absent	602.8 gm
24	1) Color: Black with more brown tinge (++++) 2) Form: Coarse powder 3) *Chandrika:* Absent	601.9 gm
25	1) Color: Black with more brown tinge (++++) 2) Form: Slightly fine 3) *Chandrika:* Absent	601.3 gm
26	1) Color: Brownish 2) Form: Fine powder 3) *Chandrika:* Absent	545.3 gm

27	1) Color: Brownish 2) Form: Fine powder 3) *Chandrika:* Absent	521 gm
28	1) Color: Light brown 2) Form: Fine 3) *Chandrika:* Absent	510.7 gm
29	1) Color: Light brown 2) Form: Fine 3) *Chandrika:* Absent	502.5 gm
30	1) Color: Light brown 2) Form: Fine 3) *Chandrika:* Absent	489.3 gm

(+.....: Indicates increasing property/Indicates improvement in the quality)

Precautions

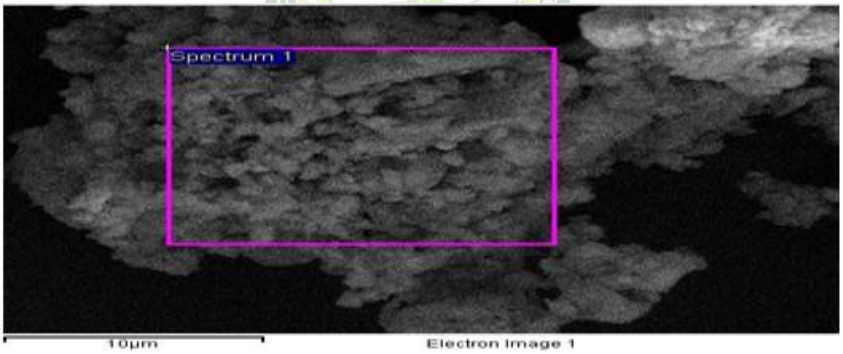
- *Abhraka* after successive *Putas* have to be pounded well before giving *Bhavana* with *Guda* and *Eranda patra swarasa.*
- Gloves can be used during this process, as *Abhraka* tends to stick to the fingers during the process.
- While giving *Bhavana* first *Eranda patra swarasa* and *Guda* have to be mixed till it becomes into a semisolid consistency and then slowly the *Abhraka* in fine powder form has to be added into it and then *Bhavana* is continued.
- At the end stages, once *Bhasma lakshanas* are observed it's better to avoid preparation of *Chakrikas* as there tends to be a lot of wastage.

Result: Final weight of *Abhraka bhasma*: 489.3 gm

Analytical data

b) SEM-EDX of *Abhraka churna* (after 3 *Putas*)

Figure.1: Spectrum analysed for SEM-EDX



Graphical representation of SEM-EDX report

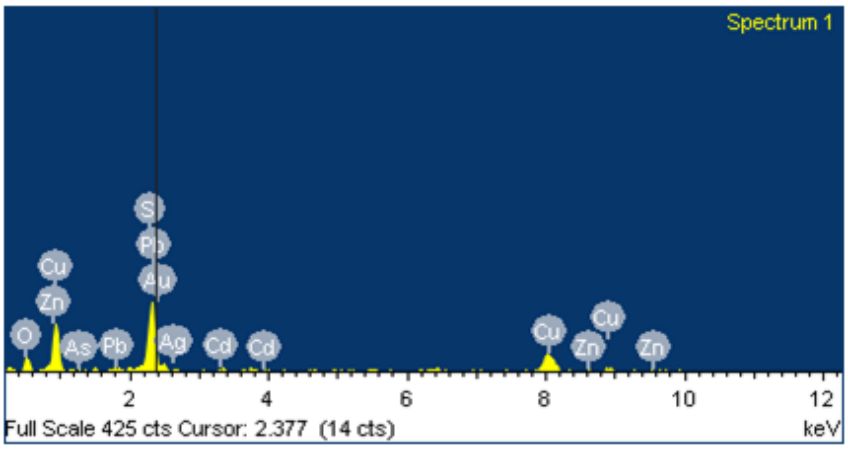


Table 3: Tabular representation of results *Abhraka churna* by SEM-EDX

Element	Weight%	Atomic%
C	44.15	57.41
O	32.81	32.03
Mg	10.73	10.47
Al	10.62	10.36
Si	66.33	63.52
S	1.50	0.73
K	9.03	3.61
Ca	4.82	1.88
Fe	30.04	28.54
As	0.00	0.00
Cd	0.00	0.00
Pb	0.00	0.00

- *Abhraka churna* showed the presence of Carbon, Oxygen, Magnesium, Aluminium, Silica, Sulphur, Potassium and Calcium.
- Particle shape could be clearly visualized.

c) SEM-EDX of *Abhraka bhasma* (after 30 *Putas*)

Table 4: Tabular representation of results *Abhraka bhasma* by SEM-EDX

Element	Weight%	Atomic%
O	46.58	63.85
Mg	8.68	7.83
Al	6.29	5.11
Si	15.42	12.04
Cl	2.04	1.26
K	9.89	5.54
Fe	11.10	4.36
As	0.00	0.00
Cd	0.00	0.00
Pb	0.00	0.00

- *Abhraka bhasma s*howed the presence of Oxygen, Magnesium, Aluminium, Silica, Chlorine, Potassium and Iron.
- No presence of heavy metals.
- Particle shape and size could be analysed.
- Size of the particle:

  580.2 nm at a magnification of 5.00 K X.

2) *Bhasma Pareeksha*

Table 5: *Bhasma pareeksha* done for *Abhraka*

Bhasmas	*Varna*	*Nischandratvam*	*Varitara*	*Rekhapurna*	*Unama*	*Slakshnatvam*
Abhraka Bhasma	Brick color	+	+	+	+	+

The Process of *Abhraka Shodhana* and *Marana*

Abhraka Shodhana *Abhraka Nirvapa* with Milk Milk after *Nirvapa*



Abhraka Chakrikarana *Chakrika* of 27th *Puta* *Abhraka Marana*



Abhraka Bhasma *Varitara Bhasma Pariksha* *Uttama Pariksha* of *Abhraka*


DISCUSSION

Discussion on *Shodana* of *Abhraka*

Milk was used as the media for doing *Nirvapa*, after *Shodana* of *Abhraka*, the outer surface of *Abhraka* tends to be slimy and gets fungus easily. Hence repeated washing of *Abhraka* has to be done with hot water to prevent this.

Discussion on *Marana* of *Abhraka*

- Marana of *Abhraka* had to be done by giving a maximum of 30 *Putas*.
- While doing *Bhavana* of *Abhraka* during each *Puta*, First *Guda* has to be broken down and then *Drava* has to be added and made into a paste and at the end *Abhraka Churna* has to be slowly and carefully added, later *Cakrikas* are made.
- Increase in the number of *Putas* might be because in the variation of size of cow dung cakes, time duration for *Bhavana* after each *Puta*, *Sandhibandana*, thickness of cowdung cakes and quantity of cowdung cakes.

Discussion on SEM-EDX of *Abhraka* by classical and in house method

- There was reduction in some of the elements present in the drug after giving successive *Putas*, till the formation of *Bhasma*.
- The atomic percentage of oxygen increased when *Bhasma* was formed, hence suggesting it to be in oxide form.
- There was absence of heavy metals after giving *Puta* according to the classical reference.
- Microscopic images of the *Churna* and *Bhasmas* could be analysed via SEM
- Particle size of *Bhasma* could be analysed.
- Particle size of *Bhasma* was in the range of nanometers.

Comparison between *Abhraka churna* and *Abhraka Bhasma* via SEM-EDX

- Significant variation in *Abhraka churna* and *Bhasma*.

- There was presence of Oxygen in *Abhraka bhasma* which was absent in its *Churna* form. (wt 45.58% & At 63.85%), Thus suggesting it to be in oxide form.
- There was presence of Carbon in *Abhraka churna* which was absent in the *Bhasma*.
- There was decrease in the level of Magnesium, Aluminium, Silica and Iron may be due the onset of giving continuous *Putas,* there is decrease in the elemental composition.
- Particle size couldn't be analysed in its *Churna* form whereas in *Bhasma* it was analysed due to its nanometer size.
- Particle size of *Bhasma*: 580.2nm at a magnification of 5.00 K X.

Discussion on *Bhasma pareeksh* [4]

Bhasmas are unique preparations in *Rasashastra*, for its preparation *Marana* has to be done. Before the process of *Marana, Shodana* of the metal has to be done. For the obtainment of a pure *Bhasma*, *Bhasmapariksha* plays an important role.

1) *Rekhapurna*

This *Pareeksha* mainly deals with the particle size of the *Bhasmas* and also deals with is softness. The *Bhasma* can only pass this *Pareeksha* when the diameter of the particles is less than the breadth of grooves on the finger surface. Also, deals with the consistency of the particles. The particles of the *Bhasma* only get entangled over the fingers if they are smooth and soft. If they are hard in consistency they will not get adhered to the finger surface though they are sufficiently small.

2) *Varitara*

The probable cause behind floating of *Bhasma* over water can be described as the atoms of water are bounded with each other due to an attractive force in between them due to which they remain in contact with each other forming a flat surface. When a fine powder is spread on its surface tension of the water doesn't allow the particle to enter/ sink thus, keeping them floating. Hence, can be considered as *Laghu* (particles having light weight). *Bhasma* particles which are *Laghu* will float on water and if it contains any unconverted heavy particles of metal it tends to sink. *Acharya* Vagbhatta states that *Bhasma* becomes ready for consumption only if it's *Varitara*.

3) *Unama*

It is a additional test to confirm the *Varitara Pareeksha*. It is similar to that of *Varitara* test but further on stating the *Laghutva* of the particle which will not allow the grain to sink.

4) *Nischandratva*

Test is carried out to check the presence of free metal, if its present there will be presence of luster.

CONCLUSION

Abhraka Bhasma prepared by this reference tends to yield the formation of *Bhasma* by around 30*putas*. This process tends to be easier when compared to the preparation of *Abhraka Bhasma* by other methods. Precise observation has to be done and care has to be taken while giving continuous *Putas* by monitoring the heat and checking the drug after each *Puta*. Proper *Shodana* and *Marana* has to be done to obtain a non-toxic product followed by analysis of the same.

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