ISSN 2456-3110
Vol 2 · Issue 4
July - Aug. 2017

Journal of Ayurveda and Integrated Medical Sciences

www.jaims.in

JAIMS

Charaka Publications

Indexed

ISSN: 2456-3110 ORIGINAL ARTICLE July-Aug 2017

Pharmaceutico Analytical Study of *Mukta Shukti Bhasma*

Biradar M. H.,[1] Shankar Gowda,[2] Madhav Diggavi[3]

[1]Associate Professor & HOD, Department of Agada Tantra & Vyavahara Ayurveda, BLDEA'S AVS Ayurveda Mahavidyalaya, Vijayapur, Karnataka, [2]Professor, Department of Rasashastra & Bhaishajya Kalpana, [3]Professor, Department of Kayachikitsa, Taranath Govt. Ayurvedic Medical College, Ballary, Karnataka, India.

ABSTRACT

Background: *Mukta Shukti* is an aquamarine calcium carbonate compound. *Mukta Shukti Bhasma* is a classical ethical economical medicament, effective in general practice, pharmaceutical processing as per texts with systematic observation and technological updating is carried out in the present work. **Objectives:** To prepare Mukta Shukti Bhasma by different Pharmaceutical processes and carry out the analytical study. **Materials and Methods:** *Grahya Ashodhita Mukta Shukti* was subjected to *Shodhana* by *Kanji Swedana* for 3 hours and then divided into two parts. The first part of *Shodhita Mukata Shukti* was incinerated totally and after 1st *Puta* it was divided into two portions, first portion was subjected to *Jala Bhavana* and incinerated. The second portion was subjected to *Kumari Swarasa Bhavana* and incinerated. The second part of *Shodhita Mukata Shukti* was incinerated in *Kumari Samputa* and subjected to *Kumari Swarasa Bhavana* and incinerated until they attain Bhasma Siddhi Lakshanas and later all the three samples were subjected to analytical studies. **Results:** *Mukta Shukti Bhasma* by *Jala Bhavana* method, *Kumari Bhavana* method, and *Kumari Samputa* method requires 7, 6 and 3 *Gajaputas* respectively with an average of 324 cow dungs in each and at 793˚C temperature. **Conclusion:** *Kumari Bhavita Marana* to *Mukta Shukti* leads to calcite form and *Jala Bhavita Marana* leads to calcium oxide hydrate form. Chemically *Mukta Shukti Bhasma* may be in both calcite and calcium oxide hydrate form, and XRD is a method in Standardization of *Mukta Shukti Bhasma*.

Key words: *Pearl oyster, Mukta Shukti Bhasma, Kumari Swarasa, Kanji, Gajaputa, XRD.*

INTRODUCTION

The Indian system of medicine is the first amongst all traditional medicine systems of various civilizations where importance of metals, minerals and marine substances for curing ailments was first recognized. *Bhasmas* are metallic preparations obtained by repeated incineration of metal or its salt with herbal extracts/juices and taken orally in small amounts with honey/ghee/buttermilk so as to make them biologically assimilable.[1]

Bhasmas literally means "Ash" and is an Indian mineral preparation made from precious metals and naturally occurring salts. They undergo extensive purification and preparation methods involve crushing, boiling, etc. at specified temperature so as to make minerals ready for human consumption.[2]

Bhasma is considered to be more potent than any other healing preparations.[3] It is believed that widely used heavy metals such as Hg and Pb in traditional medicine system act as a catalyzer, which stimulates catalytic activity by their presence in the intestines without ever interacting with the blood stream thus rendering many of the toxic metals into non-toxic form. These provide a natural and effective alternative to synthetic allopathic drugs. Since these are insoluble, Bhasma particles must be tiny enough to work into blood circulation. These may be considered as biologically produced nano-particles making these biocompatible. A well-made *Bhasma*

Address for correspondence:
Dr. Biradar M. H.
Associate Professor & HOD, Department of Agada Tantra & Vyavahara Ayurveda, BLDEA'S AVS Ayurveda Mahavidyalaya, Vijayapur, Karnataka, India.
E-mail: drmhbiradar@gmail.com

Submission Date : 01/08/2017 Accepted Date: 24/08/2017

Access this article online

Quick Response Code

Website: www.jaims.in

DOI: 10.21760/jaims.v2i4.9333

ISSN: 2456-3110 ORIGINAL ARTICLE July-Aug 2017

enters the system faster and stays there for longer duration than does any other herbal formulation.

Mukta Shukti Bhasma, one of the important preparation explained in different classical texts. So far, no scientific and systemic study on *Mukta Shukti Bhasma* specially in relation to its pharmaceutical and analytical are not reported scientifically; by considering these the present work has been undertaken.

MATERIALS AND METHODS

Raw Materials: *Mukta Shukti, Kanji, Kumari* and *Jala* are the raw materials required for preparation of *Mukta Shukti Bhasma.*

***Yantras* and associated materials:** *Khalvayantra*, *Dolayantra*, gas stove, cow dung cakes, pyrometer, *Gajaputa* pit, Sharavas etc.

Methodology

These Pharmaceutical studies of *Mukta Shukti Bhasma* are designed in following steps,

1) Selection, identification and Collection of raw materials
2) Shodhana of Mukta Shukti by *Kanji*
3) Preparation of Mukta Shukti Bhasma
   a. Kumari Bhavana method
   b. *Jala Bhavana* method
   c. *Kumari Samputa* method

1) Collection and selection of raw material.

The raw drugs required for the present study like *Mukta Shukti* (Reference of Grahya Lakshana) was purchased at Khalva Achchayya Shop, Bellary. Dehusked *Shali Dhanya* was procured from a local grocery store and *Kumari* was collected from the TGAMC, Dravya Guna Herbal Garden, Bellary. Pure water was used during the process of Bhavana of Mukta Shukti.

2) *Shodhana* of *Mukta Shukti* by *Kanji*

Method of *Kanji* preparation[4]

500 gms of pounded and dehusked *Shali* rice was boiled with 7 liters of water in a big stainless vessel till the rice get well cooked. Then that cooked rice was filtered. The filtered liquid was placed in mud pot. The mouth of pot was covered with cloth tied with thread. This pot was kept undisturbed for 7 days. After 7 days *Kanji* was tested for *Amlatwa* and pH. Then the *Kanji* was filtered and stored.

Method of *Mukta Shukti Shodhana*[5]

Grahya Ashodhita Mukta Shukti sample of 600 g. was taken in *Khalva Yantra* and made into small pieces. These pieces were washed with hot water to remove sand and mud particles if any. The pieces of *Mukta Shukti* were placed in a clean cloth tied into a *Pottali*. That *Pottali* was suspended with the help of stick and immersed in *Kanji* present in the earthen pot so that the bottom of pottali will not touch the pots inner surface. This *Dolayantra* was kept over mild fire and boiled for 3 hours. *Kanji* was added subsequently to maintain the level of *Kanji* during *Swedana*. pH of *Kanji* was recorded at every half an hour interval. After 3 hour *Pottali* was taken out and allowed to cool. After cooling, *Shodhita Mukta Shukti* was collected from *Pottali* and washed with warm water and allowed for complete drying.

Observation

Foam was found during first hour of boiling. While boiling, the odor of *Kanji* turned from sour alcoholic to bad odor. Initially, 2 liters of *Kanji* was taken and its quantity reduced during boiling. So another 1litre of warm *Kanji* was added subsequently to maintain the level of *Kanji*. After 3 hours, the *Kanji* in the pot was 1.25 liters, at the rate of loss of 1.75 liters of *Kanji* during the Swedana procedure. When Pottali was taken out after 3 hours, white scum was observed over it. White small pieces of sediments were found at the bottom of *Kanji*. Initial pH of *Kanji* was 3.7 and there was gradual increase of pH of *Kanji* during the process and at the end it was 5.4 with gross rice of 1.7 in its pH

Table 1: pH recording during *Swedana* procedure

Time	0 hr	After ½ an hr.	After 1 hr.	After 1½ hrs.	After 2 hrs.	After 2½ hrs.	After 3 hrs.
pH	3.7	3.90	4.59	5.23	5.34	5.38	5.40

ISSN: 2456-3110 ORIGINAL ARTICLE July-Aug 2017

Table 2: *Mukta Shukti* before and after *Shodhana*

Observations	Before *Shodhana*	After *Shodhana*
Color	Dull cream white	Bright white
Brittleness	Not Brittle	Brittle
Edges of cut surfaces	Lusterless	Shinning

3) Preparation of *Mukta Shukti Bhasma*

Method adopted: *Shodhita Mukta Shukti* was incinerated totally and after first *Puta*, divided into two equal proportions. First portion was subjected to *Jala Bhavana* and incinerated. The second portion was subjected to *Kumari Swarasa Bhavana* and incinerated.

The other method adopted was, *Shodhita Mukta Shukti* subjected to incineration by sandwiching between *Kumari* pulps in a *Sharava Samputa.* After first puta, *Kumari Swarasa Bhavana* was given and incinerated.

A) Preparation of *Mukta Shukti Bhasma* by *Kumari Bhavana* method.

Method: The preparation of *Mukta Shukti Bhasma* was carried out under following steps

- Extraction of *Kumari Swarasa*
- Giving *Bhavana* of *Kumari Swarasa* to *Marita Mukta Shukti*
- Preparation of *Chakrikas*
- Formation of *Sharava Samputa*
- Subjecting for *Gajaputa*

Extraction of *Kumari Swarasa*

- *Kumari* was collected from herbal garden of TGAMC Bellary
- Skin of Kumari was pealed off and pulp was removed.
- The pulp was placed in the juice extractor and juice was extracted.

Kumari Swarasa Bhavana

- 200gms of *Marita Mukta Shukti* which was subjected to one *Gajaputa* was placed in *Khalva Yantra* and powdered.
- *Kumari Swarasa* was added to it and was enough to immerse *Shukti* in it.
- Trituration was done for three hours. At the end the whole mass was converted into a viscous and semisolid state.

Fig. 1: Raw *Mukta Shukti*

Fig. 2: *Kanji*

Fig. 3: *Mukta Shukti Shodhana* in *Kanji*

ISSN: 2456-3110 ORIGINAL ARTICLE July-Aug 2017

Fig. 4: *Shodhita Mukta Shukti*

Preparation of *Chakrikas*

The semisolid material was taken out of *Khalva Yantra.* A small portion around 10gms of material was taken and converted into a bolus. That bolus was placed over a plastic sheet and pressed gently and uniformly so that a pallet of 2-3cm diameter and 1mm thickness was prepared. Same way totally 20-25 pallets were made and kept for drying.

Formation of *Sharava Samputa*

Complete dried *Chakrikas* were placed in a *Sharava* uniformly. Another *Sharava* of same size was placed over it and the edges were sealed with *Multani* mud smeared thread followed by the same mud smeared cloth for seven layers and dried under the shade.

Subjecting to *Gajaputa*

The 2/3 rd of the pit of *Gajaputa* was filled with 210 cow dung cakes. Over that, *Sharava Samputa* was placed and thermocouple was placed vertically at that point. The rest 1/3rd portion was filled with 112 cow dung cakes. *Gajaputa* was ignited with camphor in all directions and the temperature was measured for every five minutes. After complete burning of *Gajaputa*, the *Sharava Samputa* was allowed for self cooling. After cooling the mud smeared layers were scraped gently with the help of knife. The *Mukta Shukti* was collected from the *Sharava* and was tested for *Bhasma Siddhi Lakshanas*. But it was not fulfilling the *Bhasma Pariksha*, so the same procedure was repeated for 4 more time.

Observations

- During trituration with *Kumari Swarasa*, initially the mixture was soft and trituration was done at the rate of 22-24 strokes/min. As the procedure continued, mixture became thick, semisolid and heavy and trituration was done at the rate of 14-16 strokes / min.
- It took 3 hours for the appearance of *Subhavita Dravya Lakshanas* like *Dravya* not sticking to the *Peshani* or *Khalva*, can made into pill form easily.
- After *Bhavana* with *Kumari Swarasa* and pellet formation, the weight of the *Marita Shukti* increased from 200-229gms.
- *Chakrikas* were of 2-3cm in diameter and 1mm in thickness. Total 20-25 *Chakrikas* were made.
- *Chakrikas* were placed uniformly in the *Sharava*.
- *Sandi Bandhana* was done carefully without shaking the *Sharavas* after drying the previous layer.
- Size of the pit for *Gajaputa* was one *Raja Hastha* (30 *Angula* - 58.5cm)
- Size of a cow dung was average circumference: 45cm, Thick ness 6.2cm in center, 3.2cm in peripheral, Average weight: 140gm
- The *Sharava* was placed in *Gajaputa* only after complete drying.
- Lower 2/3rd of *Gajaputa* was filled with 210 cowdungs and upper 1/3rd by 112 cowdungs.
- The same procedure was repeated again for 4 times to attain all *Bhasma Siddhi Lakshanas*.

B) Preparation of *Mukta Shukti Bhasma* by *Jala Bhavana* method

Method: The preparation of *Mukta Shukti Bhasma* was carried out as follows,

- Giving *Bhavana* of *Jala* to *Marita Mukta Shukti*
- Preparation of *Chakrikas*
- Formation of *Sharava Samputa*
- Subjecting for *Gajaputa*

ISSN: 2456-3110 ORIGINAL ARTICLE July-Aug 2017

Jala Bhavana

- 200gms of *Marita Mukta Shukti* was placed in Khalva yantra and powdered.
- 350ml of *Jala* was added to it and was enough to immerse *Shukti* in it.
- Trituration was done for three hours. At the end the whole mass was converted into a viscous and semisolid state.

Preparation of *Chakrikas*

The semisolid material was taken out of *Khalva Yantra.* A small portion around 10gms of material was taken and converted into a bolus. That bolus was placed over a plastic sheet and pressed gently and uniformly so that a pallet of 2-3cm diameter and 1mm thickness was prepared. Same way totally 20-25 pallets were made and kept for drying.

Formation of *Sharava Samputa*

Complete dried *Chakrikas* were placed in a *Sharava* uniformly and another *Sharava* of same size was placed over it. Edges were sealed with *Multani* mud smeared thread followed by the same mud smeared cloth for seven layers and dried under shade.

Subjecting to *Gajaputa*

2/3 rd of the pit of *Gajaputa* was filled up with 208 cow dung cakes and over that *Sharava Samputa* was placed. Thermocouple was placed vertically at that point and the remaining portion was filled with 114 cow dung cakes. *Gajaputa* was ignited with camphor in all directions. Temperature was measured for every five minutes. After complete Burning, cow dung cakes of *Gajaputa*, the *Sharava Samputa* was allowed for self cooling. After cooling the mud smeared layers were scraped gently with the help of knife. The *Mukta Shukti* was collected from the *Sharava* and was tested for *Bhasma Siddhi Lakshanas.* But it was not fulfilling the *Bhasma Pariksha.* So the same procedure was repeated for 5 more time.

Observations

- During trituration with distilled water, initially the mixture was soft and trituration was done at the rate of 20-22 strokes/min. As the procedure continued, mixture became thick, semisolid and heavy and trituration was done at the rate of 14-16 strokes / min.
- It took 31/2 hours for the appearance of *Subhavita Dravya Lakshanas* like *Dravya* not sticking to the peshani or *Khalva*, can made into pill form easily.
- After *Bhavana* with distilled water and pellet formation, the weight of the *Marita Shukti* increased from 200-219gms..
- *Chakrikas* were of 2-3cm in diameter and 1mm in thickness. Total 20-25 *Chakrikas* were made.
- *Chakrikas* were placed uniformly in the *Sharava*.
- *Sandi Bandhana* was carefully without shaking the *Sharava* after drying the previous layer.
- The *Sharava* was placed in *Gajaputa* only after complete drying.
- Size of the pit for *Gajaputa* was one *Rajahastha* (30 *Angula* - 58.5cm)
- Size of a cow dung was average circumference: 45cm, Thickness 6.2cm in center, 3.2cm in peripheral, Average weight: 140gm
- Lower 2/3rd of *Gajaputa* was filled with 208 cowdungs and upper 1/3rd by 114 cowdungs.
- The same procedure was repeated again for 5 times to attain all *Bhasma Siddhi Lakshanas*.

C) Preparation of *Mukta Shukti Bhasma* by *Kumari Samputa* method.[6]

Method: The preparation of *Mukta Shukti Bhasma* by *Kumari Samputa* method was done under following steps:

- Preparation of *Kumari Samputa*
- Giving *Gajaputa*

Preparation of *Kumari Samputa*

Kumari was collected from herbal garden of TGAMC Bellary, the outer layer was peeled off and pulp was collected and weighed. 250gms of *Kumari* pulp was

ISSN: 2456-3110 ORIGINAL ARTICLE July-Aug 2017

placed in a *Sharava*. Over that 125gms of *Shodhita Mukta Shukti* was spread uniformly. Again rest of 250gms of *Kumari* pulp was placed over that. The *Samputa* was closed with the same sized *Sharava*. *Sandhi Bandhana* was done with mud smeared thread and cloth as done in previous experiments. This *Sharava* was kept for drying.

Subjecting to *Gajaputa*

2/3 rd of the *Gajaputa* pit was with filled with 214 cow dung cakes. The *Sharava Samputa* was placed over it. Thermocouple was placed at the same point vertically. The rest of 1/3rd is filled with 107 cow dung cakes. Then *Puta* was ignited with camphor. After self cooling, *Sharava* was taken out and *Marita Mukta Shukti* was collected This was tested for *Bhasma Siddhi Lakshanas*, but didn't fulfill the same. Then again it was subjected for *Kumari Swarasa Bhavana* and again subjected for *Gajaputa.* Similarly another 2 *Gajaputa* was given.

Observation

- The *Kumari* pulp was taken and cut into equal size.
- Kumari pulp was placed in *Sharava* uniformly.
- The rest of *Kumari* pulp was placed over *Mukta Shukti* so that any single piece of *Mukta Shukti* was left uncovered.
- *Sandi Bandhana* was done carefully and tightly without shaking the *Sharava*.
- Size of the pit for *Gajaputa* was one *Raja Hastha* (30 *Angula* - 58.5cm)
- Size of a cow dung was average circumference: 45cm, Thickness 6.2cm in center, 3.2cm in peripheral, Average weight: 140gm
- 2/3 rd of the *Gajaputa* was filled with 214 cow dung cake and upper 1/3rd by 107 cow dungs
- The *Mukta Shukti* was taken out of the *Sharava* after self-cooling was tested for *Bhasma Siddhi Lakshanas.* But it didn't fulfill the same.
- Again the same *Mukta Shukti* was subjected for *Bhavana* with *Kumari Swarasa*. The quantity of *Kumari Swarasa* used was 150ml. Trituration was done for 41/2 hour and speed was 20-22 strokes/ min. *Chakrikas* were made of 3cm diameter and 1mm thickness.
- Again for *Gajaputa* 324 cow dung cakes were used.
- The *Marita Mukta Shukti* was subjected again for *Bhasma Siddhi Lakshanas* and it was not totally fulfilling.
- The same *Marita Mukta Shukti* was subjected again for *Bhavana* with *Kumari Swarasa.* Trituration was done with the speed of 22-24 strokes/min. for 4 hours. The *Swarasa* added was 100ml. The total no of cow dung cakes used for *Gajaputa* were 328.
- The *Marita Mukta Shukti* this time fulfilled the *Bhasma Siddhi Lakshanas.*

Observations and Results

Table 3: Comparative pharmaceutical procedures of *Mukta Shukti Bhasma*

SN	Parameters	MSB by *Kumari Bhavana*	MSB by *Jala Bhavana*	MSB by *Kumari Samputa*
1	Procedure adopted	*Sh. Mukta Shukti* was incinerated; *Bhavana* was given with *Kumari Swarasa* and incinerated	*Sh. Mukta Shukti* was incinerated; *Bhavana* was given with *Jala* and incinerated	*Sh. Mukta Shukti* was placed in between *Kumari* pulp in a *Sharava* and was incinerated.
2	No. of *Putas* required	6	7	3
3	Weight of Sh. *Mukta Shukti*	200gms	200gms	125gms
4	Weight of *Mukta Shukti Bhasma*	40gms	53gms	56.5gms

ISSN: 2456-3110 ORIGINAL ARTICLE July-Aug 2017

5	Weight loss	160gms	147gms	68.5gms
MSB - Mukta Shukti Bhasma				

Table 4: Organoleptic results of *Mukta Shukti Bhasmas*

SN	Parameters	MSB by *Kumari Bhavana*	MSB by *Jala Bhavana*	MSB by *Kumari Samputa*
1	Color	Olympus white	Bright white	Francois white
2	Taste	Tasteless	Tasteless	Tasteless
3	Touch	Soft smooth	Soft smooth	Soft, smooth
4	Appearance	Very fine powder	Very fine powder	Very fine powder
5	Odor	Odorless	Odorless	Odorless
MSB - Mukta Shukti Bhasma				

Table 5: Comparative Analytical Study of *Mukta Shukti Bhasmas*

Parameters	*MSB* by *Kumari Bhavana*	*MSB* by *Jala Bhavana*	*MSB* by *Kumari Samputa*
Varna	Olympus white	Bright white	Francois white
Sparsha	Soft smooth	Soft smooth	Soft smooth
Gandha	Odorless	Odorless	Odorless
Rekhapurnatwa	+ve	+ve	+ve
Varitaratwa	+ve	+ve	+ve
Ash value	61.82%	64%	62.45%
Acid insoluble ash	1.21%	1.0%	1.12%
Loss on drying at 110^0c[7]	0.042%	0.049%	0.038%
pH	9	9	9
Particle size retention at 80no mesh	12.22%	13.24%	11.84%
Particle size microscopic[8]	30µ	32µ	30µ
XRD d-identified [9,10]	2.620, 1.793 and 1.923	2.629, 1.797 and 1.931	3.031, 1.912 and 2.282
XRD report (Name and Composition)	Calcite $CaCO_3$ (Trigonal	Calcium oxide Hydrate $Cao.H_2O$ (Trigonal)	Calcite $CaCO_3$ (Trigonal)
MSB - Mukta Shukti Bhasma			

DISCUSSION

Shukti is subjected to *Kanji Swedana* by *Dolayantra* method. During this process, many physico-chemical changes can be infered. Physical impurities will be removed, making the *Drava* more bright, clean and clear. This process makes the *Dravya* more fragile with a view to reduce it to a fine powder form by the process of *Marana*. *Dravya* releases certain undesired chemical constituents in the liquid, taking certain required chemical constituents of the liquid and because of which certain chemical changes taken place. *Swedana* is done with acids. As these are chemically active and potent, the chemical reaction taking place will be more significant, so due to *Kanji Swedana* probably chemical changes would be oxidation, reduction, neutralization, salt formation, sublimation and formation of complex conjugates etc. might have happened upon *Shukti*.

Trituration is a process, which allows effective combination of different constituents of a particular preparation and divides it into finest particles, thus increasing its assimilative power and therapeutic effect. *Bhavana* makes the particles finer by *'Sanghatha Bhedana'* effect. It potentiate the *Dravya*

ISSN: 2456-3110 ORIGINAL ARTICLE July-Aug 2017

and in augmentation of different types of therapeutic values.

Fig. 5: *Mukta Shukti Bhasma Kumari Bhavana* method

Fig. 6: *Mukta Shukti Bhasma Jala Bhavana* method

Fig. 7: *Mukta Shukti Bhasma Kumari Samputa* method

Marana is a procedure adopted to convert the heterogeneous material in to homogenous substance and converting it in to nano particles. The *Puta* adopted in the present study was *Gajaputa*, which exerts up to 1000^0C.

Shukti Shodhana

When *Grahya Mukta Shukti* were subjected to *Shodhana* procedures, changes were observed, dull white *Shukti* changed to bright white and the cut edges became lustrous. This may be due to the removal of impurities by boiling. Physical characteristic of Aragonite is lustourous. Boiling *Shukti* in acidic media clears out the masked lustour and made it lustourous.

Acharya Charaka described the properties of *Amla Rasa* as *Mukham Apakarshayathi*, *Kledayathi* and *Jarayathi*. *Amlarasa* having dissociative property softens the drug due to its *Mukham Apakarshayathi* property, *Amla Rasa* having capacity to open minute poses of the drug by its *Teekshna Guna* to remove the impurity. Due to the *Jarana, Teekshnatva, Kshalana* properties of *Amla Rasa, Kanji* helps in reduction of hardness, particles size and to develop brittleness. *Kanji* properties can also be appreciated just by its touch, so in the process *Swedana* in *Kanji*, the only physical contact is enough to impose its properties viz., *Vata Kaphahara, Deepana, Pachana, Koshta Shuddikarana* and *Jwaraghna* to *Shukti*.

Increased pH of *Kanji* during the procedure shows that alkaline particles of *Shukti* have diffused into *Kanji*. So it indicates that diffusion has taken place, hence the fick's law of diffusion i.e. ds/dt = DA (dc/dx), where ds/dt= the rate of moment of solutes, D – diffusion constant, A- the area of planes, and dc/dx- the concentration gradient i.e. difference between the concentration between X and Y. By following this rule the time duration required for *Shukti Shodhana* was 3 hours.

Shukti Marana

Mukta Shukti Marana was done with 200gms of *Shodhita Mukta Shukti* by subjecting to *Kumari*

ISSN: 2456-3110 ORIGINAL ARTICLE July-Aug 2017

Bhavana and 6 *Gajaputas* with average temperature of 781^{0}C and the end product obtained was 40gms.

While in *Jala Bhavana* method the initial weight of *Mukta Shukti* was 200gms and the 7 *Gajaputas* were given with average temperature of 783^{0}C. The *Mukta Shukti Bhasma* by *Jalabhavana* obtained was 53gms.

Shodhita Mukta Shukti of 125gms was subjected to *Kumari Samputa* method with 3 *Gajaputas* with average temperature 821^{0}C produced 56.5 gms of *Bhasma*.

Kumari Bhavana was done before subjecting it to further *Putas* because *Kumari* is a reducing agent, helps in disintegration of particles and thus getting more fineness to *Bhasma* in successive heating. *Kumari Swarasa* contains 'Aloin', alkaline chemical constituents which help in breakdown of particles. Also the impregnation or trituration loosens the molecular cohesiveness and helps *Shukti* to break into fine particles during the subsequent processing. *Kumari Bhavana* reduces the alkaline property of *Shukti Bhasma*, making it weak base, having unionized forms of ions, which are readily absorbed by the cells. *Kumari* has *Vatakaphahara Swasahara* property and due to the good purgative effect, it also counteracts the constipating effect of Calcium carbonate.

Jala is neutral in pH, universal solvent and absorbs enormous amount of heat. Hence it has been used in the *Bhavana* of *Shukti*. Water helps in reducing the alkalinity of *Shukti*. Water helps in catching the CaO and also preventing the further disintegration of CaO.

During *Shukti Marana*, *Chakrikas* were found to be more advantageous due to the better *Agni Paka*, availability of more surface area and hence maximum amount of dissociation of particles took place, while adding *Kumari Swarasa* and *Jala* to *Shukti* after one *Gajaputas*, the warmth ness was felt may be due to exothermic reaction.

Chemically, *Shukti* is Calcium carbonate, and it undergoes thermal decomposition at 500-600^{0}c or 932^{0}F and the chemical reaction occurring during *Shukti Marana* can be explained as below, On heating, $CaCO_3$ dissociates into calcium oxide with liberation of CO_2.

$CaCO_3 \rightleftharpoons CaO + CO_2\uparrow$.

The reaction is reversible and to avoid it, CO_2 must be swept off. In some procedures CO_2 escapes leaving the CaO alone and CaO on exposure to atmosphere catches the water molecule and forms the Calcium oxide hydrate, $CaO.H_2O$.

Marana done in closed condition have little chance of escaping of CO_2 through the minute pores of the Sharava. So, in the present study dissociated $CaCO_3$ might have combined with CO_2 to reform $CaCO_3$ and also CaO when exposes to atmosphere, it readily absorbs moisture and CO_2 to form calcium carbonate

$CaO + H_2O \rightarrow Ca(OH)_2$

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2\uparrow$

So, the left out CaO might have react with atmospheric moisture and CO_2 to form calcium carbonate, hence major composition of Shukti bhasma will be $CaCO_3$ and very less concentration of calcium oxide may present.

Marana is an endothermic reaction in energy supplied in the form of heat. This can be compared to Annealing which is the process of heating metal or mineral which is in a metastable or distorted structure state, to temperature will remove the instability or distortion and then cooling at a slow rate, so that the room temperature is stable.

Its purposes are inducing a completely stable Refining and homogenizing the structure, reducing hardness, producing desire microstructure, Removing residual stresses, Improving mechanical, physical and electro magnetic properties. So the changes after marana electromagnetic can be inferred as due to the process of Annealing.

The temperature recording during *Shukti Marana* in *Gajaputa* was done with an intention of giving pyrometric objectivity to the pharmaceutical process. Temperature was recorded by placing the pyrometer vertically from bottom of the pit, at the junction of upper 1/3rd and thermocouple placed near the

ISSN: 2456-3110 ORIGINAL ARTICLE July-Aug 2017

Sharava Samputa. No much difference were observed in average temperature of each *Gajaputa* and also in the peak range temperature of each puta, also mean differences between these were less and they are statistically not significant, showing that temperature given to all *Gajaputas* were almost same with minimum variation.

Total ash

The total ash value of *Mukta Shukti Bhasma* by *Kumari Bhavana* method was 61.82%, *Mukta Shukti Bhasma* by *Jala Bhavana* method 64%, and *Mukta Shukti Bhasma* by *Kumari Samput*a method was 62.45%.

The *Mukta Shukti Bhasma* by *Kumari Bhavana* method had least ash value hence was considered best among all the other *Bhasmas.*

Acid insoluble ash

As there was negligible insoluble ash, all the samples of *Shukti Bhasma* were free from contamination of mud, sand and other siliceous materials and almost all the amount of inorganic material present is soluble in acid and digestible in human GI tract, hence the drug is safe.

Loss on drying at 110^{0}C

Reduction in moisture content reduced the chance of microbial contamination, decomposition due the undesired chemical changes. Moisture content of *Shukti Bhasmas* shows the rare chance of bacterial and fungal growth, less hygroscopic, least drug deterioration and contamination. Hence, the shelf life of prepared *Shukti Bhasmas* in the present study is more.

ph Value

ph value of all *Shukti Bhasmas* samples were 9. This alkalinity of the drug indicates the site of absorption and action of the drug. Basic drugs are not absorbed until they reach the alkaline environment of the small intestine. The alkaline environment in which the major component of the drug exists in an unionized form, facilitates their absorption

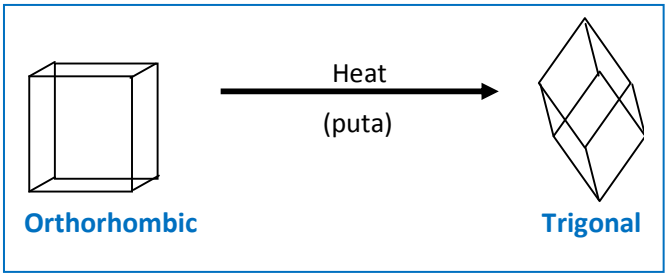
Calcium percentage

The Calcium percentage of Raw *Mukta Shukti* was 38.7%. It kept on increasing after each proceedings. After *Shodhana* it was 39.2% and the same in *Bhasma* prepared by *Kumari Bhavana* method was 40.3%, *Bhasma* prepared by *Jala Bhavana* method was 40.9% and by *Kumari Samputa* method was 40.4%.

As the percentage of Ca increased after each proceedings it indicates that concentration of Calcium increased as well as other ingredients present in the Shukti were reduced. CaO contains more Ca percentage compared to $CaCO_3$. As the *Shukti Bhasmas* prepared by *Jala Bhavana* are in oxide form naturally the percentage of Ca increased. But in other *Bhasmas* it indicated that the other impurities or contaminated materials were removed.

XRD study

The diffraction of X-rays are used in the study of the crystalline materials which produce diffraction. X – ray diffraction leads primarily to the identification of crystalline compound from their diffraction patterns. This XRD pattern shows the change in chemical form and structure. Aragonite and calcite both are the forms of $CaCO_3$. Mineralogical, Aragonite changes into calcite on heating. This is observed in the present study, that *Shodhita Shukti* (X-RD identification Aragonite) after subjecting it into *Gajaputa* changes to calcite. Here the polymorphic form of $CaCO_3$ crystal from orthorhombic system changes to another polymorphic form of Trigonal system of crystallisation, also changes in the cleavage and cleavage fragment shape. Hardness from 3.5 to 4 reduced to 3, which may be due to the effect of heat.



Chemically, calcium carbonate is converted into calcium oxide by heating $CaCO_3 \rightarrow CaO + Co_2 \uparrow$ and CaO readily absorbs moisture from the atmosphere to

ISSN: 2456-3110 ORIGINAL ARTICLE July-Aug 2017

form calcium oxide hydrate. The hydrate form may be because of CaO. Combining with the water molecule in the atmosphere, or by *Bhavana* forming calcium hydroxide. This is what seen in *Bhasmas* prepared by *Jalabhavana* method.

But in *Kumari Bhavana* again carbon molecule present in the organic matter of *Kumari* will convert in to CO_2 and react with calcium hydroxide and again reforms the calcium carbonate but will be in calcite form. The same happens in the *Kumari Samputa* method.

CaO+ H2O = Ca(OH)2

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2\uparrow$

NPST[11]

Namboori's phased spot test showed no marked difference in each samples of *Shukti Bhasmas* when compared with the *Pravala Bhasma* standards. Only the settling time is slower in the *Shukti Bhasma* samples compared to the *Pravala Bhasma* standard. All the samples showed the exothermic reaction and the absorption was also normal. So all the *Bhasmas* were within the standard limit. Only way to differentiate them was by settling time.

CONCLUSION

Shukti Marana by *Kumari Bhavana, Jala Bhavana* and *Kumari Samputa* method is promising. 6, 7 and 3 *Gajaputas* are respectively required for the preparation of *Mukta Shukti Bhasma* by *Kumari Bhavana, Jala Bhavana* and *Kumari Samputa* method. XRD analysis is one of the current analytical methods to know the form of *Shukti Bhasma* and hence useful in the standardization.

REFERENCES

1. Pal D, Sahu CK, Haldar A. Bhasma : The ancient Indian nanomedicine. Journal of Advanced Pharmaceutical Technology & Research. 2014;5(1):4-12. doi:10.4103/2231-4040.126980.
2. Mishra LC, Adra T, Batchu SV, Bhatt HA. LLC Boca Raton, Florida: CRC Press; 2004. Scientific basis for ayurvedic therapies; pp. 84–99.
3. N. V. Vardhini, T. N. Sathya, P. Balakrishna Murthy, Assessment of genotoxic potential of herbomineral preparations - bhasmas, Current Science, Vol. 99, No. 8, 25 October 2010.
4. Ramachandra Reddy K. Bhaishajya Kalpana Vijnana. 3rd ed. Varanasi: Chawkhamba Sanskrit Bhavan; 2004;p.418.
5. Sadananda Sharma, Rasa Tarangini, Kashinath Shastry ed, New Delhi, Motilal Banarasidas publication, 12th chapter, 2000;p.296.
6. Shyamasundar Acharya, Rasayana Sara part 1, Varanasi, Krishnadas Academy, 5th edition, 2002;p.327
7. Indian Herbal pharmacopoeia, Volume I, Mumbai, A Joint Publication of Regional Research Laboratory Jammu and Indian Drug manufactur's Association, 180 - 181 pp.
8. C.V.S. Subramanyam, Text Book of Physical Pharmaceuties, 2nd edn, Vallabha Prakashan, 2000, P. 195-200.
9. Biotechnology - 3including molecular biology, bio physics, by S. Mahesh, new age international publishers, Delhi, part B, 9th chapter 282-284pp.
10. Turner RA, Analgesic in screening method cited in pharmacology edition turner or a academic press London, New York, 1952,110-117pp
11. Namburi Hanumanth Rao, Manual of Namburi phased Spot test, Vijayawada, Namburi Inventions and Publication, 1997;p.2.

How to cite this article: Biradar M. H., Shankar Gowda, Madhav Diggavi. Pharmaceutico Analytical Study of Mukta Shukti Bhasma. J Ayurveda Integr Med Sci 2017;4:89-99.
http://dx.doi.org/10.21760/jaims.v2i4.9333

Source of Support: Nil, **Conflict of Interest:** None declared.