Pharmaceutico Analytical Study of Mukta Shukti Bhasma

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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 Mukta 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 Swarasara Bhavana and incinerated. The second part of Shodhita Mukta Shukti was incinerated in Kumari Samputa and subjected to Kumari Swarasara 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 Swarasara, 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.⁴

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.⁵

Bhasma is considered to be more potent than any other healing preparations.⁶ 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
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

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**

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**

<table>
<thead>
<tr>
<th>Time</th>
<th>0 hr</th>
<th>After ½ an hr.</th>
<th>After 1 hr.</th>
<th>After 1½ hrs.</th>
<th>After 2 hrs.</th>
<th>After 2½ hrs.</th>
<th>After 3 hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>3.7</td>
<td>3.90</td>
<td>4.59</td>
<td>5.23</td>
<td>5.34</td>
<td>5.38</td>
<td>5.40</td>
</tr>
</tbody>
</table>
Table 2: Mukta Shukti before and after Shodhana

<table>
<thead>
<tr>
<th>Observations</th>
<th>Before Shodhana</th>
<th>After Shodhana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Dull cream white</td>
<td>Bright white</td>
</tr>
<tr>
<td>Brittleness</td>
<td>Not Brittle</td>
<td>Brittle</td>
</tr>
<tr>
<td>Edges of cut surfaces</td>
<td>Lusterless</td>
<td>Shinning</td>
</tr>
</tbody>
</table>

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.
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 1/3 rd 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 times.

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, Thickness 6.2cm in center, 3.2cm in peripheral, Average weight: 140gm
- The Sharava was placed in Gajaputa only after complete drying.
- Lower 2/3 rd of Gajaputa was filled with 210 cowdungs and upper 1/3 rd 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
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
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 1/3 rd 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.
- Sandhi 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

<table>
<thead>
<tr>
<th>SN</th>
<th>Parameters</th>
<th>MSB by Kumari Bhavana</th>
<th>MSB by Jala Bhavana</th>
<th>MSB by Kumari Samputa</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Procedure adopted</td>
<td>Sh. Mukta Shukti was incinerated; Bhavana was given with Kumari Swarasa and incinerated</td>
<td>Sh. Mukta Shukti was incinerated; Bhavana was given with Jala and incinerated</td>
<td>Sh. Mukta Shukti was placed in between Kumari pulp in a Sharava and was incinerated.</td>
</tr>
<tr>
<td>2</td>
<td>No. of Putas required</td>
<td>6</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Weight of Sh. Mukta Shukti</td>
<td>200gms</td>
<td>200gms</td>
<td>125gms</td>
</tr>
<tr>
<td>4</td>
<td>Weight of Mukta Shukti Bhasma</td>
<td>40gms</td>
<td>53gms</td>
<td>56.5gms</td>
</tr>
</tbody>
</table>
Table 4: Organoleptic results of Mukta Shukti Bhasmas

<table>
<thead>
<tr>
<th>SN</th>
<th>Parameters</th>
<th>MSB by Kumari Bhavana</th>
<th>MSB by Jala Bhavana</th>
<th>MSB by Kumari Samputa</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Color</td>
<td>Olympus white</td>
<td>Bright white</td>
<td>Francois white</td>
</tr>
<tr>
<td>2</td>
<td>Taste</td>
<td>Tasteless</td>
<td>Tasteless</td>
<td>Tasteless</td>
</tr>
<tr>
<td>3</td>
<td>Touch</td>
<td>Soft smooth</td>
<td>Soft smooth</td>
<td>Soft, smooth</td>
</tr>
<tr>
<td>4</td>
<td>Appearance</td>
<td>Very fine powder</td>
<td>Very fine powder</td>
<td>Very fine powder</td>
</tr>
<tr>
<td>5</td>
<td>Odor</td>
<td>Odorless</td>
<td>Odorless</td>
<td>Odorless</td>
</tr>
</tbody>
</table>

MSB - Mukta Shukti Bhasma

Table 5: Comparative Analytical Study of Mukta Shukti Bhasmas

<table>
<thead>
<tr>
<th>Parameters</th>
<th>MSB by Kumari Bhavana</th>
<th>MSB by Jala Bhavana</th>
<th>MSB by Kumari Samputa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varna</td>
<td>Olympus white</td>
<td>Bright white</td>
<td>Francois white</td>
</tr>
<tr>
<td>Sparsha</td>
<td>Soft smooth</td>
<td>Soft smooth</td>
<td>Soft smooth</td>
</tr>
<tr>
<td>Gandha</td>
<td>Odorless</td>
<td>Odorless</td>
<td>Odorless</td>
</tr>
<tr>
<td>Rekhapurnatwa</td>
<td>+ve</td>
<td>+ve</td>
<td>+ve</td>
</tr>
<tr>
<td>Varitaratwa</td>
<td>+ve</td>
<td>+ve</td>
<td>+ve</td>
</tr>
<tr>
<td>Ash value</td>
<td>61.82%</td>
<td>64%</td>
<td>62.45%</td>
</tr>
<tr>
<td>Acid insoluble ash</td>
<td>1.21%</td>
<td>1.0%</td>
<td>1.12%</td>
</tr>
<tr>
<td>Loss on drying at 110°C [7]</td>
<td>0.042%</td>
<td>0.049%</td>
<td>0.038%</td>
</tr>
</tbody>
</table>

MSB - Mukta Shukti Bhasma

**DISCUSSION**

*Shukti* is subjected to *Kanji Swedana* by *Dolayantra* method. During this process, many physico-chemical changes can be inferred. 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*...
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°C.

Shukti Shodhana

When Grahy 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. \( \frac{ds}{dt} = DA \left( \frac{dc}{dx} \right) \), where \( \frac{ds}{dt} \) the rate of moment of solutes, \( D \) – diffusion constant, \( A \) - the area of planes, and \( \frac{dc}{dx} \) 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
Bhavana and 6 Gajaputas with average temperature of 781°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°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°C produced 56.5 gms of Bhasma.

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°C or 932°F and the chemical reaction occurring during Shukti Marana can be explained as below, On heating, CaCO₃ dissociates into calcium oxide with liberation of CO₂.

\[
\text{CaCO}_3 \leftrightarrow \text{CaO} + \text{CO}_2
\]

The reaction is reversible and to avoid it, CO₂ must be swept off. In some procedures CO₂ escapes leaving the CaO alone and CaO on exposure to atmosphere catches the water molecule and forms the Calcium oxide hydrate, CaO.H₂O.

Marana done in closed condition have little chance of escaping of CO₂ through the minute pores of the Sharava. So, in the present study dissociated CaCO₃ might have combined with CO₂ to reform CaCO₃ and also CaO when exposes to atmosphere, it readily absorbs moisture and CO₂ to form calcium carbonate.

\[
\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2
\]

\[
\text{Ca(OH)}_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}
\]

So, the left out CaO might have react with atmospheric moisture and CO₂ to form calcium carbonate, hence major composition of Shukti bhasma will be CaCO₃ 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 electromagnetic 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...
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 Samputa 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°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 CaCO₃. 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 CaCO₃. 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 CaCO₃ 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.
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 CO₂
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.

\[
\text{CaO+ H}_2\text{O} = \text{Ca(OH)}_2
\]
\[
\text{Ca(OH)}_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2 \uparrow
\]

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

2. Mishra LC, Adra T, Batchu SV, Bhatt HA. LLC Boca
ayurvedic therapies; pp. 84–99.

3. N. V. Vardhini, T. N. Sathy, P. Balakrishna Murthy,
Assessment of genotoxic potential of herbomineral
8, 25 October 2010.

4. Ramachandra Reddy K. Bhaishajya Kalpana Vijana. 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 manufacture’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

Spot test, Vijayawada, Namburi Inventions and
Publication, 1997;p.2.

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