A comparative study of prepared *Bhasma* using different marine-originated animal materials

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Abstract

Rasa shastra is a main pharmaceutical branch in Ayurveda and Mercury is the main material in *Rasa shastra*. Other than mercury, different animal resources, minerals, gems, marine originated materials and some toxic plants are also described under *Rasa shastra*. *Shankha*, *Shukthi* and *Kaparda* are some of the commonly used marine originated animal materials. These materials contain Calcium and categorized under *Sudha varga*. The objective of this study is to prepare *Shankha*, *Shukthi* and *Kaparda bhashmas* according to *Rasa shastra* and to comparatively analyze the physico-chemical parameters and to determine the Calcium content of these *Bhashmas*. Boiling and steaming method was used for the purification, and incineration was done by using the muffle furnace at 550°C. *Bhashma* standardization parameters in *Rasa Shastra*; *Rekha purnatva, Varitharathva, Uththama, Gatha rasathva, Avami, Anjana sadrusha sukshma* and *Dantagra na kacha kacha* were performed for all these *bhashmas*. Calcium percentage in each *bhashma* was determined by titrating with 0.1M NaOH solution using phenolphthalein as the indicator. Results revealed that all the *Bhashmas* were within the standard parameters according to classical texts. According to modern physico-chemical analysis, moisture contents of all the samples were relatively low (0.40%, 1.30%, 0.95%). Total ash contents were 99.20%, 98.50% and 98% respectively. Acid insoluble ash values (52%, 77.80%, 57%) were higher than water soluble ash values (3.80%, 2.60%, 1.65%). All the samples were having an alkaline pH value (8.2, 8.0, 8.7). The highest calcium percentage was reported from *Shukthi bhashma* (99.30%) and lowest from *Kaparda bhashma* (78.40%). It can be concluded that all the *Bhashmas* were having the standard quality according to Ayurveda as well as modern physico-chemical parameters. Due to the high calcium content, *Shukthi bhashma* can be highly recommended as a nutritional supplement for Calcium deficiencies among these *Bhashmas*.

Keywords: *Bhashma*, *Kaparda*, Marine originated, *Shanka*, *Shukthi*

Introduction

Ayurveda is considered as a natural healing system and one of the oldest traditional medicine systems not only in ancient India but also in the world. Ayurveda has two main objectives as prevention of diseases and curing of diseases[1]. According to Ayurveda authentic texts, there are four pillars needed to achieve these two objectives. They are called as *Vaidyadi chathushpadaya*, which consists of physician, patient, attendant and drugs[2]. Drugs play a key role among these four pillars. Drugs from the three natural sources of herbal, mineral, metal and animal origin have been described in Ayurveda.

Rasa shastra is a branch of Ayurveda that developed along with *Bhaisajya Kalpana*[3,4]. *Rasa shastra* started as a separate science, but it slowly merged with Ayurveda. Mercury is the main material in *Rasa shastra*[5]. Other than mercury different animal materials, minerals, gems, marine originated materials and some toxic plants are also described under *Rasa shastra*[6]. The preparations which are prepared with these materials are called as

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Rasaushadies and there is many processing techniques applied for the preparation of those *Rasaushadies*. They are *Shodana*, *Jarana*, *Marana* and *Amruthikarana*. *Rasa shastra* texts have mentioned the superiority of these preparations[7]. When comparing with herbal preparations, *Rasaushadies* are considered as the superior preparation due to the ability of administering a lower dose, tastelessness and high potency. Also, they can be absorbed and assimilated in the body quickly[8]. Due to these special features of *Rasaushadies*, patients can get quick relief.

Marine which is called as the 'mother of origin of life' is also one of the richest natural sources of minerals like Calcium (Ca), Phosphorus (P) and Iron (Fe). There are many marine originated animal parts extensively used in *Rasa shastra*[9]. Conchs (*Shankha*), oyster's shell (*Shukthi*), and cowrie shells (*Kaparda*) are some of the commonly used marine originated animal materials[10]. These materials which contain calcium are categorized under the *Sudha varga* in *Rasa Shastra* authentic texts. *Shankha* or conch (*Terbinella pyrum*) which belongs to the class Mollusca of family Turbinellidae is enclosed in a very hard, dense and calcareous shell[11]. It is a large sea snail with a long spiral shell. There are two types of *Shankha* as *Vamavartha*, *Dakshinawartha.* It has properties like cooling, detoxifying, complexion enhancing and strengthening[12]. It has an acid neutralizing capacity and anti-acid action and prolonged buffering action. *Shankha* is the drug of choice for gastritis, flatulence, abdominal pain, vomiting, diarrhoea and belching[13]. *Shukthi* or oyster's shell (*Pinctada margaritifera*) belongs to the family Ostreidae. There are two varieties as *Mukthashukthi* and *Jalashukthi*. It has a cooling effect and indicated for gastritis, gastric ulcers and duodenal ulcers[14]. It can be converted into two forms as *Bhashma* and *Pishti*. *Kaparda* or cowerie (*Cyprae moneta*) which belongs to the family Cypraidae is a yellow colour shell having weight of 3 to 5 grams. It is used as a powerful antacid for many stomach ailments [15].

All of these materials can be subjected to different special procedures mentioned in *Rasa shastra* texts and finally converted into a fine ash like preparation which is called as *Bhashma*[16]. These *Bhashmas* can be introduced to the human body for different ailments, in single or as compound formulations. Especially, these *Bhashmas* can be used as a medicine in Calcium deficiencies, without getting any unwanted effects. The main objective of this study is to compare the physico-chemical parameters of *Bhashmas* prepared using different common animal originated materials such as *Shankha*, *Shukthi* and *Kaparda* and to comparatively study the calcium content of these *Bhashmas*.

Materials and Methods

Collection of the raw material

The *Shanka* (Figure 1) was collected from Jaffna beach and *Shukthi* (Figure 2) and *Kaparda* (Figure 3) were collected from Panadura beach, Sri Lanka. All the raw materials were authenticated from the Department of Ayurveda Pharmacology, Pharmaceutics and Community Medicine, Faculty of Indigenous Medicine, University of Colombo, Sri Lanka.

Fig.1: ***Shankha*** **(Conch shell)**

Fig.2: *Shukthi* **(Oyster's shells)**

Fig.3: *Kaparda* **(Cowrie shells)**

Preparation of Shankha, Shukthi and Kaparda bhashma[17]

Shodhana of Shankha, Shukthi and Kaparda

Shanka, *Shukthi* and *Kaparda* were taken and crushed into small pieces separately. Then the crushed parts were washed with hot water separately. Each sample was kept in a piece of a clean cotton cloth separately and prepared them as pouches (Figure 4) and put into the *Dola yantra* containing *Kanji* (vinegar) (Figure5). Then each sample was boiled in the *Dola yantra* for one *Yama* (3 hours). After 3 hours the materials contained in the cloth pouches were allowed to cool. Then they were again washed with luke warm water and dried properly. Finally, the purified *Shankha*, *Shukthi* and *Kaparda* were obtained and subjected to *Marana* process.

Fig.4: Pouches of the samples

Fig.5: Boiling in the *Dola yantra*

Marana* of *Shankha

The sample of purified *Shankha* was placed in a *Sharava* (earthen crucible) and covered it with another *Sharava* having the same size, to prepare the *Sharava Samputa yanthra.* The joint between the two *Sharavas* was sealed with a mud cotton cloth layer. The *Sharava samputa yantra* was subjected to a temperature of 550˚C for one hour in the muffle furnace. It was taken out and let to be self-cooled. Then the pieces were powdered in a *Kalva yantra* (mortar and pestle) and grinded it with fresh *Kumari swarasa* (aloevera juice). Then the *Chakrikas* (pellets) were prepared and dried. These pellets were kept in the

Sharava samputa yanthra (Figure 6) and again subjected to a temperature of 550˚C for one hour in the muffle furnace. Then let to be self-cooled. Finally, the sample of *Sankha bhashma* was obtained and subjected to further analysis.

Fig.6: *Sharava samputa yanthra*

Marana of Shukthi and Kaparda

The sample of purified *Shukthi* was placed in a *Sharava* (earthen crucible) and covered it with another *Sharava* having the same size, to prepare the *Sharava samputa yanthra*. The joint between the two *Sharavas* was sealed with a mud cotton cloth layer. The *Sharava samputa yantra* was subjected to a temperature of 550˚C for one hour in the muffle furnace. It was taken out and let to be self-cooled. Then the pieces were powdered in a *Kalva yantra*. Finally, the sample of *Shukthi* (Figure 7) and *Kaparda bhashmas* (Figure 8), and *Shankha bhashma* (Figure 9) were obtained and subjected to further analysis.

Fig.7: *Shukthi bhashma*

Fig.8: *Kaparda bhashma*

Fig.9: *Shankha bhashma*

Organoleptic analysis

Color, odor, taste and texture were assed under organoleptic parameters. All three samples were examined under diffuse daylight to observe the color. A small portion of samples were placed on a dish and slowly and repeatedly inhaled the air of material to sense the odor. Samples were chewed and tasted for taste sensation. Samples were touched to detect the texture.

Physico- chemical analysis[18]

Moisture content, total ash value, acid insoluble ash and water soluble ash values and pH were determined under physico-chemical analysis. All the procedures were repeated in triplicate.

Determination of moisture content

Accurately weighed 2g of each *Bhashma* was taken in a previously measured moisture dish. The sample was heated in a hot air oven at 105^0C till constant weight was obtained. The percentage moisture content of the sample was calculated with reference to the air-dried sample.

Determination of total ash value

Accurately weighed 2g of each *Bhashma* was taken in a previously measured silica crucible. The sample was evenly spread and ignited in a muffle furnace at 550^0C for 5-6 hours till carbon free white ash was obtained. The total ash value was calculated with reference to the air-dried sample.

Determination of acid insoluble ash value

To the crucible containing the total ash, 25ml of 7% HCl was added. Then the crucible was covered with a lid and boiled gently for 5 minutes. Then the lid was rinsed with hot water and this liquid was added to the crucible. Then the solution in the crucible was filtered. Insoluble matter in the crucible was collected to an ashless filter paper (whatmann no. 42) and washed it with hot water until the filtrate became neutral. The filter paper containing the insoluble matter was transferred to the original crucible, and ignited in a muffle furnace at 450˚C to a constant weight. Residue was cooled in a desiccate for 30 minutes and weighed. Acid insoluble ash value was calculated with reference to the air-dried sample.

Determination of water-soluble ash value

The above procedure was repeated with 25ml of distilled water and the weight of water insoluble ash was calculated. The weight of the insoluble matter was subtracted from the total ash to obtain the weight of water-soluble ash. Water insoluble ash value was calculated with reference to the air-dried sample.

Determination of pH value

One part of each *Bhashma* was mixed with 5 parts of distilled water and then the pH was measured using a calibrated pH meter.

Determination of Calcium content

Accurately 1.30g from *Shankha bhashma* was measured. This mass was dissolved in 50ml of 1M HCl solution in a 250 ml beaker. The contents were transferred to a 250ml volumetric flask and diluted up to the 250ml mark. Then 25ml of the above solution was taken out using a pipette and transferred to a 250ml conical flask containing 2-3 drops of phenolphthalein indicator. The burette was filled up from 0.1M NaOH solution. Finally, the 25ml of acid solution in conical flask was titrated against the NaOH solution (Figure 10) till light pink end point comes (Figure 11). The titration was repeated for 3 times and taken the average volume of NaoH that was spent. The above procedure was repeated with *Shukthi* and *Kaparda bhashmas*.[19]

Fig.10: Titrating against NaOH

Fig.11: Light pink end point

Results

Results of Ayurveda parameters used for *Bhashma pariksha* is mentioned in Table 1.

Table 1: Results of Ayurveda parameters used for *Bhashma pariksha*

Bhashma pariksha	***Shankha bhashma***	***Shukthi bhashma***	***Kaparda bhashma***
Rekha purnatva	Completed	Completed	Completed
Varitharathva	Completed	Completed	Completed
Uththama	Completed	Completed	Completed
Gatha rasatva	Completed	Completed	Completed
Avami	Completed	Completed	Completed
Anjana sadrusha sukshma	Completed	Completed	Completed
Danta grana kacha kacha	Completed	Completed	Completed

Results of organoleptic analysis is mentioned in Table 2.

Table 2: Results of organoleptic analysis

	Shankha bhashma	***Shukthi bhashma***	***Kaparda bhashma***
Colour	off- white	dark white	white
Odor	odorless	odorless	odorless
Taste	characteristic	characteristic	characteristic
Texture	powder form	powder form	powder form

Results of physico-chemical analysis mentioned in Table 3.

Table 3: Results of physico-chemical parameters

Results of determination of calcium percentage is shown in Table 4.

	Shankha bhashma **M±SD**	***Shukthi bhashma*** **M±SD**	***Kaparda bhashma*** **M±SD**
Moisture content	0.40±0.10 %	1.30±0.10 %	0.95±0.10 %
Total ash	99.20±0.20 %	98.50±0.20 %	98±0.20 %
Acid insoluble ash value	52±0.30 %	77.80±0.30 %	57±0.30 %
Water insoluble ash value	3.80±0.30 %	2.60±0.30 %	1.65±0.30 %
pH	8.2±0.2	8.0±0.2	8.7±0.2

Table 4: Results of determination of calcium percentage

	Shankha bhashma **M±SD**	***Shukthi bhashma*** **M±SD**	***Kaparda bhashma*** **M±SD**
Calcium%	86.60±0.25 %	99.30±0.25 %	78.40±0.25 %

Discussion

Shankha, Shukthi and *Kaparda* are categorized under *Sudha varga* in *Rasa shastra*. *Bhashmas* of these materials were prepared according to authentic Ayurveda *Rasa shastra* texts. Final *Bhashmas* were tested by using different conventional *Bhashma pariksha* methods. They are *Rekha purnatva*, *Varitharathva, Uththama, Gatha rasathva, Avami, Anjana sadrusha sukshma* and *Dantagra na kacha kacha.*

In this study ash values of *Shankha, Shukthi* and *Kaparda* were 99.20±0.20%, 98.50±0.20% and 98±0.20% respectively. Ash value is a physical method which is used in drug standardization and it gives the percentage of inorganic constituents of the sample. It can be used to determine whether the *Bhashma* preparations have undergone the proper manufacturing procedure. According to the standard, *Bhashmas* should have an ash value near to 100% because ash itself is entirely composed of inorganic materials. Acid insoluble ash value of a standard *Bhashma* preparation should be more than the water soluble ash values. In this study, all three ashes are fulfilling this standard. Moisture content can detect the percentage of water content in a sample. It reflects the shelf life of a sample. The least moisture content, the better will be the shelf life of a drug. Higher moisture content is responsible for deterioration and contamination of a drug. In this study, all the three *Bhashmas* were having very low moisture content. pH values of the three *Bhashmas* are alkaline in nature. To minimize the gastric irritation due to the alkaline nature of these *Bhashmas*, authentic texts recommended grinding these materials by using aloevera juice before incineration (*Marana*)[20]. The highest calcium percentage was founded in *Shukthi bhashma* (99.30±0.25%) and the lowest in *Kaparda bhashma* (78.40±0.25%).

Conclusion

All the 3 *Bhashma* preparations were according to the Ayurveda standards mentioned in authentic *Rasa shastra* textual references. Modern physico-chemical analysis proves that all the *Bhashmas* are having standard quality and purity. The results of the study concludes that maximum Calcium percentage was in *Shukthi bhashma* while least one in *Kaparda bhashma.* Therefore, in Calcium deficiencies *Shukthi bhashma* can be highly recommended as a nutritional supplement.

Conflicts of Interest

Not declared.

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