Bhasma: The ancient Indian nanomedicine

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ABSTRACT

Ayurveda and other Indian system of medicine use metals, but their use is also amply described in Chinese and Egyptian civilization in 2500 B.C. Bhasma are unique ayurvedic metallic/minerals preparation, treated with herbal juice or decoction and exposed for Ayurveda, which are known in Indian subcontinent since 7th century A.D. and widely recommended for treatment of a variety of chronic ailments. Animal’s derivative such as horns, shells, feathers, metallic, nonmetallic and herbs are normally administered as Bhasma. A Bhasma means an ash obtained through incineration; the starter material undergoes an elaborate process of purification and this process is followed by the reaction phase, which involves incorporation of some other minerals and/or herbal extract. There are various importance of Bhasma like maintaining optimum alkalinity for optimum health, neutralizing harmful acids that lead to illness; because Bhasma do not get metabolized so they don’t produce any harmful metabolite, rather it breakdowns heavy metals in the body. Methods including for Bhasma preparation are parpati, rasayoga, sindora, etc., Bhasma which contain Fe, Cu, S or other manufacturing process plays a specific role in the final product(s). Particle size (1-2 µ) reduced significantly, which may facilitate absorption and assimilation of the drug into the body system. Standardization of Bhasma is utmost necessary to confirm its identity and to determine its quality, purity safety, effectiveness and acceptability of the product. But the most important challenges faced by these formulations are the lack of complete standardization by physiochemical parameters.

Key words: Ayurveda, bhasma, marna, nano-particle, shodhna, standardization

INTRODUCTION

Ayurveda is the science made up of Veda (knowledge) and Ayush (life) i.e. knowledge of life. An Ayurvedic system adopts a holistic approach towards health care by balancing the physical, mental and spiritual functions of the human body. Rasa-Shastra (vedic-chemistry) is one of the parts of Ayurveda, which deals with herbo-mineral/metals/non-metals preparations called Bhasmas. Rasayana [1] (immunomodulation and anti-aging quality) and yogavahi (ability to target drugs to the site) are characteristics of a properly made herbo-mineral/metals/ non-metals preparation, which is also nontoxic, gently absorbable, adaptable and digestible in the body.[2]

Bhasma, is a ayurvedic metallic/mineral preparation [Table 1], treated with herbal juices or decoction and exposed for certain quantum of heat as per puta system of Ayurveda, which itself is well known in Indian subcontinent since 7th century A.D. and widely recommended for the treatment of many disease conditions [Table 2]. Bhasma are claimed to be biologically produced nanoparticles, which are prescribed with several other medicines of Ayurveda.

The concept of using nanometal particle is prevailing since Charakasamhita. [3] For a metallic preparation of Lauhadi Rasayana, iron is used to heat up until red hot and quenched in some liquid media immediately until flakes of iron become in fine powder form. [4]
Table 1: Company and marketed formulation of Bhassma

| Company name                      | Marketed formulation of Bhassma                          |
|-----------------------------------|---------------------------------------------------------|
| Shree Siddhashram Pharmacy, Jaipur, Rajasthan | Abhrak Bhassma, Bang Bhassma, Kashish Bhassma, Ropya Bhassma, Tamra Bhassma, Swarna Bhassma |
| Shree Baidyanath Ayurved Bhawan (P) Ltd. Kolkata | Abhrak Bhassma, Akik Bhassma, Vaikrant Bhassma, Godanti (Harital) Bhassma, Kashish Bhassma, Ropya Bhassma, Tamra Bhassma, Swarna Bhassma, Naga Bhassma |
| Dindayal Aushadhi Pvt. Ltd. Dindayal City Mall, Gwalior | Swarna Bhassma, Ropya Bhassma, Tamra Bhassma |
| Gurukul Kangri Pharmacy, Haridwar | Abhrak Bhassma, Bang Bhassma, Kashish Bhassma, Dhanwantry Frasad, Ropya Bhassma, Tamra Bhassma, Swarna Bhassma |
| Unjha Ayurvedic Pharmacy, Unjha, Gujarat |                                                                 |

QUALITY CONTROL OF BHASSMA

Traditionally, the end points of incineration of a metal and its conversion to a Bhassma state are evaluated based on the following criteria:

1. Lusterless: There should be no chandrika or metallic luster (nischandrika)
2. Rekapurnatvam: When a Bhassma is spread between the index finger and thumb and rubbed, it should be so fine as to get easily into the lines and crevices of the fingers and should not be washed out from the lines of the fingers
3. Varitaratvam: When a small quantity is spread on cold and still water, it should float on the surface
4. Apurnabhava: The Bhassma should not revert to the original state
5. Tasteless: Bhassma should be tasteless
6. Avami: The Bhassma should not produce nausea or administration.

(14A technique known as the phased spot test has been developed by the investigators of Central Council for Research in Ayurveda and Siddha (CCRAS) of India to identify Bhassmas. This technique is very effective and accurate in identifying genuine quality of Bhassmas) [Figure 1].[7]

CLASSIFICATION OF BHASSMA

- Metal-based Bhassma
- Mineral-based Bhassma
- Herbal Bhassma.

BHASSMA AS A NANOPARTICLE

Animal derivatives such as horns, shells, feathers, metallic and nonmetallic minerals are normally administered as Bhassma. A Bhassma means an ash obtained through incineration. The starter material undergoes an elaborate process of purification (shodhana), followed by the reaction phase, which involves incorporation of some other mineral and herbal extracts. Then the material in pellet form is incinerated in a furnace. The end product is expected to be a nontoxic material. Examples are Swarna Bhassma, Shankha Bhassma, Tamra Bhassma etc. Gold in tradition Indian ayurvedic medicine as Swarna Bhassma (gold ash) has been characterized as globular particles of gold (56-57 nm). Mercury compound contains mercury sulfide (crystalline size 25-50 nm) [Figure 2].[8]

IMPORTANCE OF BHASSMA

1. Maintain optimum alkalinity for optimum health
2. Provide easily absorbed and usable calcium
3. Cleanse the kidneys, intestines and liver
4. Maintain stronger bones and healthier teeth
5. Alleviate insomnia, depression

CHARACTERIZATION OF BHASSMA

Physical characteristic

1. Color (Verna): A specific color is mentioned for each Bhassma. Bhassmas are generally white, pale, or red. The color of the preparation primarily depends on the parent material
2. Lusterless (Nischandratvam): Bhassma must be lusterless before therapeutic application. For this test, Bhassma is observed under bright sunlight whether luster is present are not, if luster is still present, it indicates further incineration
3. Lightness and Fineness (Varitara): Bhassma floats on stagnant water surface. This test is based on law of surface tension. Properly incinerated Bhassma need to float on water surface
4. Tactile sensation: Tactile sensation can be absorbed and assimilated in the body without producing any irritation to mucous membrane of gastrointestinal tract
5. Particle size: Prepared Bhassma should be in powder form. Particle of Bhassma should be like pollen grains of Pondanus odoratissimus flower (ketaki rajah).

Chemical characteristic

1. Apurnabhavata: It means incapability to regain original metallic form. For this test Bhassma is mixed with equal quantity of seeds of Abrus precatorius,[9] honey, ghee, borax then sealed in earthen pots and heated with similar grade of heat. Thereafter particular Bhassma is observed on self-cooling
2. Nirruttha: Nirruttha is to test inability to regain metallic form of metallic Bhassma. In this test Bhassma is mixed with a fixed weight of silver leaf and kept in sealed earthen pots, then similar grade of heat is applied and after selfcooling, the weight of silver is taken. Increase in weight of silver leaf indicates improperly prepared Bhassma.[9]
Table 2: Marketed Bhasmas products and their uses

| Name                  | Ingredients                                                                 | Dosage             | Uses                                                                                     |
|-----------------------|------------------------------------------------------------------------------|--------------------|------------------------------------------------------------------------------------------|
| Navrattankalp amrit ras | Calcined ash of expensive gems, minerals like ruby, sapphire, emerald, cat's eye stone, pearl, coral, silver, gold, iron, zinc | 62.5 mg twice daily | Cancers of all types, anemia, complications of diabetes                                   |
| Heerak Bhasma          | Diamond                                                                      | 12.5-25 mg twice daily | Useful in cancers, immunity disorders, crippling rheumatoid arthritis, bone marrow depression |
| Tsrailokya chintamani ras | Diamond, gold, silver, iron                                                | 62.5 mg twice daily | Severe respiratory tract infections, bone marrow depression, ovarian cysts, uterine fibroids |
| Swarna basant mali ras | Gold, piper-nigrum, white pear powder                                       | 62.5 mg twice daily | Tonsillitis, fevers, cough, bronchitis, decreased immunity, cancers, autoimmune disorders |
| Kamdudha ras           | Ochre, Tinospora cordifolia, mica (calcined)                                | 250-500 mg twice daily | Hyperacidity, headache, fever, blood pressure                                              |
| Vasant kusumakar ras   | Gold, silver, coral                                                         | 62.5-125 mg twice daily | Complications of diabetes, neuropathy, general weakness                                  |
| Kumar kalian ras       | Gold, iron, mica, copper pyrite, red sulfide of mercury                     | 62.5-125 mg twice daily | General debility in children, fever, respiratory tract infections                          |
| Tamra Bhasma           | Copper, mercury, sulfur                                                     | 62.5-250 mg twice daily | Anemia, jaundice, digestive disturbance, abdominal disorders                             |
| Loha Bhasma            | Iron, cinnabar                                                              | 125-250 mg twice daily | Enlargement of liver, anemia, jaundice                                                   |
| Vaikrant Bhasma        | Manganese, sulfur (Tourmaline)                                              | 62.5-125 mg twice daily | Diabetes, can be used in place of diamond ash in case of poor patients                    |
| Loknath ras            | Mercury, sulfur, conch shell                                                | 62.5-125 mg twice daily | Diarrhea, respiratory disorders, immunity disorders, cancers, ovarian cysts              |
| Abhirk Bhasma          | Calcined purified mica ash                                                  | 125-250 mg twice daily | Respiratory disorders, diabetes, anemia, general weakness                                |
| Swarna Bhasma          | Ash of gold (Calcined gold)                                                 | 12.5-62.5 mg twice daily | Improves body immunity, general weakness, anemia, energetic                              |
| Rajat Bhasma           | Silver ash (Calcined silver)                                                | 62.5-125 mg twice daily | Irritable bowel syndrome, acidity, pitta disorders                                          |
| Ras raj ras            | Red sulfide of mercury, mica, gold, iron, silver, with ania somnifera, Syzygium aromaticum | 62.5-125 mg twice daily | Paralysis, hemiplegia, rheumatism, insomnia, stroke                                       |
| Shwaskuthar ras        | Black sulfide of mercury, aconitum ferox, sodium bicarbonate, piper nigrum, ‘Trikatu’ | 125-250 mg twice daily | Cough, pneumonia, bronchitis                                                             |
| Swarnmakshik Bhasma    | Copper pyrite (calcined), mercury, sulfur                                   | 125-250 mg twice daily | Anemia, jaundice, stomatitis, chronic fever                                               |
| Kahanya pishiti        | Amber of succinit (trinkantmani), rosa centifolia (rose)                    | 125-250 mg twice daily | Bleeding                                                                                 |
| Yogender rasa          | Red sulfide of mercury, gold (calcined), magnetic iron, mica, myristica fragrans | 62.5-125 mg twice daily | Polio, paralysis, muscular weakness, insomnia, headache                                  |
| Bolbadh rasa           | Black sulfide of mercury, Tinospora cordifolia, Commiphora mukul            | 125-250 mg twice daily | Bleeding                                                                                 |
| Praval pishiti         | Purified powder of corals                                                   | 125-250 mg twice daily | Calcium deficiency, blood pressure, insomnia, agitation                                   |
| Praval panchamrit      | Powder of corals, pearls, conch shells                                       | 125-250 mg twice daily | Richest source of natural calcium, agitation, acidity, burning sensation                   |
| Jaharmohra pishiti     | Powder of serpentine orephite                                               | 125-250 mg twice daily | Natural source of calcium, useful in burning sensation, acidity, heart burn               |
| Sarvatobhadra Vati     | Mercury, sulfur (purified and calcined), with gold                           | 62.5-125 mg twice daily | Renal failure, nephrotic syndrome, dialysis, high urea and creatinine                      |

(Contd...)
Table 2: Contd...

| Name               | Ingredients                                                                 | Dosage             | Uses                                                                                     |
|--------------------|------------------------------------------------------------------------------|--------------------|------------------------------------------------------------------------------------------|
| Punarnavam andoor | Iron ore ash, Boerhavia diffusa, Picrorhiza Kurroa, Embelia ribes            | 125-250 mg twice daily | Diuretic, anemia, swelling around joints, blood pressure, liver cirrhosis, ascites       |
| Akikpishti         | Agate stone calcined                                                          | 125-250 mg twice daily | Heat/pitta diseases, blood pressure, acidity, ulcers                                      |
| Mukta pishti       | Pearls powder (moti pishti)                                                   | 62.5-125 mg twice daily | Calcium, cooling and soothing, blood pressure, acne, headaches, acidity, ulcers, heat disorders |
| Vriht vat chintamani ras | Herbs and minerals for vitiated vata: calcined mercury, sulfur (purified) and other metals and minerals | 62.5-125 mg twice daily | Stroke, paralysis, parkinsonism, epilepsy, tetany, muscle stiffness, joint pains         |

6. Keeps rhythmic heart beating
7. Keeps arrhythmias and minerals balance
8. Help metabolize iron in body
9. Aid nervous system
10. Breakdown heavy metals and drug residues in body
11. Neutralize harmful acids that lead to illness
12. Achieve a healthy alkaline level by neutralizing acid
13. Protect body from free radical damage.[9]

**PREPARATION OF BHASMA**

**General procedures**
The name Bhasma is generally applied to all metallic and nonmetallic substances that are subjected to the process of incineration and reduction into ash [Table 3]. Here it is applied to the scientific basis for ayurvedic therapies metals, minerals, and animal products that are, by special processes, calcinated in closed crucibles in pits with cow dung cakes (puttam). [10]

**Steps used to prepare Bhasmas**

*Shodhana*
In Ayurveda, purification is called Shodhana. Shodhana is the process through which the external and internal impurities of metals and minerals are removed.
The following processes are involved:
1. Elimination of harmful matter from the drug
2. Modification of undesirable physical properties of the drug
3. Conversion of some of the characteristics of the drug to different stages
4. Enhancement of the therapeutic action.

**Marana**
*Marana* is basically a burning process or calcination.[11] The purified metal is placed into a mortar pestle and ground with the juice of specified plants or kashayas, mercury (in metallic state), or a compound of mercury such as mercury perchloride (*sauviram*), an amalgam of sulfur and mercury (*kajjali*) for a specified period of time. The metal that is intended for marana is known as a primary metal (*pradhundaya*); the other metal, which is taken in small proportions for the marana of the primary metal, is known as secondary metal (*sahayadhatu*). *Marana* differs with the nature of the substance to be calcinated. For example, organic substances such as herbs are burnt in open air, whereas inorganic substances such as metals like *rajata* (silver) are burnt in closed containers. In either case, the end product is a *Bhasma* of substance taken for *marana*. For example, the end product in the case of silver (*rajata*) is called as Rajata *Bhasma*. *Marana* of inorganic substances is called *puta* and the process of *marana* of herbs in closed freshly made containers is known as *puta-paka*. *Bhasma* obtained by *marana* from primary metals together with herbs (*mulika*) are called Mulikamarita *Bhasma*.[12]

**Gold (Swarna) Bhasma**
The general preparation of *Swarna Bhasma* involves the three processes of *shodhana*, dravana, and *marana*. The leaves of gold are heated over fire and dipped in sesa (*Sesamum indicum*) oil when its red hot, process is continued seven times separately.[13] The soft leaves are processed with buttermilk/cow’s urine and the decoction of *kulantha* (*Dolichous biflorus*), *kanji* (sour gruel processed from rice [*Oryza sativa*]), and radish (*Raphanus sativus*). Finally, the leaves are dried by heat.[14] The mixture is triturated and the paste thus obtained is dried under sunlight. The process of triturating and drying under sunlight is repeated 7 to 14 times using fresh aliquots of latex, and the final product is obtained.

Its organoleptic characteristics are as follows color dark brown, fine in touch and tasteless.[15] It should contain sulfur (<3.33% w/w), calcium (<1.625% w/w), sodium (<0.922% w/w), potassium (<0.370% w/w), sulfate (<3.00% w/w), copper (<17.2% w/w), iron oxide (ferric) (<85.0% w/w), iron oxide (ferrous) (<5.7% w/w), phosphate (<1.101% w/w), silica (<3.8% w/w), acid insoluble (<11.93% w/w), ash value (<98.20% w/w), acid-insoluble ash value (21.20-31.18% w/w).[16] It shows following pharmacological activity like analgesic activity against chemical, thermal, electrical and mechanical stimulation, stimulatory effect on peritoneal macrophages and antioxidant activity [Table 4]. Assessment of liver function test (enzymes) and histological investigation show no toxic effect of chronic administration of *Swarna Bhasma*. The particle size of the raw material was between 6 and 8 µ while that for the *Bhasma* particles was 1- and- 2 µ.[17]

**Mukta Shouktic *Bhasma***
*Mukta shouktic* *Bhasma* (MSB) is a calcium-containing *Bhasma* consisting of pearl (mote), *Aloe vera* Linn. (*Guar- patha*) and vinegar (*kanji*).[18] This *Bhasma* is prepared from the outer covering of the shell (pearl-oyster), and is grounded and triturated with *A. vera* and vinegar in sufficient quantity to make a homogeneous paste.[19] The recommended proportion of pearl-oyster and *A. vera* is 1:4. Standardization parameters of MSB are [Table 5] (1) bulk density and tapped density (used to indirectly calculate the flow properties by deriving Carr’s index. The static angle of repose was determined by the funnel method). (2) Particle size analysis with dynamic light scattering method (particle size of MSB ranges from 1.22 to 10.20 µ having a mean

### Table 3: *Bhasma* and their ingredients

| Bhasma            | Ingredients                      |
|-------------------|----------------------------------|
| Abhrak *Bhasma*   | Mica                             |
| Halthiana *Bhasma*| Charcoal of elephant tusk        |
| Jasada *Bhasma*   | Zink oxide                       |
| Loah *Bhasma*     | Iron oxide                       |
| Mandura *Bhasma*  | Iron oxide                       |
| Mayrapicha *Bhasma*| Ash of peacock feather          |
| Mukta *Bhasma*    | Oxide of pearl                   |
| Nag *Bhasma*      | Lead                             |
| Parade *Bhasma*   | Mercury compound                 |
| Pravala *Bhasma*  | Oxide of coral                   |
| Rajata *Bhasma*   | Silver oxide                     |
| Sankha *Bhasma*   | Oxide of conch *Bhasma*          |
| Mukta Shukti *Bhasma*| Oxide of pearl, oyster shell    |
| Talaka *Bhasma*   | Arsenic sulfide                  |
| Tamra *Bhasma*    | Cupric oxide                     |
| Vanga *Bhasma*    | Tin compound                     |
| Varatika *Bhasma* | Oxide of cowrie shell            |

### Table 4: Biologically active gold compounds

| Name                         | Gold concentration |
|------------------------------|--------------------|
| Gold sodium thiomalate       | 50.5               |
| Gold thioglucose             | 50.5               |
| Gold thioglycoanilide        | 54.2               |
| Calcium aurothioglycolate    | 64.1               |
| Sodium-2-aurothiobenzadole-4-carboxylate | 47.8 |
| Sodium-auroallythioure-a+m-benzoate | 43.4 |
| S-triethylphosphine gold 2,3,4,6 | 29.1 |
| tetra-O-acetyl-1-thio-B-D-glycopyranoside | 56.2 |

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**Table 3: Bhasma and their ingredients**

**Table 4: Biologically active gold compounds**
particle size of 22.52 ± 0.45 µm). (3) Transmission electron microscopy (particles are irregular rod shaped). It shows following pharmacological activity like antacid, anti-pyretic and as a source of calcium.\textsuperscript{[20]} It is also used in tuberculosi, cough, asthma, dysmenorrheal, arthritis, rheumatism, conjunctivitis. Recent studies have shown that adding heated oyster shells to the diet of elderly patient increased the bone mineral density of the lumbar spine. MSB is one-third to one-half as potent an anti-inflammatory as the amino salicylic acid further, even as MSB is widely used for its antipyretic activity.\textsuperscript{[21]}

**Varatika Bhasma**

*Varatika* is identified as the external shell of sea animal *Cypraea moneta* Linn.\textsuperscript{[22]} It occurs in the coastal areas of the sea. *Cypraea moneta* is commonly known as the money cowry [Figures 3-5]. Chemically it is carbonate of calcium.

**Table 5: Quality assessment of MSB**

| Test parameter | Test | Interference |
|----------------|------|--------------|
| Identity       | Macroscopic test | No luster, grayish white, fine powder |
| Physical properties | Bulk density | 9.08±0.031 g/cm\(^3\) |
|                 | Tapped density | 1.218±0.047 g/cm\(^3\) |
|                 | Particle size | 1.22-10.20µm |
|                 | Angle of repose | 36.17±1.28 |
|                 | Carr’s index | 46.21±0.5 |
|                 | Loss on ignition | <0.05% w/w |
|                 | Loss on drying (100°C) | <0.5% w/w |
| Purity | Yeast and mould | <1×104 CFU/g |
|                | Total aerobic count | <1×105 CFU/g |
|                | *Escherichia coli* | Absent |
|                | *Salmonella spp.* | Absent |
|                | *Staphylococcus aureus* | <1×102 CFU/g |
| Quantity | Arsenic | <0.14 mg/kg b.w./day |
|            | Cadmium | <0.09 mg/kg b.w./day |
|            | Lead | <0.29 mg/kg b.w./day |
|            | Total mercury | <0.29 mg/kg b.w./day |
|            | Calcium | 40.22 ± 0.05% |

MSB: Mukta shouktic Bhasma

**Table 6: Observation during Sodhana process with kulatha kashaya**

| Properties | Raw material | Purified material |
|------------|--------------|------------------|
| Color      | Yellowish white | Grayish white |
| Chemical compound | CaCO\(_3\) | CaCO\(_3\) |
| Habit      | Amorphous | Amorphous |
| Nature     | Hard | Brittle |
| Luster     | Pearly | Pearly |
| Cleavage   | Absent | Absent |
| Fracture   | Conchoidal | Conchoidal |

Its *kashaya* (decoction) was prepared for the purification process [Table 6]. Fresh *Aloe-vera* was collected and its juice was used for making cakrikas or pellets to be used in the incineration process of *Varatika*. Ingredients are the raw *Varatika*, *Kulattha* kashaya (Horse gram decoction for purification), *Kumari svarasa* (*Aloe-vera* juice) for grinding during incineration. It shows following organoleptic

**Figure 3: Varatika (before purification)**

**Figure 4: Varatika (after purification)**

**Figure 5: Varatika Bhasma (Final product)**
properties color is dull white fine powder, odorless, tasteless soluble in dilute HCl and physio-chemical analysis showed Loss on drying (0.6566%). It contains ash (2.06%), organic carbon (1.09%), total nitrogen (0.72%), total potassium (3.49%), total zinc (1.48 ppm), total iron (113.6 ppm). [33]

**Mandura (Iron) Bhasma**

Iron Bhasma contains three basic processes shodhama, dravana, and marana. Iron is prepared by two steps: Purification and quenching by sinking the red-hot leaflet in liquid medium like fresh Triphala decoction (nishechan) or cow’s urine and calculations with repeatedly 9 times. Coarse pieces of sulfur are taken in khalva yantra and some amount of deveodali suvaras are added for bhavana. It is rubbed thoroughly and the process is repeated for at least 7 days. [24] Iron Bhasma should always be prepared with mercury; otherwise, it is not absorbed properly in the intestine. Another process includes lohamarakagana, amritkarana, and niruttthikarana. In the lohamaraka, fresh lemon juice is prepared and a specific amount of hingula powder is added. In the amritkarana process, equal amounts of Loha Bhasma and ghrita are placed in an iron pan and mixed properly under mild heat until the fat disappears. [28] It contains following organoleptic characteristics color dark brown, fine in touch, tasteless and having iron as Fe$_2$O$_3$ (<96.575% w/w), iron as Fe (<75% w/w), ash value (96.8-99.7% w/w), acid-insoluble ash (0.101-2.803% w/w). It shows following pharmacological activity that it has not only in resorting hemoglobin level, but in significantly increasing body weight gain in Bhasma-treated animals and also helpful in iron deficiency anemia. It is a powerful hematonic and tonic and is valuable in the treatment of hemolytic jaundice and microcytic anemia. [29]

**Naga Bhasma**

Processing of the Naga Bhasma was done according to the Shastiputa Naga Bhasma process listed in the Grantha Ananda Kanda 2/6/25-28. Lead is purified through sublimation. Lead metal was melted in iron ladle and poured into a vessel containing lime water (called Curnodaka), decoction strength and filtered. [27] The process was repeated seven times with fresh lime water each time. In the first puta (step), the purified lead thus obtained was melt with equal amount of manahsila (As$_2$S$_3$) and a small amount of Chichiri (Plectranthus cuesta L Her.), herb (root, stem, leaves, flower and fruit generally all parts were used) until it becomes dried powder. After cooling, powder is triturated with the juice of Vaasa (Adhatoda vasica Nees.) leaf. Small pellets were made and dried in shade. Dried pellets were packed airtight in two earthen pots one above the other (called Sharavasampuit). Finally the pots were subjected to heat in the electric furnace at 600° in aerobic condition. This was the first puta (step) Naga Bhasma sample. Sample thus obtained was used in the next step. In rest of the each steps (remaining 59 step), manahsila was added in 1/20th proportion to the prepared Bhasma with juice of Vaasa and subjected to heat treatment. The process was repeated sixty times to get the finally prepared Naga Bhasma. The final product in the form of the pellets were taken out of the earthen pot and powdered. The powdered material was packed in airtight containers. Physio-chemical characterization powdered Bhasma was characterized by powder X-ray diffraction (XRD, IR, TEM, Atomic absorption spectrophotometer was utilized). Histopathological studies of Bhasma were done in skin, small intestine, pancreas, testis, brain, lung, kidney and liver. [28]

**Copper (Tamra) Bhasma**

Tamra Bhasma is used as a single drug and also in combination with many medicinal plant juices and then repeated calculations performed with air so that the metallic state is transformed into the corresponding oxide form, which is traditionally known as Bhasma. [29] Tamra Bhasma is used for the management of liver disorder, arthritis, old age disorders, leukoderma, etc. It shows the following pharmacological activity like (1) hepatoprotective effect on cumene hydro-peroxide-induced per-oxidation, (2) it showed significant reduction in the level of lipid peroxidation, (3) Tamra Bhasma is a strong antioxidant drug and could be used in the management of lipid peroxidation, (4) it showed no acute detectable adverse effects; levels of SOD were also enhanced by Tamra Bhasma. [30]

**Abhrak Bhasma**

Abhrak Bhasma is prepared by treating biotite (mica) with the juices of a number of re-constituent plants that make it a powerful cellular regenerator. It is a commonly used ayurvedic drug against many diseases including hepatitis (hepatoprotective). [31] It is also a nerve tonic and is widely used in respiratory tract infections and anemia. It contains iron, magnesium, potassium, calcium, and aluminum in trace amounts. Abhrak Bhasma is an amorphous powder drug. It also contains silicates of iron, magnesium and aluminum. [32]

**Yashada Bhasma**

Yashada Bhasma is specially processed with zinc. It is administered in sprue, diabetes, leucorrhea and hyperhidrosis. The role of the Bhasma in arresting myopia has been examined in one study. [33] Contamination of Bhasmas directly through the herbs used in the preparation and formation of polycyclic aromatic hydrocarbons (PAHs) is expected. Bhasmas were analyzed and found to contain PAH (2.32-9.55 ppm) among the preparation tested. The benzo[a]pyrene level also varied, the highest concentration being 9.7 ppm. [34] The studies presented here suggest Bhasmas may have a hepatoprotective effect. However, efforts should be made to study their beneficial effects on other systems. Especially, evaluation of their immunomodulatory and neuroprotective actions may prove to be rewarding. [35]
**Sankha Bhasma**

*Sankha Bhasma* is a powder prepared from the calcinated conch shell. It consists mainly of calcium, iron and magnesium. *Sankha Bhasma* is well known for its antacid and digestive properties. It is useful in hyperchlorhydria, sprue, colic and hepatosplenomegaly.[36] A mixture of some ayurvedic medicines that contained *Sankha Bhasma* and the herbs Glycyrrhiza-glabra, Terminalia-chebula, and Piper-longum showed protection against duodenal ulcer in rats. Studies show that these drugs act on Bruner's gland by improving its secretory state.[29,30]

**CONCLUSION**

*Bhasma* which contains metals, minerals, and animal products, the manufacturing process plays a specific role in the raw material mixture in the final product. These could be important chemical markers for *Bhasma* prepared using a particular method. As a result of different stages of processing techniques like *shodhana* (which involves roasting, with addition of herbal juices and continuous stirring) and *marana* [which involves *bhasana* (wet trituration) and *puta* system of heating], the particle size reduces significantly, which may facilitate absorption and assimilation of the drug into the body system. The particle size in the *Bhasma* is 1-2 μ, which could be specified as the criterion for the final product conforming to all the traditional parameters under *Bhasma* pariksha (examination of properly prepared *Bhasma*). Although *Bhasmas* are complex materials, physicochemical analysis using modern techniques will be most attractive for the standardization of *Bhasma* medicines. This would definitely help in building confidence in use of such products for medication by ensuring safety, efficacy, and batch to batch uniformity.

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