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## A Review on the *Samskaras* of Metals

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### ABSTRACT

Ayurveda is a personalized medicine with the antiquity of around 5000yrs. Historically it was probably India who was the first nation to maintain records of medicinal utilization of metals like Gold, Iron, Copper, Lead etc. In the classical texts like Charaka Samhita, Susruta Samhita and other literatures of vedic era many such metals were mentioned as therapeutic agents, however in most of the cases their uses were limited to external applications only. It was later after the 8th Century AD by the advent of Acharya Nagarjuna extensive processing of these metals to consumable form was introduced and practiced widely. The therapeutic application received wide acceptance and evolved as one of the potent science during the 15<sup>th</sup> to 18<sup>th</sup> century. But since the 19<sup>th</sup> century the science faced set backs relating to the norms and criticisms regarding the safety and efficacy of these formulations as they has presence of heavy metals in them. Though a series of researches proved these formulations safe and effective, still a large community of common people are too concerned about its safety. This review gives a brief outlook regarding the scientific explanations and importance of each procedure conducted to process the metal to its therapeutically active form. This review also aims to establish an interdisciplinary approach with the pharmaceutical chemistry to open up and bridge the lacunae existing regarding the chemistry behind these procedures in Rasashastra.

### KEYWORDS

*Samskaras, Dhaturvarga, Metallurgic concepts, Sodhana, Marana*



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## INTRODUCTION

Ayurveda is a personalized traditional Indian Science- with a wide spectrum of resources to its asset derived from plants, animals, metals as well as mineral sources modified into an array of pharmaceutical and the rapeutical forms<sup>1</sup>. From this rich heritageonly random references could be sorted out regarding the therapeutic utility of metals and minerals in the vedic era and the era of Brihath traysees. It was with the onset of the medieval period around 8<sup>th</sup>Century AD, that the use and application of metals began to emerge as an independent system of science- The Rasashastra<sup>2</sup>. The classics mention only a scattered reference regarding the effect of pure metals and minerals on the human health, their toxic effects and also thereby the need of refinement and mentioning of Bhasmas. It was Siddha Nagarjuna, known as 'Father of Bhasmas' using the Alchemical knowledge who introduced the Science Rasashastra which includes the extraction of metals from their minerals, the knowledge regarding naturally existing metals, its purification and conversion into digestable metallic bhasmas which can be administered safely in prescribed doses<sup>2</sup>. By the later period of the 15th Century the technology of preparation of potent metallic bhasmas was fully developed and

the use of other metals ie zinc, tin, arsenic, antimony had also begun. The details of these processes have been recorded and published in many books viz. Rasaratnasamucchaya, Rasarnava, Rasachandrachudamani, Ayurveda Prakasha, and Rasatarangini.

With the advent of time herbomineral and other rasa formulations came to occupy a significant seat in Ayurveda Pharmacopeia of India, as the 7th Vol is solely dedicated to metals and minerals and is being routinely used in practice in India since decades<sup>3</sup>.In Rasashastra the knowledge pertaining to these metals are included in *dhatuvarga* or *lohavarga*. The Sanskrit word dhatu is derived from a verb *dha* meaning to support and the word *Loha* is derived from the root word *Luha* meaning to pull<sup>4</sup>. These word meaning denotes the importance of metals in supporting not only the body but also the earth and also signifies that these are available after the process of extraction from the ores. In Rasashastra these metals are classified as Suddha loha (Swarna, Rajata, Tamra, Loha), Puti loha (Nagam, Vangam, Yasadam), Misra loha (Pittala, Kamsya, Vartaloha)<sup>4</sup>. Therapeutic preparations with these metals are proved to be safe as well as effective even in minute doses when it follows the stringent guidelines of production and used following the



specified guidelines<sup>4</sup>. However, in the past few decades the western healthcare professionals has expressed norms of concern, in regardsto the safety of these rasa and herbomineral preparation in regard to heavy metal toxicity and thus paving an area of extensive research in the field of Ayurveda<sup>5</sup>. Eventually these researches have proved these preparations to be completely safe and effective provided they are manufactured as per the specified guidelines as mentioned in the Ayurvedic Classics and administered in the prescribed doses along with the concerned vehicles<sup>5</sup>.

## METAL TOXICITY- MAJOR CONCERN OVER RASAUSHADIES

Many of the Ayurvedic formulations classified as Rasaushadies includes metals or minerals as an integral part which if not manufactured and consumed as per the

strict guidelines as mentioned in the Ayurvedic classics can show symptoms of toxicity. A drug can be a boon as well as a poison based on the way its been used and consumed. A drug if matches up to the criteria of a standard formulation will always become panacea provided if used in the right dose in the right manner to the right person. On the other hand a poorly prepared drug however used skillfully will always prove to be a poison<sup>6</sup>.

In account of these, meticulous guidelines have been laid down in classical texts while preparing Rasaushadies, bhasmas etc. Pinpointed pathyas has been imposed while using atthese rasaushad his in therapeutics. These formulations are advised to be administered orally in specified quantities with caution along with requisite anupana<sup>7</sup>. Anupana is anticipated to play a key role in safety aspects of Rasaushadies. In absence of anupanas adverse reactions are likely<sup>7</sup>.

**Table 1** Assudha seva dosha and their treatment

	<b>Dhatu</b>	<b>Asuddha Seva dosha</b>	<b>Ref</b>	<b>Treatment</b>
1.	Swarnam	Decrease Oja, Bala and veeryam cause asaukhya and maranam	Brihath rasaraja sundaram	Haritaki with Sita
2.	Rajatam	Sharira Tapa , Vidbaddhata , Shukranasha , Bala and Virya Kshaya	Ayurveda Prakasha 3/92	-
3.	Tamram	Bhrama , Murccha , Vidaha , Sweda , Kleda , Vanti, Aruchi , Citta santapa .	Ayurveda Prakasha 3/115	Agastya with Sita
4.	Loham	Shandatwam, kushta mrityu, hridroga vividha soola, asmari, hrillasa	Brihath rasaraja sundaram	Munirasa pishta vidangam
5.	Nagam	Kushtam, aruchi, gulma, pandu, kshayam, rakta vikaras, jwara, asmari, bhagandhara	Brihath rasaraja sundaram	Hema and Hareetaki
6.	Vangam	Kushta, gulma, pandu, prameha, apache, vatasonita	Brihath rasaraja sundaram	Meshashringi and sita
7.	Kamsyam	Bhramam, guda rujam, vividha tapam, maranam	Brihath rasaraja sundaram	



Risk of toxic as well as other side effects with irrational drug use and Medical negligences. WHO also considers irrational use of medicines as one of the major problems faced world wide causing high health hazards<sup>8</sup>. This aspect has been described by the seers of Ayurveda in detail and also mentions other possible such conditions have also been prescribed by the seers. They are briefly tabulated in Table 1.

### **METALLURGIC CONCEPTS AND PROCEDURES IN AYURVEDA**

In Ayurveda all the drugs especially the Rasaushadis are subjected to specified processing before being used therapeutically. These processing procedures are termed as Samskaras.

Processing or Samskarana is making change in its inherent properties.<sup>[9]</sup> The primary aim of this process is to convert the sthoola rupa of the raw drug to sukshma rupa to confirm its bio availability. Furthermore many other properties are enhanced or nullified by these procedures ultimately converting the drug to a therapeutically administrable form. Thereby the primary aim related to the preparation of a therapeutic drug is to convert it in a way so that it is easy to administer, digest, and the rate of absorption is optimum and the drug action is met up to the expectation and have a

have been repeatedly reported associating. ways by which toxicity, untoward effect can occur and has thus provided all the guidelines to avoid the occurrence of such incidences. Even if in any eventuality, some untoward effect are noticed due to non compliance of code of conduct of the treatment, the treatment procedures for more beneficial outcome to the patients. All these processes which will make the drug ready with above properties comes under *Samskaras*.

The general procedures coming under samskaras are<sup>9</sup>

- *Toya Sannikarsha*
- *Agni Sannikarsha*
- *Saucha*
- *Manthana*
- *Desa*
- *Kala*
- *Vasana*
- *Bhavana*
- *Kala prakarsha*
- *Bhajana*

While considering the Dhatu Varga or Metals in Rasashastra these Samskaras can be conglomerated under following procedures:

- *Sodhana*
- *Marana*
- *Amrutikarana*
- *Jarana*



## CONCEPT OF SODHANA

Metals and minerals being availed from the natural ores found on earth, they are inherently impure and therefore not fit for internal administration in crude form<sup>10</sup>. Thereby sodhana is the primary procedure that is to be completed during Ayurvedic drug formulation. The literal meaning of sodhana may signify just purification but as we analyse from the point of Rasashastra it carries further scientific meaning. In this process the metals in its innate form are treated with specific substances and *peshanadis* are done to remove the impurities<sup>11</sup>.

### *Objectives of Sodhana*

When we analyse various methodologies adopted for Sodhana described in different texts of Rasashastra, we can easily understand that they are advised with a specific intention<sup>12</sup>.

They are:

#### **1. Elimination of Physical impurities**

As the primary metal sources being naturally occurring ores it will have quite a good percentage of physical impurities like stones, mud etc. These are removed by the mere process of washing and drying (Toya, agni sannikarshas)

#### **2. Neutralizing the toxins and removing Chemical impurities**

Removal of Physical Impurities alone can never make the metals consumable as they

are highly toxic themselves. So as the next stage of purification these are subjected to certain procedures like Nirvapa, Dhalana and Bhavana to remove the chemical impurities as well as to neutralize the toxins. These procedures are further explained as follows<sup>12</sup>.

#### a) Nirvapa

It involves a Heating phase and a Quenching phase in the specified liquid media. Metals are solids, closely packed crystal structure which have a definite inter atomic space and strong electrostatic force which keep the space in equilibrium. During heating to red hot due to the increased temperature the individual atoms obtain a high source of energy by which it begins to vibrate vigorously thereby breaking the electrostatic force and increasing the interatomic space. This is linear expansion. During the Quenching phase the immediate immersion of the red hot metal into the corresponding liquid media leads to decrease in tension and increase in compression force<sup>12</sup>. The media immediately penetrates inside the available spaces and the media soluble impurities gets dissolved. By repeating this process subsequently for 7 times neutralizes the toxins as well as removes the chemical impurities present in the metals. It also further makes the metal more brittle



enabling it suitable for the next process –  
Marana eg loha sodhana

b) Dhalana

In this process the melted metal is poured into any liquid and is usually adopted in sodhana of metals which have low melting point eg naga, vanga. When metal is melted and suddenly poured in cold liquid media, the immediate cooling leads to microscopic cracks in the electrostatic forces of these metals which in turn leads to its brittleness<sup>12</sup>.

c) Bhavana

It is the process of grinding by using drava dravya. By this process the particle size is reduced and each particle come in direct contact with the concerned media. By this process of tituration, the Bhavya dravya looses the molecular cohesiveness and breaks into fine particles. This is because of rubbing action and the pressure applied during the process. The materials will be titurated between the rough surface of mortar and pestle which leads to attrition of substance which breaks them into smaller particles. The continuous movement of pestle on hard surface also helps in adding the pressure on the substance. The weight of the pestle with the vibratory movement will further enhance breakdown of molecules<sup>12</sup>.

The significance of Bhavana is that, the toxic effects if any, in a Bhavya dravya

will be neutralized because of influence of Bhavana dravya. Therefore, selection of Bhavana dravya has an important role, in reducing the impurities/ toxic effects of the substance and also makes the drug more bio available.

***3.Enhances the therapeutic qualities of the drug***

The drugs used in the sodhana process act as a catalyst agent and bring some desired changes in the drugs enhancing the pharmacological qualities of the drug.

***4.Makes the metals and minerals suitable for further processes***

These processes of Nirvapa, dalana etc plays a major role in imparting brittleness and enabling sookhmikarana to facilitate & fasten the process of Bhasmikarana. Hence Shodhana is highly beneficial in further process like Marana, Satvapatana, etc.

***5.Brings organic qualities***

During different sodhana procedures the herbal drugs not only nullify the toxicity & modifies the active principles, but also brings organic qualities, which is highly necessary for administration and assimilation of the drug as our human system is purely organic in nature.

***Types of Sodhana***<sup>13</sup>

a) *Samanya Sodhana*

b) *Visesha Sodhana*

*Samanya Sodhana*



These are meant for the purification of the common impurities that are likely to be meant in a particular varga of substances.

#### *Visesha Sodhana*

The common impurities will be removed by the Samanya sodhana. There are also certain impurities which may vary from substance to substance and are peculiar to some substance. Therefore in order to remove these specific impurities certain unique techniques and procedures and techniques are utilized. This is called Vishesha sodhana. Thus both Samanya and Vishesha Sodhana are essential for any pharmaceutical preparation and cannot be avoided.

#### **Changes Occuring during Sodhana<sup>12</sup>**

##### I. Physical changes

- Eradication of Physical impurities
- Reduction in hardness
- Increase Brittleness

##### II. Chemical Changes

- Eradication of Chemical impurities
- Formation of Chemical compounds.
- Change into desired compounds.

##### III. Biological Changes

- Increase bio availability
- Decrease in particle size for better absorption
- Smoothens which reduces irritability
- Makes it homologous to tissue cells
- Reduction in toxicity increases the acceptability of the compound to the cells

#### **CONCEPT OF MARANA**

The word marana means killing. In this context, the metal is killed, so that it loses all its physical properties Sodhana and Marana are two important methods in Rasashastra. Sodhana is always done prior to marana. In this process, metals are converted into bhasma by applying required quantum of heat after grinding with herbal extracts<sup>12</sup>.

#### **Objectives**

- Size reduction of the particles
- Transformation into cell acceptable compound form
- Making the compound non irritantable to GIT
- To enhance the potency as well as the quality of drugs
- Conversion into absorbable, adaptable and assimilable form
- To bring out the therapeutic uses of the compound.

#### **Stages**

##### *i. Purvakarma*

- Collection of grahya drugs
- Sodhana
- Bhavana
- Chakrikarana
- Samputikarana

##### *ii. Pradhana Karma*

##### *Putra*



It is a process in which specific degree of heat is given which is necessary for the paka of specific drug<sup>11</sup>. It denotes the quantum of heat required to convert different rasasadhies into their corresponding compound forms to make it bio available to the human system<sup>14</sup>. In Marana, the required puta is the primary key which aids in the bhasmeekarana of the various rasasadhies.

#### *Effects of Puta*

Any metal or mineral subjected to Marana process needs some kind of puta for its paka. It was found that there is a proportional increase in the enhancement of quality of the rasasadhies on increasing the number of putas. In Rasa Prakasha Sudhakara there are references substantiating this view. Acc to the references from Rasendra Chudamani, greater no of putas makes the bhasma more ruksha, sukshma, jalaplava and in produces vichitra gunadeepthi in the bhasma. Further Rasendra Sara Sangraha mentions that putas in the range of 10-100 enhances the vyadhihara property of bhasma while those ranging in number of 100-500 putas produce vajeekarana property and putas ranging from 100-1000 are claimed to have the Rasayana property. By putas the bhasma attain deepana guna and Seeghra vyapti and dosa vinasana property.

#### *Bhasmas and Bhasma Pareeksha<sup>15</sup>*

The term bhasma is in general coined to all metallic and non metallic substances that are being reduced to the form of ash by the process of incineration or by the application of the specified amount of heat. The basic principle involved in bhasmeekarana is to provide a high quantum of heat in a closed kiln which is below the melting point of the substance in an inadequate supply of air thereby ensuring just partial oxidation. The basic process involved is a thermal decomposition of the compounds or at the most just a phase transition other than melting. On account of this process the metal turns more brittle

#### *Bhasma pareeksha<sup>15</sup>*

The methods by which we could confirm the optimal preparation of the bhasmas of the rasasadhies are termed as Bhasmapareekha. These tests have been accepted as well as described in detail in API with respect to the parametric values of each bhasma. The tests can be broadly classified into Physical and Chemical tests.

#### Physical

- a) Varitara- to float over the surface of water
- b) Unnama or Uttama- reassessment test of the floating character of bhasm
- c) Rekapurnata - indicates the fineness of a bhasma



- d) Anjana Sadrusha Sukshmatva
- e) Nischandratva – for abraha, swarna etc
- f) Gatarasatva - bhasma attains tastelessness
- g) Mridutva And Slakshnatva

#### Chemical

- a) Nirdhoomatva
- b) Apunarbhava
- c) Nirutha

#### Modern Parameters<sup>16</sup>

- 1) EDX-SEM – chemical nature, size and morphology of particles
- 2) TEM , AM – particle size, size distribution
- 3) EPMA – distribution of individual elements
- 4) XRD – phase analysis
- 5) XRF PIXE – Bulk chemical analysis after making pellets detecting metal as elements.
- 6) ESCA – Electronic nature and oxidation state of metal
- 7) Extraction and Chromatography – To extract out organic matter if any
- 8) HPTLC, NMR, IR, MALDI – Characterization of organic matter

### iii. *Paschat Karma*

#### a) *Amrutikarana*<sup>17</sup>

Amrutikarana literally means changing into nectar. It is a special procedure followed to remove the shishta doshas from the mruta lohas even after sodhana and marana. This specific process is generally

followed for tamra, swarna makshika abraha and loha.

By Amrutikarana process quality enhancement of bhasma and reduction in colour happens. Madhava Upadhyaya, author of Ayurveda Prakasha had made references about Amrutikarana in the context of Abraha bhasma . In this context he emphasizes that by this process though the properties of bhasma are enhanced but it is found to lose its arunatwa varna. Whereas Acharya Yadavji Trikamji, author of Rasamrita opines that it removes the eight bad effects of tamra.

It was the Acharyas after the period of 13<sup>th</sup> century who has quoted about the process Amrutikarana. Though Ayurveda Prakasha and Rasatarangini has expressed difference while quoting the definition of Amrutikarana, the ultimate aim involved by the process referred to as by both the Acharyas were the same i.e. to enhance the quality of the corresponding bhasma. Rasaratna samucchaya though does not mention the term Amrutikarana ,in the context of tamra marana, describes a process involving the mrta tamra by which it removes the 8 impurities of the tamra bhasma. The author of Rasatarangini further opines that this process has to be considered for lohadi bhasmas also , but explained the procedure for Abraha and tamra only. From the references available



in these classics we can infer that this process Amrutikarana has been described for bhasmas which requires more number of putas to avail the optimum bhasma. This excess Agni samskara might increase the rukshata in bhasma which may hamper its property. Perhaps it may be to preserve the Rasayana properties, it is treated with triphala and goghrita. Triphala Kwatha and goghrita are mentioned in the amrutikarana of Abraka and loha. It might assist to remove the remnant impurities and enhance the quality of bhasma. In contrary to the opinion of all Acharyas Bhudeva Mukherjee the author of Rasa Jala Nidhi, has opined that the Amrutikarana has to be done to the Abraka Bhasma which is not red in colour, if done to red coloured abraka bhasma it hampers the properties of bhasma.

#### ***b) Lohitkarana***<sup>17</sup>

It is a process of giving colour to the Bhasmas. The literatures of Ayurveda have guidelines given for identification of a bhasma based on its colour. Hence having proper colour is an essential requirement of a bhasma. For Lohitkarana the colouring agents are augmented to the bhasmas with the help of bhavana.

Eg bhavana with raktavarga dravya Kashaya impart brick red colour to Abraka.

#### **CONCEPT OF JARANA**<sup>12</sup>

This is another metal processing technique which is done before marana process in case of low melting point metals like naga, vanga, yasada to convert these into powder form by heating and rubbing with kshariya herbs like Apamarga and Aswattha panchanga till their burning and molted metal convert into black powder form in an open atmosphere. On self cooling it is further taken for marana process.

#### **CONCLUSION**

Comprehensive documentation in classics gives us a clear picture that the seers of Ayurveda were very well aware of the toxicity as well as of the untoward effects that occurs with the improper use of each rasausadhi. They were also keen to comprehend the unique techniques and methods to overcome these ill effects and have also documented in detail about the therapeutic dosage range of each as well as the concurrent pathya to overcome these untoward effects. They were also very vigilant enough to include the treatment protocols for any untoward complications that may arise due to any of the errors that may happen during processing or administering of these rasausadhies. This implies that, the seers were well versed with the pharmacokinetics and pharmacodynamics of metallic preparations.



It is ensured by Quality parameters that by the different proceedings (like Shodhana and Marana etc.) the different rasasadhies undergo structural as well as chemical transformation by which it acquire the corresponding therapeutic activities. Hence, a person who is unaware of such classical techniques only can raise concerns over the safety issues.

All this information leaves no doubt that the pioneers of Ayurveda were well aware of both the remarkable therapeutic benefits and potential toxicity of metals and minerals. Elaborate processing techniques were tried and tested for each material to nullify its toxicity and maximize the benefits. Safe dosages were codified. Suitable Anupana (adjuvants) and dietary advises were recommended. Looking into the glorious heritage, documentation of the classical literatures, clinical practices and preclinical observations; it can be authentically and strongly said that the metallic preparations are the BOON TO THE AILING POPULATION.

Considering all the concerns, there is a need to develop a strong networking between the present day well equipped laboratories, scientists of life technologies, and Ayurvedic physicians<sup>18</sup>. It is also important that the knowledge acquired about these concepts and different classical procedures need to be highlighted at every

possible training opportunity to the individuals of scientific profession, which will generate awareness regarding the traditional pharmaceutical procedures.



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