



Review Article

A CLASSICAL REVIEW ON METAL TOXICITY WITH SPECIAL REFERENCE TO *DHATU VARGA*

Sonbhoyar Devaki^{1*}, Dongre Sushma²

¹PG Scholar, ²Assistant Professor and PG Guide, Dept. of Rasashastra & Bhaishajya Kalpana, Govt. Ayurveda College, Dharashiv, Maharashtra, India.

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ABSTRACT

A drug or formulation produces adverse events if it is not processed properly and used as per the classical guidelines. **Aim and Objectives:** In this review article, an attempt was made to throw some light on origins of those adverse drug reactions and various measures taken in literature. **Material and Method:** All the classical literature in *Rasagrantha*, *Sangraha grantha*, textbook of Ayurveda and *Rasashastra* regarding toxicity effect of *Dhatu varga* have been reviewed for this work. **Observation and Result:** For safe use of *Dhatu Bhasma*, various classical parameters at every stage of preparation and use have been stated. Starting from *Grahyagrayatwa* of raw metals, *Samanya Shodhana* of all *Dhatu*s, toxic effect of improper processing of *Dhatu Bhasma*, and specific *Putra* for each *Dhatu* have been mentioned. Also, the *Amruti Karana* process, *Samanya* and *Vishesh Bhasma Pariksha* (parameters) have been exclusively done for the safety of *Dhatu Bhasma*. In order to reduce the residual toxic effect of *Bhasma* specific *Anupana* for specific *Bhasma* along with *Pathyapathya* have been detailed by ancient seers. Apart from that in case if any untoward effect has been found then the remedial therapies have been specified. **Conclusion:** *Rasaushadhi* can cause adverse effect if not prepared as per the classical guidelines. Hence there needs to follow classical guidelines at each and every step of *Bhasma* preparation scrupulously to get standard quality of *Bhasma*.

INTRODUCTION

Ayurveda is emerging globally due to its wide range of therapeutic dosage forms and high drug potential. *Bheshaja* (medicine) is the one amongst four basic factors of the Ayurvedic treatment^[1]. The pharmacological section of Ayurvedic system of medicine recognizes three major sources of medicine those of herbal, animal and mineral origin.^[2] Herbo-mineral, metallic and mineral drugs are called as *Rasaushadhis*. *Rasaushadhis* are gain popularity quickly, well work in small dosages and play a big role in Ayurvedic medicine. ^[3]

In past period, *Rasavaidyas* would make their own patient medication. In *Rasashashtra*, various *Dhatu* (metals) *Bhasmas* are used for therapeutic purposes have been processed by following the classical guidelines critically.

However, sometimes deficiency in processing techniques or shortcut processes may hamper its quality which leads to the toxicity.

Ancient Ayurvedic scholars were very much aware about the toxic nature of raw material used and hence described '*Aushadh sevan janya vikar*' (prescribed drug toxicity) in the classics elaborately, which express their apprehension about the negative consequences of Ayurvedic drugs. There are some guidelines given by the *Rasacharya* to minimize adverse drug reactions and increase the safety of *Rasaushadhi* during its preparation and use. So, there need to follow these guidelines stringently so that, quality can be achieved.

Present study was aimed to explore the classical guidelines regarding authentic features of raw metals, side effects of unauthentic raw material, adverse drug reaction of ill-treated *Bhasmas* and its antidotes as well as *Pathyapathya* to be followed.

MATERIALS AND METHODS

Original classical literature of Ayurveda and various *Sangraha Grantha* (reference books) of *Rasashastra* were reviewed for this study. Also, various

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national and international journals as well as online databases were referred for the study.

OBSERVATIONS

A) Selection of raw material

Literature mentioned different kinds of metals and minerals along with the preferred varieties (*Grahyadravya*).

Table 1: Various signs of *Dhatuvarga Grahyagrahyatva* (characters and variety of authentic raw material)

S.No	Name of <i>Dhatu</i>	<i>Grahya lakshana</i>	<i>Grahya prakar</i>
1.	Swarna (Gold)	<i>Daaha rakta</i> (red colour on heating), <i>Sitam chhede</i> (white colour on cutting), <i>Nikashe kukumprabham</i> (saffron colour while rubbing on touch stone), <i>Guru</i> (heavy), <i>Komal</i> (soft), <i>Snigdha</i> (smooth) [4]	<i>Khanija</i>
2.	Rajat (Silver)	<i>Chandravat Shweta</i> (white like moon), <i>Guru</i> , <i>Snigdha</i> , <i>Mrudu</i> (soft), <i>Vranadhya</i> (bright) [5]	<i>Khanija</i>
3.	Tamra (Copper)	<i>Snigdha</i> , <i>Japakusumsankasha</i> (hibiscus flower like colour), <i>Ghana</i> (heavy) [6]	<i>Nepalaka</i>
4.	Lauha (Iron)	<i>Pakwajambuphala</i> (like ripen jamun fruit like colour) [7]	<i>Kanta</i>
5.	Vanga (Tin)	<i>Dhaval</i> (white like silver), <i>Mrudu</i> , <i>Snigdha</i> , <i>Gaurav</i> (heavy), <i>Drutadrav</i> (melt rapidly) [8]	<i>Khuraka</i>
6.	Naag (Lead)	<i>Krushnasujjala</i> (blackish colour), <i>Mahabhar</i> (heavy), <i>Drutadrav</i> , <i>Putigandha</i> (smells putrid) [9]	<i>Kumar</i>
7.	Yashada (Zinc)	<i>Mahabhar</i> , <i>Mrudu</i> , <i>Drutadrav</i> [10]	Not mentioned

B) Shodhana/purification process

There are 2 types of *Shodhana* 1) *Samanya shodhana* 2) *Vishesh shodhana*

Table 2: *Samanya shodhana* mentioned by various classical texts

S.No.	Media (Quenching)	Times of quenching
1.	1. <i>Kanji</i> (rice gruel), <i>Takra</i> (butter milk), <i>Kulattha kwath</i> (horse gram decoction), <i>Gomutra</i> (cow urine) and <i>Tila taila</i> (sesame oil) in each media in this order 2. <i>Kadlimula Swaras</i> (banana roots juice) [11]	3 times 7 times
2.	<i>Tila tail</i> , <i>Takra</i> , <i>Gomutra</i> , <i>Aranala</i> , <i>Kulattha kwath</i> in each media [12]	7 times
3.	<i>Tila taila</i> , <i>Takra</i> , <i>Kanji</i> , <i>Gomutra</i> and <i>Kulattha kwath</i> in each media [13]	3 times

Table 3: Toxic effects due to use of *Ashuddha Dhatuvarga* for medicine preparation

S.No.	Name of <i>Dhatu</i>	Toxic effects caused by <i>Dhatu</i>
1.	Swarna	<i>Sukha-virya-balanashaka</i> (reduced pleasant strength and potency), <i>Rogakaraka</i> (cause many disease) [14,15]
2.	Rajat	<i>Aayu-sukha-balahara</i> , <i>Santaapa</i> (burning sensation), <i>Malabaddhata</i> (constipation), <i>Rogakaraka</i> , <i>Angasaada</i> (body ache) [16]
3.	Tamra	<i>Vaanti</i> (vomiting), <i>Moorchcha</i> (fainting), <i>Bhrama</i> (hallucination), <i>Utklesha</i> (nausea), <i>Kushtha</i> (skin disease), <i>Daaha</i> (burning sensation), <i>Moha</i> (delusion), <i>Sweda</i> (excessive perspiration), <i>Kleda</i> (hyperlipidemia), <i>Aruchi</i> (anorexia) [17,18]
4.	Lauha	<i>Gaurava</i> (heaviness), <i>Utkleda</i> , <i>Daaha</i> , <i>Ashmari</i> (urolithiasis), <i>Kushta</i> , <i>Aayu-bala-kantinasha</i> (destruction of vitality and radiance) [19,20]
5.	Vanga	<i>Prameha</i> (diabetes), <i>Gulma</i> (abdominal tumours), <i>Hrudroga</i> , (cardiac disease) <i>Kasa</i> (cough), <i>Shwasa</i> (dyspnoea) [21]
6.	Naaga	<i>Prameha</i> , <i>Kshaya</i> (emaciation), <i>Kamala</i> (jaundice) [22]
7.	Yashada	<i>Gulma</i> , <i>Prameha</i> , <i>Kshaya</i> , <i>Kushtha</i> [23]

C) Drug manufacturing processes

1) *Marana/Incineration*

Incineration is the method in which *Rasadraavya* with the help of *Maraka Dravya* and herbs are reduced to ashes by *Puti*. It yields an assimilable product called *Bhasma*.

Table 4: Puta required for Dhatuvarga

S.No.	Type of Puta	RPS	RRS	RT	AP	Sh.S
1.	Surya Puta	--	Lauha [24]			
2.	Maha Puta	--				Swarna & Rajat [25]
3.	Gaja Puta	Lauha & Kansya [26]		Lauha [27]	Rajat, Tamra, Naga, Pittal & Kansya [28]	Tamra, Lauha & Vanga [29]
4.	Varaha Puta	Swarna & Naga [30]				
5.	Kukkut Puta	Swarna, Rajat & Tamra [31]				
6.	Kapota Puta	Swarna [32]				
7.	Govar Puta	Swarna [33]				

Table 5: Toxic effects due to use of Apakwa Dhatu Bhasma

S.No.	Dhatu Name	Toxic effect of Apakwa Dhatu Bhasma
1.	Swarna	Decreases Oja and Bala (defense mechanism), Rogavajra (create many other diseases even death) [34,35]
2.	Rajat	Sharir tapa, Vidbadhata (constipation), Shukranasha (azoospermia), Bala and Virya kshaya [36,37]
3.	Tamra	Daaha, Sweda, Aruchi, Kleda, Moorchha, Vamana [38]
4.	Lauha	Shool (abdominal colic), Kushta, Agnimanda (anorexia), Maharoga, Hridiprapida, Aayubala-kantinasha [39,40]
5.	Naaga	Pandu (anemia), Prameha, Shoth (oedema), Bhagandar (fistula) [41]
6.	Vanga	Daaha, Ashmari, Shoth, Prameha, Kilas, Kushta, Bhandara, Shool, Gulma, Pandu [42]

i) Bhasma pariksha [43]

The processed sample of Bhasma must be tested on the basis of specific parameters given in classical texts.

Table 6: Bhasma Pariksha of Dhatuvarga

S.No.	Dhatu	Samanya Bhasma Pariksha				Vishesh Bhasma Pariksha		
		Rekhpurnav	Varitar	Apurnabhav	Nirutth	Amala	Avami	Amalaki
1.	Swarna	✓	✓	✓	✓			
2.	Rajat	✓	✓	✓	✓			
3.	Tamra	✓	✓	✓	✓	✓	✓	
4.	Lauha	✓	✓	✓	✓			✓
5.	Naga	✓	✓	✓	✓			
6.	Vanga	✓	✓	✓	✓			
7.	Yashada	✓	✓	✓	✓			

2) Amrutikarana [44]

It is an important process described in the context of Lauha and Tamra Bhasma. It had been indicated to remove left over Doshas of Bhasma and to make them right for therapeutic uses.

Table 7: Amrutikarana mentioned in various classical text

S.No.	Bhasma type	Ingredients	Process used
1.	Tamra Bhasma	Tamra Bhasma + Amala -Q.S.+ Surankanda [45]	Gaja Puta
		Tamra Bhasma one part +Half part of Gandhaka +one part of Panchamruta [46]	Putta (3 times)
		Tamra Bhasma one part + Half part of Gandhaka + Nimbu swarasa Q.S. + Surankanda one part	Gaja Puta
		Tamra bhasma + Kumari swarasa Quantity Sufficient	Varahaputa (8 times)
		One Pala of Lauha Bhasma+ one Kudava guda	Till Paka (Heating)
2.	Lauha Bhasma	Lauha Bhasma+ Triphala kwath (equal or double) [47]	Pachana till Madhyama Paka
		Triphala kwath (one/eight parts) + Goghrita + Lauha Bhasma in equal amount [48]	Pachana

D) Drug administration (Sevanvidhi)**1) Matra/Dose**

Rasaushadhis are more commonly used than herbal medicines because of their minute dosage.

2) Duration

Long-term consumption of certain medications can produce complications. Inadequate action of the drugs may be noticed if not directed for a prescribed period.

3) Sahapana and Anupana [49]

Rasaushadhi's were advised to be administered with definite Anupana and Sahapana or vehicle, which helps in proper absorption of the medicine.

Table 8: Anupana mentioned for Dhatuvarga

S.No.	Name of Dhatu	Anupana
1.	Swarna	Madhu, Ghrita, Bringaraj swaras, Dugdha, Punarnava
2.	Rajat	Madhu, Ghrita, Navneet, Sharkara, Vara, Kshara
3.	Tamra	Madhu, Pippali, Ghrita
4.	Lauha	Triphala churna, Madhu, Ghrita, Navneet, Dugdha
5.	Vanga	Madhu, Navneet, Ghrita, Dugdha, Sita, Haridra, Rasana, Tankana
6.	Naaga	Haridra, Rasna, Sita, Ashoktwakkwath, Guduchisatva
7.	Yashada	Madhu, Ghrita, Dugdha, Navneet, Triphala

4) Pathya-Apathya

Pathya literally means anything it may be Ahara and Vihara which is not damaging to one's physiological state, in contrast, the Apathyas are considered to be damaging to our body channels. The concept of Pathya-Apathya is important during the consumption of Rasaushadhis.

Table 9: Apathya during Dhatubhasma sevankaal

Name of Dhatu	Apathya Ahara
Louha Bhasma [50]	Kushmand, Til taila, Mash, Rajika, Madhya, Amlarasadravya

E) Remedies for Adverse drug reactions

If any undesired events were noticed due to defective processing, improper administration, the treatment procedures for such complications have also been prescribed as per table 10.

Table 10: Remedies to cure adverse effects caused due Dhatu sevana (Vikarshanti Upaya)

S.No.	Name of Dhatu	Vikarshanti Upaya
1.	Swarna	1.Haritaki churna + Sita for 3 days [51]
2.	Rajat	Madhu+Sita for 3 days [52]
3.	Tamra	1.Dhanakya+ Munibrihi and Sita in equal quantity with water [53] 2.Surankanda [54]
4.	Lauha	1. Triphala churna + Madhu [55] 2. Rub Vidanga with Vasa swarasa and expose this to sunlight for long time. 3. Siddha sara (antidote) prepared using Haritaki, Saidhava, Shunti, Shweta jeerak in equal parts with 2 parts of Trivit bhavana with Nimbu swarasa. Dosage 1 Ratti -2 Ratti [56] 4. Vidanga + juice of Agasta or Araggvadha phala majja[57]
5.	Naag	1. Swarna Bhasma + Haritaki + Sita [58] 2. Swarna Bhasma + Haritaki for 3 days [59]
6.	Vanga	Meshshringi churna + Sita for 3 days [60]
7.	Yashada	Bala + Haritaki + Sita for 3days [61]

DISCUSSION

Safety and efficacy of herbo- metallic or mineral formulations in Ayurvedic therapeutics is major concern in present era. The most crucial step in pharmaceuticals of Rasaushadhis is raw material selection. A safe and effective final product is ensured by using prescribed raw materials. If the chosen

material variety is different from Grahalakshana of Dhatu (Table 1), then the prepared medicines are of poor quality and it would be harmful to the individuals. Metals are considered to be toxic on consumption but while using it as an ingredient in Rasaushadhis, these materials should pass through a unique

pharmaceutical process called *Shodhana* (purification). Drug toxicity is reduced by these *Shodhana* procedures to a level that body can tolerate.

In *Samanya Shodhana* of *Dhatu* (metal) various *Acharyas* modified the order of quenching (Table 2). The alternate acidic and alkaline media of *Samanya Shodhana* might help in inducing certain changes. The alkalis will help in disassociating the impurities from the main element. The acidic media will aid in purification and digestion of the materials subjected too.^[62] If any substance was administered further without purification, then the prepared medicine may lead in serious adverse events (Table 3).

Marana process helps in making the metals and minerals acquire better therapeutic values and also in removing or reducing their toxic properties to such an extent that they will not produce any harmful effects on body. Depending on the material and purpose, there were differences in the type and quantity of *Putra*. Types of *Putra* required for *Rasadavya* (Table 4) is well stated in *Rasashashtra* texts. The *Bhasma* was said to *Apakwa* if sufficient *Putra* of the right kind and quantity were not provided. If this *Apakwa Bhasma* used in medicinal preparation then toxic effect happens (Table 5).

Various *Bhasma pariksha* have been mentioned to optimize the quality of *Bhasma* (Table 6). *Rekhapurnata* and *Varitar* indicate the minuteness and fineness of *Bhasma* particles. *Apurnarbhava* and *Nishchandratvam* indicates the absence of any free or reactive metal in *Bhasma*. *Niruttha Pariksha* signifies the complete conversion of metal into *Bhasma* form.^[64] *Amalaki Pariksha* is specific test for *Lauha Bhasma* indicated in some texts for detection of free metal of *Lauha* in *Lauha Bhasma*. *Amla Pariksha* is specific test for *Tamra Bhasma* it indicates that absence of free conjugated metal in *Tamra Bhasma*. There are various complications (*Vyapad*) manifested out of *Apakwa Bhasma Sevana Doshas* (Table 5). *Amrutikarana* has been indicated to eliminate left over *Doshas* of *Bhasma* and to make them suitable for therapeutic uses. The residual *Doshas* in these *Bhasmas* will create negative effects if they are utilised without *Amrutikarana*. *Amrutikarana* is referenced for *Lauha* and *Tamra Bhasma* in a number of classical texts (Table 7).

All the *Rasaushadhis* mentioned in the classical texts are described with their individual therapeutic doses best suited for the individuals. *Anupana* is an important tool to avoid the toxicity of *Bhasma*. As most of the *Anupana* (Table 8) have *Rasayana* and *Yogavahi* properties which helps to improve the therapeutic activity of it. Also, it synergizes the effect of *Bhasma* in various disease conditions as well as antagonize the toxic effects of *Bhasma*. When taking *Rasaushadhis*, the idea of *Pathya-Apathya* is crucial since it can change the drug's pharmacokinetics. *Apathya ahara-*

vihara may induce the failure of treatment which in turn leads to unintended drug reactions. *Apathya* during *Loha Bhasma Sevankaala* (Table 9).

Ayurveda while practicing came to notice about the ill-effects of these drugs on human body. At the same time, it was directed to manage various natural constituents in the form of antidotes such as honey, ghee, cow's milk, etc. These herbal remedies could be viewed as Ayurvedic chelating agents, since they prevent the body from losing vital elements while also effectively counteracting the harmful effects of metals and minerals without having any negative side effects. Various remedies to reverse the adverse effects caused due *Apakwa* or injudicious use of *Dhatu Bhasma (Vikarshanti Upaya)* (Table 10) is mentioned which states the use of specific *Dravya* in toxic effects of specific *Bhasma* that may have detoxifying effect, purgative properties and may control the deposition of that metal in the body.

CONCLUSION

Rasaushadhi can cause adverse effect if not prepared as per the classical guidelines. Hence there needs to follow classical guidelines at each and every step of *Bhasma* preparation scrupulously to get standard quality of *Bhasma*. Ayurvedic scholars were well versed with the pharmacokinetics and pharmacodynamics of metallic preparations as they mentioned all safety measures to combat with adverse reactions. So, awareness regarding proper use of *Bhasma* and its probable toxicity is necessary in order to limit the occurrence of adverse effects.

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***Address for correspondence**

Dr. Sonbhoyar Devaki

PG Scholar

Dept. of Rasashastra &

Bhaishajya Kalpana,

Govt. Ayurveda College,

Dharashiv, Maharashtra, India.

Email:

devakisonbhoyar@gmail.com

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