

## REVIEW ARTICLE

**Ayurvedic View on Heavy Metal Poisoning with Special Reference to *Naga bhasma* (Incinerated Lead) - A Literary Study****Dhirajsingh Rajput\* and Biswajyoti Patgiri***Dept of Rasashastra, IPGT & RA, Gujarat Ayurved University, Jamnagar, Gujarat, India*

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**ABSTRACT**

*Naga bhasma* (incinerated Lead) is one such preparation containing lead as a main ingredient. According to the modern science, lead and lead compounds are toxic to human health. Manifestation of some extraordinary medicinal properties in *Naga bhasma* indicates that, the *Ayurvedic* processes performed during its preparation must be bringing about some radical changes in lead, which not only destroy its toxic nature but impart some extraordinary medicinal properties ascribed to *Naga bhasma*. Present work centered on the fact of heavy metal poisoning and *Ayurvedic* point of view towards the use of such metals with special reference to current research on toxicity of *Naga bhasma*. This study clearly shows that *Naga bhasma* is not just Lead, it's a compound form predominantly crystalline i.e. mixture of PbO Pb<sub>3</sub>O<sub>4</sub>. XRD data revealed OH and (CO<sub>3</sub>)<sub>2</sub> group which contain some other essential elements in minute quantity and didn't have any toxic effect at LD<sub>50</sub> which was 160 times higher to that of Therapeutic Equivalent Dose (TED) (12.5 mg/kg) in acute toxicity study.

**Key words:** *Ayurveda*, Heavy metal poisoning, *Naga bhasma*.**INTRODUCTION**

The pharmacological section of *Ayurvedic* system of medicine recognizes three major sources of medicine, those of herbal origin (e.g. herbs), mineral origin (e.g. salts, metals like gold, copper, silver), and animal origin (e.g. milk, honey etc). Although, *Kashthaushadhis* and *Rasaushadhis* are two main groups of medicines, the former is devoid of any metals and minerals and is purely herbal product and can be considered as safest of medicines, and later consists of metal and minerals in the form of *Bhasma* (incinerated metal, minerals etc.). These metallic preparations occupies significant seat in *Ayurvedic* pharmacopoeia. The well known metal mostly used in *Ayurveda* includes mercury, gold, silver, copper, arsenic, lead and tin. These metals have specific gravity more than five hence these are categorized in group of heavy metals. Accumulated toxicity data on the hazardous effects of heavy metals have made health scientists afraid of heavy metals. As a result, renewed interest in the beneficial effects of metals and minerals is often viewed with skepticism. Many people's which are unaware of the pharmaceutical processing of *Rasaushadhis*

(*bhasma* and other herbo-metallic preparations), are in doubt about their safety and efficacy.

*Bhasmas* are unique *Ayurvedic* metallic preparations with herbal juices/fruits widely used for treatment of a variety of chronic ailments. The *bhasmas* are products of classical alchemy, organo-metallic compounds of certain metals and gems in a very fine powdered form, mostly oxides, made in elaborate incineration processes perfected several centuries ago. Now a days, some people who are unaware of the pharmaceutical processing of *Rasaushadhis*, are in doubt about their toxicity. Recent articles pertaining the alarming level of heavy metals, especially Pb, Hg, and As in *Ayurvedic* formulations have created a lot of controversy regarding the safety and efficacy of *Ayurvedic* formulations. In same context, Lead, mercury, and arsenic have been detected in a substantial proportion of Indian-manufactured traditional *Ayurvedic* medicines. Whether toxic metals are present in both US – and Indian – manufactured *Ayurvedic* Medicines are unknown, hence an attempt was made to study the fact of heavy metal poisoning and view of *Ayurveda* towards using the metals with special

reference to current research on toxicity of *Naga bhasma*.

### Definition of Heavy metal and Heavy metal poisoning:

Heavy metals are essentially those chemical elements that have a specific gravity which is five times that of water.<sup>[1]</sup> The heavy metals which are most often found to be responsible for harmful damage to humans in cases leading to environmental pollution from various sources are mercury, arsenic, lead, cadmium and thallium. Heavy metal toxicity refers to the excessive build-up of heavy metals in the body.<sup>[2]</sup> Since body cannot degrade them, they get accumulated in body tissue and interfere in the healthy functioning of systems and may result in diseases like Alzheimer's, neurological degenerative processes, Parkinson's disease, muscular dystrophy, and multiple sclerosis.<sup>[3]</sup>

### Modern and ayurvedic hazards of impure lead<sup>[4]</sup>:

Lead is a metallic irritant poison. As with other metals, the soluble compounds of lead are more poisonous than lead itself, except when lead is in the volatile state. Lead may obtain access to the body by inhalation, by ingestion, or by absorption from the skin or mucous surfaces. The primary effect of lead is to cause spasm of the capillaries and arterioles. The toxic effects result from fixation of lead in certain tissues such as brain and peripheral nervous system. Acute lead toxicity is infrequent and occurs from ingestion of acid-soluble lead compounds or inhalation of lead vapors. Symptoms are similar to arsenical or mercurial poisoning except that the stool is blackened and offensive. The principal manifestations are GIT and CNS disturbances. These are Astringency, thirst, and a metallic taste, Nausea, abdominal pain, vomiting, Stools may be black from lead sulphide, and there may be diarrhea or constipation, Shock, Paresthesias, pain, muscle weakness, Hemolytic crisis followed by severe anemia and hemoglobinuria, Kidney damage with oligouria and Death may occur in 1 or 2 days.

Lead poisoning is mostly of chronic type. The signs and symptoms of chronic lead poisoning (plumbism) can be divided into six categories: gastrointestinal, neuromuscular, CNS, hematological, renal, and other. The neuromuscular and CNS syndromes usually result from intense exposure, while the abdominal syndrome is a more common manifestation of a very slowly and insidiously developing

intoxication. The former is more common in children and later is more prevalent in adults.

### Toxic effect of Lead mentioned in ayurveda.

*Rasashastra* a branch of *Ayurveda* basically related with use of metals and minerals. In *Rasashastra* not only the toxic effect of many metal and mineral are discussed in detail but also the treatment of the poisoning is also mentioned. According to *Rasashastra* if *Naga* (Lead) used without proper purification and incineration as per advised in classics, it will cause various diseases like *Kushtha* (various skin diseases), *Gulma* (abdominal tumors), *Ruja* (pain), *Meha* (diabetes), *Pandu* (anemia), *Jwara* (fever), *Tridoshaprakopa* (vitiating of all three *dosha*)<sup>[5]</sup>; *Mrityu* (death)<sup>[6]</sup>; *Udara* (ascitis)<sup>[7]</sup>; *Sandhishhula* (joint pain), *Pakshavadha* (hemiplegia), *Anaha* (flatulence), *Avabahuka* (stiffness of shoulder)<sup>[8]</sup>; *Kandu* (itching) and *Anilasada* (anorexia)<sup>[9]</sup> etc. most of the symptoms mentioned in *ayurveda* are same as mentioned in modern science, this indicate that the Lead poisoning is nothing but the effect of impure lead or improperly proceed and administered lead without following specified *ayurvedic* classical guidelines.

### *Bhasma* and heavy metals:

Trituration of curd leads to formation of ghee but it doesn't mean that curd is ghee. Similarly *bhasma* are prepared from heavy metals but they are not heavy metal. *Sanskara* (processing) brings significant difference in the initial and final material. Before using metals for therapeutic purpose *Ayurveda* clearly advised to conduct some procedures which are known as *shodhana* (purification). After purification the metals and minerals are subjected to repeated cycle of incineration followed by triturating with some herbal juices. Thus the formed product is a herbo-metallic incinerated form (*bhasma*) with new physical and chemical properties. Heavy Metals as popularly explained metals with specific gravity greater than 5 gm/cm which means when they are put on to the water they will settle at the bottom. But going by the tests for *bhasmas* for the final approval to use on the human beings must have following three qualities *Varitar* (they should float on water), *Unnam* (they should be able to take the weight of a rice grain, more weight bearing must be a critical change for the metals), *Rekhapurna* (they should have microfineness to fit into the lines of the hand and should not glitter), *Niruttha* (metal should not gain its crystalline form after heating with ghee, seed of *Abrus precatorius*, honey, borax and extract of *comifora mukul*). It clearly

indicate that the in the process of repeated incineration the previous metal get completely destroyed (that's why ancient *achary* named this process as *marana* means killing of metal) thus *bhasma* are not heavy metals, they are nano-particles with a mixture of organic and inorganic compounds. E.g. lead has a low melting point

327.46<sup>0</sup>C but the *Naga bhasma* (incinerated lead) didn't melt even at 800<sup>0</sup>C and *Naga bhasma* is mixture of PbO Pb<sub>3</sub>O<sub>4</sub> and contain either OH, (CO<sub>3</sub>)<sub>2</sub> or (SO<sub>4</sub>)<sub>2</sub> and (AsO<sub>4</sub>)<sub>3</sub> group. The detail chemical form of *Naga bhasma* prepared by five different methods is given in (Table 1 & 2).

**Table 1: XRD Investigation of *Naga bhasma***

S. No	Sample Code No.	Constituents Identified
1	NGA.01	PbO+Pb <sub>3</sub> O <sub>4</sub> +Pb (CO <sub>3</sub> ) <sub>2</sub> (OH) <sub>2</sub>
2	NGA.02	PbO+ Pb <sub>3</sub> O <sub>4</sub> + Pb (CO <sub>3</sub> ) <sub>2</sub> (OH) <sub>2</sub> H <sub>2</sub> O+Pb <sub>10</sub> (CO <sub>3</sub> ) <sub>6</sub> (OH) <sub>6</sub> O
3	NGA.03	PbO+ Pb (CO <sub>3</sub> ) <sub>2</sub> (OH) <sub>2</sub> + Pb <sub>10</sub> (CO <sub>3</sub> ) <sub>6</sub> (OH) <sub>6</sub> O
4	NGA.04	PbO+ Pb (CO <sub>3</sub> ) <sub>2</sub> (OH) <sub>2</sub> + Pb <sub>10</sub> (CO <sub>3</sub> ) <sub>6</sub> (OH) <sub>6</sub> O
5	NGA.05	[KNaPb <sub>8</sub> AsO <sub>4</sub> ) <sub>6</sub> ]+[Pb <sub>4</sub> (SO <sub>4</sub> )(CO <sub>3</sub> ) <sub>2</sub> (OH) <sub>2</sub> ]+[NaPb <sub>4</sub> (AsO <sub>4</sub> ) <sub>3</sub> ]+[K <sub>2</sub> Pb(SO <sub>4</sub> ) <sub>2</sub> ]+[Pb <sub>2</sub> (SO <sub>4</sub> )O]

**Table 2: Infrared spectra of *Naga bhasma***

S. No	Sample Code No.	Significant Absorption peaks in cm-1 and Assignments								
		(OH)- +(H <sub>2</sub> O)	(OH) <sup>·</sup>	(CO <sub>3</sub> ) <sup>2-</sup>	(CO <sub>3</sub> ) <sup>2</sup>	(SO <sub>4</sub> ) <sup>2-</sup>	(SO <sub>4</sub> ) <sup>2-</sup> (ASO <sub>4</sub> ) <sup>2</sup>	δ(OCO)	(CO <sub>3</sub> ) <sup>2</sup>	(OH) <sup>·</sup>
1	NGA.1	3529	2363	1406	1044	-	-	890	682	668
2	NGA.2	3466	2361	1406	1040	-	-	870	682	668
3	NGA.3	3466	2361	1404	1020	-	-	880	683	668
4	NGA.4	3445	2360	1417	1020	-	-	884	682	668
5	NGA.5	3447	2361	1400	1020	1090	841	-	681	668

### Current research on Lead

Pravin Tate *et al.*<sup>[10]</sup> conducted a work on acute and chronic toxicity of *Naga bhasma*. Acute toxicity study at LD<sub>50</sub> which was 160 times higher to that of Therapeutic Equivalent Dose (TED) (12.5 mg/kg). In Chronic toxicity study, at a dose level TED x 05, and the overall toxicity study shows that both the test drugs do not produce significant toxicity at the dose level studied. Mrudula Wadekar *et al.*<sup>[11,12]</sup> conducted a comparative study of some representative samples of *Naga bhasma* from chemical and structural point of view by using XRD, IR and UV spectroscopy and thermogravimetry is reported here. This study showed that the *bhasma* samples were predominantly crystalline i.e. mixture of PbO Pb<sub>3</sub>O<sub>4</sub>. XRD data revealed OH and (CO<sub>3</sub>)<sub>2</sub> group in all samples. According to an antidiabetic research work on *Naga bhasma* carried out by Anjana Choube *et al.*,<sup>[13]</sup> the drug showed no untoward effect in any of the patients during and after the clinical study, ninety percent of the patients expressed sense of well-being and 70% of the patients showed improvement in the symptoms. 65% of the patients showed reduction in blood sugar and they were taking other hypoglycaemics also along with *Sastiputa Naga bhasma*. Fifty percent patients, those on *Sastiputa Naga bhasma* alone, showed reduction in blood sugar. This study revealed that *Sastiputa Naga bhasma* can be recommended as a medicine and also as an adjuvant along with synthetic medicines for the management of diabetes mellitus.

Sing Maksoodan *et al.* studies on testicular regenerative potential of *Naga bhasma*. In this study it was observed that the test drug when given simultaneously with CdCl<sub>2</sub> showed marked prevention of toxic effects of CdCl<sub>2</sub> and when given alone after 36 hours of CdCl<sub>2</sub> administration, showed a noticeable regenerative potential on partially degenerated testes. It has showed specific regenerative effect on germinal epithelium of testes. CdCl<sub>2</sub> is toxic to testicular germinal epithelium and its effects can be minimized by *Naga bhasma*. In higher doses the drug is very effective, thus these findings are well collaborated with the Ayurvedic concept of *vrishya* property of *Naga bhasma*<sup>[14]</sup>. S.K.Sing *et al.*<sup>[15]</sup> carried out a significant work on synthesis, characterization and histopathological study of a lead-based Indian traditional drug: *Naga bhasma*. A higher dose (adopted in the animal experimentation) of 6 mg/100 g of body weight per day has been tried for the toxicity study. No significant changes were observed in histology as well as normal anatomy of the skin, small intestine, pancreas, testis, brain, lung, kidney and liver in *bhasma*-treated and untreated groups of animals, while in case of crude lead treated group of animals significant changes in certain organs were observed. Thus, histopathological studies show that *Naga bhasma* is non-toxic (6 mg/100 g/day), while crude lead (6 mg/100 g/day) is highly toxic. Thus it appears that in *bhasmikarana*

process the crude lead is converted into *Naga bhasma*, which is found to be non-toxic at lower dosages.

#### **Basic concept of ayurveda and therapeutic use of metals:**

The question which should arise is that whether the herbs and Metals used according to *Ayurvedic* principles does any harm to the human body the answer is simple and one word - no, because *Ayurveda* has given supreme importance to the human body and diet. *Ayurvedic* doctor will prescribe different medicine to the persons suffering from the same disease based on their individual *Prakruti* (nature), *Vikruti* (Disease), *Dosha* - *dushya sammurchana* (gradation of disease process) and *Sroto-dushti* (tissues involved) and that to with proper *Anupan* (vehicle for medicine) along with *Pathya* - *Apathya* (do's and don'ts for diet) details. It's mentioned if a person is taking *pathya ahar* and *vihara* then he doesn't need any medicine, on the other hand if a person is not taking *pathya* then any medicine can't cure his disease completely. In *ayurveda* detail instruction is available about *pathya* and *apathy*. E.g. *Pathya* and *Apathya* to be followed during intake of *Naga bhasm*;

#### **Pathya:**

Cereals, breads, rice, eat more dark green vegetables; eat more beans, fresh fruits, cow milk, Satu, Kulitha, Godhum, Sali rice, Karvellaka, Laghu and ruksha ahara.

#### **Apathya:**

Alcohol, Meat and Sweets, Poultry and eggs, fish, Dadhi, Til tail, Kshara, oily foods, Amla Rasa, Anup Mamsa and Smoking.

All metals are present in the earth's crust and enter our bodies continuously at low levels. It is a common mistake, based on fear and misinformation, to believe that a toxin has a linear toxic effect. Down to the lowest levels, all toxins have a safe threshold below which there is no toxicity. In fact, below a safe threshold toxicity disappears and there is no toxicity at all - and in some cases even benefit exists. Acharya Charaka said that;

It means a highly poisonous substance can prove to be an effective drug if used appropriately; conversely irrelevant or inappropriate use converts a good drug into a highly poisonous material. The situation suggests that possession of complete knowledge of the drug with regards to properties, dose, therapeutic action and *pathya* (do's and don'ts for diet) that should be followed after

medication insures the safety and efficacy of that drug.

#### **DISCUSSION**

Toxicity of metals was not only fabulously known but also well documented in many *Rasashastra* texts, e.g. for the treatment of lead toxicity *Acharyas* advised to take *Swarna Bhasma*, *Haritaki*, and *Sita* internally for 3 days to remove unwanted effects of improperly processed or unripe *Naga bhasma*. *Rasataranginikara* mentioned *Vishatinduka* as an antidote for *Nagadosha*. *Rasahridaya Tantra* mentioned *Gomutra*, *kutki*, and *Karavellaka Shifa* as a remedy for *Nagadi Kalankita Rasa (Rasajirna)*.

Modern research proved that heavy metals are found in everyday existence and are frequently hard to avoid entirely. Most people can excrete toxic heavy metals from the body successfully.<sup>[16]</sup> However, some people—especially those who suffer from chronic conditions cannot excrete them efficiently enough and a build-up occurs. Recent research also reveals that those who cannot excrete heavy metals efficiently appear to be genetically predisposed to this condition. Research has shown that the APO-E 4/3 and 4/4 genotypes are the worst excretors of heavy metals. Those with this version of APO-E protein abundant in the cerebral spinal fluid surrounding the brain will have the highest affinity for becoming ill from exposure to neuro-toxic heavy metals, especially mercury when it is present in combination with others. Heavy metal may affect the body through various sources. These sources include water, air, food, or absorption through the skin when in contact with those exposed to toxic farming, chemical and toxic exposure in industries, etc. These situations indicate that any medicine should be administered only after complete knowledge of person's body and condition of disease i.e. by undertaking *prakriti* (individual personality), *dosha-dushya samurchhana* (involved organ and vitiated *dosha*) and condition of *dhatu* (seven basic component of body mentioned in ayurveda).

#### **CONCLUSION**

The herbo-metallic preparations of ayurveda including *Naga bhasma* are safe and devoid of any major untoward effects, when manufactured and administered by following specified classical guidelines. The direction given by *Acharya Charaka* support this theory that is even fatal poison when used with skill and knowledge proves to be a good medicine, and a medicine used ignorantly acts as a poison. For the better

safety of ayurvedic herbo-metallic medicines, it is high time that instead of blindly following the text and prescribing the medicine, one should test it thoroughly for its side effects, dose, duration and toxicity in the target organ of the body. These tests will allow us to form some guidelines regarding contra-indications of our drug, and also unravel the myths and ambiguities about *Rasaushadhis*. Animal studies are also needed because they give us the guidelines and help us to solve the queries on the extent of use of *Rasaushadhis* in regards to its safety margins. It does not mean that these guidelines are not mentioned in the text but in some cases it is difficult to evaluate dose and duration of drug in human body in modern era. The findings of animal studies have helped modern medicine a lot to know the pros and cons of the drug. This can also be applied to our ancient formulations to know the extent of dose response it can produce in human body.

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