



A Review of *Haratala* (Arsenic Trisulfide) and its Management in Ayurveda and Contemporary Science

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ABSTRACT

The science of *Ayurveda* includes eight branches (*Astanga Ayurveda*) of treatment specialization and *Agadatantra* is one among the eight branches. *Gada* literally means disease and *Agada* means any agent which makes the body free from disease. The word *Agada Tantra* is mentioned by *Acharya Sushruta*, *VishaGaraVairodhikaPrashamanam* by *Acharya Charaka* and *Damstra Chikista* by *Acharaya Vagbhata*. *Acharayas* mentioned ten *Adhithana* for *Sthavara Visha* and *Dhatu Visha* is one among them. *Haratala* and *Phenashma* are considered as *Dhatu Visha*. In text books of *Rasa Shastra*, *Haratala* has been explained under *Uparasa*. Three types of Arsenic compounds are described in our classics such as; *Haratala*, *Manashila*, and *Gauripashana*. So, the present article aimed to discuss vernacular names, properties and types of *Haratala*, characteristics of each variety, toxic symptoms mentioned in *Brihat Trayi*, *Ashuddha Haratala Janya Lakshana* according to different *Acharyas*. Toxicokinetics of arsenic, its mechanism, fatal dose, fatal period, presentation, inhalation (Arsine Gas), diagnosis, tolerance and treatment in modern science and postmortem appearance is also explained. *Pratyauoshada* for *Haratala Visha*, like *Kushmanda Swarasa* along with *Jeeraka* and *Sharkara* is highlighted.

Keywords: *Haratala*, Arsenic Trisulfide, Arsenic Toxicity, *Kushmanda*, *Jeeraka*, *Sharkara*.

INTRODUCTION

The science of *Ayurveda* includes eight branches (*Astanga Ayurveda*) of treatment specialization and *Agadatantra* is one among the eight branches.¹ *Gada* literally means disease and *Agada* means any agent which makes the body free from disease². The word *Agadatantra* is mentioned by *Acharya Sushruta*³, *VishaGaraVairodhikaPrashamanam* by *Acharya Charaka*⁴ and *Damshtra Chikista* by *Acharya Vagbhata*⁵. In ancient *Ayurveda*, *Visha* is classified as *Sthavara* and *Jangama Visha*⁶.

Acharayas has mentioned ten sites for *Sthavara Visha* and *Dhatu Visha* is one among it⁷. *Haratala* and *Phenashma* are considered as *Dhatu Visha*.⁸ In text books of *Rasa Shastra*, *Haratala* has been explained under *Uparasa*.⁹ *Uparasa* are 8 in number; including *Haratala* (orpiment) along with *Gandhaka* (Sulphur), *Gairika* (Ferric oxide), *Kasisa* (Ferrous sulphate), *Manashila* (Realgar), *Anjana* (Group of Substance which can be used as ointment or instillations of eyes), *Kankshi* (Allum Potash) and *Kankustha*¹⁰.

Three types of Arsenic compounds are described in our classics such as;

- 1- *Haratala* (As_2S_3) – Arsenic Trisulfide – *Uparasa*
- 2- *Manashila* (As_2S_2) – Arsenic disulfide – *Uparasa*
- 3- *Gauripashana* (As_2O_3) – Arsenic trioxide – *Sadharana rasa*

Table 1: Vernacular names of *Haratala*:¹¹

Sl.no.	Language	Name
1.	Assameese	Haritala
2.	Hindi	Haratal
3.	Kannada	Harital, Ardal
4.	Malayalam	Aritalam
5.	Gujarati	Aradal, Hartal
6.	Marathi	Harital
7.	Tamil	Aridaram, Yellikunud Pashanam
8.	Telugu	Doddipashanam
9.	Bengali	Harital
10.	English	Orpiment, Yellow Arsenic

The occurrence of *Haratala*¹²

The chief sources of *Haratala* are Iran and Italy and it is also found in Burma and China. Countries like China, Italy, and Cicely have the mines of both Realgar and Orpiment. Now a days it is available all over the world.

Table 2: Properties of *Haratala*

Sl.no.	Identified as	Orpiment or Yellow arsenic
1	Chemical name	Arsenic Trisulfide
2	Chemical formula	As_2S_3
3	Molar mass	246.02 g.mol ⁻¹
4	Appearance	Orange crystals
5	Density	3.43g cm ⁻³
6	Melting point	310 °C
7	Boling point	707 °C



• Types of *Haratala*¹³

There are mainly two varieties of *Haratala* explained in the classical Rasa Shastra books.

They are:

1. *Patra Haratala*
2. *Pinda Haratala*

Toxic symptoms of *Haratala* mentioned in *Bruhat Trayi*:

Acharya Sushruta has explained *Haratala* in the context of *Dhatu Visha* and its *Lakshana* include:¹⁹

- *Hrit-Pida* (pain in cardiac region),
- *Murccha* (fainting),
- *Daha in Talu* (Burning sensation in Palate)
- *Prayena Kala Ghatani* (Death in due course of time).

All these symptoms are suggestive of *Haratala's* (Arsenic Trisulfide) acute toxicity.

Table 3: In *Rasa Tarangani*, *Rasa Ratna Samuchaya*, *Rasaamrutam*, *Rasendra Chudamani*, *Anand kand*, *Ayurveda Prakasha*, *Rasa Chandansu*, *Brahat Rasa Raj Sundara*, the supremacy of the *Patra Haratala* is highlighted.

Acharaya	Patra	Pinda	Godanti	Bagadadi	Vakradala	Tabaki
<i>Rasa Tarangani</i>	+	+				
<i>Rasa Ratna Samuchaya</i>	+	+				
<i>Rasaamrutam</i>	+	+				
<i>Rasendra Chudamani</i>	+	+				
<i>Anand kand</i>	+	+				
<i>Ayurveda Prakasha</i>	+	+				
<i>Rasa Chandansu</i>	+	+				
<i>Brahat Rasa Raj Sundara</i>	+	+				
<i>Rasendra Sara Sangraham</i>	+ (Patala/Dala)	+ (Ashma)				
<i>Rasarnava</i>	<i>Patala</i>	+				
<i>Rasa Prakash Sudhakara</i>	<i>Dalakhya</i>	<i>Ashma</i>				
<i>Rasa Jala Nidhi</i>	<i>Vamsha Patra</i>	+	+		+	

Table 4: Characters of each variety

<i>Patra Haratala</i> ¹⁴	<i>Pinda Haratala</i> ¹⁵	<i>Godanti Haratala</i> ¹⁶	<i>Tabaki/Baghdadi Haratala</i> ¹⁷	<i>Vakradala Haratala</i> ¹⁸
It is also known as <i>Patala Haratala</i> or <i>Vamshapatra Haratala/Barki Haratala</i> . And is usually preferred for the therapeutic purposes.	This type of <i>Haratala</i> is not preferred orally because it is of very low quality and is usually used for external application only.	It does not possess arsenic in its chemical formulation. It is composed of calcium, oxygen & Sulphur i.e. CaSo ₄	It is the 4 th classification of <i>Haratala</i> which is prepared artificially from <i>Somal & Gandhaka</i> in the modern age.	It is very soft and is generally known by the name of ' <i>Cold Haratala</i> '.
It is better quality, resembles like golden coloured, <i>Snigdha</i> , <i>Guru</i> , <i>Bhasuram</i> , <i>Sukshma Patra</i> , <i>Rasayana</i> properties, <i>Tridoshaghna</i> and <i>Kusthaghna</i>	It is found in a compact form with stones, mud, etc. and form of small lumps, without lustre, stone like form, low weight, not good in appearance.	It is soft & heavy, without lustre, appearance like that of a cow's teeth, has yellow blue streaks at the center.	It is highly poisonous, very much smooth in touch, possesses the layers and marked weight and is known as king's yellow and is useful in paint industries.	It has layers, heavy and can cure leucoderma and leprosy and appears to be a special variety, which has been used to cure <i>Indra Kustha</i> .



Table 5: Ashuddha Haratala Janya Lakshana – According to different Acharyas.

Sl.no.	Ashuddha Haratala Janya	RT ²¹	RRS ²²	RJN ²³	RDP ²⁴	AP ²⁵	RSS ²⁶
1	Atyanta Daha	+					
2	Kshobha	+			+		
3	Prakampa	+					
4	Toda	+			+		
5	Kushtha	+		+	+	+	
6	Rakta Dusti	+			+		
7	Kamahinta	+					
8	Vata Kapha Janya Vikara	+	+	+	+	+	+
9	Mrutyu	+			+		
10	Ayughna		+	+			+
11	Mehakruta		+	+		+	+
12	Tapa		+	+	+	+	+
13	Sphota		+	+			+
14	Sankocha		+	+	+	+	+
15	Pida				+	+	

*RT – Rasataranagni, RRS- Rasa Ratna Samuchhya, RJN- Rasa Jala Nidhi, RDP- Rasa Darpana, AP- Ayurveda Prakash, RSS - Rasa Sara Sangraha.

These symptoms are present in chronic toxicity of Arsenic Trisulfide also. These may be produced due to improper purification or long term exposure.

❖ Toxicokinetics of Arsenic –

1. Absorption-²⁷

Arsenic is absorbed through all routes including oral, inhalational and cutaneous. Average arsenic consumption unknowingly, per day ranges from ½-1 mg (contained in food and water). Arsenic is well absorbed from GIT (Pentavalent Arsenic), respiratory tract (Arsine gas), and or skin (Arsenite). Upon ingestion, it is bound to the protein segment of Hb and α-globulins.

2. Distribution:²⁸

- Once absorbed, arsenic is immediately circulated to all the organs and tissues.
- Initially, arsenic is found maximally in the liver (in fatal cases >1mg %) followed by kidneys and spleen.
- In case if person survives, it can be found in muscles for days, in bones and in the keratin tissue, hair, nails, and skin for quite a long time (years). Ordinarily, the hair contains < 2 parts/million arsenic.
- Inorganic arsenic can cross the placenta.

3. Excretion - ²⁹

- It is excreted mainly by the kidneys (urine), but some part through feces, bile, sweat, milk, nails, and hair.
- Arsenic excreted mainly by kidney –
 - a- As methylated Arsenic

b- Mostly found in urine within ½ an hour of ingestion, then elimination is continuous for about 10-12 days.

Mechanism of action:³⁰

1. Arsenic inhibits with cellular respiration by uncoupling mitochondrial oxidative phosphorylation by combining with the sulfhydryl groups of mitochondrial enzymes, especially pyruvate dehydrogenase and certain phosphatases.
2. So, conversion of pyruvate to acetyl CoA is decreased, citric acid cycle activity is decreased and the production of cellular ATP is decreased.
3. It inhibits cellular glucose uptake, gluconeogenesis, fatty acid oxidation and further production of acetyl CoA.
4. Locally, it causes irritation of the mucous membranes, and remotely, depression of the nervous system.
5. Arsenic is a carcinogenic substance since lung, skin, and bladder (transitional cell) carcinoma has been observed in populations with multiple exposures.

Fatal Dose -

- I. Toxicity in Children; 2 mg/kg of arsenic trioxide.
- II. Toxicity in Adults; 120-250mg/kg of arsenic trioxide.

Fatal period: 1-2 days

B- Inhalation (Arsine Gas): ³²

Exposure causes hemolysis, damages the liver and kidneys (hemoglobinuria and renal failure) and depresses the CNS. There is nausea, vomiting, shaking chills, backache, and

anemia. The urine appears black due to hemoglobinuria. Death may be preceded by anuria and convulsions.

- Fatal dose: 25-30ppm
- Fatal period: 30 min.

Table 6: Presentation³¹

Fulminant type: Acute Toxicity	Gastro-enteric type: Sub acute toxicity	Narcotic type: Chronic toxicity
When large dose (> 3 g) is taken, CVS symptoms are prominent, with an almost complete absence of GIT symptoms. Death occurs in 1–3 hours from shock and peripheral vascular failure.	Acute revelations generally presented with cholera-like gastrointestinal symptoms of nausea, vomiting, abdominal pain, and severe diarrhea.	G.I.T symptoms are minor. There is giddiness, fornication, and tenderness of muscles, delirium, coma, and death; rarely there is complete paralysis of the extremities. CNS and muscular symptoms are prominent.

Table 7: Diagnosis^{33,34}

Sl.no.	Test name	Value
1.	Urine level:	As >100mcg/24 hours suggestive of arsenic toxicity.
2.	Blood Level:	As >7mcg/100ml is generally considered in the normal range.
3.	Hair Level:	As > 75ug%
4.	Nails	AS > 100ug%
5.	Radiography:	Arsenic is radiopaque.
6.	Chemical Test	Marsh Test, Reinsch Test, Gutzeit Test
7.	Neutron Activation Analysis and Atomic absorption Spectroscopy	Helps in estimating the concentration of arsenic in hair, nails, and bone.

- **Tolerance:**³⁵ Some people take arsenic daily as an aphrodisiac, and they acquire tolerance up to 0.3 or more than one dose. Such people are known as Arsenophagists.

Common Pratyashadha for Haratala Visha -

Pratyashadha is mentioned in different Ayurvedic texts & Rasa Shastra books for Haratala Janya Vikara.

1-Ashtanga Sangraha –³⁶

- Haratala toxicity is treated according to the predominance of *Dosha* and also like *Mandali Sarpa Vat Chikitsa*.
- *Haratala* induced toxic patient is to be treated by the purification methods such as *Vamana* (emesis) and *Virechana* (Purgative).
- Drugs such as *Ankola*, *Jalini*, *Shukanasa*, *Priyanguka*, *Lodhra*, *Dhyamaka*, *Talisa*, *Nata*, *Kustha*, *Yashthimadhu*, *Guggulu*, *Heebera* and *Bhadrakastha* are made into powder form and consumed with *Madhu* and *Ghrita*.
- The same powder can also be macerated with bile of mongoose and cow and can be used for *Anjana* and *Nasya*.

2-Ayurveda Prakasha.-³⁷

- *Mishri* and *Jiraka* powder are taken in equal quantity along with *Madhu* (3 *Masha*) for thrice a day.

- *Kushamanda Swarasa* taken along with *Mishri* (3 *thola*) for thrice a day.

3- Rasa Jala Nidhi -³⁸

- Intake of impure *Haratala* is corrected by taking, *Jira* mixed with *Sugar* for three days.
- The ill effects produced by intake of *Haritala* are removed by taking the juice of these three, Viz, *Javasa*, *Kushamanda* and *Rajamasha*.

4- Rasataranagni –³⁹

- If any toxic effect was seen in the body of the person by consumption of improperly purified *Haratala* or any of its compound formulation, then they can be nullified by administration of *Kushmanda Swarasa*, thrice daily in suitable dosage along with sugar and *Jiraka Churna*.

5-Rasendra Sambhava.-⁴⁰

- The removal of severe, effect due to consumption of impure *Haratala* is nullified by the intake of *Jiraka* mixed with sugar for three days.
- The evil effects of taking *Haritalama* are removed by taking juice of these three, Viz. *Javasa*, *Kushmanda*, and *Rajamasha* Specially it is mentioned in the removal of *Godanti Haratala*.



6-Rasa Darpana – ⁴¹

- Haratala toxic effect can be nullified by administration of *Kushamanda Swarasa*, thrice daily in suitable dosage along with *Sugar* and *Jiraka Churna*.

7-Rasendra Purana – ⁴²

- Removal of evil effect due to intake of impure *Haratala* is effected by taking, for three days, *Jiraka* mixed with *Sugar*.
- The evil effects of taking *Haritalama* are removed by taking the juice of these three, Viz., *Javasa*, *Kushmanda*, *Rajamasha*.

8-Anupana Darpana - ⁴³

- *Mishri* and *Jiraka* powder are taken in equal quantity along with *Madhu*, in the dose of 3 *Masha* for thrice a day.

9-Anupana Taranagani - ⁴⁴

- They can be nullified by the administration of *Kushmanda Swarasa* or *Yavasa* or *Nakulakanda*, in suitable dosage along with sugar.
- Intake of *Jiraka* and *Mishri* for seven days will make the person free from the *Haratala Dosha Janaya Vikara*.

10- Vaidya Sara Sangraha - ⁴⁵

- In case of poisoning caused due to *Talaka*, *Yashtimadhu* mixed with water or outer skin of the roots of *Ankola* paste with water and mixed with sugar should be given.
- In case of poisoning caused due to *Manashila*, *Gandhaka*, and *Talaka*, powder of *Shimshapa*, gingely oil, coconut milk, *Kanjika*, sugar, *Guduchi*, and *Haritaki* is given⁴⁶.
- **Treatment- ⁴⁷**

a) Acute Arsenic poisoning treatment

- 1- Gastric Lavage- the stomach should be repeatedly washout with warm water and milk to remove arsenic particles adherent to the mucous membrane of the stomach.
- 2- Then freshly precipitated hydrated ferric oxide (which is rather slowed to prepare) orally in small dose converts toxic arsenic to non-toxic ferric arsenite.
- 3- If ferric oxide cannot be quickly prepared, calcined magnesia or charcoal may be substituted.
- 4- Butter and greasy substances are useful to prevent absorption.
- 5- The systemic effects should be treated by intramuscular injection of B.A.L. (Dimercaprol) in an oily solution.

- 6- Parenteral fluid should be administered to counteract dehydration, glucose to combat liver damage, sodium bicarbonate to regulate acid-base balance.
- 7- Hemodialysis or exchange transfusion may be given in cases of renal failure.
- 8- Additional symptoms should be treated along general lines.

b) Chronic Arsenic Poisoning-⁴⁸

- 1- The treatment poisoning of chronic poisoning consists of removal of the patient from further exposure.
- 2- Dimercaprol (B.A.L.) has greatly improved the prognosis.
- 3- Vitamin B-complex
- 4- Intravenous sodium thiosulphate is useful.
- 5- The other treatment is symptomatic
- 6- Complete recovery may require six months to one year.

Anupana & Pathya for Haratala -⁴⁹

Haratala Bhasma is administered along with *Guduchyadi Kashaya* or any other suitable adjuvant.

The person consuming "*Haratala Bhasma*" should avoid *Lavana*, *Amla* and *Katu Rasa Dravya* and exposure to fire or hot sun.

If *Lavana* is to be used, then it is advised to use *Saindhava lavana* instead of any other salt.

❖ Postmortem appearance:⁵⁰**1) Acute arsenic poisoning – Postmortem appearance-**

The character of the appearances depends very largely upon the quantity taken and the period which has elapsed before death.

a) Externally - In acute poisoning-

- The body presents a dehydrated and cyanosed appearance with sunken eye balls.
- The skin is wrinkled and may be jaundiced.
- Rigor mortis lasts longer than usual.

b) Internally –

- The stomach appearance is classically described as Red Velvet.
- The mucous appears red, oedematous, and swollen in patches corresponding to the deposit of arsenic particles.
- It is enclosed with a considerable amount of tenacious mucous tinged with blood.
- Small acute ulceration or large erosions may be found at the pyloric end.



- Sub mucous petechial hemorrhages are common.
- The mucous membrane of the small intestine is inflamed usually in its upper part, and of the large intestine, the rectum is most prone to inflammation.
- Petechial hemorrhages under the endocardium of the left ventricle are comparatively common and may be found even when the stomach presents little sign of irritation.
- Hemorrhages may be found in the abdominal organs, and occasionally, there may be widespread hemorrhages in larynx, trachea, and lungs.
- The liver may show patchy fatty degenerative changes and, less frequently, necrosis with jaundice.
- The heart and kidneys may show fatty degeneration.
- Decomposition is not suggestively retarded by the presence of arsenic in acute poisoning.

2) In chronic poisoning - Postmortem appearance-⁵¹

- In chronic poisoning, retardation of decomposition is evident.
- The effects of long-standing absorption of the poison are seen in progressive emaciation; anemia; fatty degenerative changes in the heart muscles, liver and kidneys; in addition to congestion of the gastrointestinal tract.
- Microscopy may disclose peripheral neuropathy.
- The skin changes have been described under symptomatology.
- Arsenic is also deposited at the end of long bones which may be examined for the presence of poison.
- Hair and nail should be taken for analysis.

CONCLUSION

In Ayurvedic literature there is mentioning about different types of arsenic, their utility when toxicity is produced, and different stages of the poison along with treatment protocol. Information regarding antidote has been mentioned in contemporary science we get detailed descriptions regarding different types of poison, its features, management and its postmortem appearance. As arsenic is a common heavy metal poisoning thus detailed knowledge about arsenic will aid in better management in its toxicity

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