

Introduction and Pharmaceutical study of Rajata (Silver)

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ABSTRACT

Rajata is commonly known as *Silver*. It is described in *DhatuVargain* *RasaShastra* of *Ayurveda*. It is used in many formulations in *Ayurveda*. It is used in various diseases internally and externally. If *Asodhita Rajata* (*Impure Silver*) is taken internally it produces many undesirable effects and disorders in the body, so it should be used carefully after proper *shodhan* according to *Ayurvedic* text. Pharmaceutical study of various steps of *Shodhana* process of *Rajata* (*Silver*) is described here along with its introduction. The pharmaceutical study was done in National College of *Ayurveda*, Barwala, Hisar. AFI was followed for *Shodhana* of *Rajata*. *Rajata*, after undergoing *shodhana* treatment becomes free from impurities (undesirable substances) and untoward toxic effects and may not cause any undesirable symptoms in the body. Here in this pharmaceutical study of *Rajata Shodhana* total loss in weight was observed 5%.

Keywords: *Rasashastra*, *Rasaratna Samuchchaya*, *Shodhana*, *Nirwapa*, *AFI*.

INTRODUCTION

According to the *Rasa* literature, *Rajata* (*Silver*) has been included in '*Dhatu*' group and it is the second drug of this group. In *Samhita* period, medicinal value of *Rajata* was discovered. Acharya Charak has mentioned the *gunas* of *Rajata* as *Katu Rasa*, *SheetaVirya*, *SwaduVipaka* and we get clear picture about the medicinal value of *Rajata*⁵ and he mentions the uses of *Rajata* in powder form and the therapeutic uses of *Rajata* as *Medhya*, *Vrishya*, *Rasayana*. Acharya *Sushruta* has mentioned *Rajatashalakas* useful for the application of *anjana* in *netraRogas*¹. Among metals "*Rajata*" is included under "*Shuddhaloha*" or *Saraloha* i.e. noble metal. "*Rajata*" is considered to be "whitish, Silvercoloured metal, whitish Gold"²

Vernacular names³ :

Latin	- <i>Argentum</i>	Arabi	- <i>Nukara</i>	Kannada	- <i>Belli</i>
Bengali	- <i>Rupa</i>	Marathi	- <i>Chandi, Rupe</i>	English	- <i>Silver</i>
Malayalam	- <i>Velli</i>	Telugu	- <i>Vendi</i>	Hindi	- <i>Chandi</i>

Types :

- Classification according to different authors⁴:
 1. *Sahaja*
 2. *Khanija*
 3. *Kritrima*
- According to *Rasarnava*⁵:
 1. *Tara Shukla*
 2. *Tara Krishna*
- According to *Bhruhat Yoga Tarangani*⁶:
 1. *Prakrita*
 2. *Kritrima*

Occurrence⁷

Occurs in native form in small quantity. Occasionally associated with Cobalt, Nickel, Iron and Arsenic in basic igneous rocks. Such Silver is available in USA, Canada, Norway, Mexico, Australia, Russia etc. Silver is extracted from its ores.

The important ores are as follows:

Argentite or Silver Glance -	Ag_2S
Paragyrite or Ruby Silver -	Ag_3SbS_3
Stephanite -	Ag_5SbS_4
Proustite -	Ag_3As_3
Hestite -	Ag_2Te
Cerargyrite or Horn Silver -	AgCl

Sources

Silver occurs native and in ores including Argentite (Ag_2S) and Horn Silver (AgCl). Lead, Lead-Zinc, Copper, Copper-Nickel and Gold ores are other principle sources of Silver. Commercial fine Silver is at least 99.9% pure. Commercial purities of 99.999+% are available.

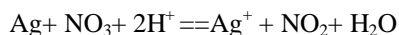
Physical properties of Silver

- It is a white lustrous metal. Next to Gold in malleability and ductility and next to Copper in exerting oligodynamic properties.
- Best known conductor of heat and electricity among all metals.
- When properly polished, about 95% of the light, striking the surface, is reflecting.
- It is resistant to atmospheric oxidation hence it is placed under noble metals but is attacked by Sulphur.
- When melted, it absorbs Oxygen, which it again expels on cooling globules often molten Silver are thrown off. This is called Spitting of Silver.

Chemical properties

Silver is monovalent and electropositive. Oxidation potential of Silver is low, hence it does not react with dil.HCl and H_2SO_4

With conc. HNO_3



Action of Sulphur : Silver reacts with Sulphur compounds to form black Silversulphide.

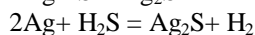
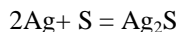


Table No 1: Showing General properties

Name, symbol, At. No.	Silver, Ag, 47
Element category	Transition Metal
Group, period, block	11, 5, d
Standard atomic weight	107.8682 g·mol ⁻¹
Electron configuration	[Kr] 4d ¹⁰ 5s ¹
Electrons per shell	2, 8, 18, 18, 1 (Image)

Table No 2: Showing Physical properties

Phase	solid
Density (near r.t.)	10.49 g·cm ⁻³
Liquid density at M.P.	9.320 g·cm ⁻³
Melting point	1234.93K, 961.78 °C, 1763.2 °F
Boiling point	2435 K, 2162 °C, 3924 °F
Heat of fusion	11.28 kJ·mol ⁻¹

Pharmacology

Silver is absorbed slowly. Silver ions are bound to protein and are also precipitated as Silver chloride at the site of application. Absorbed Silver is widely distributed in the body especially in the sub epithelial portion of the skin. Silver has got main role in chelation. Its salts increase both the permeability of the inward facing membrane of the epithelial cell layer.

Silver is widely used in topical gels and impregnated into bandages because of its wide-spectrum antimicrobial activity. The anti-microbial properties of Silver stem from the chemical properties of its ionized form, Ag^+ . This ion forms strong molecular bonds with other substances used by bacteria to respire, such as molecules containing Sulphur, Nitrogen, and Oxygen. When the Ag^+ ion forms a complex with these molecules, they are rendered unusable by the bacteria, depriving them of necessary compounds and eventually leading to the bacteria's death.

Amount of Silver present in human beings in various organs is as follows:-

Heart: 0.0033-0.26 mg/kg wet	Liver: 0.005-0.25mg/kg dry
Kidney: 0.05-0.26mg/kg dry	Lungs and Trachea: 0.1-0.5 ash mcgm/ gm

Silver Poisoning

Acute Silver Poisoning:

Silver itself is not toxic but most Silver salts are, and some may be carcinogenic. Silver and compounds containing Silver (like colloidal Silver) can be absorbed into the circulatory system and get deposited in various body tissues leading to a condition called Argyria which results in a blue-greyish pigmentation of the skin, eyes, and mucous membranes.

Silver has affinity for Sulphur; it is partly eliminated in the urine and faeces but a great deal remains in the system and gets deposited in the tissues. Protein and Chloride precipitate Silver ion.

Symptoms:

Severe pain in stomach and throat. Vomiting and vomited matter is flaky white at first but becomes black on exposure to light, followed by diarrhoea and sometime blood stools. Anuria, convulsions and collapse precede death.

Fatal Dose:

About 2gm of Silver Nitrate but recovery from larger doses is known.

Fatal Period:

Death occurs in few hours to few days.

Treatment:

Stomach wash with NaCl, 15mg NaCl dissolved in 500 ml of milk acts as antidote.
Dimulsent drinks, egg, milk.

Rajata Shodhana:

Shodhana is a procedure which is performed to remove the impurities and to induce new properties into the drug. It is mandatory for almost all the drugs of Rasashastra. It is carried out in two steps i.e. Samanya and Vishesha Shodhana.

Samanya Shodhana is explained in various Rasa granthas. Nirvapa is done in Taila, Takra, Gomutra, Aarnala, Kulathakwatha for 7 times.

Vishesha Shodhana is performed to attribute special property to the drug. Hence different drugs are mentioned for this purpose which can be selected considering the disease condition. According to different authors Nirvapa can be performed in any of these medias like jyotishmatitaila, Pishachitaila, Agastya Swarasa, Ksharamla, Changeri Swarasa, Nimbukadrava, Draksha etc.

PHARMACEUTICAL STUDY

Raw Rajata:

Thin sheets of Silver were taken for Shodhana as it was fulfilling the criteria of Kantaka VedhiPatra as it was easily pierced by needle. Because of thin sheets it was easy for quick & uniform heating.

Rajata Samanya Shodhana⁸:

Procedure:

- 200 gms of red hot RajataPatras were dipped into a vessel containing Tilataila.
- After RajataPatras become cool they were taken out and washed with warm water then dried.
- RajataPatras were again heated to red hot and the entire procedure was repeated for 6 more times.
- Each time 1000ml fresh Tilataila was taken.
- Finally Rajata was dried. The same procedure was repeated in Takra, Gomutra, Aranala and KulathaKwatha.

Vishesha Shodhana of Rajata⁹

Procedure:

- Samanya Shodhita Rajata Patras were heated to red hot and dipped in vessel containing Agastya Patra Swarasa.
- After Rajata became cool it was taken out and washed with warm water & Rajata was again heated red hot and entire procedure was repeated for another 2 times.
- After each Shodhana procedure Agastya Patra Swarasa was changed.

Table No. 3: Observations in Rajata during Samanya and vishesha Shodhana

Media	Total Qty (In grams)		Loss/Gain		Colour Changes	
	Before Shodhana	After Shodhana	In grams	In %	Before shodhana	After Shodhana
Tilataila	200	210	10 gm gain	5	Bright white	Blackish shade of burned oil
Takra	210	202	8 gm loss	3.80	Blackish shade of carbon dipposition	Bright White
Gomutra	202	200	2 gm loss	0.99	Bright whitish	Light coppery
Aranala	200	198	2 gm loss	1	Light coppery	Coppery white
KulathaK watha	198	196	2 gm loss	1.01	Light coppery tinge	More Brighter with little coppery tinge
AgastyaSw arasa	191	190	1 gm loss	0.52	Silver with coppery tinge	Dull silver colour

Table No. 4: Observations in Medias during Samanya and vishesha Shodhana

Media	Initial colour	Final colour	pH	
			Before shodhana	After Shodhana
Tilataila	Light yellowish brown	Slight Dark brown	6	6.5
Takra	Yellowish white	Dull White colour with black carbon particles	4	4.5
Gomutra	Yellowish	Dark brown	9	8
Aranala	Milky white	Milky white with black tinge	3	4
KulathaK watha	Brown	Dark brown	6.5	6
AgastyaSw arasa	Dark green	Light green	6.5	5.5



Fig 1: Ashodhita Rajata patra Fig 2: Heating of Rajata fragments Fig 3: Nirvapa in Tila taila



Fig 4: NirvaRajatapatra after TakraNirvap

Fig 5: Rajatapatra after Nirvap in Gomutranirvapa in Aranala

Fig 6: Rajatapatra after Nirvap in Gomutranirvapa in Aranala



Fig 7: Rajatapatra after In Gomutra Kulatthakwatha

Fig 8: Rajatapatra after Vishesha Shodhana

In between the atoms of the drugs there is a space called as Void space or interstitial space in which there are chances of presence of impurities. When the drug is heated and melted these impurities come to the surface of the drug and if the impurities are volatile they escape in the form of vapour. When the heated metal is suddenly quenched in the liquid media the following two phenomena may occur; if the impurity is soluble in the liquid media then it gets dissolved in the media or else the impurity may get neutralized by the reaction in between the liquid media and the impurities. In order to remove the impurities and improve its potency we get the explanation of different medias which are lipid, acid, and alkaline in nature for the purpose of RajataShodhana. The lipid soluble impurities get dissolved in the lipid media, the impurities which are acidic in nature gets neutralized or dissolved by the alkaline media and vice versa.

According to Rasarnava, the Kshara drugs are used for eliminating impurities. Amla rasa Dravyas are used to introduce Prabhodhana in the metal and Sneha Dravyas are used to produce softness in the metal.

Maximum weight loss was observed during Nirvapa in Takra which might be because of removal of impurities along with oil adhered over it. After Samanya Shodhana 2.5 % weight loss was observed and after Vishesh Shodhana 5% weight loss was observed. Though the total weight loss was 5% but half of the loss was observed during Vishesh Shodhana, which indicates that Agastya Patra Swarasa has capacity to remove impurities which could not be removed by Samanya Shodhana.

DISCUSSION

Maximum weight loss of Rajata (Silver) was observed during Nirvapa in Takra which might be because of removal of impurities along with oil adhered over it. After Samanya Shodhana 2.5 % weight loss was observed and after Vishesh Shodhana 5% weight loss was observed. Though the total weight loss was 5% but half of the loss was observed during Vishesh Shodhana, which indicates that Agastya Patra Swarasa has capacity to remove impurities which could not be removed by Samanya Shodhana. Hence, Rajata (Silver) after undergoing shodhana treatment becomes free from impurities(undesirable substances) and untoward toxic effects.

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