AYU

Access this article online
Website: www.ayujournal.org
DOI: 10.4103/0974-8520.96135
Quick Response Code:

Pharmaceutical Standardization

Standard manufacturing procedure of *Rajata Bhasma*

Rekha Chaturvedi[1], C. B. Jha[2]

[1]Lecturer, Department of Rasa Shastra, Vaidya Yagya Datta Sharma Ayurvedic College, Khurja, Bulandshahar, [2]Professor and Head, Department of Rasa Shastra, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Abstract

Rasa Shastra is a branch of *Ayurveda* which deals with the processing of minerals and metals having therapeutic importance. *Rajata* comes under the group of metals having high therapeutic value. Minerals and metals are mostly used in the form of *Bhasma*. During the medieval period *Rasacharyas* extensively worked and developed a number of processing methods for a single drug. They all are standard manufacturing procedures (SMP) which ensure the quality, safety, efficacy and reproducibility of the product. Earlier Ayurvedic physicians were producing medicines by themselves according to their need. Now a day, due to commercialization of Ayurvedic medicines and ignorance of classical methods, quality of drugs has deteriorated. Presently, the demand of Ayurvedic drugs in the global market is increasing day by day. Hence it is the need of time to develop SMP for Ayurvedic products for global acceptability. This paper aims at providing SMP for the manufacture of *Rajata Bhasma* and also attempts to study the effect of *Shodhana* process on *Rajata*. *Rajata* was obtained from the local market of Varanasi. *Rajata Bhasma* was prepared and it was observed that during the preparation of *Rajata Bhasma*, use of Muffle Furnace instead of conventional *Puta* is more advantageous due to better temperature control. Use of mercury and sulphur together acts as best medium in the preparation of *Rajata Bhasma*.

Key words: *Bhavana*, *Marana*, *Rajata*, *Rajata sindura*, *Shodhana*

Introduction

Studies on human civilization reveal that metals were first identified just after the Stone Age. They were used for making house hold utensils, hunting tools, knives, suturing needles, etc. After recognition of their therapeutic properties, were recognized, various processing techniques were developed, in order to make them suitable for human body and for use in the treatment of various ailments. *Agastyapatra Swarasa*, *Malkangni Taila*, *Nimbu Swarasa*, *Changeri Swarasa*, *Naga*, *Kshara*, *Amla*, *Tankana* are given as the *Shodhana* media of *Rajata* in different texts. *Parada*, *Hartala*, *Gandhaka*, *Swarnamakshika*, and *Hingula* are also used in various *Putas* as described in *Rasa* texts for preparation of *Rajata Bhasma*. *Rasa Vagbhata* has said that *Parada* is the best medium for making *Bhasma* of metals. Thus mercury and sulphur were selected for incineration of *Rajata*. Now a days, there is need to standardize the pharmaceutical methods, so that we can obtain *Bhasma* of same quality in every batch. Also materials for its processing should be made more readily available and cost effective. In this paper, attempts were made to develope SMP for *Rajata Bhasma*.

Address for correspondence: Dr. Rekha Chaturvedi, Department of Rasa Shastra, Vaidya Yagya Datta Sharma Ayurvedic College, Khurja, Bulandshahar, Uttar Pradesh, India.
E-mail: rekha_ansh@rediffmail.com

Aims and objectives

1. To study the effect of *Shodhana* process on *Rajata*.
2. To set forth Standard manufacturing procedure of *Rajata Bhasma*.

Materials and Methods

Rajata 99.9% pure was purchased from the local market of Varanasi. Purity was checked by Scanning Electron Microscope/ Energy Dispersive X-ray spectroscopy analysis and it was found to be 100% pure. *Rajata* was processed through *Shodhana* and Marana to prepare *Rajata Bhasma*. Table 1 gives information of the material required for *Shodhana* process.

Procedure

Samanya Shodhana of *Rajata*

Materials required

Rajata- 245 g., *Tila Taila* (*Sesamum indicum* Linn.)- 1500 ml,

Takra- 1500 ml, *Gomutra*-1500 ml, *Kanji*-1500 ml, *Kullatha Kwatha* (*Dolichos biflorus* Linn.)-1500 ml.

- Principle: *Nirvapa* (heating and dipping).
- Equipments required: Earthen casseroles, stainless steel bowls, heating device, tongs (*Sandasi*).
- Procedure-*Rajata patra* were heated till red hot and quenched subsequently into the *Kanji*, *Takra*, *Kulattha Kwatha*, *Gomutra* and *Tila Taila*, 3 times in each, for *Samanya Shodhana*. After every *Nirvapa*, the liquid medium was changed.[1]

Observations

- When red hot *Rajata* was dipped into liquids, some sound was produced and vapors were liberated from the media.
- After every *Nirvapa*, *Rajata* was found dull and some black carbon formed and was found adhered on the surface of the *Rajata*.
- When the red hot *Rajata* was dipped in *Tila Taila*, flame appeared for few seconds and irritant fumes of *Tila Taila* were liberated simultaneously. Carbon got adhered on the surface of the *Patra* during dipping in *Tila Taila*, which was removed on heating.

Vishesha Shodhana of *Rajata*

Materials required

Samanya Shodhita Rajata, *Nimbu Swarasa* (*Citrus medica*-3500 ml

- Principle: *Nirvapa*
- Equipments: Earthen casseroles, stainless steel bowls, heating device, tongs.
- Procedure-*Samanya Shodhita Rajata* was again heated till red hot and quenched in *Nimbu Swarasa* seven times repeatedly. Juice was changed after every dipping. Finally *Shuddha Rajata* was collected carefully.[2]

Observations

- *Rajata Patra* became very soft and shining. Its whiteness increased.
- Some of the particles which broke from the *Patra* were collected carefully from the liquid medium.

Effect on pH of the materials used before and after *Nirvapa* has been placed at Table 2.

Results after *Samanya Shodhana*

- Initial weight-245 g.
- Final weight- 222.7 g.
- Gain-2.7 g.

Results after *vishesha Shodhana*

- Initial weight-222.7 g.
- Final weight- 222.9 g.
- Gain- 0.2 g.

Please note: After *visheshaShodhana* 10 g. sample was kept for analytical study.

Marana process of *Rajata*

Marana was done as per *Rasa Tarangini*[3] however, with a slight modification the method. (In the first phase, *Kupipakwa* process was done which was followed by the *Puta* process).

Preparation of Kajjali

- Principle- Trituration
- Materials required: *Shuddha Rajata*- 210 g., *Shuddha Parada*-420 g., *Shuddha Gandhaka*- 420 g., *Gritakumari* pulp - 350 g.
- Equipments-*Khalvayantra*, spatula
- Procedure- Mercury was taken in a stone mortar. Foils of *Shuddha Rajata* were cut into small pieces and taken in the above mortar and triturated till it was converted into complete amalgam. *Shuddha Gandhaka* was added to the amalgam and triturated till a black colored, shining, powder (*Kajjali*) was obtained. This was then followed by the *Bhawana*of *Gritakumari Swarasa*. It was triturated till *Kajjali* was dried.
- Observations- The color of the mixture becomes black.

Results of preparation of Kajjali

- Initial weight of Mixture- 1050 g.
- Weight of *Kajjali*- 1030 g.
- Loss of weight- 20 g.

Kupipakwa process

It was completed in 5 batches.

- Materials required-*Kajjali*- 206 gm (in each batch),
- Equipments required- Electric Muffle Furnace, Iron rod, beer bottle which was wrapped 7 times with a cloth smeared with multanimitti, cork.
- Procedure-*Kajjali* filled *Kach-kupi* was kept in a vertical furnace and heated. Temperature was maintained in increasing order of *Mradu*, *Madhya* and *Teevragni and the time was divided into* 3 parts [Table 3, Graph 1].

Table 1: Details of materials, references and source from where obtained

Name of the material	Reference	Source of material
Kanji	Vaidayaka Paribhasha Pradeepa	Prepared in the Dept. of Rasa Shastra
Gomutra		Animal Husbandry BHU*
Kullatha (Dolichos biflorus) Kwatha	*Sharangadhara Samhita*	Prepared in the Dept. of Rasa Shastra
Tila (Sesamum indicum) Taila		Local market
Takra	*Sushruta Samhita*- 45/85	Prepared in the Dept. of Rasa Shastra
Nimbu (Citrus medica)		Local market
Parada		Local market
Gandhaka		Local market
Hingula		Local market
Gritakumari (*Aloe vera* Tourn.ex Linn) Pulp		Herbal garden of BHU

*BHU stands for Banaras Hindu University

Table 2: Effect on pH of materials before and after *Nirvapa*

Media used	Before *Nirvapa*	After *Nirvapa*
Kanji	4.93	5.03
Takra	5.72	5.59
Kullathakwatha	8.28	8.34
Gomutra	8.04	8.82
Tilataila	7.59	8.90
Nimbuswarasa	4.51	4.59

Table 3: Temperature pattern followed in *Kupipakava*

Type of agni	Temperature in degree celsius	Stages	Time in hours
Mraduagni	19-250	Stage of melting	3
Madhyamaagni	250-450	Stage of fuming	3
Teevraagni	450-650	Stage of flaming	3

Table 4: Results of *Kupipakva* process in different batches

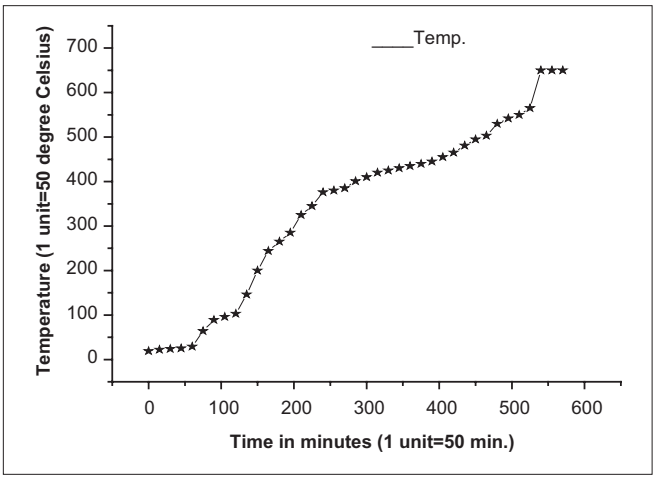
Batch no.	Weight of *kajjali* (in g.)	Weight of *Rajata Bhasma* (in g.)	Weight of *Rajata Sindura* (in g.)
1	206	49.81	85.01
2	206	50.41	84.25
3	206	52.4	86.2
4	206	49.1	85.6
5	206	53.2	86.9

Observations

- After around one and half hour, when the temperature was reached to 200 degree Celsius, yellow fumes were slowly liberated from the mouth of the bottle.
- As the temperature increases, fumes become thicker.
- At temperature of 530 degree Celsius, bluish yellow colored flames started coming out from the mouth of the *kupi*, and reached a maximum height of 3 inches as the temperature kept increasing.
- Gradually the length of the flames shortened and they disappeared after 45 minutes.
- Red hot iron rod was inserted into the mouth of bottle to clean any blockage.
- When flames stopped, a copper coin was put on the mouth of the bottle. When fumes becomes free of sulphur, corking done. After corking, heat was given for around half an hour and Electric Muffle Furnace was switched off.

Breaking of the bottle

Next day when the furnace cooled down, the bottle was carefully taken out, cleaned and a kerosene soaked thread was wrapped below the neck of the bottle and burnt. When the flame subsided, small amount of water was sprinkled over the bottle, due to which the bottle broke. Sublime material (*Rajata Sindura*) was collected from the neck of bottle, and residue of partially prepared *Rajata Bhasma* was procured from the bottom of the bottle carefully.



Graph 1: Temperature pattern in *kupipakwa* process

Results of Kupi-paka process

The results of the *Kupi-paka* process are shown in Table 4.

Puta process

After *Kupi-pakva*, the collected *Rajata Bhasma* was divided into 6 batches of equal weight. *Marana* of first 3 batches were done by conventional *Puta* method and another 3 through Electric Muffle Furnace.

Marana through Electric Muffle Furnace

Reference-Rasa Tarangini-16/26-28

Materials required – Partially prepared *Rajata Bhasma* obtained from the *Kupi-paka*–40 g., *Hingula*-4 g.(1/10th quantity of *Rajata*), *Grita Kumari* pulp-17 g.

- Equipments required -Mortar and pestle, earthen casseroles, clay and cloth, Electric Muffle Furnace (EMF).
- Procedure- *Rajata* was triturated with *Hingula* and *Gritakumari Swarasa* till a paste was formed. The paste was then dried and pellets were created. *Sarava Samputa* was done and it was kept in horizontal EMF. Temperature was allowed to gradually rise to 350 degree celsius in one and a half hour and maintained for 15 minutes. The furnace was then switched off and allowed for self cooling [Graph 2]. The next day, *Sarava* was taken out and pellets were again triturated with 1/10th of part *Hingula* and *Grit kumari Swarasa*. *Puta* was then given as above. In all, 5 *Puta* were given to obtain *Rajata Bhasma* of the desired quality. The results of the *Putapaka* have been depiced in Tables 5-7. Color of the *Rajata Bhasma* obtained was dark black.

Marana process in conventional *Puta*

Reference - Rasa Tarangini-16/26-28

Method was same as in EMF except that heating was done by cow dung cakes, weighing 500 gm (*Laghu Puta*). Experiment was done in the month of May. It took 3 hours and 20 minutes time for the *Puta* to self-cool. The temperature pattern is depicted in Graph 3.

Observations and Results of *Marana* Process

Reason for the increase in weight after *Marana*- Weight of

Table 5: Details of *Putapaka* in batch-1

No. of *Puta*	Weight before *Puta* (in g.)	Weight after *Puta* (in g.)	Colour	Consistency	Shining
1	45.7	40.5	Black	Soft	+
2	46.67	41.51	Black	Hard	+
3	49.72	44.4	Black	Soft	+
4	56.02	48.71	Black	Soft	-

Table 6: Details of *Putapaka* in batch-2

No. of *Puta*	Weight before *Puta* (in g.)	Weight after *Puta* (in g.)	Colour	Consistency	Shining
1	48.19	40.91	Black	Soft and rough	+
2	49.58	41.63	Black	Hard and rough	+
3	52.24	44.61	Black	Soft and smooth	+
4	53.71	47.23	Black	Soft and smooth	-

Table 7: Details of *Putapaka* in batch-3

No. of *Puta*	Weight before *Puta* (in g.)	Weight after *Puta* (in g.)	Colour	Consistency	Shining
1	47.56	40.13	Black	Soft and rough	+
2	47.91	41.91	Black	Hard and rough	+
3	48.7	44.26	Black	soft and smooth	+
4	54.17	46.91	Black	soft and smooth	_

Rajata Bhasma was increased after each *Puta* because *Rajata* and other elements present in the intermediary material, reacts chemically with *Hingula* to form compounds, which in turn cause an overall weight gain. The results are summarized in Tables 8-10.

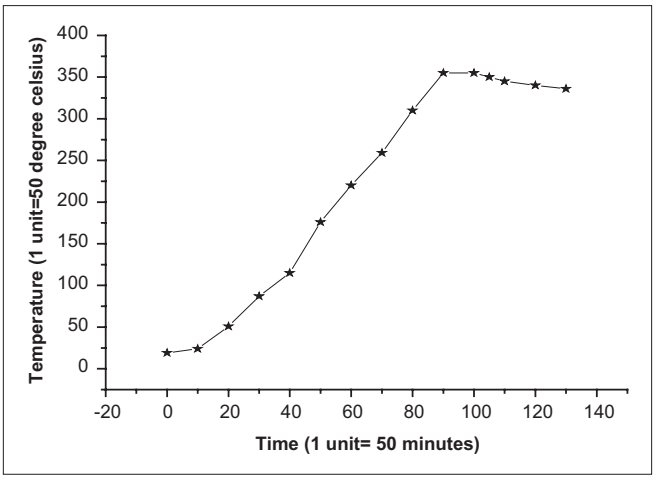
Bhasma Pariksha

All the samples were subjected to the following tests-

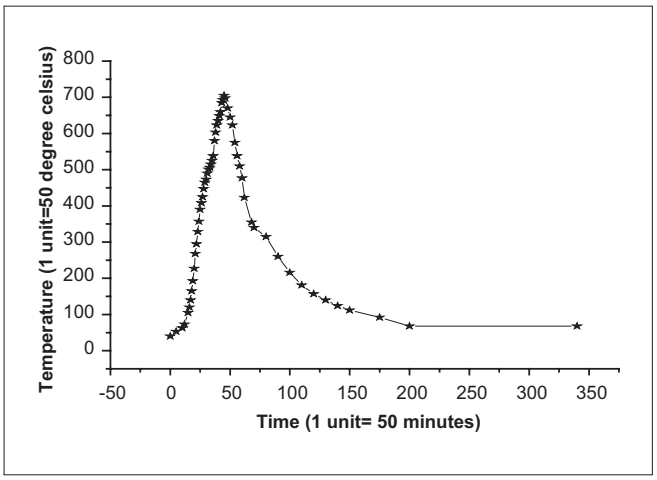
- *Rekhapoorana*- When small amount of *Bhasma* was taken in between the thumb and the first finger, and rubbed between them, it settled in the fingerlines.
- *Varitara*- when *Rajata Bhasma* was sprinkled over a beaker filled with water, 80% of the particles floated on water.
- *Nishchandra*- When *Bhasma* was exposed in sunlight, it was devoid of shining particles.
- *Mradutva- Bhasma* was soft to touch.
- *Gatrasatva- Bhasma* was tasteless.

Discussion

Shodhana and *Marana* are two essential steps in *Bhasma* preparation of metals. *Shodhana* detoxifies and makes material suitable for *Marana*. Heating till red hot and quenching in different liquids are the important procedures for *Shodhana* of metals. This process is also known as *Nirvapa*. On repeated *Nirvapa*, porosity develops in the *Rajata* foil, bonding between silver atoms becomes loose and some bonds are seen to break



Graph 2: Temperature pattern in electric muffle furnace during *Putapaka* process



Graph 3: Temperature pattern recorded in conventional *Puta*

up. During the *Nirvapa*, inorganic and organic compounds present in liquids come in contact with hot foils of silver and dissociate due to high temperature (700 degree Celsius) and may react with silver atoms. Thus, few elements infuse with the silver atoms. When *Nirvapa* process is done further, many elements react with compounds of the medium used. As the process of *Nirvapa* is done 22 times in 6 different media, repeated chemical reactions take place. After completing the *Shodhana* process, *Rajata* foils were subjected to X ray florescence analysis. Reports clearly indicate infusion of Sn, Cd, Mg, K, Na, S, Ca, P, Si, Al, Cl, Ar, In, Fe, Cu, Ba, Hg, and Cr. These elements came from liquids used for *Shodhana* process. This may be the cause of increase in weight after *Shodhana*. As *Patra* became softer on repeated heating, it can be interpreted that the bonding between silver atoms became looser on successive *Nirvapa* process.

Marana is a compounding process. As per the medium used, *Marana* of metals can be done by using any of the four as follows: *Rasa Bhasma*; herbal extracts; *Gandhaka* and its minerals; and by *Arilauhas*. Amongst these, first three are used in daily practice. *Marana* with *Arilauhas* can be therapeutically harmful. *Acharya Rasa Vagbhata* has stated that mercury is best for *Marana* of metals.[4] Metals disintegrate when amalgumated with mercury.

Table 8: Details of *Putapaka* in batch no.-4

No. of *Puta*	Weight before *Puta* (in g.)	Weight after *Puta* (in g.)	Consistency	Colour	Shining
1	47.65	40.52	Soft and rough	Black	Present
2	48.51	40.49	Soft and rough	Black	Present
3	49.41	41.26	Hard and rough	Black	Present
4	51.35	42.61	Hard and rough	Black	Present
5	52.71	43.27	Hard and rough	Black	Present
6	55.3	44.9	Moderately hard	Black	Present
7	57.3	45.8	Soft and smooth	Black	Present
8	59.1	47.2	Soft and smooth	Black	Present
9	60.5	48.2	Soft and smooth	Black	Absent
10	62.1	50.6	Soft and smooth	Black	Absent

Table 9: Details of *Putapaka* in batch no.-5

No. of *Puta*	Weight before *Puta* (in g.)	Weight after *Puta* (in g.)	Consistency	Colour	Shining
1	47.4	41.6	Soft and rough	Black	Present
2	49.1	42.9	Soft and rough	Black	Present
3	51.4	43.6	Hard and rough	Black	Present
4	52.1	43.9	Hard and rough	Black	present
5	53.1	44.1	Hard and smooth	Black	Present
6	55.3	46.1	Moderately hard	Black	Present
7	57.1	47.5	Moderately hard and smooth	Black	Present
8	59.1	48.4	Soft and smooth	Black	Present
9	61.9	48.9	Soft and smooth	Black	Absent
10	62.4	49.9	Soft and smooth	Black	Absent

Table 10: Details of *Putapaka* in batch no.-6

No. of *Puta*	Weight before *Puta* (in g.)	Weight after *Puta* (in g.)	Consistency	Colour	Shining
1	46.5	41.4	Soft and rough	Black	Present
2	47.1	43.2	Soft and rough	Black	Present
3	49.5	44.6	Hard and rough	Black	Present
4	51.5	44.9	Hard and rough	Black	Present
5	53.1	45.6	Hard and smooth	Black	Present
6	55.8	46.5	Moderately hard	Black	Present
7	56.9	47.1	Moderately hard and smooth	Black	Present
8	58.4	48.5	Soft and smooth	Black	Present
9	59.6	48.9	Soft and smooth	Black	Absent
10	61.5	49.1	Soft and smooth	Black	Absent

Due to this, the surface area of metals is widely enhanced, which facilitates the rapid compounding process. Thus, mercury acts as a catalyst in the compounding reaction and minimizes the time and labour. Due to these reasons, mercury was selected as medium for *Marana* of *Rajata*. Here, firstly *Kupipaka* heating was done. The product obtained was then subjected to *Putpaka*. On amalgamation of metal in mercury, the particle size was reduced and a fine powder was obtained. Hence, the surface area available for further incineration was increased. *Kupipaka* has its own advantages as *Rajata Sindura* can be procured as by product which has its own therapeutic uses. In the *Kupipakwa* process, a particular quantity of *Gandhaka* is utilized by the *Rajata* and other elements present in *Kajjali*. Mercury which forms mercuric sulphide is ultimately sublimated at the neck of the *Kachkupi* which is collected as *Rajatasindura*. Remaining amount of sulphur is destroyed.

With the help of mercury, best quality of *Rajata Bhasma* was produced. Partially formed *Rajata Bhasma* was subjected to *Bhavana* and *Putapaka*. Two or more materials get uniformly mixed in *Bhavana*, the size is reduced and certain medicinal properties are induced into it.

Many elements present in partially prepared *RajataBhasma* obtained from *Kupipaka*, react with the *Hingula* and *Gritkumari* pulp to form compounds. Due to this, gradual increase in the weight of *Rajata* is seen after every *Puta*.

Putapaka done in EMF, helped to achieve a better temperature control. Due to the variability of the cow dung cakes, the peak of the temperature obtained and the temperature pattern keeps changing, making it difficult to determine the exact number of *Puta* that will be obtained. Minimum 4 *Putas* are essential to obtain *Bhasma* of *Rajata*.

Conclusions

- Mercury and sulphur together act as the best media in preparing *Rajata Bhasma*.
- *Kupipaka* followed by *putapaka* is easy to follow and economical method. Here, can save time and labor, and also achieve best quality *Bhasma*.
- Electric muffle furnace is better than conventional *Puta* heating due to controlled heating system.

References

1. Sadananda Sharma, *Rasa Tarangini*, 15/4-6, Sanskrit commentary by Pandit Hari Datta Shastri. In: Pandit Kasinath Shastri, editor. 11th ed. Delhi, Motilal Banarasi Das; 1971.
2. Sadananda Sharma, *Rasa Tarangini*, 16/10-11, Sanskrit commentary by Pandit Hari Datta Shastri. In: Pandit Kasinath Shastri, editor. 11th ed. Delhi, Motilal Banarasi Das; 1971.
3. Sadananda Sharma, *Rasa Tarangini*, 16/26-28, Sanskrit commentary by Pandit Hari Datta Shastri. In: Pandit Kasinath Shastri, editor. 11th ed. Delhi, Motilal Banarasi Das; 1971.
4. Vagbhata. *Rasa Ratna Samuchchya*, 5/14, commented by Kulkarni D.A. 3rd ed. Delhi. Mehar Chand Lachman Das; 1982.

हिन्दी सारांश

रजत भस्म की मानक निर्माण विधि

रेखा चतुर्वेदी, सी. बी. झा

आयुर्वेद की रसशास्त्र शाखा औषधीय महत्त्व के धातु एवं खनिजों के प्रसंस्करण से सम्बन्धित है। रजत, धातु वर्ग में आने वाली श्रेष्ठ चिकित्सीय महत्त्व की धातु है। मुख्यतः धातु एवं खनिजों का प्रयोग आयुर्वेदिक योगों में भस्म के रूप में होता है। मध्यकाल में रसाचार्यों ने प्रयत्नपूर्वक प्रत्येक द्रव्य की भस्म बनाने की अनेक विधियाँ विकसित की, वे सभी एस. ओ. पी. हैं। पूर्व में चिकित्सक ही औषधि निर्माता होता था। वर्तमान में औषधि निर्माण का व्यापारीकरण होने से तथा शास्त्रीय विधियों की अनदेखी से उनकी गुणवत्ता कम होती गयी। वर्तमान में विश्वस्तर पर स्वीकार्य बनाने के लिये आयुर्वेदिक औषधियों की गुणवत्ता सुनिश्चित करने हेतु उनकी एस.ओ.पी. का विकास करना समय की माँग हैं। एस.ओ.पी. द्वाराऔषधियों की गुणवत्ता, विकार रहित कार्मुकता, यथानुरुप पुनरोत्पादकता को सुनिश्चित किया जाता है। रजत शोधन एवं मारण की अनेक विधियाँ शास्त्रों में वर्णित हैं। उनमें पारद एवं गन्धक के द्वारा रजत का मारणश्रेष्ठ पाया गया। रजत भस्म के निर्माण के लिये पारम्परिक पुट के स्थान पर विद्युतचालित भट्टी, नियन्त्रित तापक्रम देने से अधिक लाभकारी पायी गयी।