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PHARMACEUTICO – ANALYTICAL STUDY OF RAJATA GARBHA POTTALI

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ABSTRACT

Rajata (silver) comes under the group of metal having high therapeutic value and it is one among the potent *Sara Loha*. In *murchana* there are four methods are mentioned i.e. *kharaliya*, *Parpati*, *Kupipakwa*, *Pottali rasayana*. Among this the *pottali kalpana* is considered as more effective and supreme than other methods of preparation. It is one of the unique preparations because of its sustained heat pattern and the media used for *paka*. *Shodana* (purification) and *Marana* (incineration) of ingredients is an essential step before *Pottali Rasayana* which will modify the raw drug into its safe, bioactive, therapeutic form. *Rajata Garbha Pottali* (R.G.P) is a *Sagandha*, *Sagni, Gandhakajarita, Kajjalibhanda Pottali kalpana* containing *Rajata Bhasma, Shudda Swarna, Shudda Parada* and *Shuddha Gandhaka* processed with mild heat (120-250^{o}C) as it is explained by *Pandith Hariprapannaji* in *Rasa yoga Sagara* along with other *Pottali kalpana*. The preparation of the *Rajata garbha pottali* carried out and the yield obtained was 106%. The analytical study also carried out for the prepared product shows the XRD results the peaks of silver mercury sulphide, the EDX study reveals the percentage of R.G.P contains S-14.12%, Hg-22.23%, 44.08%, Au – 2.23%, FTIR analysis of R.G.P shows that it contains organic compounds with functional groups like Alkenes, Alkanes, Aromatics, Carboxylic acids, Primary and secondary amines.

Keywords: *Rajata Garbha pottali*, EDX, XRD, FTIR, *Rasa yoga sagara*

INTRODUCTION

Ayurveda is most ancient medical system of India known to human being since time immemorial. It is as old as Indian civilization. It is science of life. In Ayurvedic literature, diseased condition is defined as imbalance or loss of equilibrium of natural harmony of body, mind and spirit. Ayurveda not only guide to maintain this harmony but also recommend the various ways to normalize the deranged harmony among body mind and spirit.

Medicines of Ayurveda can be divided in two groups: *Kasthaushadhies* and *Rasaushadies*. According to ancient texts, Silver is believed to have originated from the semen of lord *Chandrama*. *Silver* is a famous white metal and a mineral product. It is also used in the preparation of ornaments.

In Ayurveda classics, especially in *Charaka Samhita* during the descriptions regarding vessels and *Vastinetra*, use of *Rajata(silver)* is available. After 5th century A.D. different kinds of silver, their features,

purification and incineration techniques were elaborately described in different classics.

According to most of the literatures metals are divided into 3 groups' i.e *Shudda lauha*, *Puti Lauha* and *Misra lauha*. *Silver* is an important metal of *Shudda lauha* group. *Rajata garbha pottali* (R.G.P) is a unique *pottali rasayana* mentioned in *Rasa Yoga Sagara*. It is a variety of *murchita parada yoga* which was invented with a vision of compact, comprehensive size and shape, convenience in preserving and its efficacy in treatment with minimum dosage. To prepare this the *Gandaka paaka* method was adopted. It is a completely balanced therapeutic agent which is designed to tackle the varied types of diseases like *Prameha, Shukra dosha, Pitta vikruti, Mutra vyadhi*.

The present study deals with the preparation of the *R.G.P* which involves the *Shodana* (purification) of the raw materials, preparation of the *Rajata bhasma*, preparation of *Rajata garbha pottali* with *gandhaka paaka* (sulphur bath) method and the analytical study of the final product obtained.

AIM: To prepare *Rajata Garbha Pottali* and evaluating its pharmaceutico-analytical results.

OBJECTIVES

- To carry out *Shodhana* of *Hingula, Swarna, Rajata, Gandhaka*
- To Prepare *Rajata Bhasma* by *Urdwapatana* method
- To prepare *Rajata Garbha Pottali* by *Gandhaka Paaka* method
- To carry out analytical study of final product

MATERIALS AND METHODS

MATERIALS

Raw materials

Swarna(Gold coin), *Rajata*(Silver), *Gandhaka*(Sulphur), *Parada*(Mercury)

Kanji, Tila taila(sesame oil), *Takra*(butter milk), *Gomutra*(cow's urine), *Kulattha kwatha(*horsegram decoction), *Nimbu swarasa*(lemon juice), *Kanchanara patra (*Bauhinia variegate), *Godugdha*(cow's milk), *Goghrita(*ghee), *Saindhava Lavana*(rock salt), *Haridra* (turmeric powder), *Kumari* (aloe vera).

Equipments

Urdwapatana yantra (Yantra is made with two earthern pots, where the upper pot is bigger than the lower pot The mouth of the upper pot should be inserted into the mouth of lower pot in such a way, that the same should reach up to the neck of the lower pot. The joint of the apparatus should be sealed air tight with the help of multanimitti smeared cloth or other sealing material).

Bhoodara yantra modified into *vidyuth patana yantra* (a mud pot is closed with the mudplate and heating coil is placed above the mud plate).

Khalva Yantra (It is a hollow, round or boat shaped apparatus made of iron, stone, glass or porcelain as per need. For mercurial operations, *khalvas* made out of iron are preferred while for preparing *pistis*, *bhasmas* and formulations, *khalvas* made out of stone are preferred).,

Valuka yantra (the iron vessel with sand filled in it)

Other instruments are earthen pot, Gas Stove, Knife, Mixer, Silk Cloth, Thread, Wood Stick, plates, Measuring jar, Match Stick, Pyrometer

METHOD

Pharmaceutical method

The preparation of *Rajata Garbha Pottali*

Rajata Shodhana[1,2]

Samanya Shodhana of Silver was done by *Nirvapa* (quenching) method in *Tila taila*(sesame oil), *takra* (butter milk), *Gomutra* (cow's urine), *Aranala*, *Kulattha kwatha* (horse gram decoction) for 7 times in each media. *Vishesha Shodhana* of silver was done by *Nirvapa* (quenching) in *Nimbu swarasa* (lemon juice) for 7 times.

Rajata Marana [2a,3,4,5]

Rajata Bhasma was obtained from *Urdwapatana* method were 1 part of *Rajata Choorna* mixed homogenously with 2 parts of *shuddha hingula* and subjected to 9 *urdwapatana* to obtain *bhasma lakshanas*. This apparatus was heated for 12 hours, in the pattern of *mild heat (*350-400^{o}C) for 6 hours, moderate heat (550- 600^{o}C) for 5 hours, intensive heat (upto700^{o}C) for 1 hour. The whole procedure was monitored allowing the water coolant to provide cool water to the dorsal surface of upper pot, and the hot water to flow out through another pre-fixed pipe from the pot to the basin. Thus heat was monitored continuously. After stopping the heating process, the water coolant was run for one hour to cool the apparatus to room tem-

perature. The apparatus was slowly dismantled after six hours. The *Urdhwa patana* procedure was repeated in the same way till the *Bhasma Siddhi lakshanas* were obtained. Every time 2 parts of *Shuddha Hingula* was added to the product collected from lower pot of the *Urdhwa patana Yantra* and triturated. The mercury adherent to the inner surface of the upper pot was collected carefully.

Swarna Shodhana [6]

Shodhana of *Swarna* (Gold coin) was done by *Nirvapa* (quenching) in *Kanchanara patra swarasa* for 3 times after heating the coin redhot, each time fresh *swarasa* (juice) was taken.

Gandhaka Shodhana [7]

Gandhaka (Sulphur) was taken in *khalwa yantra* and pounded. The mud pot was taken and cow's milk is filled in the pot and tied the cloth around the mouth, above the cloth the powdered sulphur was uniformly spread and mud plate was closed which is concave in shape. The heating coil was placed above the mud plate and heated for about 15 minutes. The sulphur melts and collected in the milk present inside the pot.

MAIN STUDY[8]

Purva karma

Preparation of *Swarna Pisti*

Purified Gold coin was cut into small pieces and taken in *Khalwa yantra* containing *Shodhita parada.* Immediately continuous trituration was carried out slowly with pressure. As trituration was continued within 20 min. the pieces of *Swarna* turned into Silver colour. After complete formation of *Pishti*, *Nimbu swarasa* (lemon juice) and *Saindhava lavana* (rock salt) was added and triturated well. After 2 hours of trituration the *swarasa* colour turned into greyish black. This was then washed by luke warm water, until the water stopped turning into black colour and all the acid content disappeard (it was checked with the litmus paper till neutral). Then this *Swarna pisti* kept for complete drying.

Preparation of *Rajata Garbha Pottali Kajjali (R.G.P.K)*

R.G.P.K was prepared by adding *Rajata Bhasma* 60 g, *shuddha swarna* 750mg, *Shuddha Parada* (purified mercury)12 g and *Shuddha Gandhaka* (purified sulphur) 4 g. In *Swarna Pisti gandhaka* (sulphur) was added, after triturating for 75 hours the *lakshanas* of *kajjali* obtained i.e. *Slakshnatva* (soft), *Nischandratva* (without shining), *Kajjalabha*, *Rekhapurnatha* (the powder should fill the lines in fingers) then *Rajata Bhasma* was added to this mixture and was triturated for 3 days to obtain *R.G.P.K.*

R.G.P.K Lingakara (cone shape)

Kumari Swarasa (aloevera juice) 50ml quantity was taken in *Khalva yantra* and first *Bhavana* was done. Later from 2nd to 7 th *bhavana* 30 ml of *kumara swarasa* (aloevera juice) was taken. On the 7th day of *bhavana* after attaining semisolid consistency, 4 *Pottalis* of '*Shikhararambha'* shape weighing 28, 11, 12, 16 respectively were prepared and dried. For the main study the *pottali* weighed about 28g was taken to the *Gandhaka paaka* (Sulphur bath).

Preparation of *lingakrita kajjali* for *Gandhaka paka* (Sulphur bath): Equal quantity of purified sulphur to that of dried *lingakrita kajjali* was taken and made into four parts i.e. each part contains 7g of *Gandhaka* (Sulphur). Silk cloth is spread and upon it thin layer of purified Sulphur is smeared uniformly. Another silk cloth is placed over the previous silk cloth which was smeared with purified Sulphur. Two more layers of silk cloth lay as before and sand witching is done. After this the well dried *lingakrita kajjali* was placed in the center of the top layer silk cloth. It is wrapped with silk cloth and tied with catgut thread tightly and in between iron rod is placed perpendicularly and then tied to facilitate immersion in *Ghata* (mud pot).

Placement of *Ghata* (mud pot) in *Valuka yantra*: An iron vessel of Semilunar shape with the measurement of 16 cms height and diameter of 46 cms., a *Ghata* (mud pot) – 18cm height and 15 cm diameter at the mouth, *Loha Shalaka* (iron rod) 30 cms in length was taken. At first thin layer of *Valuka* (sand) of uniform size (5 cm height) was spread evenly in iron vessel, over this *Ghata* (mud pot) was kept firmly and centrally and remaining portion of the iron vessel was filled with *Valuka* (sand) upto the neck of the mud pot.

***Pradhana karma/*Main Procedure**

***Gandhaka paka* for *lingakrita kajjali*:** The *Ghata* (mud pot) kept in the *Valuka yantra* was placed on the gas stove and *purified sulphur* filled in it. Fire was set

and temperature reading was carried out with the help of pyrometer (3-4 cms distance) for every fifteen minutes. Mild heat (120-250^{o}C) was maintained according to classical reference. *Pottali* was immersed after complete melting of sulphur. Purified sulphur was added whenever sulphur quantity is decreased below the knot tied to the *Pottali.* After the attainment of *Pottali Siddha Lakshanas* like *Gandhaka* (sulphur) turned completely into (bluishblack colour) *Vyoma Varna*, when *Pottali* banged with iron rod metallic Sound heard, and burning of silk cloth observed, *Pottali* was removed and placed in an empty pot and was allowed for self cooling

Paschat karma

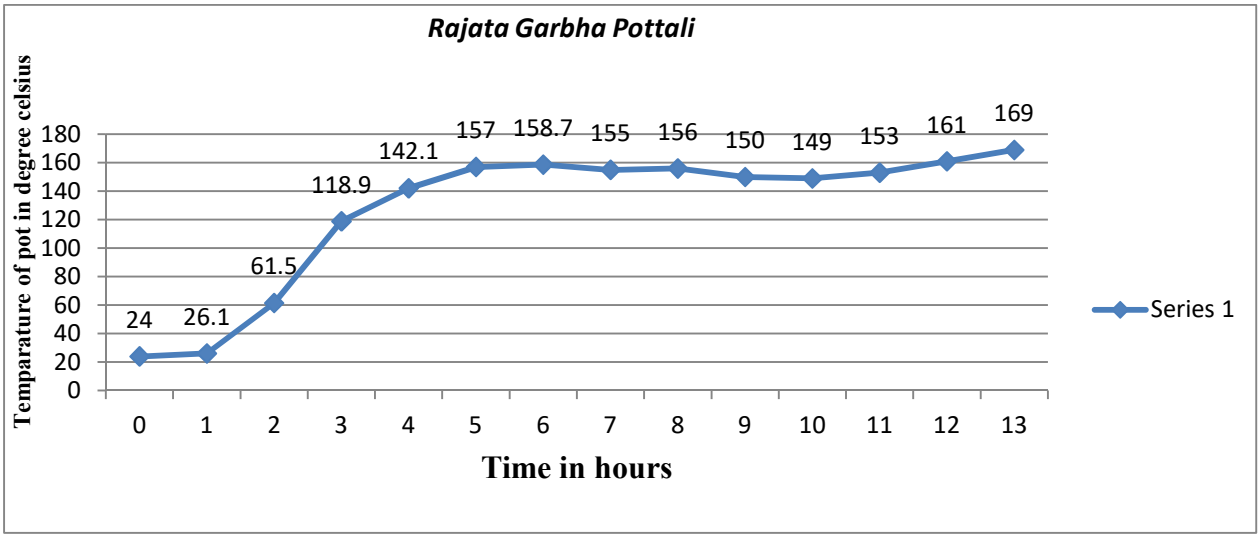
Collection of the Final product: With the help of Knife, debris which are attached to the *Pottali* like burnt silk cloth, *Gandhaka* (sulphur) etc are removed and scarped till one will get smooth surface. Then the final product was collected in an air tight container.

Observations

Table 1: Showing observations during *Paaka kala* of *R.G.P*

Time	Temperature in degree Celsius	Observation
0 hr	Sand: 23.2 Pot: 24	*Agni* was ignited, the sulphur initially 972g taken in the pot. It was light yellow in colour
1 hr	Sand: 30.5 Pot: 26.1	There were no changes observed
2 hr	Sand: 49.6 Pot: 61.5	Sulphur started to melt
2 ½ hr	Sand: 54.8 Pot: 65.3	Sulphur was melting inside and outer part of sulphur became hard. 100 g of sulphur was added to the pot
3 hr	Sand: 78.9 Pot: 118.9	250g of sulphur was added
3 ½ hr	Sand: 75.2 Pot: 120	sulphur was melted completely and the *Pottali* was immersed in molten sulphur.
4 hr	Sand: 82.3 Pot: 142.1	Light yellow colour of sulphur was observed, the scum was removed
5 hr	Sand: 76.5 Pot: 157	Orange colour of sulphur was observed
6 hr	Sand: 71.5 Pot: 158.7	Dark brown colour with reddish tinge was observed and the fumes of sulphur was well appreciated
7 hr	Sand: 82.9 Pot: 155	Colour became dark brownish
8 hr	Sand: 83.4 Pot: 150	
8 ½ hr	Sand: 82.7 Pot: 150.5	50 g of sulphur was added
9 hr	Sand: 83.4 Pot: 149	Fumes became dense
10 hr	Sand: 85.1 Pot: 153	Brownish with bluish tinge colour was seen
11 hr	Sand: 120 Pot: 161	Molten sulphur colour was changed to blackish
11 ½ hr	Sand: 126 Pot: 169	Colour was changed to blackish blue, the metallic sound heard, silk was burnt. After attaining the *Paaka lakshanas* the *Pottali* was removed from the *Paaka*

Graph 1: Showing the heating pattern during sulphur bath of *R.G.P*



Analytical method [9]

1. Determination of pH

Requirements: Glass electrode, pH meter, beakers buffer tablet

(pH- 4) Acid – 0.05H Potassium hydrogen phthalate

(pH – 8) Alkali – 0.05H Sodium tetraborate

Ta.G.P – 1 g

Method: the pH meter and electrode system were operated according to the manual instructions. The meter and electrodes were standardized with 0.05H Sodium borate while measuring an alkaline solution.

At the end of a set of measurements, take a reading of the solution used to standardizing the meter and electrodes. This reading should not differ by more than 0.02 from the original value at which the apparatus was standardized.

2. Determination of Total Ash

Requirements: Muffle furnace, Silica crucible with cover, tongs, Spatula, Desiccator, Analytical balance, Sample 1 gm

Procedure: 1gm of *Pottali choorna* was incinerated. Then the charred mass was exhausted with hot water, the residue was collected on an ashless filter paper, the residue and filter paper incinerated, the filtrate was added, and was evaporated to dryness and ignited at a temperature not exceeding 450°C. the percentage of ash was calculated with reference to the air-dried drug.

3. Determination of Acid Insoluble Ash:

Requirements: Muffle furnace, Silica crucible with cover, Tongs, Spatula, Desiccator, Analytical Balance, Sample

Procedure: The ash obtained as above was boiled for 5 minutes with 25 ml dilute hydrochloric acid, the insoluble matter was collected in a Gooch crucible, washed with hot water and ignited to a constant heat. The percentage of acid insoluble ash was calculated with reference to the air dried drug.

4. Determination of Water Soluble Ash:

Requirements: Muffle furnace, Silica crucible with cover, Tongs, Spatula, Deciccator, Analytical balance, Sample

Procedure: The ash obtained as above was boiled for 5 mins. with 25 ml of water, insoluble matter was collected in a Gooch crucible, washed with hot water and ignited for 15 mins. at a temperature not exceeding 450°C. Subtract the weight of the insoluble matter from the weight of the ash; the difference in the weight represents the water soluble ash. The percentage of water soluble ash was calculated with reference to the air dried drug.

5. Loss on Drying at 110°C:

Requirements: Silica crucible, Electronic weighing machine, Electronic air oven, Sample

Procedure: 1 gm of sample was taken in a silica crucible and accurately weighed, heated on electric hot air oven up to 110°C for 3 hrs. Again weighed the difference and weight was calculated.

6. Estimation of Sulphur

Requirements: Timbli, Distillation apparatus, Sochlet, Porcelin, water bath, weighing machine

Procedure: the sample was weighed 1 g and taken in timbli and carbon disulfide was taken in conical flask, it was kept in sochlet connected to apparatus and heat was given. The temperature was maintained to 25°C for 1 hour. the carbon disulfide evaporates and again by the water circulating system present around the tube it becomes liquid and collected in same conical flask. There were 6 cycles are done in one hour to extract all sulphur present in the sample. After one hour it was allowed to cool. After cooling the collected liquid was taken in porcelain and kept for water bath and allowed for complete evaporation of water present in it. The remaining residue which left gives the approximate value of Sulphur present in the sample.

INSTRUMENTAL ANALYSIS

1. X-Ray Diffraction Study:

Method: Different methods available for x-ray diffraction are Lane photographic method, Bragg X-Ray spectrometer method, Rotating crystal method, and powder method. In the present study, powder method of diffraction has been adopted.

Sample preparation: The samples are ground to a fine, homogenous powder then placed in sample holder or the specimen may be mixed with a suitable non-crystalline binder and moulded into a suitable shape.

As a result large number of small crystallites is oriented in all possible directions and when x-ray beam traverses the material a significant number of particles are expected to be oriented in such a manner that Bragg's a equation for reflection from every possible inter planar spacing becomes satisfied.

2. Scanning Electron Microscopy (EDX) Study:

Materials:-

- Scanning Electronic Microscope (SEM) with EDX detectors which collects and analyze the fluorescent x-rays from the sample along with the beam source, the pulse processor and the analyzer.

Method:-A pinch of each powder was placed on the carbon tapes over the sample base. They were frost introduced into sputtering chamber for gold ions sputter for electrical conductivity. Then the base was placed inside the sample chamber and bombardment of X rays was done. The images found in display were taken for each sample. In one image three different areas were selected and mass percentage of elements present in each area, along with the particle size, were analyzed and mean of the percentage of these two values were taken out as Total % of the respective element present in the sample for accuracy of the values.

3. FTIR- Fouier Transmission Infrared Spectroscopy

Method: FTIR stands for Fourier Transform Infrared, the preferred method of infrared spectroscopy. Infrared spectroscopy, IR radiation is passed through a sample. Some of the infrared radiation absorbed by the sample and some of it is passed through. The resulting spectrum represents the molecular absorption and transmission, creating a molecular finger prints of the sample. Like a fingerprint no two unique molecular structures produce the same infrared spectrum. This makes infrared spectroscopy useful for several types of analysis.

RESULTS

Pharmaceutical results

Table 2: Showing the results of *Samanya shodhana* of *Rajata*

Raw Rajata Taken	206 g
After shodhana	206 g
Loss/Gain	0
% of yield	100%

Table 3: Showing the Result of *Vishesha Shodhana* of *Rajata*

Samanya Shodita Rajata	206 g
After *Shodhana*	206 g
Loss/Gain	0
% of yield	100%

Table 4: Showing the results of *Hingula shodhana*

Raw *Hingula* (cinnabar)	2050 g
Hingula obtained after *shodhana*	2057 g
Loss/Gain	7 g
% of yield	100.34%
Niramleekarana of *Hingula*	2057 g
After *Niramleekarana*	2044 g
Loss/Gain	13 g
% of yield	99.36%

Table 5: Showing the results of *Rajata Bhasma Nirmana*

Vishesha Shodita Rajata taken in *Choorna* form	75 g
Rajata Bhasma obtained	62.20 g
Loss/Gain	12.8
% of yield	82.93%

Table 6: Showing the results of *Parada obtained*

Shoditha Hingula (cinnabar)	1521 g
Parada (mercury) obtained	1058.58 g
Loss/Gain	462.42 g
% of yield	69.59%

Table 7: Showing the results of *Gandhaka shodhana*

Raw *Gandhaka* taken	4200 g
Shodhita Gandhaka (sulphur)	3935 g
Loss/Gain	265 g
% of yield	93.69%

Table 8: Showing the result of *Swarna pisti*

Shuddha swarna + shuddha Parada	12.750 g
After *Pisti* formation	12.750 g
Loss/Gain	0
% of yield	100%

Table 9: Showing the result of *R.G.P.K*

Swarna pisti + Gandhaka	16.75 g
Kajjali nirmana	10.64 g
Loss/Gain	6.10 g
% of yield	63.52%

Table 10: Showing the observation of Pottali after Gandhaka paaka

Character	**Observation**
Initial weight of *R.G.P* before *paka*	28.516 g
Weight of *R.G.P* after *paka*	30.367 g
Gain in weight after *paka*	1.851 g
% of yield	106.49%
Amount of *Shuddha Gandhaka* taken initially	972 g
Gandhaka (sulphur) added during *paka*	400 g
Total sulphur required for *paka*	1372 g
Total duration of heat given	For melting of sulphur it took 3 and ½ hours. After melting the pottali is placed in sulphur bath and it took 8 hours to get metallic sound of pottali and bluish black color of sulphur. So for complete procedure the time taken was 11 and ½ hours.

Analytical results

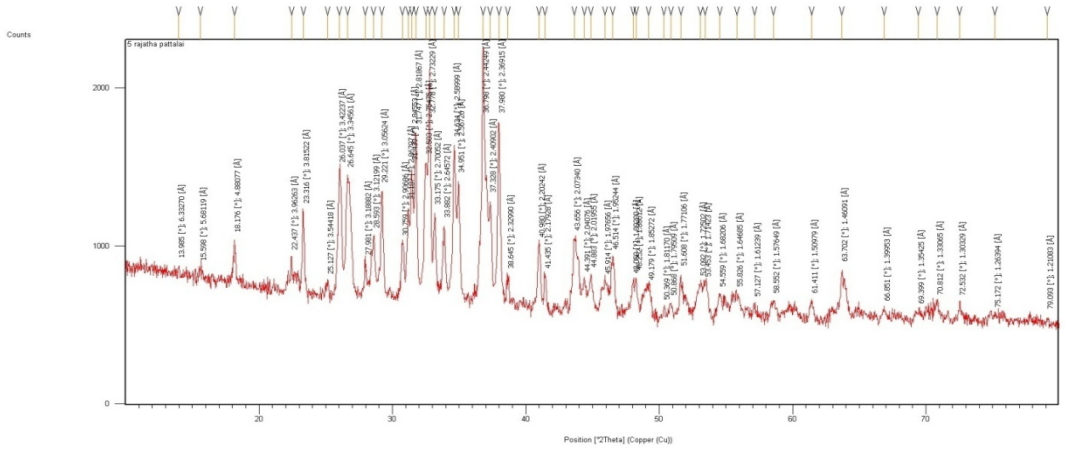
Table 11: Showing Classical Parameters for analysis of *R.G.P.*

Test	**Observation**
Color (Varna)	Dark grayish black
Taste (Rasa)	Tasteless
Touch (Sparsha)	*Mrudu* (smooth)
Smell (Gandha)	Burnt sulphur odour
Shape	*Lingakara*

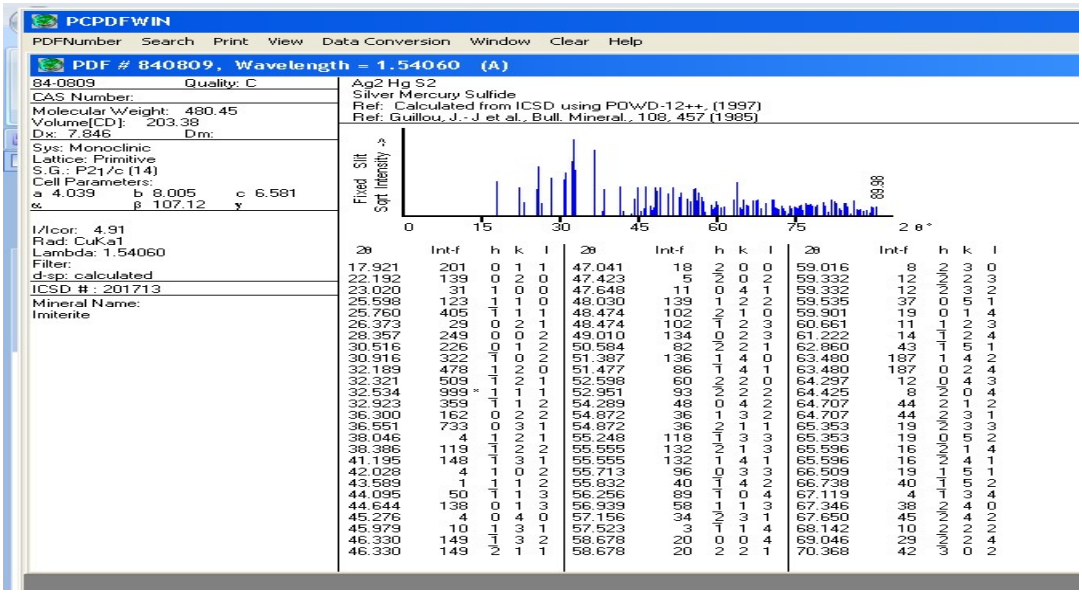
Table 12: Showing the result of Physico chemical analysis of *R.G.P*

pH	4.9
Total Ash value	80.05%
Acid insoluble ash	21.47%
Water soluble ash	5.9%
Loss on drying at 110°C	0.39%
Estimation of Sulphur	12.40%

Graph 2: Showing the XRD of *Rajata Garbha Pottali*



Graph 3: Showing the standard values taken for XRD of R.G.P



2θ	Int-f	h	k	l	2θ	Int-f	h	k	l	2θ	Int-f	h	k	l
17.921	201	0	1	1	47.041	18	2	0	0	59.016	8	2	3	0
22.192	139	0	2	0	47.423	5	2	0	2	59.332	12	2	2	3
23.020	31	1	0	0	47.648	11	0	4	1	59.332	12	2	3	2
25.598	123	1	1	0	48.030	139	1	2	2	59.535	37	0	5	1
25.760	405	1	1	1	48.474	102	2	1	0	59.901	19	0	1	4
26.373	29	0	2	1	48.474	102	1	2	3	60.661	11	1	2	3
28.357	249	0	0	2	49.010	134	0	2	3	61.222	14	1	2	4
30.516	226	0	1	2	50.584	82	2	2	1	62.860	43	1	5	1
30.916	322	1	0	2	51.387	136	1	4	0	63.480	187	1	4	2
32.189	478	1	2	0	51.477	86	1	4	1	63.480	187	0	2	4
32.321	509	1	2	1	52.598	60	2	2	0	64.297	12	0	4	3
32.534	999	1	1	1	52.951	93	2	2	2	64.425	8	2	0	4
32.923	359	1	1	2	54.289	48	0	4	2	64.707	44	2	1	2
36.300	162	0	2	2	54.872	36	1	3	2	64.707	44	2	3	1
36.551	733	0	3	1	54.872	36	2	1	1	65.353	19	2	3	3
38.046	4	1	2	1	55.248	118	1	3	3	65.353	19	0	5	2
38.386	119	1	2	2	55.555	132	2	1	3	65.596	16	2	1	4
41.195	148	1	3	1	55.555	132	1	4	1	65.596	16	2	4	1
42.028	4	1	0	2	55.713	96	0	3	3	66.509	19	1	5	1
43.589	1	1	1	2	55.832	40	1	4	2	66.738	40	1	5	2
44.095	50	1	1	3	56.256	89	1	0	4	67.119	4	1	3	4
44.644	138	0	1	3	56.939	58	1	1	3	67.346	38	2	4	0
45.276	4	0	4	0	57.156	34	2	3	1	67.650	45	2	4	2
45.979	10	1	3	1	57.523	3	1	1	4	68.142	10	2	2	2
46.330	149	1	3	2	58.678	20	0	0	4	69.046	29	2	2	4
46.330	149	2	1	1	58.678	20	2	2	1	70.368	42	3	0	2

PDF # 840809
Standard: Ag2HgS2 Silver Mercury Sulfide
Crystal system: Monoclinic

Table13: Showing the EDX result of *R.G.P*

Element	Wt%	At%
S	14.12	19.02
Hg	22.23	4.80
Ag	44.08	17.69
O	5.06	13.69
C	12.28	44.26
Au	2.23	0.49

Particle size estimation

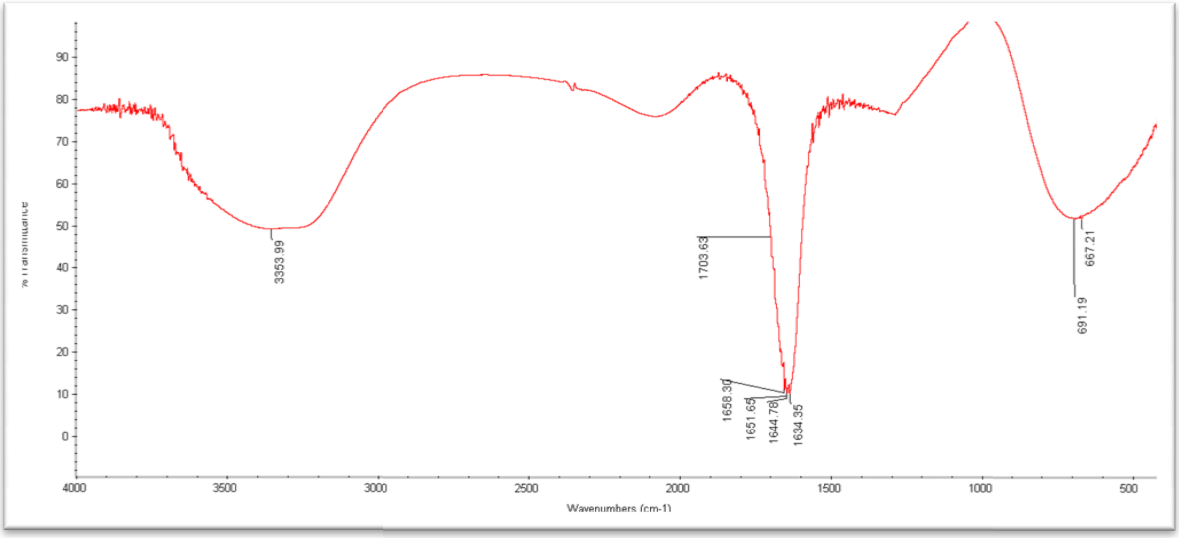
Particle size of *R.G.P:*

Smallest particle identified in given areas: 297.2 nm
Largest particle identified in given areas: 992.2 nm
All particles were found to be in nanoparticle range
Mean particle size: 644.7 nm

Table 14: Showing the result of FTIR for sample *R.G .P*

Absorption	Appearance	Group	Compound
3400-3300	Medium	N-H stretching	Alphatic primary and secondary amines
1710-1680	Strong	C=O stretching	Carboxylic acid, conjugated aldehyde
1662-1626	Medium	C=C stretching	Alkene
1671	Strong	C=C	Alkene

Graph 4: showing the curve peaks of FTIR



DISCUSSION

Silver is said to be a *Shudda Loha* and also a *Sara loha*. This indicates that silver is a noble metal, available in pure form.

During quenching process redox reaction is that chemical reaction in which oxidation and reduction take place simultaneously. Silver reacts with atmospheric oxygen at red hot state. The surface area of *Rajata patras* (silver foils) when exposed to oxygen might convert into oxide form. This oxidation reaction continues in all 6 Medias for 7 times in each media. Thus it may help to convert portion of *Rajata patras* (silver foils) into oxide form.

Marana (incineration) is procedure adopted to convert the heterogeneous material into homogeneous substance and converting into nano particles. During incineration, final change in the physical form of the material takes place. Heating during incineration causes linear expansion of both the metals and the compound from the metal, causing exposure of the metallic part, facilitates further change. Repetition of this process leads to reduction in particle size and fineness of the particles. Silver is having greater affinity towards Sulphur, when comes in contact with Sulphur, tarnishing effect is observed. This is the reason for *Krishna varna* of *Rajata bhasma*.

The chief constituent's aloe resis B with its P- coumaryl derivatives aleoresin A and C and the aglycone aloesone. Because of these resinous constituents bind the ingredients of *R.G.P kajjali* firmly and gives shape and compactness.

During the sulphur bath the mild heat was maintained throughout the procedure. Initially during melting of the sulphur there were dense fumes was produced. After complete melting of sulphur the pottali was immersed completely in sulphur bath. After observing the metallic sound and bluish black colour of the sulphur the pottali was removed and weighed. There was gain in weight about1.81g.

R.G.P has acid insoluble ash of 21.41%. Less insoluble ash indicates more bioavailability of the drug.

The total ash of *R.G.P* is 80.05%. It indicates the total amount of inorganic material remaining after ignition.

This includes both the ash samples ignited and physiological ash which is derived from plant tissue. The loss might be due to the emission of moisture or volatile content at 600°C employed in this procedure.

The least loss on drying at 110°C the better will be the drug. In the present study *R.G.P* possessed have least amount of moisture content and very rare chance of bacterial and fungal growth.

Phase analysis of *R.G.P.K* and *R.G.P* were done to clear out the structure and chemical composition of the samples. XRD result of *R.G.P.K* showed Silver sulfide compound and monoclinic crystal system. *R.G.P* showed Silver Mercury Sulfide compound and monoclinic crystal system. All the values of *R.G.P.K* and *R.G.P* were matched with the standard values of Silver sulfide and silver mercury sulfide respectively.

EDX reveals the accurate elemental analysis of the sample. The *R.G.P.K* contains S- 16.94%, Hg – 32.80%, Ag – 27.06%, Au- 2.81% and *R.G.P* contains S-14.12%, Hg- 22.23%, 44.08%, Au – 2.23%.

Particle size is one of the factors which will affect dissolution, absorption of drug and bioavailability. Smaller the drug particle size larger the surface area, leads to faster dissolution. The mean particle size of *R.G.P.K* and *R.G.P* is 712.1 nm and 644.7 nm respectively. *Pottali kalpana* should be rubbed on to the stone and then administered so the particle size will be further reduced leading to better bioavailability of the drug.

FTIR analysis of *R.G.P* reveals the presence of many functional groups which affirms the entity of herbal compounds used for the whole procedure. The range FTIR analysis of *R.G.P* shows that it contains organic compounds with functional groups like Alkenes, Alkanes, Aromatics Carboxylic acids Substitution Overtones and Primary and secondary amines. Chemically *Rajata Garbha Pottali* can be considered as organo-metallic compound of Ag, Hg, S and Au with the presence of organic functional groups like like Alkenes, Alkanes, Aromatics Carboxylic acids Substitution Overtones and Primary and secondary amines.

CONCLUSION

Pottali rasayana is one of the unique preparations because of its sustained heat pattern and the media used as sulphur. *Rajata Garbha Pottali* is a *Sagandha, Sagni, Gandhakajarita, Kajjalibhanda Pottali kalpana* containing *Rajata Bhasma, purified gold coin, Shuddha Parada(*mercury) *and Shuddha Gandhaka* (sulphur) processed with *Mridvagni (mild heat)*. As it is explained by *Pandith Hariprapannaji* in *Rasa yoga Sagara* along with other *Pottali kalpana*.

Mild heat (120-250^{o}C) was maintained for 11 and half hours which play an important role for proper preparation of R.G.P. Dark Greyish Black coloured product was obtained, and the average yield of *R.G.P* was 106% after *Pottali paka*. It was round conical shape, state grey in colour. The formation of complex compound between *Rajata* (silver), *Parada* (mercury), *Swarna* (gold) and Sulphur the chemical reaction taken place resulting into change in their allotropic form and recrystallization.

Particle size is one of the factors which will affect dissolution, absorption of drug and bioavailability. Smaller the drug particle size larger the surface area, leads to faster dissolution. The mean particle size of R.G.P is 644.7 nm. Pottali kalpana should be rubbed on to the stone and then administered so the particle size will be further reduced leading to better bioavailability of the drug.Chemically *Rajata Garbha Pottali* can be considered as organo- metallic compound of Ag, Hg, S and Au with the presence of organic functional groups like like Alkenes, Alkanes, Aromatics Carboxylic acids Substitution Overtones and Primary and secondary amines.

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