PHARMACEUTICAL STANDARDIZATION OF RAJATA YOGA

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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 values. Minerals and metals are mostly used in the form of Bhasma. There is no specific Anupana mentioned for Rajata, it depends upon Dosha and disease. Rajata bhasma when given with proper Anupana is indicated in all types of diseases. Rajata Yoga is one such formulation mentioned in Rasa Tarangini, indicated in Prameha. Rajata bhasma, Twak churna, Ela churna and Patra churna are the main ingredients. The present study has been planned to standardize the method of preparation of a Herbo-mineral formulation i.e., Rajata Yoga. Samanya Shodhana and Visesha Shodhana procedures were adopted for Rajata patra (50g). After Visesha Shodhana, 48g of obtained coarse Rajata patra were subjected to Marana with equal quantity of Kajjali (48g) and sufficient quantity of Kumari Swarasa as Bhavana dravya. Totally 25 Putas were given to attain Rajata bhasma (90g) which passed all Bhasma lakshanas as mentioned in our classics. Rajata bhasma (45g) was mixed with Trijataka churna (Twak churna-300g; Ela churna -300g and Patra churna – 300g) to form homogenous 945g of Rajata Yoga. Thus it can be concluded that ‘Supaka’ i.e. neither less nor more heat is desirable and is essential for making a drug safe and efficacious.

KEYWORDS: Rajata Yoga, Rasa Tarangini, Standardization, Prameha.

INTRODUCTION
Many 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 etc. After recognition of their therapeutic properties, various processing techniques were developed in order to make them suitable for human body and for the treatment of various ailments. Different manufacturing processes like Shodhana, Marana, Jarana, Mardana (trituration), Bhavana (soaking with liquid and triturating till drying), Nirvapanana (heating and quenching), Prakshalana (washing), Bharjana (frying), Pruthakkikarana (separation), Galana (filtration) etc, are adopted for this processing. All these procedures play a significant and vital role in converting these metals & minerals into safe, non-toxic and efficacious form. Prameha as a disease itself is having a peculiar type of Samprapti. A great deal of work has also been done by Ayurvedic research scholars on various herbal and mineral drugs to find an effective treatment for Prameha. So to fulfill the expectations from Ayurvedic Rasa Shastra field and to find out more effective and safe therapy for Prameha, the formulation ‘Rajata Yoga’ was selected for present work. Rajata Yoga is mentioned in Rajata Vignaniyam adhyaya 71st slokha pp.367 in Rasa Tarangini.

AIM OF THE PRESENT STUDY:
• Pharmaceutical Standardization of various steps involved in the preparation of Rajata Yoga.

MATERIAL AND METHODS:

Table 1: Total Pharmaceutical study was carried out in five stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage II</td>
<td>Kajjali Nirmana with Shodita Parada and Shodita Gandhaka.(R.R.S 8/52)</td>
</tr>
<tr>
<td>Stage III</td>
<td>Marana of Visesha Shodita Rajata Patra. (R.T 26-28/16)</td>
</tr>
<tr>
<td>Stage IV</td>
<td>Twak, Ela and Patra churna nirmana. (Sh.M.Kh 6/12)</td>
</tr>
<tr>
<td>Stage V</td>
<td>Preparation of Rajata Yoga by mixing of fine churnas of Twak, Ela and Patra with Rajata bhasma in a Khahwa yantra thoroughly until homogenous mixture is obtained. (R.T 71/16)</td>
</tr>
</tbody>
</table>


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**Rajata Yoga preparation**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Rasa Tarangini – Rajata Vigniyanam 71/16.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Materials</strong></td>
<td>Rajata bhasma~ 45g, Trijataka churna ~ 900g</td>
</tr>
<tr>
<td><strong>Method/Principle</strong></td>
<td>Shodhana, Marana and Churna nirmana</td>
</tr>
<tr>
<td><strong>Apparatus</strong></td>
<td>Gas Stove, Iron ladle, Steel vessel, KHALWA Yantra, Knife, cloth, Multani mitti, measuring jar, wide mouthed earthen pot, cow dung cakes, spoon, Sharava, sieve.</td>
</tr>
</tbody>
</table>

**Procedure**

- **Samanya Shodhana of Rajata Patra** was carried out by heating the Rajata Patra to red hot and quenching them subsequently into Tila Taila, Takra, Gomutra, Kanji and Kulattha Kwatha for seven times in each. After every Nirvapa, the liquid medium was changed.
- **Visesha Shodhana** was carried out by placing the Samanya Shodhana Rajata patra in an iron ladle and heating to red hot and then dipping them in a vessel containing Agastya patra Swarasa. This process was repeated for 2 more times by taking fresh Agastya patra swarasa each time.
- **Parada** was mixed with equal quantity of Sarja kshara, Yava kshara and Tanka and Mardana was carried out by addition of sufficient quantity of Ardhaka swarasa and Nagavalli swarasa for 3 days. After triturating for three days, the mixture was washed with hot water to obtain Shudha Parada.
- **Shodhana of Gandhaka** was done by pounding it in a KHALWA Yantra to form coarse powder. Cow’s milk was poured in the wide mouthed earthen pot.
- The mouth of pot was covered with double layered cotton cloth and Gandhaka was spread evenly over it. Earthen lid was placed over the pot and sealed with Fuller’s Earth. The pot was buried up to the neck level in a pit and 8 Cow dung cakes were arranged above it.
- After ignition of Cow dung cakes, Gandhaka melted and dropped into milk through the cloth. After self-cooling, the apparatus was removed out of the pot and opened. Purified Gandhaka was collected at bottom of the pot in form of small pellets and washed in hot water and dried.
- **Equal quantity of Shudha Parada** and Shudha Gandhaka were taken in a KHALWA Yantra and triturated till Siddha Lakshanas of Kajjali are attained.
- **Marana** of Visesha Shodhita Rajata Patras was done by triturating Visesha shodhita Rajata patra in a KHALWA yantra with equal quantity of Kajjali and sufficient quantity of Kumari Swarasa as bhavana dravya.
- **Chakrikas** of uniform size were prepared and dried well. They were kept in Sharava and subjected to Sandhibandhana. Sharavasamputa was kept in sunlight for drying.
- After drying it was subjected to Laghu Puta (8 upalas). Whole procedure was repeated until it attains Bhasma lakshanas. Totally 25 Putas were given during the whole procedure to attain Rajata bhasma.
- Dried Twak, Ela and Patra were thoroughly checked for any external impurities, worms and insects. Later they were taken in KHALWA yantra and pounded separately. The pounded material was sieved through a cloth to obtain very fine powder.
- **Trijataka churna** was prepared by taking equal quantities of Twak, Ela and Patra churnas in a KHALWA yantra and mixing well to form a homogenous mixture.
- **Trijataka churna** (900g) & Rajata Bhasma (45g) were taken in KHALWA Yantra mixed properly to form a homogenous mixture (Rajata Yoga).

**Observations**

1. During Samanya shodhana, the metallic glaze was decreased in Rajata patra. Rajata Patra looked dull white and became brittle after Samanya Shodhana.
2. During Visesha Shodhana in Agastya patra swarasa, hissing sound was noticed and Patra became soft and fragile after Visesha Shodhana.
3. During Shodhana of Parada, 25ml each of Ardrika and Nagavalli swarasa were consumed on first day, whereas on the second and third day 50 ml each of Nagavalli and Ardrika swarasa were consumed.
4. Initially the mixture was creamy white in colour, later it turned to dark green colour.
5. By the end of first day, Parada was completely mixed with the Sarja kshara, Yava kshara and Tanka and the mixture turned into paste. After Shodhana, shining of Parada increased.
6. After Shodhana colour of Gandhaka turned to bright yellow. Gandhaka was collected as fine pellets.
7. In Kajjali Nirmana, mixture turned black after three hours of Mardana. After 15 hours Kajjali was checked for shine under the sun and small globules of mercury could be clearly observed. It took 42 hours for complete loss of shine and other characters of Kajjali to develop.
8. In Rajata marana, Nischandratva (lusterless) of Rajata bhasma was attained after whole process.
9. Laghutva (lightness) and Mrudutwa for Rajata bhasma were attained after whole the process. Varitaratva attained partially after 12th Puta and completely after 23rd Puta.
10. Rekhatpurnatwa was attained after 8th Puta. Maximum temperature (514˚C) was attained after 30 minutes.

**Precautions**

- The quantity of Dravadravyas taken for each Nirvapa should be sufficient to immerse the Rajata patra completely. Heating should be intense so as to make the Rajata patra red hot. In each quenching the Dravadravya should be changed.
- During Shodhana of Parada, triturating should be done with utmost care to prevent spillage. Washing should be done carefully to avoid loss of Parada.
During the Shodhana of Gandhaka, temperature should be maintained around the melting point of Gandhaka.

Milk level in vessel should be sufficient to accommodate sedimentation of Gandhaka.

Gandhaka pellets should be washed properly with warm water and dried.

In Kajjali nirmana, Mardana should be done carefully to avoid spilling.

During Marana of Rajata, Sandhi bandhana should be done properly. Temperature should be noted at regular intervals. Sharava should be kept at the centre of the pit.

Result

**Table 1: Showing the changes in weight of various practical’s in the preparation of Rajata Yoga**

<table>
<thead>
<tr>
<th>Name of the practical</th>
<th>Initial weight (g)</th>
<th>Final weight (g)</th>
<th>Loss in weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rajata Shodhana</td>
<td>50</td>
<td>48</td>
<td>2</td>
</tr>
<tr>
<td>Parada Shodhana</td>
<td>250</td>
<td>223</td>
<td>27</td>
</tr>
<tr>
<td>Gandhaka Shodhana</td>
<td>250</td>
<td>240</td>
<td>10</td>
</tr>
<tr>
<td>Kajjali Nirmana</td>
<td>400</td>
<td>390</td>
<td>10</td>
</tr>
<tr>
<td>Twak churna Nirmana</td>
<td>1000</td>
<td>980</td>
<td>20</td>
</tr>
<tr>
<td>Ela Churna Nirmana</td>
<td>1000</td>
<td>900</td>
<td>100</td>
</tr>
<tr>
<td>Patra churna Nirmana</td>
<td>1000</td>
<td>980</td>
<td>20</td>
</tr>
<tr>
<td>Rajata Yoga Nirmana</td>
<td>Trijataka- 900g, Rajata bhasma-45g</td>
<td>945</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 2: Showing the Heating pattern of Laghu Puta**

<table>
<thead>
<tr>
<th>Time (in minutes)</th>
<th>Temperature (in Degrees Celsius)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>36</td>
</tr>
<tr>
<td>10</td>
<td>119</td>
</tr>
<tr>
<td>20</td>
<td>240</td>
</tr>
<tr>
<td>30</td>
<td>514</td>
</tr>
<tr>
<td>40</td>
<td>442</td>
</tr>
<tr>
<td>50</td>
<td>270</td>
</tr>
<tr>
<td>60</td>
<td>180</td>
</tr>
<tr>
<td>70</td>
<td>136</td>
</tr>
<tr>
<td>80</td>
<td>86</td>
</tr>
<tr>
<td>90</td>
<td>54</td>
</tr>
<tr>
<td>110</td>
<td>44</td>
</tr>
<tr>
<td>120</td>
<td>36</td>
</tr>
</tbody>
</table>

**Table 3: Showing change in weight of Rajata with respect to Puta**

<table>
<thead>
<tr>
<th>Puta No.</th>
<th>Weight of Chakrikas (g)</th>
<th>Weight Loss (g)</th>
<th>Loss %</th>
</tr>
</thead>
<tbody>
<tr>
<td>After Bhavana</td>
<td>After Puta</td>
<td>1</td>
<td>96</td>
</tr>
<tr>
<td>5</td>
<td>132</td>
<td>130</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>162</td>
<td>156</td>
<td>6</td>
</tr>
<tr>
<td>15</td>
<td>128</td>
<td>115</td>
<td>13</td>
</tr>
<tr>
<td>20</td>
<td>118</td>
<td>106</td>
<td>12</td>
</tr>
<tr>
<td>25</td>
<td>98</td>
<td>90</td>
<td>8</td>
</tr>
</tbody>
</table>

**Table 4: Showing Varitaratva**

<table>
<thead>
<tr>
<th>Puta No.</th>
<th>Varitaratva</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>+</td>
</tr>
<tr>
<td>15</td>
<td>++</td>
</tr>
<tr>
<td>18</td>
<td>+++</td>
</tr>
<tr>
<td>23</td>
<td>++++</td>
</tr>
</tbody>
</table>

**Table 5: Showing Rekhapurnatwa**

<table>
<thead>
<tr>
<th>Puta</th>
<th>Rekhapurnatwa</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>++</td>
</tr>
<tr>
<td>5</td>
<td>+++</td>
</tr>
<tr>
<td>8</td>
<td>++++</td>
</tr>
</tbody>
</table>
The pharmaceutical procedures adopted in this study are Shodhana, Marana and Churna nirmana. Shodhana is done for Rajata, Parada and Gandhaka. Shodhana is done to convert materials into suitable form for further procedures, to remove visible & invisible impurities, to reduce the toxicity and to enhance the therapeutic properties\cite{1}. Marana of Rajata was done with Sama guna gandhaka kajjali and Kumari swarasa (Bhavana dravya) to make it adaptable, absorbable and assimilable in body. Churna Nirmana is done for Twak, Ela and Patra.

**Parada Shodhana**
- Substances having Ushna, Tikshna, Kshara, Amla and Lavana property are considered as purifiers (Sarva malaharah Kshara).\cite{2} Kshara is an alkaline substance; it may be helpful in removing external and internal impurities of Mercury.
- Kshara traya includes Sarja Kshara, Yava Kshara and Tanka.\cite{3}
- Because of alkalinity, these substances help in the corrosion of unwanted material from the Dravya.
- Nagavalli possess Kshara guna by which it might be helpful in minimizing the toxic qualities of Mercury.\cite{4}
- Swarasa of Ardraka is used in the Swedana Sansksara of Parada by which it can be said that it may be useful in the “Mala Saithilya Karana” of Parada.\cite{5}

**Gandhaka Shodhana**
- Gandhaka Shodhana includes melting and dropping of Gandhaka.
- Sulphur turns into liquid at 115.21°C. However, at that temperature, arsenic sulphides (Orpiment M.P 310°C, Realgar M.P 360°C) which are the chief impurities of Sulphur stay back in cloth and liquid sulphur flows freely through fine pores.
- Agni by cow dung cakes ensures uniform spreading of temperature and prevents Sulphur to get in contact with external oxygen, which otherwise causes oxidation and considerable weight loss.
- Gandhaka is highly Pitta vardhaka. Milk is Vata Pitta shamaka Dravya, Vishahara and Rasayana\cite{6}. It can remove Visha doshas of Gandhaka and enhance Rasayana property of Gandhaka. Final cleaning with hot water removes greasy remnants of milk.

**Kajjali**
- Kajjali was checked for loss of shine at various stages of preparation and Mardana was done until it turned lusterless.

**Rajata Samanya Shodhana**
- According to Rasa Tarangini, Ashudha Rajata Bhasma when taken internally causes Vidbandha, Angasadha, Virya nasha and Shakti nasha.\cite{7}
- Shodhana procedure makes Rajata free from fat soluble and water soluble impurities and makes it suitable for next procedure i.e. Marana.
- Repeated heating and quenching in specific media in specific order (pH: acidic, acidic, basic, acidic and basic) disrupts the compression tension equilibrium in the internal structure of Rajata which leads to cracks on its surface (Griffith theory, Stress corrosion theory and Theory of thermal expansion).\cite{8}
- Rajata patra were cut into small pieces to facilitate more surface area to get exposed to the heat and liquids.

**Vishesha Shodhana of Rajata**
- Agastya patra Swarasa was taken as a liquid media for Nirvapa in Vishesha Shodhana process.
- It was found that the Sesbania grandiflora leaves extracts contain flavonoids, saponins, tannins, diterpenes, triterpenoids, glycosides and phenols. The presence of these biologically active constituents shows the antidiabetic and anti oxidant properties in a study conducted in STZ induced experimental Diabetic rats.\cite{9}
- Nirvapa in Agastya Patra swarasa may enhance the Pramehagna property in Rajata patras.
Rajata Marana
- Metallic drugs should always be reduced to Bhasma form for internal use. Main aim of Marana is to make Rajata react with Rajata and reduce it to Bhasma form.
- Marana makes Shodhita dravyas adaptable, absorbable and assimilable for the body. During this procedure, various physico-chemical changes take place gradually and after repeated processing metals change into such forms that are suitable for internal administration.\[10\]
- After Visesha Shodhana, Rajata Patras became more brittle. After completion of first 2 incinerations, Rajata Patras became coarse powder which later easily mixed with Rajaji while doing Bhavana with Kumari swarasa to form Chakrikas.

Role of Kumari swarasa bhavana
- Wet trituration facilitates particle size reduction and homogenization leading to modification of properties (Gunantatradhana) of the end product. Bhavana helps in increasing the therapeutic efficacy by converting the Bhavya dravyas into smaller particles and adding the trace elements in Bhasma and converting a metal into a Herbo-metallic compound\[11\].
- Kumari is having Tikta Rasa, Katu Vipaka and Kapha-Vatahara properties. It is also having properties like Bhedana, Chakshushya, Rasayana and Vrushya.\[12\] By virtue of its Guna, it helps in enhancing the Pramehagna property of Rajata bhasma.
- Aloe Vera can increase insulin sensitivity in the cells which reduce the level of blood glucose and Insulin in serum.\[13\]
- After attaining Subhavita lakshanas, Chakrikas were prepared of uniform size and shape to facilitate uniform distribution of heat during the Putapaka. These Chakrikas were dried properly, subjected to Sharava samputikarana, and then subjected to Laghu puta.
- Puta is the heating system and heating schedule which indicates the quantum of heat required by the Rasadi dravyas for their conversion into suitable form (Bhasma).
- Neither less nor excess heat is desired i.e. the desired quantum of heat is needed to be applied for making it converted to desired form suitable for internal use\[14\].
- According to classics Agni mentioned for Marana of Rajata is Kukkuta Puta\[15\]. But in the present study Laghu Puta has been selected for preparation of Rajata Bhasma.
- The maximum temperature recorded during Puta was 514^\circ C and it was maintained for a period of 3-4 minutes. After that, gradual fall in temperature was noted.
- The material turned to soft powder without any lustre after complete process, which indicates that the temperature was sufficient for the formation of the desired compound.
- Most of the reactions that happen between metals and Sulphur are Redox type. Redox is a kind of reaction in which electrons are transferred, thereby oxidizing some atoms, and reducing others\[16\].
- Sulphur readily reacts with metals (by reducing) because of its valency i.e. 2 and tends to gain electrons and becomes S-2. Metals oxidize by sharing its electrons of outer orbits. Rapidity of these reactions depends upon temperature and pressure. If metals are allowed to react with Sulphur in open air most of the sulphur reacts with atmospheric oxygen to form oxides.
- Blackish red colour of Rajata Bhasma may be due to presence of Cinnabar (HgS) & Silver Sulphide (Ag,S). Since sulphur is an accompaniment to the metal in the Bhasma preparation, Rajata is converted to its sulphide form in major. Some part of Rajaji on subjecting to repeated Puta converts into Cinnabar (Mercuric Sulphide).
- So as a whole, Rajata Bhasma is the combination of sulphides of Silver and Mercury which gives Blackish red colour to it.
- Nischandratwa, Varitaratwa and Rekhapurnatwa for Rajata Bhasma were checked after every Puta. Rajata Marana was done till all the Bhasma lakshanas were obtained.
- Nischandratwa, Laghutwa and Mrudutwa was obtained after whole process, Rekhapurnatwa was obtained after 8th Puta, Varitaratwa was obtained after 23rd Puta.

CONCLUSION
- Rajata Yoga is one of the Kharaliya Rasayana in which Rajata bhasma, Twok, Ela and Putra churnas are the main ingredients.
- The combination of all these drugs synergistically acts together to pacify the symptoms of Prameha as all are having the Pramehagna property.
- Pharmaceutical standardization is the first step towards standardization of any drug. So it should be done with utmost accuracy. This leads to reproducibility of drug and production of safe and efficacious drug.

REFERENCES

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IMAGES SHOWING THE PREPARATION OF RAJATA YOGA

PARADA SHODHANA

Ashudha Parada  Addition of Ksharatraya to Parada  Mardana with Nagavalli & Ardraka swarasa  Shudha Parada

GANDHAKA SHODHANA

Ashudha Gandhaka  Gandhaka is placed over cloth tied to the pot  Pot is sealed with Sharava

Ignited cow dung cakes over the Sharava  Shodhita Gandhaka

KAJJALI NIRMANA

Mardana of Parada with Samaguna Gandhaka  Kajjali

Available online at: http://ijapr.in
SAMANYA & VIHESA SHODHANA OF RAJATA PATRA

Small pieces of Rajata patra taken in iron ladle

Rajata Patra heated to red hot

Tila Taila

Takra

Gomutra

Kanji

Kulattha kwatha

Agastya patra swarasa

Nirvapana was done in above liquids

MARANA OF VIHESA SHODITHA RAJATA PATRA

Bhavana of Vishesha Shodhita Rajata & Kajjali with Kumari swarasa

Chakrika Nirmana
Sandhibandana

Laghu puta

Rajata bhasma

Varitaratva

Rekha purnatwa

CHURNA NIRMANA

Twak churna

Ela churna

Patra churna

RAJATA YOGA NIRMANA

Mixing of Trijataka churna with Rajata bhasma

Rajata yoga