ABSTRACT

Background: Malla Sindura (MS) is one of the Kupipakwa Rasayanas prepared by a unique pharmaceutical process in Valuka Yantra, a specialized graduated heating system. In recent time, an electric muffle furnace is specialized and designed for Kupipakwa Rasayan. It is one such medicament indicated mainly in diseases such as Shwasa, Kasa (respiratory disorders), and is thought to be an effective drug in combating Vedana and Vataroga hara property.

Aim: The aim of this study is to establish the standard manufacturing process for MS.

Objectives: (1) To achieve good quality product, (2) to establish the quality control parameter.

Design: Pharmaceutical standardization.

Materials and Methods: Extracted murury (Hingulottha Parad) and purified sulfur (Shodhita Gandhaka) are mixed to make fine lusterless black powder (Nischand Kajjai); it was mixed with purified arsenic trioxide (Shudh Somal) and titurated for 6 h. After proper mixing, sufficient quantity of Aloe vera juice (Kumari Swarasa) was added for Bhavana and ground into a fine powder. The powder thus formed was filled in the Kupi and processed in an electrical muffle furnace for 48 h at graded heating (Mridu, Madhyam, and Tivra). On cooling, the product was collected formed the neck of the Kupi. Organoleptic and physicochemical parameters of MS were analyzed and tabulated.

Conclusion: MS is a Kanthasta Kupipakva Rasayana. It requires Mṛidu (<250°C) and Madhyamagni (250-450°C) for 40 and 8 h of Tivraagni each to prepare MS with 52.10% yield with following parameters mentioned in Ayurvedic Pharmacopeia of India.

Key words: Kupipakva Rasayana, Malla Sindura, Rasashadhies, standardization

INTRODUCTION

Rasashastra, a branch of Ayurveda deals, with pharmacotherapeutic aspects of metals and minerals.[1] Metals are well known and used for therapeutic purpose since from ancient time. The pharmaceutical processing techniques and their internal use remained same for a long time without much changes and progress. Since 8th to 9th century A.D. the popularity of Rasashastra had taken place in the field of Ayurveda. It is a branch of Ayurveda explaining pharmaceutical aspects of the conversion of metals and minerals into therapeutically potent drugs. The idea behind a combination of organic and metallic substances is to obtain quick therapeutic action using lesser dosage.[2] Many new pharmaceutical processing techniques along with equipment and drugs were evolved and developed which have revolutionized Ayurvedic pharmaceutical technology to such an extent that metals could be converted to such a form which is considered to most suitable for its internal use. The converted form of metals is less toxic, highly absorbable, and therapeutically very effective. There have been questions raised about quality, standardization and often about the safety of Ayurvedic medicines in recent past.[3] Formulation prepared in a glass bottle and by subjecting into a gradually raised temperature in a specific heating device like furnace, is known as Kūpīpakva Rasāyana,[4] Makaradhvaja,[5] Rasasindhūra,[6] Svarṇa Vānga,[7] Samīrapannaga Rasa,[8] and Malla Sindhura[9] (MS) are few therapeutically potent and widely used formulations prepared by this method. As Rasashadhies

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which accomplish quickly desired effects in smaller doses.[10] Standardization of Rasaushandhis can be defined with the number of processes, involved in the production of a drug. The standard protocols are mentioned in the literature.[11] The selection of the processes for the preparation of MS was done on the basis of the specific process mentioned in classical texts. While reviewing Rasashastra texts, various reference of MS preparation are found with variation in their ingredient and temperature pattern. However, each reference has its own importance of therapeutic efficacy. Considering this fact present study was planned to develop the standard manufacturing procedure of MS prepared having less ingredients and high-temperature duration.[12]

Rasoushandhis are novel molecules for combating the various diseases. Among them Kupipakva Rasayanas are well known to be potent because of the specific pharmaceutical process, excellent clinical result, long-lasting potency, and safety even on prolonged use. MS is prepared by the combination of Shudh Somal (As₂O₃), Pārada (mercury), and Gandhaka (sulfur) in the ratio 1:2:2 and processing done by Kupipakva method in electrical muffle furnace (EMF). MS as the name denotes itself that, it is a type of Sindura Kalpana which is one such Sa-agni, Sa-gandha, Bahir-dhooma, Kanthasta, Kupipakva Rasayana, having Sindura color (vermilion). It is named due to the Malla (Somal) as one of the main ingredients. MS is having mainly Vataroga hara property and is thought to be an effective drug in combating Vedana.[11]

A total of two formulations are found described by the name of MS Vati[13] and Khanjarika Rasa,[14] and two types of instruments are used for its preparation, i.e., Valuka Yantra and Khalwa Yantra in classical literature. Most of the classical books using Rasa Karpura is one of the ingredients of MS, but here attempt have been taken to prepare MS without Rasa Karpura as per reference of Rasatantrasara and Shidhprayogsangrha, due to easy and convenient preparation method along with the economy. Here, Somal, Parada, and Gandhaka are used in 1:2:2 ratio, but in different Rasa classics it is described that the amount of Rasa Karpura is one of the major ingredients taken in the same proportion.

There is an ever increasing concern pertaining to safety aspects of metals and mineral in developed countries; hence, there is a crying need to produce “standardized formulations.” Drugs from traditional medicine many a time do not qualify meet this requirement because the methods of validation, quality control, and manufacturing process are not in accordance with globally accepted methodologies. Therefore, the need of an hour is to subject metallomineral formulations to rigorous modern scientific testing and develop standards to maintain quality.

**Aim and Objective**

To develop the standard manufacturing process for MS prepared by using EMF.

**MATERIALS AND METHODS**

All the ingredient such as Hingula, Gandhaka, and Somal were collected from the Pharmacy, Gujarat Ayurved University, Jamnagar. Kumari, Nimbu, etc. were taken from the local garden and local market of Jamnagar respectively and processed through prescribed methods as per the classical reference. The whole process has been divided into the following unit operative procedure.

**Shodhana of Raw Materials**

**Shodhana of Somal[14]**

In classics, it is mentioned that Somal (As₂O₃) is one of the most toxic materials classified under Sadharana Rasa Varga. It is also mentioned in the schedule E1 of Drug and cosmetic act 1945. The Shodhan of Somal is done as per classic, Rastarangini, 11/137. The weighted quantity of cow milk was taken in Dola Yantra for Swedan. Somal was wrapped in cotton cloth and make a Pottali. This Pottali was tie up in Dola Yantra and boiled for 3 h continuously. Milk was added in Dola Yantra and whenever it required [Table 1].

**Shodhana of Gandhaka[15]**

Weighed quantity of Goghrita was taken in a vessel, and Ashuddha Gandhaka Churna was added to it. The heat was continued till complete melting and poured in vessel containing pre-heated Godugdha, through cotton cloth. Then it was thoroughly washed with hot water. This procedure was repeated 3 times. A solid mass with some granular part of Gandhaka was taken out of the vessel and then washed with hot water. The same procedure was repeated for each time, and fresh milk and Ghrita was taken every time. After drying, it was powdered, weighed, and kept in a glass jar [Table 2].

**Hingulothla Parada Nirmana[16]**

Shodhana of Hingula was done by giving Bhavana of lemon juice 3 times.[17] After that, it was washed, dried and stored. The required amount of Parada was extracted from Hingula by Nada Yantra method. Fine powder of Shudha Hingula was wrapped in cotton cloth (equal weight of Hingula) and burnt under the pot. Thus, due to heat, the sulfur part of Hingula burns and leaves the Parada, which gets evaporated as vapor and is collected on the inner side of the pot. Parada was collected by rubbing with cloth and then washing with hot water and filtering through four folders of cloth. This Parada was used to prepare MS [Tables 3-5].

**Preparation of Kajjali of MS[11]**

An equal amount of Hingulothla Parad and Shuddha Gandhaka was taken in in Khalvyantra and tituration (Mardana) was done for 24 h till fine, soft, lusterless (Nishchandra) Kajjali was formed. It was mixed with 1/4th...
part of Shudha Somal, and tituration (Mardana) was done for 6 h until the uniform homogeneous mixture was formed. Aloe vera juice (Kumari Swarasa) used as a Bhavana Dravya for levigation of Kajjali in an adequate amount to wet the Kajjali (Rasapankavat)\textsuperscript{[18]} semisolid and Mardana was carried out for 3 h, till the homogeneous, soft mass was formed and then it was dried in sunlight and it was taken one-fourth of the total amount of Kajjali as it was found to be sufficient to wet the total material [Table 6].

### Preparation of MS Apparatus

Mortar and pestles, Kanchakupi, Multani Mitti, cloth, Loha Shalakas-2, kerosene oil, matchbox, thread, enamel tray, glass container, cork, copper coin, torch, knife; electric muffle furnace: Outer length: 40 cm, breadth: 40 cm, height: 50 cm, inner hearth length: 15 cm, breadth: 15 cm, depth: 30 cm, Kanchakupi: Amber-colored beer bottle, capacity: 625 ml, total height: 28 cm, cylindrical part:
Height: 14 cm; circumference: 24.5 cm; diameter of the bottom: 6.5 cm, conical part: Height: 14 cm; diameter of the mouth: 2 cm, weight: Before Kapadamitti: 450 g; after Kapadamitti: 590 g.

**Procedure**

The preparation of MS\(^{[11]}\) was divided into three stages namely, preoperative (Purvakarma), operative (Pradhankarma), post-operative (Paschatkarma) stages. MS was subjected to various organoleptic and physicochemical analysis such as texture, color, teats, odor, pH,\(^{[19]}\) ash value,\(^{[20]}\) loss on drying,\(^{[21]}\) percentage of mercury,\(^{[22]}\) and percentage of free sulfur.\(^{[23]}\)

**Purvakarma**

Cotton cloth was cut into small pieces and smeared on the glass bottle with the help of Multani Mitti. This process was repeated 10 times after complete sun drying to each step. This 10 layered smeared Kach Kupi was filled prepared Kajjali and placed in EMF [Figure 1].

**Pradhanakarma**

Preparation of MS was carried out in EMF by providing Kramagini, i.e., controlled intermittent and gradually increasing temperature that is, 18 h of mild (140-250°C) and 22 h of moderate temperature (250-450°C) [Graph 1]. Accumulated Somal and Gandhaka at the neck of the bottle were cleared using a red hot iron rod. After observation of the confirmative tests like coin test [Figure 3] complete cessation of Gandhaka and Somal fumes, the mouth of the Kupi was corked and the temperature was gradually increased to around 50°C up to 630°C and was maintained for 3 h to facilitate the complete formation of the compound. After cooling, the bottle was removed and thus MS was prepared in six batches of 400 g of Kajjali in each.

**Paschatkarma**

After allowing the Kupi to naturally cool, layers of wrapped cloth were carefully scraped, and the bottle was broken in specific manner. The product formed at the neck of Kupi was carefully collected and weighed. Apart from the product, some residue was also obtained in each batch [Figures 5 and 6].

## Table 6: Result showing the preparation of MS Kajjali

<table>
<thead>
<tr>
<th>Batch No.</th>
<th>Hingulottha (Parad) (g)</th>
<th>Shodhita Gandhak (g)</th>
<th>Kajjali (g)</th>
<th>Weight of Shudh Somal (g)</th>
<th>Kumari Swarasa (ml)</th>
<th>Kajjali (g)</th>
<th>% Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch 1</td>
<td>400</td>
<td>400</td>
<td>780</td>
<td>200</td>
<td>330</td>
<td>992</td>
<td>1.53</td>
</tr>
<tr>
<td>Batch 2</td>
<td>400</td>
<td>400</td>
<td>783</td>
<td>200</td>
<td>310</td>
<td>992</td>
<td>1.14</td>
</tr>
<tr>
<td>Batch 3</td>
<td>520</td>
<td>520</td>
<td>1017</td>
<td>260</td>
<td>410</td>
<td>1266</td>
<td>0.86</td>
</tr>
<tr>
<td>Total</td>
<td>1320</td>
<td>1320</td>
<td>2580</td>
<td>660</td>
<td>1050</td>
<td>3250</td>
<td>3.53</td>
</tr>
</tbody>
</table>

*MS: Malla Sindura*

**OBSERVATIONS AND RESULTS**

Different stages during the process such as Gandhaka and Somal fuming, melting of Kajjali, flaming (Figure 2), confirmative test for completion of product formation such as flame disappearance (Graph 2), Sita Salaka test, were observed and recorded [Table 7]. *Sita Salaka* test was taken using an iron spoke measuring 30 cm in length and 0.2 cm in diameter. This test was taken at 480°C temperature after 40 h of heating. *Sita Salaka* was slowly inserted up to 20 cm in the bottle and then slowly withdrawn. Adhesion of white particles on the lower part of Salaka indicated the proper formation...
of MS. MS collected from the top of the Kupi from all the batches were weighed and calculated for the percentage of absolute and relative yield [Table 8]. MS was subjected to various organoleptic and physicochemical analysis result obtained is depicted in Tables 9 and 10.

**DISCUSSION**

MS is a *Kanasthantha Kupipakva Rasayana* (a preparation in which product is obtained at the neck of glass bottle). For the preparation of *Kupipakwa rasayan*, preparation of Kajjali, time duration, and heating pattern are the most important factors to obtain maximum quantity of yield and to increase the efficacy of the product without any untoward effect. As per classical texts, the *Kramagi* heating pattern should be provided during processing of any *Kupipakwa Rasayana*. It means temperature pattern should be an increasing order but intermediate heating process. In can be divided into three stages, i.e., Mridu, Madhya and Tivraagni. Here, Mriduagni indicates the melting stage of Kajjali, Madhyamagni indicates the boiling stage of Kajjali and Tivraagni means...
### Table 7: Observations during preparation of MS

<table>
<thead>
<tr>
<th>Time (h)</th>
<th>Set temperature (°C)</th>
<th>1(^{st}) batch temperature recorded (°C)</th>
<th>2(^{nd}) batch temperature recorded (°C)</th>
<th>3(^{rd}) batch temperature recorded (°C)</th>
<th>4(^{th}) batch temperature recorded (°C)</th>
<th>5(^{th}) batch temperature recorded (°C)</th>
<th>6(^{th}) batch temperature recorded (°C)</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>140</td>
<td>37</td>
<td>36</td>
<td>33</td>
<td>35</td>
<td>32</td>
<td>36</td>
<td>Light white fumes</td>
</tr>
<tr>
<td>2</td>
<td>160</td>
<td>164</td>
<td>166</td>
<td>164</td>
<td>163</td>
<td>168</td>
<td>162</td>
<td>Kajjali started melting</td>
</tr>
<tr>
<td>4</td>
<td>180</td>
<td>189</td>
<td>188</td>
<td>183</td>
<td>185</td>
<td>184</td>
<td>187</td>
<td>Light yellow fumes</td>
</tr>
<tr>
<td>6</td>
<td>190</td>
<td>197</td>
<td>194</td>
<td>198</td>
<td>193</td>
<td>197</td>
<td>192</td>
<td>Light yellow fumes</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
<td>208</td>
<td>203</td>
<td>205</td>
<td>204</td>
<td>208</td>
<td>203</td>
<td>Gandhaka collected at the neck</td>
</tr>
<tr>
<td>10</td>
<td>210</td>
<td>218</td>
<td>215</td>
<td>217</td>
<td>214</td>
<td>216</td>
<td>212</td>
<td>Melting of Kajjali was confirmed by inserting sheeta shalaka</td>
</tr>
<tr>
<td>12</td>
<td>220</td>
<td>224</td>
<td>227</td>
<td>223</td>
<td>225</td>
<td>224</td>
<td>221</td>
<td>Complete melting of Kajjali reflecting light</td>
</tr>
<tr>
<td>14</td>
<td>230</td>
<td>236</td>
<td>236</td>
<td>237</td>
<td>232</td>
<td>235</td>
<td>238</td>
<td>Light fumes</td>
</tr>
<tr>
<td>16</td>
<td>240</td>
<td>243</td>
<td>246</td>
<td>244</td>
<td>248</td>
<td>245</td>
<td>243</td>
<td>Kajjali seen reddish from torch.</td>
</tr>
<tr>
<td>18</td>
<td>250</td>
<td>257</td>
<td>259</td>
<td>254</td>
<td>256</td>
<td>257</td>
<td>252</td>
<td>Thick yellow fumes</td>
</tr>
<tr>
<td>20</td>
<td>270</td>
<td>277</td>
<td>274</td>
<td>278</td>
<td>278</td>
<td>275</td>
<td>272</td>
<td>Gandhaka</td>
</tr>
<tr>
<td>22</td>
<td>290</td>
<td>296</td>
<td>299</td>
<td>293</td>
<td>294</td>
<td>297</td>
<td>293</td>
<td>Thick fumes with reddish reflection of bottom</td>
</tr>
<tr>
<td>22</td>
<td>300</td>
<td>308</td>
<td>306</td>
<td>306</td>
<td>305</td>
<td>309</td>
<td>307</td>
<td>Thick fumes</td>
</tr>
<tr>
<td>24</td>
<td>320</td>
<td>324</td>
<td>323</td>
<td>329</td>
<td>326</td>
<td>327</td>
<td>328</td>
<td>Kajjali solided</td>
</tr>
<tr>
<td>26</td>
<td>340</td>
<td>348</td>
<td>346</td>
<td>348</td>
<td>345</td>
<td>348</td>
<td>346</td>
<td>Yellow fumes of Gandhaka</td>
</tr>
<tr>
<td>28</td>
<td>360</td>
<td>365</td>
<td>367</td>
<td>364</td>
<td>364</td>
<td>362</td>
<td>367</td>
<td>Hot Shalaka used to clean Gandhaka</td>
</tr>
<tr>
<td>30</td>
<td>380</td>
<td>385</td>
<td>389</td>
<td>385</td>
<td>388</td>
<td>382</td>
<td>387</td>
<td>Yellowish white fumes of Gandhaka and Somal</td>
</tr>
<tr>
<td>32</td>
<td>400</td>
<td>409</td>
<td>407</td>
<td>407</td>
<td>403</td>
<td>406</td>
<td>407</td>
<td>Hot Shalaka done 4-6 times in this duration to clear the Gandhaka</td>
</tr>
<tr>
<td>36</td>
<td>420</td>
<td>422</td>
<td>428</td>
<td>429</td>
<td>426</td>
<td>424</td>
<td>425</td>
<td>Yellow fumes of Gandhaka</td>
</tr>
<tr>
<td>40</td>
<td>450</td>
<td>455</td>
<td>453</td>
<td>458</td>
<td>457</td>
<td>453</td>
<td>458</td>
<td>Honey cumb appearance seen, bottom appeared red</td>
</tr>
<tr>
<td>44</td>
<td>530</td>
<td>537</td>
<td>531</td>
<td>528</td>
<td>529</td>
<td>532</td>
<td>536</td>
<td>Flame started 3-4 inch in length Sheeta Shalaka, coin test was taken, corking</td>
</tr>
<tr>
<td>48</td>
<td>630</td>
<td>635</td>
<td>637</td>
<td>636</td>
<td>632</td>
<td>634</td>
<td>636</td>
<td>Furnace turned off</td>
</tr>
</tbody>
</table>

MS: Malla Sindura
immense heating, which takes place a confirmative test of the final product. One such effort had been done by Prajapati et al.[25-27] who has given the temperature range for the particulars of Agni, such as - Mriduagni 140-200°C (18 h), Madhyamagni 200-450°C (22 h), Tivraagni 450-630°C (8 h). This standardization was done in an electric muffle furnace for the preparation of MS in the ratio of 1:2:2. However, for the present study, for the preparation of the MS, 48 h of heat patterns was designed, this heating pattern was modified from as per mentioned in classics. In the most of the classical text, Rasa Karpura is one of the main ingredients of MS and using the same proportion of Parada. It was observed that there is an increase in the heating duration for the Jarana. Here, an attempt was made to prepare the MS without using the Rasa Karpura as per reference mentioned in RTS and SPS. It has been made to prepare MS without Rasa Karpura (to reduce ingredient, toxicity, and cost) while maintaining its therapeutic efficacy. The heating process was carried out in a Kramagni pattern, i.e., increasing order but intermediate heating. This Kramagni was slightly modified as per classics because it was not possible to provide continuous heat after Mukhikaran to such a long duration. Hence, duration of Mriduagni and Madhyamagni was increased, and the duration of Tivraagni was slightly shortened. Heat was gradually increased over a period as per the schedule, i.e., 18 h Mandagni (140-250°C), 22 h Madhyamagni (250-450°C), 8 h Tivraagni (450-600-630°C). Therefore, the duration of Mriduagni and Madhyamagni period was increased and decreasing the duration of Tivraagni.

The Hingulotha Parada was used because as per classical text; its properties are equal to those of Astasamskarita Parada.[28] The Shudha Gandhaka and Hingulotha Parada was taken iron Khalwa Yantra, and Mandand was started until the Nischandratva, and Rekhaburnatva tests of Kajjali were passed in 16 h, but 24 h trituration was done for the fineness. The weight of Kajjali was found to be decreased (3.53% on an average). After preparation of Kajjali one-fourth amount of Somal was added in Khalwa Yantra and Mandanda was done for 6 h to form homogeneous uniform Kajjali. The weight of Kajjali was found to be decreased (0.5% on an average). After Bhavana of Kumari Swarasas, the weight of Kajjali was found to increased (1.52% on an average) which may be due to the added solid contents of Kumari Swarasas. This Kajjali was filled in Kanch Kupi and shifted to EMF. Initially, white fumes were observed followed by yellow fumes was due to sulfur. Rigorous and intermittent probing by hot iron rod should be carried out during this period to avoid choking of Kupi by Gandhak. At temperature 380-410°C profuse, thick white and yellow fumes were seen followed by choking at the neck, and there was flaming. Completion of the process can be judged by Sita Salaka test and coin test, whereby, its coating appears white on the coin when it put on the neck of Kanch Kuppi. Kupi should be broken [Figure 4] after cooling naturally as it plays an important role for proper crystallization of the final product.

It was observed during a trial and error study that the amount of Gandhaka is directly proportional to the burning period. Therefore, as per the classical notes, a specific temperature pattern was mentioned for the Samguna Kajjali, i.e., Mriduagni, Madhyamagni, and Tivraagni in an equal ratio. In this, Gandhaka was just in the melting stage in the Mriduagni while in the Madhyamagni stage, Gandhaka boils and burns and in the Tivraagni period, Parada with Gandhaka sublimes. Thus, the temperature required for the melting of Gandhaka and sublimation of the product is not dependent on the amount of Gandhaka. Taking note of this, the most of the chemical reaction occurred in Mridu and Madhayamagni. Hence, the period of Mridu and Madhyamagni was increased and period of Trivagni is shortened. The period of Madhyamagni was designed for a longer period as more chemical reaction, and compound formation was done in this period. Jarana of Gandhaka gets more period for the burning, which is the main aim. Here, an attempt was made to prepare the MS without Rasa Karpura with specific designed temperature pattern. For this, many trial and error studies were carried out to finalize the temperature pattern.
During this temperature, pattern of Kupipaka, Kajjali was completely melted after temperature increased from 450°C and flame of sulfur occurred at the neck of the Kupi after 41 h on an average, which was continued for 1.32 h.

Initially, the maximum temperature of Tivraagni is decided up to 600°C but at that temperature, the product does not sublime completely and the yield of the product is lesser. The maximum temperature of Tivraagni was increases up to 630°C for the proper sublimation of product which increases the yield and decreases the residue.

CONCLUSION

MS is a Kanthasta Kupipakva Rasayana and can be prepared by following 18 h of Mrdú and 22 h of Madhyamagni and 8 h of Tivraagni were used as modified from classics, with yield of average 52.1%.

REFERENCES