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Research Article

PHARMACEUTICAL STANDARDIZATION OF TAMRA YOGA

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ABSTRACT

Rasa oushadies are the potent *Ayurvedic* preparations mainly containing metals and minerals. These oushadies possess a wide range of therapeutic efficacy and are considered superior because of their qualities like small dose, quick action, palatability and longer shelf life. *Tamra Yoga* is an important *Rasa oushadi* described in *Rasa Tantra Sara Va Siddha Prayoga Sangraha* indicated for the management of the disease *Vataja Shula*, *Gulma* and *Ajirna*. The ingredients present in the "*Tamra Yoga*" are *Tamra Bhasma*, *Yashtimadhu*, *Trikatu*, *Souvarchala Lavana*, *Chincha Kshara* and *Bharjitha Hingu*. The main pharmaceutical procedures involved in the preparation of *Tamra Yoga* are *Shodhana*, *Bhavana*, *Marana*, *Amrutikarana*, *Chincha Kshara nirmana*, *Hingubharjana*, *Churna nirmana* and preparation of capsules of *Tamra Yoga*. The specific pharmaceutical blend of these contents can result in a more effective formulation. Till date, no research work has been carried out to standardize this formulation. Therefore the present study has been planned to standardize the method of preparation of *Tamra Yoga* according to the method explained in the classical literature.

Keywords: *Tamra Yoga*, *Shodhana*, *Bhavana*, *Marana*, *Amrutikarana*, *Chincha Kshara nirmana*, Standardization.

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INTRODUCTION

Rasa Shastra is an independent and important branch of *Ayurveda* developed during the medieval period. It mainly deals with the knowledge related to Alchemy and pharmaceutical processes especially concerned with the drugs of metal and mineral origin.

Metals and minerals are the integral part of *Ayurvedic* therapeutics and are in vogue since Vedic period. During *Samhita Kala*, their use was limited in therapeutics when compared to herbal preparations. But, after the

development of *Rasa Shastra*, the frequency of use of metals and minerals in treating diseases has been increased. Before their use, they should be subjected to specialized pharmaceutical processes like *Shodhana*, *Marana*, *Amrutikarana* etc. Their use in therapeutics occupied highest place and is called as *Rasa Chikitsa*.

Tamra is one of the most important metals described in *Ayurveda* possessing various therapeutic properties. It is indicated in the management of several diseases like *Gulma*, *Grahani*, *Sthoulya*, *Udara roga*, *Prameha* etc¹. According to the *Rasa Shastra* texts it is clearly mentioned

that *Tamra* is fit for internal use only after proper purification. Impure *Tamra* is more dangerous than any poison as there is only one *dosha* in poison, while there are eight *doshas* in *Tamra* viz., - *Bhrama*, *Murcha*, *Vidaha*, *Sweda*, *Kleda*, *Vanti*, *Aruchi* and *Chitta Santapa*². Hence to remove these impurities and to make them suitable for administration into the body, procedures like *Shodhana*, *Marana* etc., are considered as must. All these procedures help in removing the toxic potential from the metals and impart them with therapeutic efficacy of a higher grade.

Tamra Yoga is a unique formulation described in *Rasa Tantra Sara Va Siddha Prayoga Sangraha*³, which contains one part of *Tamra Bhasma* and four parts each of *Yashtimadhu*, *Trikatu*, *Souvarchala Lavana*, *Chincha Kshara* and *Bharjitha Hingu*. *Shodhana*, *Bhavana*, *Marana*, *Amrutikarana*, *Chincha Kshara nirmana*, *Hingu bharjana*, *Churna nirmana* and preparation of capsules of *Tamra Yoga* are the main pharmaceutical procedures adopted in the preparation of *Tamra Yoga*. In the present study an effort has been made to highlight the significance of these pharmaceutical procedures and to standardize the method of preparation of *Tamra Yoga*.

MATERIALS AND METHODS

Collection of Raw material

Parada and *Gandhaka* were obtained from Vijayawada. *Tamra patra*, *Sarja kshara*, *Yava kshara*, *Tankana*, *Nagavalli*, *Ardraka*, *Goksheera*, *Goghrita*, *Kulattha*, *Tila Taila*, *Takra*, *Hingu*, *Souvarchala Lavana* and *Nimbu* were obtained from the local market, Tirupati. *Gomutra* was obtained from the ISCKON (dairy farm), Tirupati. *Chincha Phala Twak* was obtained from Adilabad district of Telangana State. *Yashtimadhu* and *Trikatu* were obtained from TTD's Sri Srinivasa Ayurveda Pharmacy, Tirupati. *Kumari* leaves were collected from the herbal garden, S.V. Ayurvedic College, TTD, Tirupati.

Methods

Entire preparation of *Tamra Yoga* was carried out in Department of *Rasa Shastra* and *Bhaishajya Kalpana*, TTD's S.V. Ayurvedic College and Sri Srinivasa Ayurveda Pharmacy, TTD, Tirupati.

The entire pharmaceutical study was carried out in seven stages:

1. STAGE I

- *Samanya Shodhana* of *Tamra*
- *Visesha Shodhana* of *Tamra*
- *Shodhana* of *Parada*
- *Shodhana* of *Gandhaka*

2. STAGE II

- Preparation of *Kajjali*
- *Bhavana* of mixture of *Shodhitha Tamra Churna* and *Kajjali* with *Nimbu Swarasa*

3. STAGE III

- *Marana* of *Tamra*

- *Amrutikarana* of *Tamra Bhasma* with *Kumari Swarasa*.

4. STAGE IV

- Preparation of *Chincha Kshara*
- *Bharjana* of *Hingu* with *Goghrita*

5. STAGE V

- Preparation of *Yashtimadhu churna*
- Preparation of *Trikatu churna*
- Preparation of *Souvarchala Lavana churna*

6. STAGE VI

- Mixing of *Tamra Bhasma* with the fine powders of component drugs and making into a homogenous mixture.

7. STAGE VII

- Preparation of capsules of *Tamra Yoga*.

1. *Kaanji Nirmana*:

Ingredients: *Rice* – 400g, *Kulattha* – 400g, *Sarshapa* – 200g, *Haridra* – 100g, *Saindhava Lavana*- 400 g, *Vamsa patra* – 100g, *Jeeraka* – 40g, *Shunti* – 40g, *Shuddha Hingu* – 20g, *Sarshapa Taila* – 88ml, *Masha*– 100g, *Jala* – 4 lit.

Procedure: Rice was cooked by adding 5 parts of water and *Kulattha Kashaya* was prepared by adding 4 parts of water and reducing to 1/4th. *Sarsapa*, *Saindhava lavana*, *Haridra*, *Jeeraka*, *Shunti*, *Ghritha Bharjitha Hingu* were made into fine powder separately. *Vamsa patras* were cut into small pieces. *Masha* was made in the form of dough and *vataka* were prepared in *Sarshapa Taila*. All the ingredients were then added one by one in an air tight plastic container smeared inside with ghee and mixed homogeneously. Then the mouth of the container was closed with lid and sealed using fuller's earth and kept aside for 10 days for the process of fermentation. After the completion of fermentation the liquid portion was filtered and used.

Observations: Yellow coloured *Kaanji* having sour taste was obtained and the pH of the *Kaanji* was noted as 3.

2. *Kulattha Kwatha Nirmana*:

Ingredients: *Kulattha* – 500g, Water – 8 litres.

Procedure: *Kulattha* was taken in a stainless steel vessel and sixteen parts of water was added to it. It was subjected to moderate heat and reduced to 1/8th. It was then filtered using a clean cloth and *kashaya* was collected.

Observations: Brown coloured *Kulattha Kashaya* of characteristic odour was obtained.

3. *Tamra Samanya Shodhana*

Ingredients: *Kantakavedhi Tamra Patra* – 140 g, *Taila*, *Takra*, *Gomutra*, *Kaanji*, *Kulattha Kwatha* – Q.S (Quantity Sufficient)

Procedure: *Kantakavedhi Tamra patras* were taken and cut into small pieces. They were placed in a *loha darvi* and heated to red hot and quenched in sufficient quantity of *Tila taila*. This process was repeated for six more times. Each time the *Tila taila* was changed. Likewise the procedure was repeated with *Takra*, *Gomutra*, *Kanji* and *Kulaththa* Kwatha subsequently (7 times in each liquid).

Observations: Initially pieces of *Tamra patra* were reddish orange in colour. *Tamra* became red hot in 30 minutes. Crackling sound was produced on quenching in *Tila taila* along with flame and dense fumes. Irritating smell due to burning of oil was observed. The colour of oil turned to black. On quenching in other liquids, bubbling sound was produced with liberation of vapour. On quenching in *Gomutra*, ammoniacal smell was observed and *Gomutra* became turbid. The media became very hot, metallic lustre was lost gradually and *Tamra patra* became brittle after every *nirvapa*. Pieces of *Tamra patra* turned to brown colour coarse powder by the end of the procedure.

4. *Tamra Vissha Shodhana:*

Ingredients: *Samanya shodhitha Tamra churna* – 134 g, *Gomutra* – Q.S.

Procedure: *Tamra patra churna* obtained after *Samanya Shodhana* was taken and placed in a double layered cotton cloth and was made into *pottali*. A two litre borosilicate glass beaker was taken, kept over hot plate and the *pottali* was suspended in the glass beaker filled with *Gomutra*. Boiling was carried out for 3 hours by adding *Gomutra* regularly into the beaker to maintain its constant volume. After 3 hours, *pottali* was removed carefully from *Gomutra* and kept open for drying. *Vissha Shodhitha Tamra patra churna* was collected and kept in air-tight container for further use.

Observations: The colour of the *Gomutra* changed to dark brown colour from golden yellow colour whereas colour of *Tamra patra churna* remained as it is without any change. 3 litres of *Gomutra* was used for *swedana* procedure and smell of *Gomutra* was felt from *Tamra* even after washing.

5. *Parada Shodhana*

Ingredients: *Ashuddha Parada* – 250 g, *Sarja kshara*, *Yava kshara*, *Tankana* -83.4 g each, *Nagavalli* and *Ardra Swarasa* – Q.S

Procedure: *Asuddha Parada* was taken in a *khalwa yantra* and *Sarja kshara*, *Yava Kshara* and *Tankana* were added and mixed properly. *Mardana* was done with sufficient quantity of *Nagavalli Swarasa* and *Ardra Swarasa* for 3 days. By the end of the procedure entire mixture was taken out, washed with hot water and *Shodhitha Parada* was collected.

Observations: Initially the mixture was light grey in colour which turned to dark grey coloured soft paste by the end of the procedure.

6. *Gandhaka Shodhana*

Ingredients: *Ashuddha Gandhaka* – 500 g, Cow's milk – 4 litres, Water – Q.S.

Procedure: *Ashuddha Gandhaka* was taken and pounded in *khalwa yantra* to coarse powder. It was spread over a double layered cotton cloth, covered over the wide mouthed earthen pot filled with milk. Earthen lid was placed over it and *sandhi bhandhana* was done with fuller's earth. The pot was buried up to the neck level in a pit and eight Cow dung cakes were arranged above it and ignited. After self-cooling, the apparatus was removed out of the pit and opened; purified *Gandhaka* was collected at bottom of the pot in form of small pellets, which were washed in hot water and dried.

Observations: Colour of *Gandhaka* changed from bright yellow to lemon yellow. *Gandhaka* was collected as pellets after *shodhana*.

7. *Kajjali nirmana*

Ingredients: *Shuddha Parada* – 200 g, *Shuddha Gandhaka* – 200 g.

Procedure: *Shuddha Parada* and *Shuddha Gandhaka* were taken in a *khalwa yantra* and subjected to *mardana*. This process was carried out till the mixture turned to black colour powder like collyrium without any lustre.

Observations: After *mardana* for 3 hours the mixture turned black. 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. *Tamra Marana:*

Ingredients: *Shodhitha Tamra patra churna* – 100 g, *Kajjali* – 100 g, *Nimbu Swarasa* – Q.S.

Procedure: *Shodhitha Tamra patra churna* and *Kajjali* were taken in equal quantity in a *khalwa yantra* and triturated with sufficient quantity of *Nimbu Swarasa*. *Chakrikas* of uniform size were prepared and placed in a *Sharava* and dried. Then it was subjected to *sandhi bhandhana* and *Sharava samputa* was kept for drying. It was subjected to *Laghu Puta*. (8 *upalas*) and the whole procedure was repeated for 17 more times until all the *Bhasma lakshanas* were attained as mentioned in the classics.

Observations: Maximum temperature attained during the *puta* was 514°C. Gradual reduction in the weight of *Tamra* has been noticed in the whole process. *Nischandratwa* (lustrelessness) was obtained after 3rd *Putra*. *Rekhapurnatwa* was obtained completely after 14th *Putra* and no discolouration was found in *Dadhi Pareeksha* and *Amla Pareeksha* after 16th *Putra*. *Varitaratwa* was obtained after 18th *Putra*. Dark black coloured *Tamra Bhasma* was obtained after 16th *puta*.

9. *Amrutikarana of Tamra Bhasma:*

Ingredients: *Tamra Bhasma* – 167 g, *Kumari Swarasa* - Q.S

Procedure: *Tamra Bhasma* obtained after *Marana* procedure was taken in a *khalwa yantra* and triturated with sufficient quantity of *Kumari Swarasa*. *Chakrikas* of uniform size were prepared and dried. They were placed in a *Sharava* and subjected to *sandhi bhandhana*

and *Sharava samputa* was kept for drying. This was subjected to *Laghu Puta*. (8 *upalas*) and the same procedure was repeated for six more times.

Observations: *Bhasma* became very fine after Amrutikarana procedure.

10. Preparation of *Chincha Kshara*:

Ingredients: *Chincha Phala Twak* – 28 kgs, Water – Q.S.

Procedure: *Chincha Phala Twak* was collected, completely dried and it was placed over an iron mesh. This was placed over the hearth and subjected to fire till it gets converted into ash. The ash was collected in a stainless steel vessel and allowed for self-cooling. Four parts of water was added to the ash and kept undisturbed overnight. Then the supernatant water was collected in another steel vessel carefully without any sediment. It was heated under medium flame on a gas stove till the water content gets completely evaporated. After the complete evaporation of water content, white coloured flakes (*kshara*) were obtained at the bottom of the vessel. They were pounded in *Khalwa yantra*, made into fine powder and preserved in an air tight glass container.

Observations: While burning the *Chincha phala twak*, dense fumes of light brown colour appeared. White coloured ash was obtained after complete burning of the *twak*. Colour of the supernatant water changed to cloudy white after ten minutes of heating. White coloured *Chincha kshara* was obtained and its pH was 13.

11. *Bharjana* of *Hingu*:

Ingredients: *Hingu* – 600 g, *Go Ghritha* – Q.S

Procedure: *Hingu* was taken in a non-stick pan and *go ghritha* was added to it. Then it was kept on stove and fried by stirring with a spatula till it completely turned into brown colour. It was allowed for self-cooling. Then it was powdered in a mixer grinder and sieved through mesh no.120 to obtain fine powder.

Observations: While doing *Ghritha Bharjana*, fumes of brown colour appeared and *Hingu* became very brittle after frying.

12. *Yashtimadhu churna nirmana*:

Ingredients: *Yashtimadhu* - 645 g.

Procedure: Dried stems of *Yashtimadhu* were collected and made into powder by crushing them in hammer crusher. It was then passed through the Sifter sieve machine to obtain fine powder.

Observations: Very fine light brown colour powder was obtained.

13. *Trikatu churna nirmana*:

Ingredients: *Shunti* 500g, *Pippali* 500g, *Maricha* 500g.

Procedure: Dried *Shunti*, *Maricha* and *Pippali* were collected, grinded in a pulveriser and made into powder separately. Then these three powders were sieved through sifter sieve separately and mixed together.

Observations: Very fine brown coloured *Trikatu churna* was obtained.

14. *Sauvarchala Lavana churna nirmana*:

Ingredients: *Sauvarchala Lavana* crystals – 1000 g.

Procedure: Crystals of *Sauvarchala lavana* were pounded into small pieces in a *Khalwa yantra* and made into powder by grinding in mixer grinder. To obtain the fine powder, it was sieved through mesh no.120.

Observations: *Sauvarchala lavana churna* obtained was light pink in colour and very fine in consistency.

15. Mixing of *Tamra Bhasma* with the *churna* of component drugs of *Tamra Yoga*:

Ingredients: *Tamra Bhasma* after Amrutikarana – 100 g, *Yashtimadhu Churna*, *Trikatu Churna*, *Sauvarchala Lavana Churna*, *Bharjitha Hingu Churna*, *Chincha Kshara Churna* – 400 g

Procedure: All the ingredients were added one by one in a *Khalwa yantra* and mixed well till a homogenous mixture was obtained. It was collected and preserved in an air tight glass container.

16. Preparation of capsules of *Tamra Yoga*:

Ingredients: Homogenous mixture of *Tamra Yoga* – 2000g.

Procedure: Capsules of uniform size were taken and 655 mg of *Tamra Yoga* was filled in each capsule and weighed. Capsules were preserved in absolute sterile and moisture free glass containers.



Figure 1A:

- 1-Ashuddha Parada;
- 2-Mardana with Kshara traya, Nagavalli and Ardraka Swarasa;
- 3-Shuddha Parada;
- 4-Pot filled with milk placed in a pit;
- 5-Gandhaka placed over cloth tied to the pot;
- 6-Pot sealed with Sharava;

**Figure 1B:**

7-Ignited cow dung cakes over the Sharava;

8-Shodhita Gandhaka;

9- Mardana of Parada with samaguna Gandhaka;

10- Kajjali;

11- Kantakavedhi Tamra Patra;

12- Tamra Patra cut into pieces;

13- Tamra Patra turning to red hot;

14- Nirvapa in Tila Taila;

15- Nirvapa in Takra;

16- Nirvapa in Gomutra;

17- Nirvapa in Kaanji;

18- Nirvapa in Kulattha Kwatha;

19- Samanya Shodhita Tamra Patra;

20- Samanya Shodhita Tamra Patra made into pottali;

21- Dola yantra swedana in Gomutra;

22- Pottali after swedana;

23- Vissha Shodhita Tamra Patra;

24- Nimbu Swarasa;

25- Bhavana of Shodhita Tamra Patra and Kajjali with Nimbu Swarasa;

26- Chakrikas after Bhavana;

27- Sharava Samputa;

28-Laghu Puta;

29- Tamra Bhasma;

30- Dadhi Pareeksha;



Figure 1C:

- 31- Amla Pareeksha;
- 32- Rekhapurnatwa;
- 33- Varitaratwa;
- 34- Kumari Swarasa;
- 35- Bhavana of Tamra Bhasma with Kumari Swarasa;
- 36- Laghu Puta;
- 37- Tamra Bhasma after Amrutikarana;
- 38- Dried Chinchha Phala twak;
- 39- Burning of Phala twak;
- 40- Collected Ash;
- 41- Addition of water to Ash;
- 42- Boiling of Supernatant water;
- 43- Chinchha Kshara;
- 44- Bharjana of Hingu in Ghritha;
- 45- Pieces of Hingu after Bharjana;
- 46- Bharjitha Hingu Churna;
- 47- Yashtimadhu Churna;
- 48- Trikatu Churna;
- 49- Sauvarchala Lavana Churna;
- 50- Homogenous Mixture of Tamra Yoga;
- 51- Capsules of Tamra Yoga.

RESULTS

Table 1: Showing the result of *Kaanji Nirmana*.

Initial Quantity	Final Quantity	Loss in Quantity	Loss in %
6 L	5 L	1 L	16%

Table 2: Showing the result of *Kulattha Kwatha Nirmana*.

Weight of Kulattha	Quantity of Water	<i>Kashaya</i> prepared
500 g	8000ml	1000ml

Table 3: Showing the result of *Tamra Samanya Shodhana*.

Initial weight	Final weight	Loss in weight	Loss in %
140 g	134 g	6 g	4.2%

Table 4: Showing the result of *Tamra Vishesha Shodhana*.

Initial weight	Final weight	Gain/Loss in weight	Gain/Loss in %
134 g	134 g	Nil	Nil

Table 5: Showing the result of *Parada Shodhana*.

Initial weight	Final weight	Loss in weight	Loss in %
250 g	223 g	27 g	10.8

Table 6: Showing the result of *Gandhaka Shodhana*.

Initial weight	Final weight	Loss in weight	Loss in %
500 g	475 g	25 g	5%

Table 7: Showing the result of *Kajjali Nirmana*.

Weight of <i>Shuddha Parada</i>	Weight of <i>Shuddha Gandhaka</i>	Weight of <i>Kajjali</i> obtained	Loss in weight	Loss in %
200 g	200 g	390 g	10 g	2.5%

Table 8: Showing the result of *Tamra Marana*:

Initial Weight before <i>Marana</i>	Final Weight after <i>Marana</i>	Loss in Weight
200g	167g	33g

Graph 1: Showing the heating pattern of *Laghu puta*.

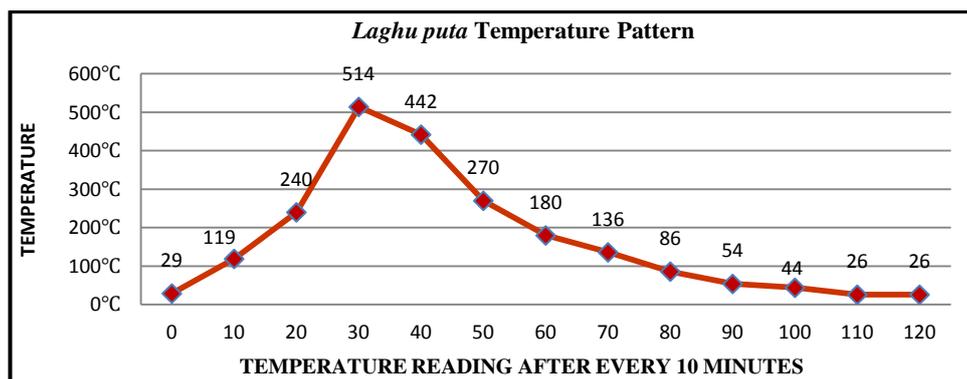


Table 9: Showing the *Bhasma Pareeksha* of *Tamra* during different *Putas*.

Number	Colour	Varitaratwa	Rekhapurnatwa
1 st <i>Puta</i>	Light Black	---	---
2 nd <i>Puta</i>	No visible change	---	---
3 rd <i>Puta</i>	Light Blackish	---	---
4 th <i>Puta</i>	No visible change	---	---
5 th <i>Puta</i>	No visible change	---	---
6 th <i>Puta</i>	No visible change	---	---
7 th <i>Puta</i>	No visible change	---	---
8 th <i>Puta</i>	No visible change	---	+
9 th <i>Puta</i>	No visible change	---	++
10 th <i>Puta</i>	Black	---	++
11 th <i>Puta</i>	Remained as the same	---	+++
12 th <i>Puta</i>	Remained as the same	---	+++
13 th <i>Puta</i>	Remained as the same	+	+++
14 th <i>Puta</i>	Remained as the same	+	++++
15 th <i>Puta</i>	Remained as the same	+	++++
16 th <i>Puta</i>	Dark Black	++	++++
17 th <i>Puta</i>	Dark Black	+++	++++
18 th <i>Puta</i>	Dark Black	++++	++++

Table 10: Showing the result of *Amrutikarana* of *Tamra Bhasma*.

Initial Weight	Final Weight	Loss in Weight	Loss in %
167 g	165 g	2 g	1.2 g

Table 11: Showing the result of Preparation of *Chincha Kshara*

Weight of <i>Chincha Phala Twak</i>	Weight of the ash	Weight of the <i>Kshara</i>
28 kg	1085 g	350 g

Table 12: Showing the result of *Bharjana* of *Hingu*

Initial Weight	Final Weight	Loss in Weight	Loss in %
600 g	480 g	120 g	20%

Table 13: Showing the result of *Yashtimadhu churna nirmana*.

Initial Weight	Final Weight	Loss in Weight	Loss in %
645 g	500 g	145 g	22%

Table 14: Showing the result of *Trikatu churna nirmana*.

Initial Weight	Final Weight	Loss in Weight	Loss in %
<i>Shunti</i> - 500g <i>Pippali</i> - 500g <i>Maricha</i> - 500g	<i>Trikatu churna</i> – 1350 g	150 g	10%

Table 15: Showing the result of *Sauvachala Lavana churna nirmana*.

Initial Weight	Final Weight	Loss in Weight	Loss in %
1000 g	950 g	50 g	5%

Table 16: Showing the result of mixing of components of *Tamra Yoga*.

Initial Weight	Final Weight	Loss in Weight	Final Weight
2100 g	2094 g	6 g	0.28%

Table 17: Showing the result of Preparation of capsules of *Tamra Yoga*.

Weight of <i>Tamra Yoga</i>	No. of Total Capsules (Each 655 mg)	No. of spoiled capsules
2000 g	3020 Capsules	33

DISCUSSION

Mineral materials as such are claimed to be toxic by *Ayurvedic Rasa* texts. By adopting specialized pharmaceutical procedures like *Shodhana*, *Marana*, *Bhavana* etc. they are converted into nontoxic, safe and potent therapeutic forms.

Parada Shodhana: There are various methods mentioned for the *shodhana* of *Parada* in different texts of *Rasa shastra*. The purification of *Parada* according to *Rasa Tarangini* was taken in the present study⁴. Substances having *Kshara*, *Ushna*, *Tikshna*, *Amla* and *Lavana* property are considered as purifiers (*Sarva malaharah Kshara*)⁵. *Kshara* is an alkaline substance; it may be helpful in removing external and internal impurities of Mercury. *Kshara* by its *Chedana*, *Bhedhana*, *Lekhana* property⁶, might help in the disintegration of *Parada*. *Nagavalli* possess *Tikshna guna*, *Ushna virya*, *Tikta*, *Katu rasa*, *Kshara guna*⁷ and *Ardraka* possess *Tikshna guna*, *Ushna virya* and *Katu rasa*⁸. *Swarasa* of *Ardraka* is used in the *Swedana Samskara* of *Parada* by which it can be said that it may be useful in the “*Mala Shaithilya Karana*” of *Parada*⁹. Because of these properties in *Kshara traya*, *Nagavalli* and *Ardraka Swarasa*, they may be helpful in minimizing the toxic qualities of Mercury.

Gandhaka Shodhana: *Gandhaka Shodhana* was done according to the method mentioned in *Rasendra Sara Sangraha*¹⁰. In this method *Agni* was provided by 8 cow dung cakes arranged on the ground over the *Sharava*. *Agni* by cow dung cakes ensures uniform spreading of temperature and prevents Sulphur to get in contact with external oxygen, which otherwise cause oxidation and considerable weight loss. *Gandhaka* is highly *Pitta vardhaka* and *Milk* is *Pitta shamaka Dravya*¹¹. Therefore, it can reduce ‘*teevra pitta vrudhikara*’ effect of *Gandhaka*. *Milk* is *Visha hara* and *Rasayana*, it can remove *Visha doshas* of *Gandhaka* and enhance *Rasayana property* of *Gandhaka*.

Kajjali Nirmana: Equal quantity of *Parada* and *Gandhaka* was taken and triturated in *Khalwa yantra*. *Kajjali* was checked for loss of shine at various stages of preparation and *mardana* was done till it turned lustreless. 390 g of *Kajjali* was obtained in this present study. The molecular weight of Mercury is 200.59 and Sulphur is 32.07. 1 mole of Mercury (200.59g) and 1 mole of Sulphur (32.07g) are required for the formation of 1 mole of *HgS* i.e. 232.66g. Mercury and Sulphur triturated at low temperature (50 - 270°C) forms *Meta-cinnabar*, hence the *HgS* that is present in *Kajjali* is considered as *Meta-cinnabar*.

Tamra Samanya Shodhana: There are two types of *Shodhana* mentioned for all metals i.e., *Samanya Shodhana* and *Vishesha Shodhana*. In *Samanya Shodhana*, *Tamra Patras* were heated to red hot and the procedure of *Nirvapa* (heating and quenching) was sequentially done in the following media (7 times in each): *Tila Taila*, *Takra*, *Gomutra*, *Aranala*, and *Kulattha Kwatha*. Subsequent heating and quenching in these liquid media helps in removing both water and fat soluble impurities and makes *Tamra* brittle by increasing the grain size.

Role of liquid media:

- *Tila Taila* has *Snigdha*, *Sukshma* and *Ashukari* property¹²; it may rapidly enter into the material through the cracks and intermolecular spaces, and makes film coating and further heating causes chemical reaction and compound formation.
- *Takra* is *Tikshna* and acidic in nature and it removes *Snigdhatata* imparted by *Tila Taila* due to its *ruksha guna*¹³.
- *Gomutra* by its *Ksharana* property¹⁴ may help in eradication of undesired substances from the material.
- *Kanji* and *Kulattha Kwatha* by their *bhedhana*¹⁵ property make *Tamra* brittle.

pH of these drugs plays an important role in the structural changes in *Tamra* as well as imposes their properties on it during the process. Repeated heating and quenching in specific media in this specific order (pH: acidic, acidic, basic, acidic and basic) disrupts the compression-tension equilibrium in the internal structure of *Tamra* which leads to cracks on its surface. (Griffith theory, Stress corrosion theory, and Theory of thermal expansion)¹⁶. As a result of this, some part is converted to coarse powder and some in fine powder. After each quenching, powder was found as sediment in media.

Tamra Vishesha Shodhana: For *Vishesha Shodhana* *Gomutra* was opted as a media¹⁷. *Gomutra* is having mild basic and corrosive nature which can effectively remove external impurities of *Tamra patra*. Since *Tamra patras* have changed to coarse powder after *Samanya Shodhana* maximum surface area of *Tamra patra* have come in contact with *Gomutra*. The impurities which are soluble in alkaline liquids could be removed through this process.

Tamra Marana: Method adopted in the present study is taken from the reference *Rasa Ratna Sammucchaya* 5/53. It is considered that – “*Lohanam Maranam Shreshtham Sarvesham Rasa Bhasmana*”¹⁸! Hence *Kajjali* was used in the preparation of *Tamra Bhasma*. Metallic drugs should always be reduced to *Bhasma* form for internal use. Main aim of present process is to make *Kajjali* react with *Tamra* and reduce it to *Bhasma* form. In this *Marana* procedure, four steps are carried out i.e., *Bhavana*, *Chakrika nirmana*, *Sharava samputikarana* and *Putapaka*.

Acharya Charaka has described *Bhavana* as one of the *samskaras*¹⁹. It is described that during preparation of any medicine, *bhavana* with *swarasa* of specific *dravya* enhances the *bala* (potency) of *aushadhi dravya*. Wet trituration (*Bhavana* with *Nimbu Swarasa*) helps to bring minute particles of material in contact with each other as well as with liquid media. *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.

Chakrikas were prepared of uniform size and shape to facilitate uniform distribution of heat during the *putapaka*. *Sharava samputikarana* was done to provide anaerobic atmosphere for complete reduction of material. According to classics *Agni* mentioned for *Marana* of *Tamra* is only *Kashtagni*²⁰. But in the

present study *Laghu Puta* has been selected for preparation of *Tamra Bhasma*. *Putra* 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*). In *Putra* system of heating there is gradual rise and fall of temperature which helps in making the material more *agnisthayi* (heat stable)²¹. It cannot regain its form back after *Marana* procedure. The maximum temperature recorded during *Putra* was 514°C and it was maintained for a period of 3-4 minutes. 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. If metals were allowed to react with Sulphur in open air most of the sulphur reacts with atmospheric oxygen to form oxides. If the same metal is allowed to react with Sulphur at required temperature in complete absence of oxygen (*Sharava Samputa*), they form only metallic sulphides. Black colour of *Tamra Bhasma* may be due to presence of black compounds of copper - cupric oxide (CuO) and copper (I) sulphide (CuS). Since sulphur is an accompaniment to the metal in the *Bhasma* preparation, copper is converted to its sulphide form in major. In nutshell, it is the combination of *sulphides* and *oxides* of copper which gives black colour to it.

Nischandratwa was obtained after 3rd *puta*, *Rekhapurnatwa* after 14th *puta*, *Dadhi Pariksha* & *Amla Pariksha* after 16th *puta* and *Varitaratwa* was obtained after 18th *puta*. These tests are very important because they give confirmation regarding the proper formation of *bhasma*. *Tamra Bhasma* also showed *mridutwa*, *slakshnatwa* and *gata rasatwa* properties.

Amrutikarana of Tamra Bhasma: In the present study, method adopted for *Amrutikarana* was according to the reference mentioned in *Rasa Tarangini*²². The possible impurities that remain in *Tamra Bhasma* after *Marana* process are advocated to be removed by another

specialized procedure known as *Amrutikarana*. This procedure is recommended for all the *Bhasmas* but claimed to be essential mainly in *Abhraka Bhasma* and *Tamra Bhasma*. *Amrutikarana* plays a very important role in making the form more assimilable, increasing the stability of the drug and increasing the therapeutic efficacy.

Chincha Kshara Nirmana: *Ksharas* are alkaline substances obtained from the water soluble ashes of herbal drugs. The preparation of *Chincha Kshara* has been carried out on the basis of the method explained by *Acharya Sarangadhara*²³. Stainless Steel Vessel was used in this procedure to avoid any chemical reactions. pH was observed as 13 which indicates the high alkaline nature of *Chincha Kshara*.

Bharjana of Hingu: *Bharjana* was carried out as a part of *Shodhana* procedure for *Hingu* using *Ghritha*. *Ghritha* by its *snigdha guna* and *visha hara* property²⁴ helps in reducing the *tikshna guna* and fat soluble impurities present in *Hingu*.

Preparation of Capsules of Tamra yoga: Capsule form was selected keeping in view of ingredients like *Tamra Bhasma*, *Sauvarchala lavana* and *Chincha Kshara*. *Tamra Bhasma* may get oxidized when it comes in direct contact with the external environment, which might affect the therapeutic efficacy of the drug. *Chincha Kshara* and *Sauvarchala lavana* which are hygroscopic in nature may absorb or adsorb moisture from the surrounding environment.

CONCLUSION

Pharmaceutical Standardization of *Rasa oushadies* is an important requisite for the establishment of their safety, efficacy and consistent biological activity. All the pharmaceutical procedures adopted in the preparation of *Tamra Yoga* like *Shodhana*, *Bhavana*, *Marana* etc. plays a vital role by removing the toxic nature and improving the therapeutic efficacy, thereby rendering a safe and effective formulation.

CONFLICT OF INTEREST

No conflict of interest.

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