



Research Article

PHARMACEUTICAL PROCESSING AND ANALYTICAL STUDY OF *TRIVANGA BHASMA*

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ABSTRACT

Background: *Rasashastra* is a branch of *Ayurvedic* pharmaceuticals, which deals with the conversion of metals & minerals into potent medicines. In *Rasashastra*, the metals like gold, silver, copper, iron, lead, tin, zinc etc. are converted into *Bhasma* and are applied in therapeutics. Validity of this branch of science totally depends on the successful completion of the practical aspects with careful observations, and it becomes necessary to perform analytical studies to check the quality of the finished products. Hence, the present study was carried out to understand the pharmaceutical processing and to analyze the *Trivanga Bhasma* with the aid of classical tests and modern analytical tools.

Materials & Methods: *Trivanga Bhasma* was prepared by subjecting the *Vanga, Naga & Yashada* to *Samanya & Vishesh Shodhana, Jarana* and *Marana* processes as per the classical references. Final product was then subjected to all the classical *Bhasmaparikshas* and also analyzed by adopting modern analytical techniques.

Results & Conclusion: Yellow coloured *Trivanga Bhasma* which passed all the *Bhasmaparikshas* was obtained after seventeen *Laghuputas*. Percentile of tin, lead & zinc were noted.

INTRODUCTION

Ayurveda is the Science of Holistic Living and Natural Healing. *Ayurveda* considered different dimensions of the nature/universe in the prevention and management of diseases. Earlier, till *Samhitakala* the main source for therapeutics were based on herbal preparation and the usage of metal & minerals was limited. Later, in the golden period of Hindu dynasty, a unique branch of medicine called *Rasashastra*, containing applicability of Mercury, Metals, & Minerals in health and treatment of diseases emerged.

Rasashastra holds a valid response of drug designing and analyzing with a vision to produce safe and efficacious drugs/ formulations to prevent & treat various ailments affecting the mankind. The metals and minerals of *Rasashastra* claimed to be immensely valuable and potent medicines. *Rasashadhis* are considered superior due to smaller doses, quick-effects, long shelf-life and palatability^[1].

Bhasmas are one among such *Rasoushadhis* which are known for their low doses and fast action^[2]. *Trivanga Bhasma* is a combination of three *Putilohas* - *Vanga, Naga & Yashada*, in which all these are subjected to *Shodhana, Jarana & Marana*^[3]. Pharmaceutical practices of *Rasashastra* invariably involve *Shodhana* i.e., purification to mitigate toxicity, *Marana* conversion of metals & minerals into fine ash like form i.e., *Bhasma*. Interestingly *Jarana* is a unique process applied only for these three *Putilohas*. *Trivanga Bhasma* is intensively applied in therapeutics in various conditions such as *Prameha, Madhumeha, Pootimeha, Kasa, Shwasa, Kshaya, Raktapitta* etc., conditions^[4,5].

The pharmaceutical science is closely related with life science. A full conception of the science will never be attained by the knowledge of only a part of science^[6]. *Acharya Charaka* indicates towards the pharmaceutical proficiency of physician^[7]. Ultimately,

success of the treatment depends on the skillful preparation of genuine drugs and their application. In *Rasashastra* it is described that *Rasa Vaidya* must have the quality of "*Kushala rasa karmani*"^[8]. The pharmaceutical preparation of metallic/ mineral/ herbo-mineral formulations requires more skill and the only way of obtaining skill is by repeated practices and careful observations. Any medicine should be of highest quality and to check the quality of the finished products, it becomes necessary to perform analytical studies of the products. Without the analysis of drug, the research of a drug is incomplete. Thus pharmaceutical processing of Trivanga Bhasma was carried out according to classical references and later final product was subjected to classical as well as modern analytical tests.

MATERIALS & METHODS

Major Material

Vanga, Naga & Yashada were the major raw materials used in the study. They were procured according to the *Grahyalakshanas* mentioned in the classics (Figure 1) & authenticated by experts.

Associated Drugs

Kanji, Takra, Kulattha kwatha, Churnodaka were prepared as per the references – AFI Vol-1, 354pg, *Sushruta Sutrasthana* 45/48, *Sushruta Sutrasthana* 2/1 and *Rasa Tarangini* 11/216 respectively. *Gomutra* was collected early in the morning from a healthy cow of local cowshed. *Tila taila* having Agmark was procured from local market.

Equipments

Pitara yantra was used for *Shodhana* of *Vanga, Naga & Yashada*. An iron vessel of 2.5 lit capacity was covered with an iron plate with a hole at the centre. *Khalva yantra* was used for *Bhavana* and *Laghuputa* was applied for *Bhasmeekarana*.

Pharmaceutical processing

All the Pharmaceuticals processes were carried out in Dept. of Rasashastra, JSS Ayurveda Medical College, Mysore, India.

Samanya shodhana of Vanga, Naga & Yashada

Dhalana method was adopted, where in raw *Vanga* was heated in an Iron ladle till it melts completely and then immediately poured into *Kanji*,

Takra, Kulatta kwatha, Gomutra and *Tila taila* through *Pitara yantra*. The process was repeated for 3 times each in five different liquid media, in the successive order and for every *Dhalana* fresh liquid media was taken. The same procedure is followed for the *Samanya shodhana* of *Naga* and *Yashada* also^[9] (Figure 2).

Vishesha shodhana of Vanga^[10], Naga^[11] & Yashada^[12]

Dhalana method was adopted with the liquid media being *Churnodaka* and the procedure was repeated for 7 times each with using fresh *Churnodaka* each time.

Jarana of Trivanga

The *shodhita Vanga, Naga & Yashada* were melted in an iron pan by adding one after the other i.e., *Yashada, Naga & Vanga* in successive order. On molten *Trivanga*, little by little quantity of coarse powder of *Apamargapanchanga* was added and stirring was done continuously with iron ladle (Figure 3). This process was continued till the *Trivanga* converted into powder form, then it was covered with a *Sharava* and heated till the powder became red. After self cooling, *Jarita Trivanga* was added with water, macerated and allowed to settle down over night. The next day morning supernatant water was decanted. The procedure was repeated for 3 days till it attained the pH 7, it was necessitated to remove excess *Kshara*.

Marana

Jarita Trivanga was subjected to *Bhavana* with *Kumari swarasa* and *Parpata kwatha* and when the mixture attained proper consistency, *chakrikas* were made and dried in shade. They were then placed in *Sharavasamputa* and subjected to *Laghuputa*^[13] (Figure 4). The procedure was repeated for 16 times till *Bhasma siddhi lakshana's* were obtained. After 17 *Putra*, the *Bhasma* passed all the tests.

OBSERVATIONS & RESULTS

General purification of *Vanga, Naga & Yashada* was carried out as per *Rasa Tarangini*, where in the order of liquid media and the number of *Dhalana* is different from the classical method. Various observations during general purification are tabulated in Table 1.

Table 1: Observations made during samanya shodhana of Vanga, Naga & Yashada

Liquid media	Kanji	Takra	Kulattha kwatha	Gomutra	Tila taila
pH	3	5	6	8	6
Change in weight of Vanga	11 gms↓	10 gms↓	9 gms↓	12 gms↓	8 gms↓
Change in weight of Naga	12gms↓	9gms ↓	8gms ↓	10gms ↓	13gms ↓
Change in weight of Yashada	13 gms↓	10 gms↓	11 gms↓	14 gms↓	17 gms↓

↓ Decrease in weight

After *Vishesha shodhana*, the *Vanga, Naga & Yashada* were converted to much more brittle state. The medium used for *Shodhana* was *Churnodaka* with pH 10. Final observations of *Samanya* and *Vishesha shodhana* are tabulated in Table 2.

Table 2: Final observations of Samanya and Vishesha shodhana

	<i>Vanga</i>	<i>Naga</i>	<i>Yashada</i>
Weight before Samanya shodhana	500gms	500gms	500gms
Weight loss in Samanya shodhana	50gms	52gms	65gms
Weight after Samanya shodhana	450gms	448gms	435gms
Weight loss in Vishesha shodhana	16gms	18gms	25gms
Weight after Vishesha shodhana	434gms	430gms	410gms

In the pilot study¹ conducted for *Jarana* of *Trivanga* it was observed that when *Trivanga* was taken together in a pan and heated, only *Vanga* got melted but *Naga* & *Yashada* did not melt even after continuous two hours heating. In pilot study², *Yashada* was melted first and later *Naga* & *Vanga* was added, all the three metals got melted easily. As pilot study² was found to be more applicable, this method was adopted. Total Time taken for melting was 50 min and the melted *Trivanga* was silvery white in colour. On adding *Apamargapanchanga churna*, sparks of fire along with smoke was seen & on due course the smoke ceased. Silvery white colour changed to bluish tinge after 1 hour and after 1¾ hour, *Trivanga* was almost converted into powder form with grayish black colour. Total time taken for *Jarana* was 2½ hrs with the usage of total 60gms of *Apamargapanchanga churna*. Out of 600gm of *Trivanga* taken for *Jarana* process, 580gm of *Jarita Trivanga* was obtained.

During *Marana* 500gm of *Jarita Trivanga* was subjected to *Putra* and the process was repeated as there is no reference about the number of *Putras* to obtain the final product. *Kumari swarasa* and *Parpata kwatha* needed in first *Bhavana* was 230ml and 200ml respectively. In subsequent *Putra* quantity of *bhavana dravyas* reduced. The *Chakrikas* found stony hard in 8th *putra*, hence 9th *putra* onwards the amount of cow dung cakes was reduced from ~2.5kg to ~2kg. The average highest temperature noted was 680°C and 595°C respectively (Graph 1 & Graph 2) and the average duration of heat treatment was 7 hours. Finally, 17th *Putra* yielded yellow coloured *Trivanga Bhasma* (Figure 5) passing all the *Bhasmaparikshas* – *Varitara* (Figure 6), *Rekha-purna*, *Unnama*, *Apunarbhava* & *Niruttha*. The observations after each *Putra* are tabulated in Table 3.

Table 3: Observations in each Putra

No of <i>Putra</i>	Colour	Weight of <i>Trivanga</i> before <i>Putra</i> (gms)	Weight of <i>Trivanga</i> after <i>Putra</i> (gms)
1.	Grey	500	550
2.	Grey	550	525
3.	Grey	525	508
4.	Grey	508	490
5.	Straw	490	475
6.	Straw	475	461
7.	Straw	461	450
8.	Straw	450	435
9.	Straw	435	420
10.	Naples yellow	420	406 *
11.	Naples yellow	401	385 *
12.	Naples yellow	380	368 *
13.	Maize	363	347 *
14.	Maize	342	325 *
15.	Maize	320	305 *
16.	Light yellow	300	288 *
17.	Light yellow	283	270 *

*5gm was taken for *Bhasmapareekshas*

In addition, *Bhasma* was also subjected to various conventional methods of analyses like NPST^[14], Ash Value^[15], LOD^[16], AIA^[17], ICPAES etc. at

Central Research Facility, JSSAMC Mysore, India; Ganesh Consultancy Mysore, India; IIT Bombay Powai; India. The results are tabulated in Table 4.

Table 4: Analysis of Trivanga Bhasma

Test	Result
Ash value	98.78%
Acid insoluble ash	7.81%
Loss on drying	1.21%
pH	9
Sulphur	1.44%
Iron	0.33%
Arsenic	1.80%
Particle size	3-9 microns
Lead	24.66 %
Tin	30.48%
Zinc	20.48%
NPST	An orange center with yellow circle, white margin with completely faded brown(Figure 7)

DISCUSSION

Even though the ancient texts of *Rasashastra* have mentioned about *Trivanga Bhasma*, it was observed that *Rasa Chandamshu* is the earliest text to explain the method of preparation.

The concept of *Samanya* and *Vishesh* *shodhana* is mentioned in recent texts of *Rasashastra*. Whether all *Lohas* need to be subjected for either/both of *Samanya* and/or *Vishesh* *shodhana* is not clearly known. In the present study the reference of *Rasa Tarangini* is followed. The concept behind *Shodhana* in different media in specific sequence is notable. It may help to remove both water soluble & fat soluble impurities. Acidic & alkaline pH of these drugs may also play an important role in disintegration of molecules and to reduce the hardness & particle size of the drug. In process of *Dhalana*, heating to complete molten state and then immediate pouring in specific media may affect the reconstruction of the crystals by changing its grain size. It brings laxity/dissociation of molecules and also the intermolecular space of metals is pierced under temperature and pressure. Repetition of heating and cooling causes disruption in compression tension equilibrium, leading to increased brittleness, reduction in hardness and finally reduction in the particle size.

For *Trivanga Jarana*, it is indicated to take all the three *Lohas* together in an iron pan and melt. But in the present study *Yashada* was melted first and later *Naga* & *Vanga* was added in sequence. Based on the observations of Pilot study, melting these three *Putilohas* was achieved easily by following this method. It may be due to melting point of these drugs i.e. zinc-419^o C, lead-327^o C and tin-231^o C. When these metals added together the least melting point drugs melts easily but higher melting point drug does not attain molten state by the same time. Hence the sequence of adding the higher melting point drug first was found better applicable for practical purposes. During *Jarana* the un-desirous volatile substances

which might have remained even after *Shodhana* process may get volatilize and *Jarana* may be equated with roasting & calcination which brings about the fine metallic powder.

Bhavana process involves breakdown of the material by rubbing action i.e. surface phenomena which is called as attrition and this impact produces small particles. For incineration of every material, specific type of *Puti* is mentioned depending on the consistency, melting point and hardness of the material. Heat flow in *Puti* can be explained by the mechanism of conduction as there is a clear temperature gradient between the outer part and inner part of *Sharavasamputa*. Repetition of the process leads to reduction in particle size and brings fineness of the particles. Hence the same process was repeated to achieve the *Bhasmasiddhi lakshanas*.

In 8th *puta*, the *Chakrikas* found stony hard, hence further *Putas* were planned with slight modification because it is predictable that if the heat treatment is excess then there is chance for increase of metallic content in the *Bhasma*. After completion of 9th *Puti*, *Rekhapoorna* test was positive and it indicates the fineness of the particles. After 11th *Puti*, small amount of *Bhasma* was *Varitara*, after 14th *Puti*, maximum particles were *Varitara*. *Varitara* test endorses the lightness of the *Bhasma*. After 17 *Puti*, yellow coloured *Trivanga Bhasma* was obtained and it passed all the tests including *Apunarbhava* and *Niruttha*, these tests authorizes the metal free status of the final product.

CONCLUSION

Pharmaceutical process of *Rasaoushadhis* especially the preparation of *Bhasma* is a unique contribution. *Trivanga Bhasma* is a combination of these metals with various operations like *Shodhana*, *Jarana* and *Marana*. The process of *Jarana* is notable. To attain *Trivanga Bhasma*, which passes all the *Bhasmaparikshas*, *Vanga*, *Naga* & *Yashada* should be subjected to *Samanya shodhana* by *Dhalana* in *Kanji*, *Takra*, *Kulatta Kwatha*, *Gomutra* & *Tila taila*; *Vishesh*

shodhana by *Dhalana* in *Churnodaka* for 7 times; then *Jarana* with *Apamargapanchanga churna* and *Marana* with 17 *Laghuputa*. Analytical study revealed the 24.66% Lead, 30.01 % Tin and 20.48% Zinc content in the obtained *Trivanga Bhasma*.

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Figure 1: Raw materials – Vanga, Naga & Yashada

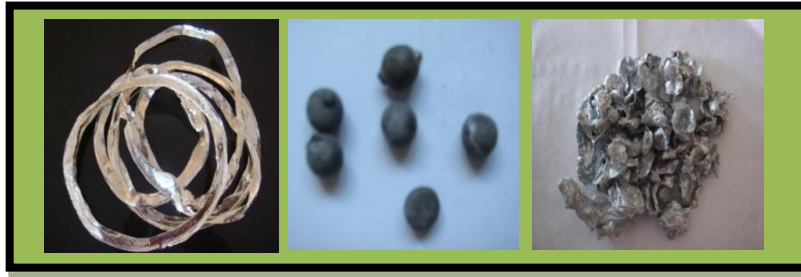


Figure 2: Shodhana – Melting & pouring of Vanga through Pitara Yantra



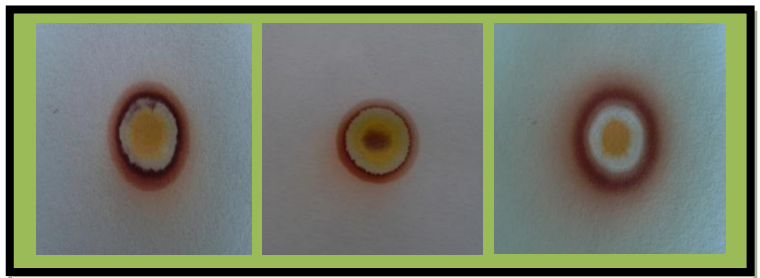
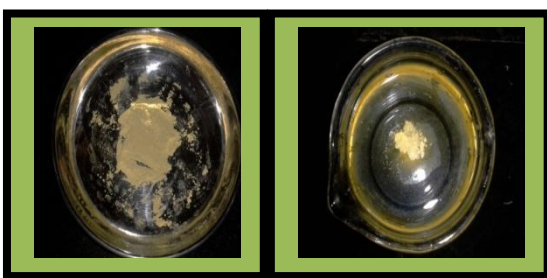
Figure 3: Jarana

Figure 4: Marana



Figure 5: Trivanga Bhasma Figure 6: Varitara

Figure 7: NPST



Graph 1 & 2: Showing temperature pattern

