WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 11, Issue 15, 899-918. Research Article ISSN 2277– 7105

PHARMACEUTICAL STANDARDIZATION AND CHARACTERIZATION OF SVARNA VANGA PREPARED WITH SPECIAL REFERENCE TO RASATARANGINI

Vd. Himanee V. Chaudhari, Vd. Raman S. Belge

[1]P.G. Scholar, Dept. of Rasashastra & Bhaishajya. Kalpana, Shri Ayurved Mahavidyalaya, Nagpur, India.

[2]Professor, H.O.D. & P.G Guide, Dept. of Rasashastra & Bhaishajya Kalpana, Shri Ayurved Mahavidyalaya, Nagpur, India.

Article Received on
05 September 2022,
Revised on 26 Sept. 2022,
Accepted on 16 Oct. 2022
DOI: 10.20959/wjpr202215-26041

***Corresponding Author**
Vd. Himanee V. Chaudhari
P.G. Scholar, Dept. of Rasashastra & Bhaishajya. Kalpana, Shri Ayurved Mahavidyalaya, Nagpur, India.

ABSTRACT

Background: The word *Rasashastra* (the Iatrochemistry of Ayurveda) explains the Science of Mercury specialized in dealing mainly with materials known as *'Rasa dravyaas'* aiming at three characteristic attributes: instant effectiveness, requirement of very small doses and extensive therapeutic utility irrespective of constitutional variation with different types of metallic preparations including *Bhasmas, Pishti, Pottali, Kupipakva* etc. *Kupipakva Rasayanas* are *Rasaushadhis* (herbomineral medicines) prepared by unique pharmaceutical process explained in Rasashastra involve utilization of various attributes like unique heating pattern,constitutional variations and catalyst leading to desired chemical changes and product formation. Svarṇa Vanga (SV) is a novel Kupipakwa Rasayana prepared from Parada (Mercury), Gandhaka (Sulfur), Vanga (Tin), Navasadara (Ammonium Chloride) and Saindhava Lavaṇa (Rock salt) mainly indicated in Madhumeha (diabetes mellitus), Shwasa (respiratory disorders), Pradara (menorrhagia), and as a Vruṣhya (aphrodisiac). **Aim and Objectives:** To study and establish the standard manufacturing processes for *Svarṇa Vanga* (SV) through in process standardization of three batches. **Materials and Methods:** SV was prepared in three batches viz. SV1, SV2 and SV3. This was done to establish a standard operating procedure for preparing SV, *Shodhita Vaṅga* was melted and triturated with *Shodhita Parada* (mercury) to form an amalgam. After amalgamation *Saindhava Lavaṇa* was mixed and levigated with *Nimbu Swarasa* and washed thoroughly. *Shuddha Gandhaka* (Sulfur)

and *Navasadara* (Ammonium chloride) were added after being dried and ground into a fine powder. The *Kajjali* thus formed was filled in *Kupi* and proceesed for gradual heating in *Valuka Yantra* for 21.30 hrs. On self cooling, the product formed at the bottom of the *Kupi* was collected. Organoleptic parameters of SV were analyzed and tabulated. **Results and Conclusion:** SV is a *Talastha Kupipakwa Rasayana*. It requires *Mṛudu* (<250 C) and *Madhyama Agni* (250-500 C) for a period of 9 h each to prepare SV in three batches with 32.08%, 33.4%, 32.3% yeild respectively.

KEYWORDS: Ayurveda, *Kupipakva Rasayana*, standardization, *Swarna Vanga*.

INTRODUCTION

The word *Rasashastra* (the Iatrochemistry of Ayurveda)literally means the "Science of Mercury" is a specialized branch of Ayurveda dealing mainly with materials which are known as '*Rasa dravyaas*' having the following three characteristic attributes: instant effectiveness, requirement of very small doses and extensive therapeutic utility irrespective of constitutional variation with different types of metallic preparations *including Bhasmas, Pishti, Pottali, Kupipakva* etc.[1] *Rasaushadhis* [Metallic / mineral preparations] which are further classified in four categories as *Khalvi Rasa, Parpati, Pottali Kalpa*.[2] *Kupipakwa Rasayana* have an edge over other Ayurvedic preparations due to their miraculous effects on chronic ailments, rapid action and low dose.[3][4]

*Kupi*pakwa Rasayana

The etymology of *Kupipakwa Rasayana* is understood by a verse-"*Kupyam Agninam Pakwam Yadrasaayanam Tat Kupipakwa Rasayanam*".[5] The terminology '*Kupipakwa*' itself denotes the pharmaceutical processing that is involved in these preparations by heating in *Kupi* (glass bottle) by subjecting into a gradually raised temperature in a specific heating yantras like *ValukaYanta*/Furnace. *Rasasindura*[6] *Mallasindura*[7], *Samirapannaga Rasa*[8], and *Svarṇa Vanga*(SV) are few therapeutically potent and widely used formulations prepared by *Kupipakwa* method.

The formulation *Svarna Vanga*[9] is a *Murchita Parada Yoga* which comes under classification of Sagandha, Talastha, Kupipakwa Rasayana. SV is Talastha Kupipakwa Rasayana (obtained at bottom of Kupi)prepared by the combination of Vaṅga (Tin), Parada (Mercury), *Gandhaka* (Sulfur), and *Navasagara* (Potassium chloride) in equal quantity and processing done by *Kupipakva* method *in Valukayantra*. Being named as per the appearance

of the final product, which is bright golden yellow in a color similar to that of gold, is indicated in *Prameha* (diabetes mellitus), *Netra Rogas* (eye disorders), *Medo roga* (obesity) and *Sukra Kṣhaya* (oligospermia), etc.

Chronology of Swarna Vanga

Svarna Vanga was firstly explained by the *Rasaprakash Sudhakar* by the name *Rasavanga*.[10] Described as one of the types of Vanga Bhasma prepared by Kupipakwa method. In 18 century AD Govind Das Sen author of Bhaishajya Ratnavali mentioned this Rasakalpa by the name Svarna Vanga for the first time. References regarding SV can be found in Rsayogsagara, Bharat Bhaisajya Ratnakara, Bhaisajya Ratnavali, Rasatarangini, Bharat Bhaisajya Ratnakara and Siddha Prayog sangraha.

Table 1: Different references of *Svarna Vanga rasa*.

Sr. No	Name	Reference	Agni in Hours	Ingredients
1.	*Vangeshwar*[11]	*Rasayogsagar*	4	Parada,Vanga – 1 Part each
2.	*Vangeshwar*[12]	*Rasayogsagar*	12	Parada,Vanga, Gandhaka – 1 Part each
3.	*Mrugankarasa*[13][14]	*Rasayogsagar*	1	Parada-1 part, Vanga- 1 part, Gandhak 1 part, Navasagar 1 part,Saindhava
4.	*Peetamriganka rasa*	Rasayogsagar		Parada 1 part, Vanga 1 part, Gandhaka 1 part, Navasagar 1 part
5.	*Vangeshwar rasa*[15][16]	*Bha.Bh.R*		Parada,Vanga, Gandhaka - 1 Part each
6.	*Svarna Vanga*[17]	*Bhartiya rasashastra*		*Parada-6 part* *Vanga* 12 part, *Gandhak*a 7 part, *Navasagar* 6 part
7.	*Swarnarajvangeshwar*[18]	*Rasayogasagar*		*Parad*a 1 part, *Gandhak*a 4 part,Swarna bhasma ½ part, Mukta bhasma ½ part, Naag bhasma 1 part, Kant bhasma 1 part, Marich 1 part, *Vanga* 2 parts
8.	*Swarnarajvangeshwar*[19]	*Bhaishajya ratnavali*	4	*Parad*a, *Vanga*, *Gandhak*a, *Navasagar* 1 part each
9.	*Svarna Vanga*[20]	*Rastarangini*	4	*Parad*a, *Vanga*, *Gandhak*a, *Navasagar* 1 part each
10.	*Svarna Vanga*[21]	*Rastarangini*	4	*Parada-6 part* *Vanga* 12 part, *Gandhak*a 8 part, *Navasagar* 6 part
11.	*Svarna Vanga*[22]	*Rasatantrasar* and *siddha prayog sangraha*	4	*Parada-5 part* *Vanga* 5 part, *Gandhak*a 5 part, *Navasagar* 4 part, *Kalmisora* 1 part

Table 2: Various names of svarana*vanga* mentioned in Rasagranthas.

Sr no	Name of Rasagrantha	Yog
1.	*Rasaprakash Sudhakar*[23]	*Rasavanga*
2.	*Bhaishajya Ratnavali*	*Svarna Vanga*
3.	*Brihat Rasarajsundara*[24]	*Maskamruganka Rasa*
4.	*Rasatarangini*[25]	*Svarna Vanga*
5.	*Rasayog sara*[26]	*1.Mruganka rasa* *2. Pita Mruganka rasa*
6.	*Bharat Bhaishajya Ratnakar*	*1.Maskamruganka Rasa* *2.Swarnrajvangeshwar*
7.	*Rasa tantra sara*	*Svarna Vanga*
8.	*Siddha Bhaishajya manimala*[27]	*Lagu mruganka rasa*
9.	*Kupipakwa rasa nirman vidnya*[28]	*Svarna Vanga*
10.	*Rasamruta*[29]	*Svarna Vanga*
11.	*Rasendra sampradaya*	*Svarna Vanga*
12.	*Rasendra vidnyan*	*Svarna Vanga*
13.	*Ayurveda saar sangraha*[30]	*Svarna Vanga*
14.	*Ayurvediya Rasashastra*	*Svarna Vanga*

There is an ever-increasing concern pertaining to safety aspects of metals and mineral; has developed the need to produce “standardized formulations”. Drugs from traditional medicine many a time do not qualify 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. This will certainly ensure safety to a great extent in pharmacological trials. A number of works regarding pharmaceutical standardization, Toxicity and efficacy studies of SV have been attempted.[31] Only a few of them are published Although a number of works have been carried out on standardization of SV at laboratory level, no published data are available for citations. This study is an attempt to formulate standard manufacturing procedure of *Svarṇa Vanga* (SV) and to develop its organoleptic standards.

MATERIALS AND METHODS

The pharmaceutical synthesis of SV was performed in a set of three batches viz. SV1, SV2, SV3.

Collection of raw materials

Vaṅga (Tin), Parada (mercury), Gandhaka (Sulfur), Navasagar (Ammonium Chloride), and Saindhava Lavaṇa (Rock salt) were procured from the local market and authenticated as per standards mentioned in the ancient texts of Rasashastra.

MATERIALS

Khalva yantra (Iron mortar and pestle measurement), *Kupi* (glass bottle coated with seven layers of mud-smeared cloth, capacity: 750 ml), *Valuka Yantra,* Mudra (cork), Ushna Shalaka, Sheeta Shalaka. were procured as per requirement.

METHODS

Vanga[32], *Parada*[33], *Gandhaka*[34], and *Navasagar*[35] were purified as per classical guidelines. The preparation of SV was divided into three stages, namely, preoperative (*Purvakarma*), operative (*Pradhanakarma*) and postoperative (*Paschatkarma*) stages. SV was subjected to various organoleptic analysis.

Purvakarma

1. Preparation of amalgam[36]

Shuddha Vanga was melted and mixed with *Shuddha Parada* in Khalwa Yantra and immediately and vigorously tritruated to form uniform semisolid silver coloured amalgam. This amalgam was levigated in *Nimbu Svarasa* and later *Saindhava Lavana* was added. Trituration was carried out thoroughly and the triturate was washed with lukewarm water. *Shuddha Gandhaka* was added with above amalgam and triturated until the formation of *Kajjalī* (lusterless fine powder). Thus, formed *Kajjali* was triturated with *Navasagara* and filled in *Kupi* (coated with seven layers of mud smeared cloth).

2. *Kupi*sthapana[37]

*Kupi*sthapana was done in Valukayantra with the distance of one Angula from the base and remaining part of the yantra was filled with sand up to the neck of the *Kupi*. Pyrometer was placed at the bottom of *Kupi* in *Valuka Yantra*.

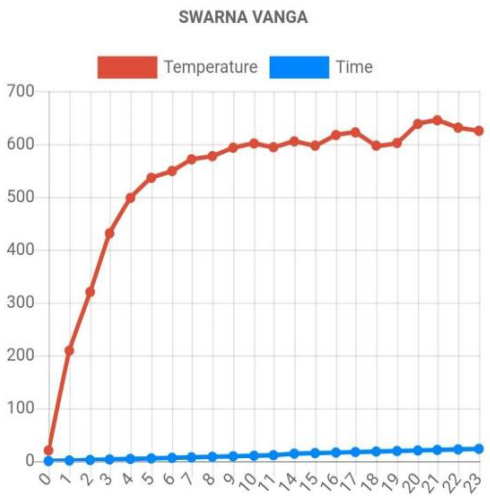
Table 1: Ingredients and observations during preparation of SV *Kajjali.*

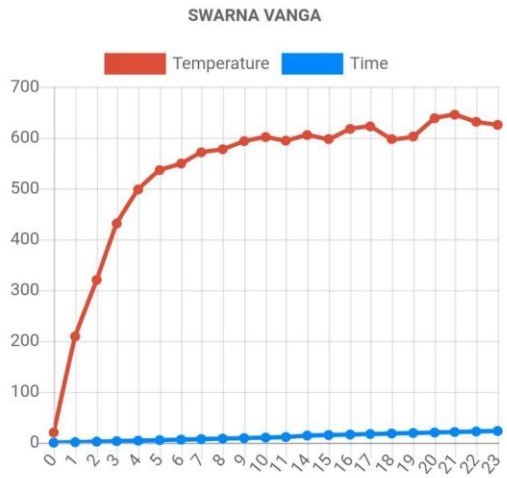
Ingredients	Batch 1	Batch2	Batch 3
Shuddha Parada	50g	50g	50g
Shuddha Vanga	50g	50g	50g
Saindhav	50g	50g	50g
Nimbu Svarasa	100ml	100ml	100ml
Amalgamation	96g	93g	95g
Shuddha Gandhaka	50g	50g	50g
Shuddha Navasagar	50g	50g	50g
Final output of Kajjali	187g	187g	190g

Pradhanakarma[38]

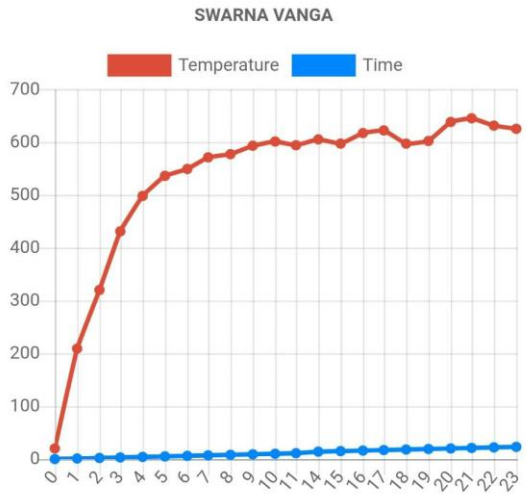
Preparation of SV was carried out in *Valuka Yantra* using *Kupi* Pakwa method with *Kramagni* (Gradually increasing temperature pattern)that is approximately 6-8hrs of Mruduagni, 6-8hrs of *Madhyama Agni*,6-8hrs of *Tivragni* respectively (Table 4,5,6)(Graph 1,2,3). Temperature reading was carried out at regular intervals of 30 min. Heat was increased gradually and regulated as per requirement.(TABLE2). Neck of *Kupi* was cleared of accumulation of *Parad* and *Navasagara* using *Usnashalaka Sanchalana* as required. After observation of the *Siddhilakshanas* (confirmative tests) and complete cessation of *Gandhaka* and *Navasagar* fumes, the mouth of the *Kupi* was corked and *Tivragni* was started.

Graph 1- Temperature graph of SV





Graph 1.Temperature pattern of SV1. **Graph 2.Temperature pattern of SV2.**



Graph 3: Temperature pattern of SV3.

Pashchat Karma

Kupi was left for self-cooling, layers were scraped and *Kupibhedana* (breaking of bottle) was done carefully. SV obtained at the bottom of the *Kupi* was carefully collected and weighed.

OBSERVATIONS AND RESULTS

Different stages during the process like *Gandhaka* and *Navasgara* fuming, melting of *Kajjali*, flaming, confirmative test for completion of product formation such as flame disappearance, *Shita Shalaka* test, etc., were observed and recorded (Table no 2,3,4). *Shita Shalaka* test was taken by using an iron spoke measuring 30 cm in length and 0.2 cm in diameter. This test was taken at 583 C temperature after 16.45 h of heating. *Shita Shalaka* was slowly inserted up to 20 cm in the bottle and then slowly withdrawn. Adhesion of yellow particles on the lower part of *Shalaka* indicated proper formation of SV. Corking was done at 16.45 h and was subjected to *Tivragni* for 5 h.

After *Kupi* Bhedana, *Svarṇa Vanga* (SV) was collected from the bottom of the *Kupi* from all the batches were weighed and calculated for the percentage of absolute and relative yield (Table. SV was subjected to organoleptic analysis result obtained is depicted in Tables 5 and 6.

Table No. 2: Temperature chart of SV-Batch 1.

Time from starting of heating	Temperature in Celsius	Observations	Time	Temperature in Celsius	Observations
0.00	20	Started	11.30	600	*Sheetashalaka sanchalan*test – Slight golden and ash colour particles can be seen sticking towards the base of *shalaka*
0.30	126	-	12.00	605	
1.00	209	-	12.30	606	*Taptashalaka sanchalan* showed white and yellow fumes
1.30	244	-	13.00	599	Yellow fumes slightly diminished.
2.00	320	Mild white fumes seen.	13.30	597	
2.30	398	Ammonia smell started	14.00	606	
3.00	431	Ammonia smell started	14.30	617	
3.30	469	Ammonia smell started	15.00	622	Yellow fumes diminished .
4.00	498	Yellow fumes seen	16.00	622	Yellow fumes diminished considerably.
4.30	522	Yellow fumes seen	16.30	598	Yellow fumes stoped considerabily.
5.00	536	Yellow fumes seen	16.45	583	No fumes are visible . Sheetashalaka test was taken .Corking done
5.30	545	Slight yellow fumes can be seen	17.00	579	
6.00	549	Slight yellow fumes can be seen	17.30	584	
6.30	558	Slight yellow fumes can be seen	18.00	602	
7.00	571	Slight yellow fumes can be seen	18.30	622	
7.30	573	Slight Kantha Avarodha	19.00	638	
8.00	575	*Tapta Shalaka sanchalan*test.	19.30	644	
8.30	580	*Tapta Shalaka sanchalan*test.	20.00	645	
9.00	593	*Tapta Shalaka sanchalan*test.	20.30	641	
9.30	598	*Tapta Shalaka sanchalan*test.	21.00	631	
10.00	601	*Tapta Shalaka sanchalan*test.	21.30	625	Heating Stopped
10.30	597	*Tapta Shalaka sanchalan*test.			
11.00	594	*Tapta Shalaka sanchalan*test.			

Table No. 3: Temperature Chart Of Sv-Batch 2.

Time from the starting of Heating (Hours)	Temperature in Celsius	Observations
0.00	25	Started
0.30	130	
1.00	210	
1.30	250	
2.00	310	Mild white fumes seen.
2.30	390	Ammonia smell started
3.00	450	Ammonia smell started
3.30	471	Ammonia smell started
4.00	499	Yellow fumes seen
4.30	525	Yellow fumes seen
5.00	536	Yellow fumes seen
5.30	545	Slight yellow fumes can be seen
6.00	550	Slight yellow fumes can be seen
6.30	561	Slight yellow fumes can be seen
7.00	571	Slight yellow fumes can be seen
7.30	573	Slight yellow fumes can be seen
8.00	577	*Taptashalaka Sanchalan* test.
8.30	580	*Taptashalaka Sanchalan* test.
9.00	594	*Taptashalaka Sanchalan* test.
9.30	598	*Taptashalaka Sanchalan* test.
10.00	603	*Taptashalaka Sanchalan* test.
10.30	591	*Taptashalaka Sanchalan* test.
11.00	594	*Taptashalaka Sanchalan* test.
11.30	602	*Sheetashalaka sanchalan*test –Slight golden and ash colour particles can be seen sticking towards the base of *shalaka*
12.00	605	*Taptashalaka Sanchalan* test.
12.30	609	*Taptashalaka sanchalan* showed white and yellow fumes
13.00	599	Yellow fumes slightly diminished.
13.30	597	Yellow fumes slightly diminished.
14.00	610	Yellow fumes slightly diminished.
14.30	617	Yellow fumes slightly diminished.
15.00	625	Yellow fumes diminished .
16.00	625	Yellow fumes diminished considerably.
16.30	599	Yellow fumes stoped considerabily.
16.45	583	No fumes are visible . Sheetashalaka test was taken .Corking done
17.00	580	
17.30	583	
18.00	602	
18.30	622	
19.00	638	
19.30	644	

20.00	645	
20.30	641	
21.00	631	Heating Stopped

Table No 4.Temperature chart of SV-Batch 3.

Time from starting of Heating (hr)	Temperature in Celsius	Observations
0.00	28	Started
0.30	129	
1.00	211	
1.30	248	
2.00	300	Mild white fumes seen.
2.30	342	Ammonia smell started
3.00	444	Ammonia smell started
3.30	469	Ammonia smell started
4.00	497	Yellow fumes seen
4.30	520	Yellow fumes seen
5.00	534	Yellow fumes seen
5.30	544	Slight yellow fumes can be seen
6.00	550	Slight yellow fumes can be seen
6.30	563	Slight yellow fumes can be seen
7.00	570	Slight yellow fumes can be seen
7.30	575	Slight yellow fumes can be seen
8.00	578	*Taptashalaka sanchalan* test.
8.30	588	*Taptashalaka sanchalan* test.
9.00	590	*Taptashalaka sanchalan* test.
9.30	599	*Taptashalaka sanchalan* test.
10.00	600	*Taptashalaka sanchalan* test.
10.30	598	*Taptashalaka sanchalan* test.
11.00	593	*Taptashalaka sanchalan* test.
11.30	601	*Sheetashalaka sanchalan*test –Slight golden and ash colour particles can be seen sticking towards the base of *shalaka*
12.00	604	*Taptashalaka sanchalan* test.
12.30	610	*Taptashalaka sanchalan* showed white and yellow fumes
13.00	595	Yellow fumes slightly diminished.
13.30	597	Yellow fumes slightly diminished.
14.00	609	Yellow fumes slightly diminished.
14.30	620	Yellow fumes slightly diminished.
15.00	623	Yellow fumes diminished .
15.30	622	Yellow fumes slightly diminished.
16.00	623	Yellow fumes diminished considerably.
16.30	600	Yellow fumes stoped considerabily.
16.45	588	No fumes are visible . Sheetashalaka test was taken

		.Corking done
17.00	585	
17.30	583	
18.00	604	
18.30	625	
19.00	640	
19.30	645	
20.00	646	
20.30	643	
21.00	638	
21.30	630	
22.00	640	Heating Stopped

Table 5: Yeild of SV.

Batches	Weight of *Kajjalī* (g)	Weight of product (g)	Yield %
1	187	59.8	32.08%.
2	187	62.4	33.4%
3	190	61.3	32.3%

Table 6: Results of organoleptic tests.

Shabda	*Nishabda*
Sparsha	*Mrudu*
Rupa	*Swarnavat*
Rasa	*Niswadu*
Gandha	*Nirgandha*

DISCUSSION

SV is a *Talastha Kupipakva Rasayana* (a preparation in which product is obtained at the bottom of a glass bottle). Accordingly the SV preparation was completed in average of 21 h. Initialy *Shuddha Vanga* was melted in an iron ladle and was poured into a mortar containing *Shuddha Parada*. The mixture was triturated in the presence of *Nimbu Swarasa* for 15-20 min to form amalgam which was silvery white in color. Addition of *Saindhava Lavana* transformed the mixture in blackish colour which was further washed with lukewarm water until it became devoid of blackish discoloration. Mixture was triturated with *Shuddha Gandhaka* for about 18 h until the formation of complete lusterless *Kajjalī*. Addition of *Navasagar*[39] was done just before initiation of *Kupi Paka* process and triturated for 1 h. *Navasagar* being hygroscopic in nature, if added earlier moistens the *Kajali*. While heating at a temperature of 126-360 C, initially white fumes were seen, in the course of time, dense white fumes followed by yellow fumes were observed White fumes adjudged by typical ammonia smell were of *Navasagara*, whereas yellow fumes are that of sulfur. At temperature 380-410 C profuse, thick white and yellow fumes were seen followed by choking at the neck

was observed caused by *Navasagara* being deposited at the neck of the bottle. Rigorous and intermittent probing by hot iron was carried out during this period to avoid choking of *Kupi* by *Navasagara*.

Completion of the process was adjudged by *Shita shalaka* test, whereby; its coating appears white, initially, indicating presence of *Navasagar* followed by black indicating presence of *Gandhaka* and finally a golden tinge indicating formation of the finished product. However, repeated probing of *Shita shalaka*[40] was avoided as it alters the overall appearance of the finished product which is vital to procure a quality product. *Kupi* was broken [Figures}after cooling naturally as it plays an important role for proper crystallization of the final product.Chemically, SV[41] is stannous sulfide SnS_2 having mosaic gold appearance.

Discussion on the importance of ingredients in the preparation of *Svarna Vanga*

1. *Vanga*[42][43]

It is the important ingredient of *Svarna Vanga*. As the final product formed is Tin sulphide. If we consider the rasa, guna, panchabhautika constitution during the *Kupipakwa* procedure, they are dominated with agni and vayu mahabhuta which must have been helpful in breaking down the compact molecular structure of the *Vanga* dhatu resulting in decreasing the hardness.

2. *Parada*[44][45]

*Parad*a plays the role of catalyst in the preparation of *Svarna Vanga*.

As Rasaacharyas mentioned.

*Parad*a has property to amalgamate all metals in it. And it has capacity to divide the metal into fine particles, so that the metal gets favourable condition to react with other components. Similarly in *Svarna Vanga*, mercury mixed with tin divides it into very fine particles. Thus it is exposed to maximum surface area to react with sulphur and get converted into tin sulphide compound.

3. *Gandhak*a[46][47]

It is also important ingredient of *Svarna Vanga* along with *Vanga*.

It is useful for *Parad*a Bandhana, *Vanga Marana* and colouration of final product.

4. *Navasagara*[48]

Similar to *Parad*a, *Navasagara* also acts as a catalyst in the preparation of *Svarna Vanga*.

It helps to motivate chemical reaction necessary to convert tin into tin sulphide.
Also plays role in maintaining the temp. inside *Kupi*.

Chemical reaction during SV preparation

1.Preparation of *Kajjali*-Amalgamation of *Shodhita Parada* and *ShodhitaVanga*

It was discovered that when molten Vanga was added to Parada, the Parada lost its consistency and quickly blended with the Vanga. The surface tension of mercury molecules is reduced as a result of trituration in the Khalva Yantra leading to crystallisation process. The probable reaction may be[49]

Hg + Sn ---→ Hg--O—Sn complex

Addition of *Gandhaka* to *Vanga Parada Pishti*

Grey coloured amalgamated mixture (600g) & Purified *Gandhaka* (400g) were taken in *Khalva Yantra* and triturated.

Within half an hour *Gandhaka* got completely mixed with above *Pishti* and After 12 hrs, the distinctive colour change was observed from dark grey to greyish black colour, indicative of the physical bonding of *Gandhaka* and *Dhatu Pishti* is in progressive state. This may indicate chemical bond formation and reduction of free mercury.[50] The reaction may be.

Hg—O—Sn complex + S S—Hg—O—Sn complex

Addition of *Navasagara* to above *Parada, Vanga, Gandhaka* mixture

Navasagara was added and triturated well. The colour changes from greyish black to Black. The reaction may be.

S—Hg—O—Sn complex +2 NH_4Cl =Homogenous mixture (Kajjali) $SnCl_2$ +
$2NH_3$+ HgS + SnO

Here the *Navasadara* acting as catalyst may help in potentiating the final product. This mixture was triturated up to 6hrs transforming in homogenous mixture. After positive *Nishchandratwa* test indicative of along with the physical bonding and chemical bonding might have taken place and reduction of free mercury in *Kajjali.*

2. Preparation of Swarna Vanga

The system of applying *Kramagni* or ladder step heating procedure is recommended to give uniform slow and steady rise in temperature which is initially gradual increase, then maintenance of the same temperature for specific time, followed by gradual decrease and

finally cooling to room temperature. This heating pattern helps provide sufficient time for the ingredients to react with each other and form a complex compound under pressure.

The following observations were noted.

1. Appearance of Slight white fumes with smell of ammonia: After 1.30 hr of heating there was slight white fumes with ammonic smell found inside of *Kupi*, may be due to liberation of Ammonia gas during heating procedure.
2. Appearance of dense white fumes inside the *Kupi*: After 2hrs of heating the white dense fume were found inside the *Kupi* with sulphur smell, it may be due to evaporation of SO_2, (Melting point of Sulphur is 118 ^{0}C).
3. Thickening of sulphur fumes: sulphur starts forming long polymer chains and thus its viscosity increase and it appear with thick yellow fumes.
4. Deposition of White particles: After 3 hrs of heating, Whitish colour particles were deposited around the neck of *Kupi*, it may be due to the deposition of *Navasadara*. Because on heating ammonia dessociates into ammonium and hydrochloric acid.
5. *Shalaka Sanchalana*: During the procedure 2 types of *Shalaka* were used.

1. Hot *Shalaka*- to burn extra Sulphur and *Navasadara* deposited at the neck region of *Kupi.* The smell of ammonia & sulphur were found. This may be due to Sulphur which burns readily in air, with a low blue flame, and gives choking fumes of sulphur- dioxide - acrid odour (forms sulphurous and eventually sulphuric acid in air) and ammonia smell may be due to evaporation of ammonia gas.
2. *Sheeta Shalaka*- to know the state of *Kajjali* i.e. whether it is in powder form, melted form or boiling, sublimation and also to identify colour of the product

6. Melting of *Kajjali:* After 6 hrs of heating, *Kajjali* got completely melted. In this stage of heating, Vanga along with *Gandhaka, Parada, Navasagara* melts. The melting point of *Vanga* is 231℃ and that of *Navasadara* is 338℃
7. Chocking of sulphur at the neck: Chocking of the narrow neck of the bottle is observed, because of increased chain reactions and formation of polymorphs of sulphur. This sulphur becomes more viscous and produces dense fumes and along with *Navasadara* which consticts the narrow neck of the bottle.
8. Boiling of *Kajjali*: At this moment, *Kajjali* is approaching its boiling point and is ready to sublime; this is the stage at which *Kajjali* transitions from a semisolid to a gaseous state and begins which further migrate towards the cool section of *Kupi*. Complete burning of sulphur was confirmed by following tests Cessation of fumes and flame when cold *Shalaka* was

introduced inside the bottom of the *Kupi* and product was taken, it was golden yellow in colour. This test showed the *Siddhi Lakshana* of *Svarna Vanga*.

Possibly these reactions may be formed by heating a mixture of tin, sulphur and ammonium chloride in glass bottle, a stannate and thiostannate is formed.

$Sn + 4NH_4Cl = (N\ H_4)_2\ SnCl_4 + H_2 + 2Nh3$

$2(N\ H_4)2SnCl_4 + 2S = SnS_2 + (N\ H_4)2\ SnCl_6 + 2N\ H_4Cl$

3. Applicable Theories behind this *Kupipakwa Rasayana*

The different concepts of chemistry which can be applied to know the mechanisms occuring in *Kupipakwa Rasayana* process are as follows.

Transition State theory[52][53]

Transition State explains the rate of reaction in terms of formation of a transition state of reacting molecules. The formation of transition state requires energy of activation. The activated transition state complexes can convert into products. i.e. The old bonds break first to form the transition state activated complex and then the new bonds form resulting into product.

In *Swarna Vanga*, the probable reaction by Transition theory may be

Hg + S + SnO + 2NH 4Cl Sn-S + Sn-Cl + NH_3 + H-Cl+ SO_2 SnS_2 + $SnCl_2$

Reactant Transitional state Products

Law of definite proportion[54]

Law of definite proportions states, The essential law of chemical combination asserts that any specific compound always contains the same elements in the same proportions by weight; and if two or more elements combine to produce more than one compound, the relative proportions of each are fixed. The ultimate product of Swarna Vanga will have the same proportion of Tin and Sulphur as the raw material.

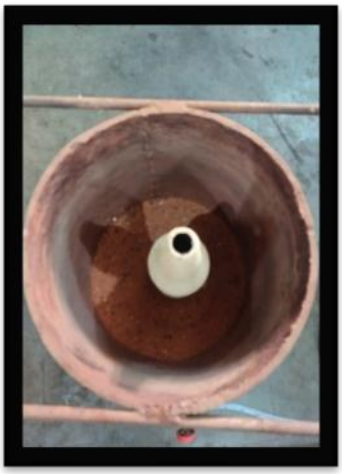
CONCLUSION

Thus, Swarna Vaṅga is a *Murchita Parada Yoga* which comes under the classification of *Sagandha, Talastha, Kupipakwa Rasayana* and can be prepared by following 21.30 hours, 20.00hours, 22.00 hours of heat, with yield of 32.08%, 33.4%, 32.3% respectively.

Formation of *Svarna Vanga*

Amalgam formation

***Kajjali* Formation**



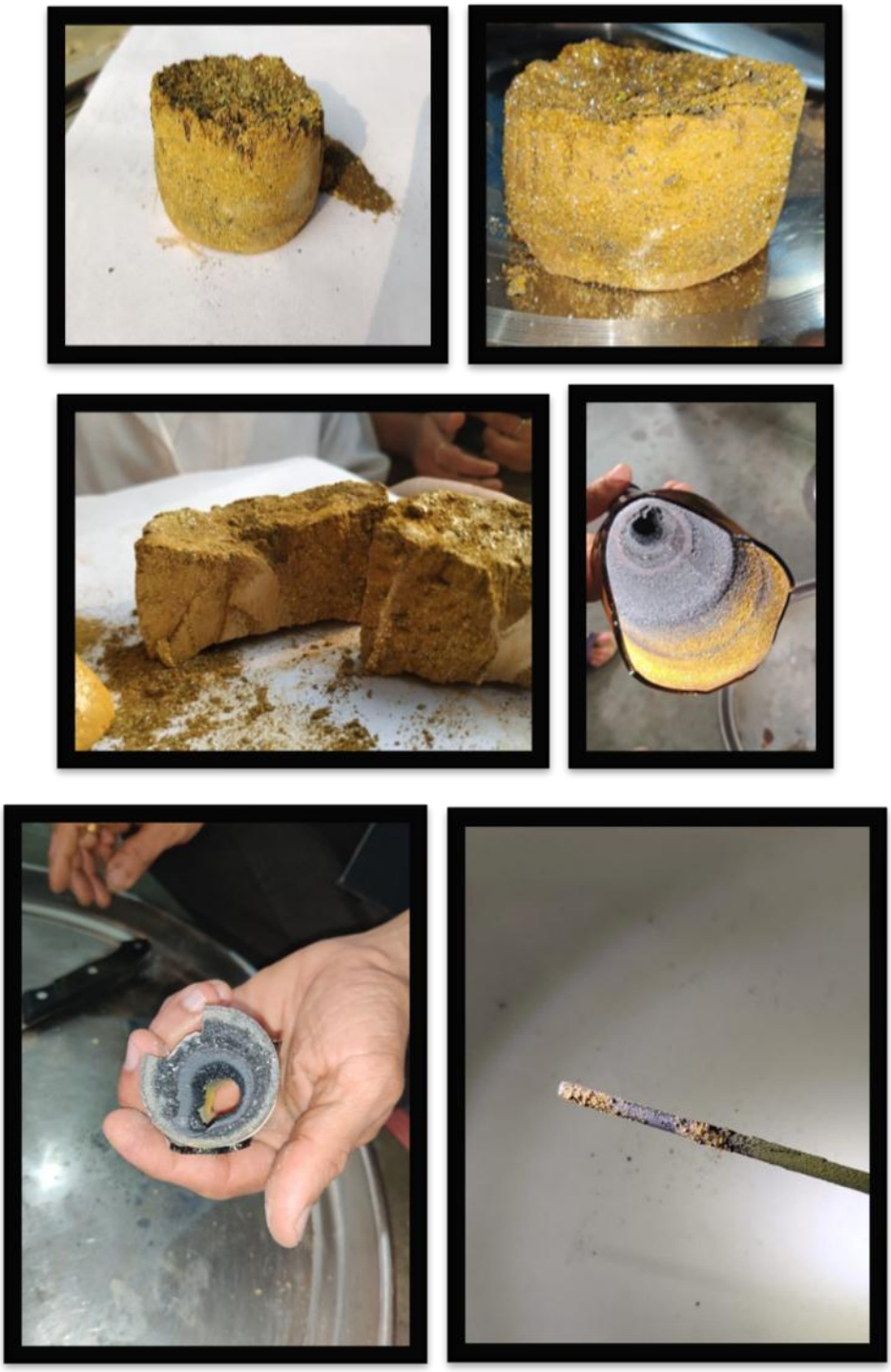
Porvakarma –Preparation of *Kupi*,

***Kupi* Stapana**

Corking

***Kupi* Bhedana**

Svarna Vanga



Vanga Sindoor **Golden particles on *Sheetashalaka Sanchalan***

REFERENCES

1. Somadev, Rasendra Chudamani, 1/33, 3rd ed, Chaukhamba Orientalia, Varanasi, 2004; 9.
2. Madhava, Ayurveda Prakasha, 1/137, Chaukhamba Bharati Academy, Varanasi, 2007; 80-1.

3. Dwivedi V. Bharateeya Rasashastra. 2nd ed., 8. Nagpur: Shri Sharma Ayurved Mandir, 1987; 224.
4. Singh SK, Chaudhary AK, Rai DK, Rai SB. Preparation and characterization of a mercury based Indian traditional drug Rasasindoor. Indian J Tradit Knowl, 2009; 8: 346-57.
5. Bhoyar, M.S., Khiyani, R.M. (2014). Conceptual And Pharmaceutical Review of *Kupi*pakva Rasayana. Int. J. Ayu. Alt. Medi, 2(4): 7-13.
6. Rasendra Purana, Hindi Commentory Ramaprasad Vaidya, Khemaraja ShriKrishnadas Publication, Mumbai, 3/163-168, 2000; 89-90.
7. Pandit Sharma Hariprapanna, Rasayana sangraha (Rasayogasagara) Choukhambha Krishna Das Academy, Varanasi, Re Edition, 2010; shloka no 2390: 157.
8. Anonyms. 2nd revised ed. New Delhi: New Delhi, Department of Health and family welfare, Department of AYUSH, Govt. of India; 2009. Ayurvedic Formulary of India. Part 1. Section 15/8; p. 212.
9. Kashinath S. Sadananda Sharma's Rasa Tarangini. 18/68-73. Delhi: Motilal Banarasidas, 2004; 449.
10. Sharandhar, Rasaprakash sudhakara, Chaukhamba Publication, Varanasi, chapter 4, verse 86-95, pp 83.
11. Vd. Hariprapannaji, Rasayogasagar, Chaukhamba publication, Part 2 336,p 322.
12. Vd. Hariprapannaji, Rasayogasagar, Chaukhamba publication, Part 2 337,p 322.
13. Vd. Hariprapannaji, Rasayogasagar, Chaukhamba publication, Part 2 603,p176.
14. Vd. Hariprapannaji, Rasayogasagar, Chaukhamba publication, Part 2 604,p 176.
15. Nagin Das Chandan Das Saha, Bharat Bhaishajya Ratnaka, Chaukhamba publication, Volume 4, slok 6922, p709.
16. Nagin Das Chandan Das Saha, Bharat Bhaishajya Ratnaka, Chaukhamba publication, Volume 4, slok 6921, p709.
17. Dr. Vaman Ganesh Desai, Bhartiya Rasashastra, new printing press, p375.
18. Vd. Hariprapannaji, Rasayogasagar, Chaukhamba publication, Part 2 336, p 350.
19. Govinda Das, edited by Rajeshwar Dutta Shastri, Bhaisajya Ratnavali: 14/222 Chowkhambha Sanskrit Series, Varanasi, Prameharogadhikara, pg no 172.
20. Kashinath S. Delhi: Motilal Banarasidas; 8/68-73 Sadananda Sharma's Rasa Tarangini. 1; 2004; p. 449.
21. Kashinath S. Delhi: Motilal Banarasidas; 8/68-73 Sadananda Sharma's Rasa Tarangini. 1; 2004; p. 450.

22. Vd Krishna Gopal, Rasa Tantrasara Siddha prayogsangraha, Krishna gopal Trust, Varanasi, p232.
23. Acharya Yashodhara Bhat, Rasapraksh Sudhakar, Ayurveda Garanthamala publication, Varanasi.
24. Rasa raj sundar, prameha prakarana. Pandit Shyamsundaracharya vaidya, Rasayanasara, 1st part, shyamsundar-rasayanashala, Dhatushodhana-marana prakaran, verse 161-167. pp319-322.
25. Guleria Praveen & Chandla Anubha: Standardisation In Ayurveda - Ancient Vis-A-Vis Modern Perspective. International Ayurvedic Medical Journal {online} 2017 {cited July, 2017}
26. Shrivaidyapatisinhagupta Sunuvagabhattacharya; Rasaratnasamucchaya; 5/154; edited by proff. Dattatreya Anata Kulkarni; Meharchanda Lachmandas publication new Delhi, 2006; p-123.
27. Vd. Hariprapannaji, Rasayogasagar, Chaukhamba publication, Part 2 336, p 322.
28. Vd Harishranand, *Kupi*pakwa Nirman Vigyan, Varnasi publication, p234.
29. Vd.Yadavji Trikamji, Rasamrita, Motilal banarasidas publication, Varanasi.
30. Ayurveda Sara samgraha, Baidyanath Ayurveda Bhavan, Seoni, Maharshstra, p353.
31. Shrivaidyapatisinhagupta Sunuvagabhattacharya; Rasaratnasamucchaya; 5/13; edited by proff. Dattatreya Anata Kulkarni; Meharchanda Lachmandas publication new Delhi, 2006; p-93.
32. Mishra Siddhi Nandan, Translator. Shree Bhairavōktam Ānandakandah. Siddhiprada Hindi Translation, Varanasi: Chaukhambha Orientalia, 2008; p. 243.
33. Sadananda Sharma. Rasatarangini. 11th ed. New Delhi: Motilal Banarsidas Publishers, 1982; p-437
34. Vd. Hariprapannaji, Rasayogasagar, Chaukhamba publication, Part 2 336, p 322.
35. Shastri A. *Rasaratnasamuchchya of Vagbghata.* 9th ed. 1 Ver. 8. Varanasi: Choukhamba Sanskrita Publication, 1995; Chapter 4.
36. Kashinath S. Sadananda Sharma's Rasa Tarangini. 18/68-73. Delhi: Motilal Banarasidas, 2004; p. 448.
37. Kashinath S. Sadananda Sharma's Rasa Tarangini. 18/68-73. Delhi: Motilal Banarasidas, 2004; p. 450.
38. Kashinath S. Sadananda Sharma's Rasa Tarangini. 18/68-73. Delhi: Motilal Banarasidas, 2004; p. 451.

39. Shastri A, editor. *Rasaratnasamuchchya of Vagbghata*. 9th ed. 23, Ver. 15. Varanasi: Choukhamba Sanskrita Publication, 1995; p. 478.
40. Pranacharya Shrisadananda Sharma; Rasatarangini; ch-18/8-9; edited by Pandit Kashinath Shastri; Motilal Banarasidas publication Delhi, 2000; p-437.
41. https://pubchem.ncbi.nlm.nih.gov/compound/Tin-sulfide-_SnS2
42. Shri Bhavamishra; Rasa Ratna Samucchaya; ch-11/20; Vol-1; Delhi: Meherchand Lachamndas Publications; Reprint, 2010; p-207.
43. F. Albert Cotton, Geoffrey Wilkinson; Advanced Inorganicchemistry; third edition; ch-18; Intersciene publisher, p503.
44. Bhava Prakasha Nighantu, Dhatvadi Varga, 87-88 150. R.P.S.1/16-21.
45. Acharya Yashodhar; Rasa Prakash Sudhakar; ch-1/16-21; Chaukhamba Orientalia, 1998; p5.
46. Ayurvedic Formulatory of India, Part II, Govt. of India, Ministry of Health and Family Welfare, New Delhi; Department of Health, Controller of Publications,1989.
47. Pranacharya Shrisadananda Sharmana; Rasatarangini; edited by Shastri P.K; Ch 11/1-3; Delhi: Motilal Banarasidas; Reprint, 2014; p244.
48. Shri Bhavamishra; Rasaratnasamucchay;Ch-3/70;edited by Mishra S.N, 1st edition, Varanasi: Chaukhamba Orientalia, 2011; p74.
49. Zabdyr, L.A., Guminski, C. The hg-sn (mercury-tin) system. *JPE*, 1993; **14**: 743–752. https://doi.org/10.1007/BF02667888
50. Sarkar, Prasanta Kumar & Mehta, Neky & Prajapati, Pradeep. (2008). Chemistry of *Kupi*pakwa Rasayanas – A Review. Ancient science of life, 27: 56-63.
51. https://en.wikipedia.org/wiki/Thiostannate
52. https://en.wikipedia.org/wiki/Transition_state_theory
53. Dean J. Tantillo, Advances in Physical Organic Chemistry, Sciendirect, 2001.
54. https://en.wikipedia.org/wiki/Law_of_definite_proportions#:~:text=In%20chemistry%2C%20the%20law%20of,source%20and%20method%20of%20preparation.