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PHARMACEUTICO - ANALYTICAL STUDY OF SOMA YOGA

Dr. Guleria Praveen*[1], Kashyap C. P.[2] and Sharma Y. K.[3]

[1]Reader Department of Rasa Shastra and Bhaishajya Kalpana, SKSS Ayurvedic College and Hospital Sarabha, Ludhiana, Punjab.

[2]Professor, PG Department of Rasa Shastra and Bhaishajya Kalpana, RGGPGAC Paprola HP.

[3]Professor, PG Department of Kaya chikitsa and Principal RGGPGAC Paprola HP.

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***Corresponding Author**
Dr. Guleria Praveen
Reader Department of Rasa Shastra and Bhaishajya Kalpana, SKSS Ayurvedic College and Hospital Sarabha, Ludhiana, Punjab.

ABSTRACT

Soma yoga is an important formulation in shwas rogadhikar in the Sidha yoga sangraha of Yadav ji Trikam Ji. At the time of present study not much research work was done on this formulation. Somlata is known for its anti-asthmatic properties. In the present study it is in a compound form with a common mercurial preparation Rasa Sindura, with an eye to understand its yogvaahi property. The preparation of Rasa Sindura forms the prototype for all the other Kupipakva Rasayanas (concept developed in relation to the procedure of Gandhaka jarana). Hinguloth Parad (mercury extracted from Cinnabar) was chosen for making the base for Rasa Sindura preparation. The involvement of two important alchemical procedures Kupipakva Nirmana and Hinguloth Parad extraction formed the reason for drug selection. The drug was subjected to modern analytical tools as XRD, FTIR, PSA and ICP analysis to satisfy the growing vigilance regarding the form of metal or mineral present and freedom from unwanted toxic heavy metal contaminants. It can be concluded from the study that Rasa sindura is chemically, the red sulfide of mercury with the presence of organic bonds. Trituration with water helps in uniform distribution of rasa sindura and helps in better absorption because of smaller particle size. It is suggested to use demineralised water for preparation of drugs; the possible source of the presence of cadmium in the study was water.

KEYWORDS: Somalata, Rasa Sindura, Kupipakva Rasayan.

INTRODUCTION

Rasa is derived from the roots such as Rasati, Rasyati, Rasayati.[1] which mean to taste, to relish, sounding etc. Rasa in Rasa Shastra is taken for mercury, it is the foundation stone of Rasa Shastra and considered as the means of Jeevanmukti i.e. liberation of life. Mercury is capable of assimilating all the metals in it and hence it is called Rasa. Sindura is derived from Syand-Saram-Samprasaranam which means having releasing properties.[2] Rasa Sindura is formed by a combination of two words Rasa + Sindura. Rasa Sindura is Rasajatam Sinduram–Paradjata Sindurabheda.[3] A substance which acts on deep seated vitiation of doshas by quickly releasing them is Sindura. It also specifies for the red/vermillion color.[4]

Rasa sindura, thus on the basis of etymology may be considered as a red coloured substance prepared with rasa or mercury and which is used for removing deep seated vitiation. Rasa Sindura is a Kupipakva preparation. Use of Kachakupi started in 10th Cent A.D. The materials for Kupi nirmana have been described as of glass, clay, gold, iron and silver.[5] The heating apparatus used for Kupipakva nirmana is known as Baluka yantra which was developed after 8th century A.D.[6] Rasa sindura has been ascribed with tridosha shamaka properties. It corrects the vitiated doshas and brings them to their natural state. It is advocated as being sarvarogahara with different anupanas.[7] According to Rasamritam it is yogavahi i.e. its acts as a catalyst to the drug with which it is administered. Other properties are Balya, vrishya and rasayana.[8]

Kajjali is the base compound which when exposed to definitive heating schedule forms ras sindura. Kajjali is the resultant of intense physical trituration of mercury and sulfur resulting in binding of mercury and sulfur to form black mercuric sulfide in amorphous form. Certain researches prove that sulfur can prevent the toxic pathologic effects of mercury to great extent in kidney and spleen.

Somalata is the main constituent of Soma Yoga. For its preparation, Somalata has been taken as Ephedra gerardiana. In Charak samhita it has been described under the divine drugs which are available with great difficulty.[9] At present Ephedra gerardiana is being used for the medicinal purpose wherever Soma is mentioned.[10,11] In 1924 Chen and Shimdt demonstrated close physiological as well as clinical relationship of ephedrine to adrenaline.[12]

Soma Yoga[13] is a compound of Rasa Sindura and Somalata churna in the ratio of 1:20. Rasa Sindura is powdered and fine powder of Somalata is added and triturated into a fine powder. It is taken in a dose 5-10 Rattis with water or honey as vehicle in Shwas Roga or Asthma.

Aims and Objectives of the Study

1. To review the literature regarding individual components of the formulation Soma yoga and the pharmaceutical concept of Kupipakva Kalpana.
2. To have a pharmaceutical study of Soma yoga.
3. To perform analytical study of the compound on modern analytical tools as XRD, FTIR etc.

MATERIAL AND METHODS

The drug for the present study has been selected from Sidha Yoga Samgraha of Yadav Ji Trikam Ji from Shwas Rogadhikara named Soma Yoga. It is a combination of Rasa Sindura and Somalata Churna.

The individual contents, the intermediate products and the pharmaceutical procedures involved were scrutinized and performed as per the classical guidelines with an attempt to standardize them at every step. The whole work was done at the pharmacy Rajiv Gandhi Government Post Graduate Ayurvedic College and Hospital, Paprola, Kangra HP. The pharmaceutical analysis was done by sending the drug samples to SICART, Anand Gujarat.

Pharmaceutical Study

The main pharmaceutical procedures included Hinguloth Parada Nirmana and Rasa Sindura preparation along with the necessary accessory procedures of shodhana, juice extraction etc.

Lemon Juice Extraction: The procedure involved extraction of juice from lemons using a manual juice extractor. The amount of juice obtained was measured and weighed. The yield was 31% w/w & 30% v/w.

Hingula Shodhana[14]: Hingula shodhana was done in the end runner to save time and labor. Shodhana was done by bhavna method with lemon juice. It was washed thoroughly with water after bhavna and water was drained by cotton wick method as it prevented loss of material with water.

Table 1: Observations during Hingula Shodhana.

No. of Trituration Done	Colour	Consistency	Nimbu Swarasa Needed	Trituration Time
Ashudha Hingula	Mercedes red	Rough, lustrous, solid	-	-
1st	Deep orange	Soft, bright semisolid	500ml	8hrs
2nd	Deep orange	Soft, Bright, sticky, Semisolid	375ml	7.30hrs
3rd	Deep orange	Soft, Bright, sticky, Semisolid	450ml	7hrs
4th	Deep orange	Soft, Bright, sticky, semisolid	400ml	8hrs
5th	Deep orange	Soft, Bright, sticky, Semisolid	400ml	6.30hrs
6th	Deep orange	Soft, Bright, sticky, Semisolid	450ml	7hrs
7th	Deep orange	Soft, Bright, very sticky, Semisolid	375ml	6 hrs
Shudha Hingula	Red	Soft, lusterless, fine	-	-

Weight of Ashudha Hingula-1250gms Shudha Hingula- 1260gms, Gain in weight- 10gms.

Gandhaka Shodhana[15]: Gandhaka shodhana was done with Ghrita and milk method by nirvapana technique, after melting it in a Ghrita smeared iron pan at low temperature. A careful monitoring of temperature during the procedure to avoid burning is of utmost importance.

Table 2: Observations during Gandhaka Shodhana.

Quenching	Date	Features	Initial	Final
First	16.06.08	Weight	500gms.	480gms.
		Colour	Sulfur yellow	Pale cream
		Consistency	Crystals made into powder	Small to large sized granules and crystals
Second	17.06.08	Weight	480gms.	465gms.
		Colour	Pale cream	Slight fading of colour
		Consistency	Granules and Crystals	Solid small sized Granules
Third	19.06.08	Weight	465gms.	450gms.
		Colour	Faded pale Cream	Primrose Yellow
		Consistency	Small sized Granules	Small size brittle Granules

Total Yield: 450gms Loss of Weight: 50gms

Hinguloth Parada Extraction[16]: Extraction was done with damru yantra method. It was done in two batches of 500gms each.

Table 3: Observations during Hinguloth Parada Extraction.

S. No.	Observation	First Batch	Second Batch
1	Wt. of Hingula	500gms	500gms
2	Wt. of material from upper pot	320gms	300gms
3	Wt. of material from lower pot	20gms	25gms
4	Wt. of Mercury	120gms	90gms

210gms silvery white and lustrous mercury extracted from hingula (in two batches).

Parada Swedana[17]: Hinguloth parad is subjected to swedana to make it free from all the flaws and thus safe. Use of leaves is probably advocated to prevent loss of mercury as it rarely sticks to the leaf surface. After swedana washing was done to remove the salt content Sieving through the four fold cotton cloth helps in filtering the light weight impurities.

Kajjali Nirmana[18]: The purpose was to help in the formation of mercury sulfide and reduce its particle size as well as decrease the presence of free mercury, which is undesirable for therapeutic purposes. The process of trituration took 96 hours to fulfill the criteria of Kajjali formation which included loss of luster, fineness tested by Rekhapurnata and chakchakya rahitva.

Kajjali Bhavna[19]: Bhavana was given with vata jata kwath. After Bhavna there was a weight gain of 10gms.

Table 4: Change in various Characteristics after Bhavna.

Characters	Kajjali before Bhavna	After Bhavna
Weight	350gms	360gms
Colour	Black	Black
Consistency	Smooth powder	Smooth powder
Smell	No specific smell.	Smell of Vata jata kwath.

Rasa Sindura Nirmana[20] The procedure involves keen observation and vigilance till the completion of paka stage. The temperature specifications followed were as per expert opinion and dependent on the observations during the procedure and are tabulated as below with the observations and interventions done.

Table 5: Procedures and Observations during Rasa Sindura Preparation.

Stages of Process	Effect/ Purpose	Duration$_1$	Time & Date	Procedure and Observation
1.The stage of low temperature	The liquefaction of material.	00.00hrs	15/10/08 7.00am	Baluka yantra kept on the furnace and ignition done.
		0030 hrs	7.30am	Furnace is well ignited. Temp. 60^0 C. Heat is maintained for mandagni and feeding done to maintain temp. below 250^0 C
		0100hrs	8.00am	Yellowish fumes start appearing
		0200hrs	9.00am	Yellow deposits start appearing on the bottle mouth
		0200hrs-0500hrs	9.00am-12.00pm	Fumes kept emanating
		0500hrs	12.00pm	On inserting RHIR* blue flame appeared which disappeared after sometime
2. The stage of moderate temperature.	Sublimation of sulfur	0500hrs-15th hr	12.00pm-10.00pm	Temp. 300-450^0 C. Flame appeared spontaneously and remains outside the bottle mouth for about 1 hr then recedes to the neck, appearing only on insertion of RHIR. Fumes continued to emanate. Neck was cleared intermittently by inserting RHIR and tests for complete paka as CPT** done intermittently- showed black deposits. Moderate heat continued till paka stage.
3.The stage of corking	Beginning of compound formation (prevent escape of useful drugs)	1500-1530 hrs	10.00-10.30pm.	Fumes almost stopped With RHIR nothing is felt at the base, on taking out is covered with white fumes, smell of sulfur not evident. Cu plate remained unchanged; bottom of the bottle was red hot. Temperature$_2$ was reduced for half an hour and corking done.
4. The stage of high temperature	Formation of the compound	1530-2130 hrs	10.30pm-4.30 am on 16.10.08	Intense heat given (tivragni).Temperature between 450-600^0C
5. The stage of cooling	Proper complete processing	2130hrs-48hrs	10.00am on 17.10.08	Complete set up was left as such for spontaneous cooling the bottle was removed$_3$ from baluka yantra on cooling.

*RHIR- Red hot iron rod ** CPT-Copper plate test

1. As the temperature was maintained according to the various observations made during the procedure as per the expert opinion, the guidelines for duration according to stage were not followed.
2. Reduction of heat during the corking was necessary for proper application of the cork and it also helped to prevent escape of mercury during the application of cork.
3. The apparatus was removed from the Bhatti after 24 hours.

Weight of the starting material-200gms, weight of ras sindura-80gms, Colour-Maroon red
The material after collection required careful screening to avoid admixture of glass particles from bottle breaking. This was done meticulously using hand lens. This was then ground into powder form and it weighed 80gms.

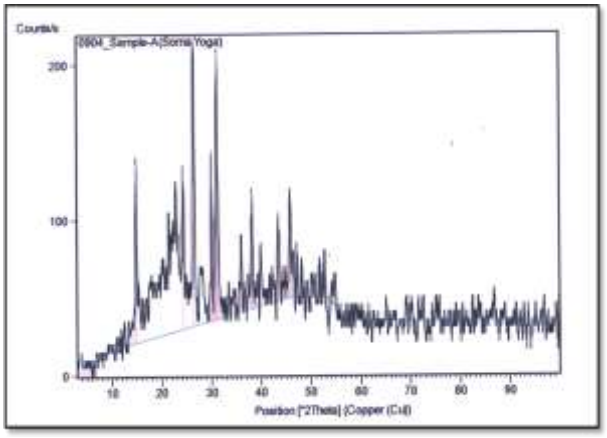
Powdering of Somalata: Proper screening of the raw drug was necessary, to avoid mixture of soil and other organic contaminants. Powder was made using cyclonic mill pulverizer. The powder was sieved and weighed.

Soma Yoga Preparation: Rasa Sindura and Somalata powder were taken in the ratio of 1:20 and triturated dry for some time. Wet trituration was done to allow proper distribution of the contents throughout the compound & to bring fineness property. Rasa Sindura being small in amount, very fine powder could not be made. Trituration time was 4 hrs, prepared Soma yog weighed-1040gms with a loss of10gms.

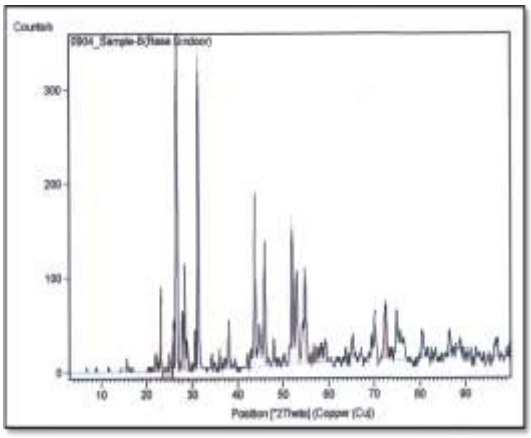
Analytical Study: To keep pace with the developing science and technology, the age old Ayurvedic concepts require scientific validation. An attempt at the same was made in the present study with the application of recent scientific advancements and techniques in the elemental analysis to have a look into the physico-chemical changes occurring during alchemical procedures in the research drug and the final compound. The results are discussed as below:

X-ray Diffraction

The results indicate the formation of mercury sulfide (synthetic cinnabarite) as the major phase in the Rasa Sindura sample. The same finding was noted in case of Soma Yoga which included an herbal powder with Rasa Sindura.



XRD Pattern of Soma Yoga



XRD Pattern of Rasa Sindura

Fourier Transformed Infrared Spectroscopy (FTIR)

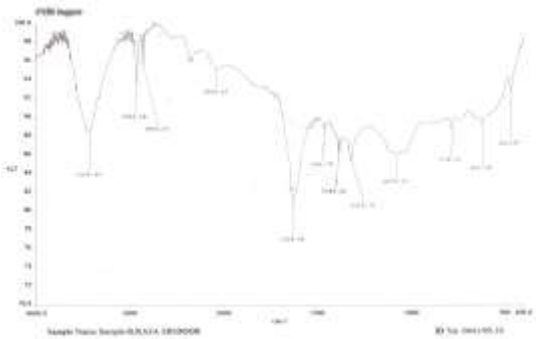
This technique helps in the identification of the chemical (organic or inorganic) bonds present in a mixture. This was done to identify the type of herbomineral compound formed by the various procedures.

Table 1: Characteristics of Band Frequencies.[21]

Sr. No.	Functional Groups	Band Frequencies
1	C-H vibration	Stretching and bending vibrations occur at 3300 to 2800cm-¹
2	O-H vibration	Stretching at 3700 to 3350 cm-¹ depending on the extent of hydrogen bonding.
3	C-O vibration	Stretching at 1280 to 1000cm-¹, depending on whether it is an alcohol, phenol, ester, ether, etc.
4	C=O vibration	Stretching at 1950 to 1640cm-¹, these bands are quite intense and very conspicious. Hydrogen bonding, field effect and conjugation affect the position.
5	N-H vibration	Stretching at 3500 to 3300cm-¹, hydrogen bonding at lower frequency. Bands for NH3, NH2, NH occur at about 3200, 2700 and 2000cm-¹ respectively.
6	C-N vibration	Stretching of aliphatic compounds at 1210, aromatic at 1250 to 1350, C=N at 1680 to 1640 and for C-N at 2250cm-¹

The results indicate the formation of organic bonds amongst the constituent elements.

Sample A (Soma Yoga)



Sample B (Rasa Sindura

Functional groups falling in the fingerprint region for Soma Yoga are O-H, C-H, C=O, C-N and an aromatic compound. The dominant groups in ras sindura are C-H, C-N and O-H.

Particle Size Analysis

The method holds importance equivalent to the rekhapurnatva and varitaratva of the ancient parameters of drug testing. The samples were analyzed for particle size determination on instrument PSA. Water was used as dispersion medium. Sample was introduced by means of a spatula to the beaker containing 700ml water till laser obscuration was between 10-15%. To ensure breakdown of any agglomerates, if present, sonification was given.

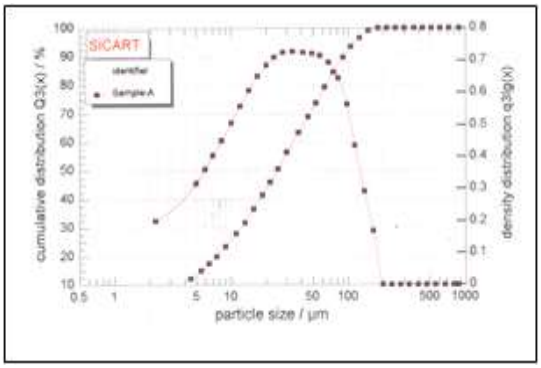
In the present study the particle size of the final compound Soma Yoga was 37.9µm, which is the volumetric mean diameter of the particles in the sample. The particle size of Rasa Sindura was 115µm which is quite bigger than the size of soma yoga.

Table 2: Particle Size Distribution.

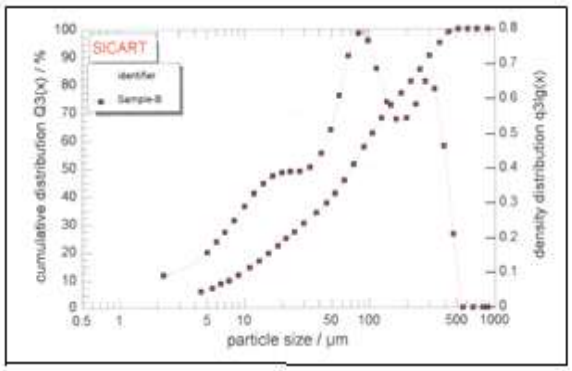
Sample Code	Sample Name	D10 Mm	D16 µm	D50 µm	D84 µm	D90 Mm	D99 µm	VMD Mm
A	Soma Yoga	3.89	6.06	24.87	74.30	92.49	157.27	37.9
B	Rasa Sindura	7.92	12.74	72.61	245.37	304.25	462.31	115

D10 – 10% of the material is below the mentioned µm value. Similar interpretation can be made for other values as 16%, 50%, 84%, 90%, 99% of the material is below the mentioned values.

VMD- Volumetric Mean Diameter in µm



Soma Yoga



Rasa Sindura

Inductively Coupled Plasma Emission Spectrometry

This is the most reliable method for the quantitative analysis. The elements analysed by this method and their respective values are tabulated below.

Table 3: IDL- instrument detection limit.

Sample Name	Elements and their Quantities in mg/kg			
	Mercury	**Lead**	**Cadmium**	**Tin**
IDL	0.0610	0.0420	0.0027	-
Soma Yoga	47254	Not Detected	24.823	Not Detected
Rasa Sindura	729860	Not Detected	3.0361	-
Soma Churna	Not Detected	Not Detected	Not Detected	-

Organoleptic Characters

The drug underwent the basic organoleptic evaluation, the findings are as under.

Table 4: Ayurvedic Parameters for the Research Drug.

Parameters	Soma yoga
Colour	Light brown
Rasa	Slightly kashaya rasa
Sparsh	Mridu
Gandh	Characteristic of somalata
Varitaratva	+ve
Nischandratva	+ve

DISCUSSION

The present study deals with the pharmaceutical concept of Kupipakva Kalpana and the use of Rasa Sindura with somalata (in the form of soma yoga) and its analytical study for the changes in the compound at molecular level and to assess the presence of heavy metals in the

drug prepared. Soma Yoga is a combination of Rasa Sindura and Somalata churna in the ratio of 1:20.

The properties of Rasa Sindura include its tridosha shamaka property along with the specific property of the regulation of vayu. It also acts as a pitta saraka, the disease shwas being pitta sthana sammudbhavah; this may also be seen as a probable contributing factor towards the use in bronchial asthma. Besides being balya, rasayana and vrishya it has got the yogavahi property which gives it the strength to enhance the property of any drug with which it is being used (Sarvarogahara with the use of different anupanas). For medicinal purposes the use of Ephedra is advocated wherever soma is mentioned. Ephedra has ephedrine and pseudoephedrine; Ephedrine is the main alkaloid whose action has been proved to have a close physiological as well as clinical relationship with adrenaline. Soma is having anti-inflammatory action, relieves the turgescence of the mucous membrane and causes a marked dilation of the bronchioles. These help in relieving the paroxysms of asthma where inflammation and broncho-constriction are the main pathological features. The Vata jata kwath used as a Bhavna dravya for Kajjali has been detected to have metal ion chelating activity which might be helping in rendering any free metal ion intoxic by making chelates with the same.[22] Anti-asthmatic property has also been reported for Vata.[23]

The pharmaceutical study findings are discussed below

Hingula shodhan: Approximately 3 liters lemon juice was used to complete seven bhavna for 1250gms of Hingula. On complete drying Shudha Hingula weighed as 1260gms, with weight gain of 10gms. Yield was 100.8%. Possible reason for weight gain was organic matter from lemon juice.

Hinguloth Parada Extraction: Yield was 24% and18% respectively. The possible cause for low yield is the crudeness of the apparatus used. Small particles of mercury likely get entrapped in the pores of the earthen pot used for making damru yantra. Collection of the mercury from the material obtained from the upper pot is tedious and time consuming. Repeated washing also results in loss of mercury. Besides these reasons mercury may also be lost due to its jiva gati.

Parada Swedana: Swedana causes the impurities to loosen up and get removed from mercury. Use of leaves is probably advocated to prevent loss of mercury as it rarely sticks to the leaf surface Heat was kept low enough to ensure only boiling of water, as at high

temperature mercury may get vaporized due to its low vapor pressure. Loss of weight is 10gms.

Gandhak Shodhan: Yield after three nirvapana followed by washing with water and subsequent drying was 90%. Loss during the melting procedure due to burning of Gandhaka and loss with milk and water are possible reasons for the decreased yield.

Kajjali Nirmana and Bhavna: The process of trituration took 96 hours; the longer duration probably due to the presence of moisture in the atmosphere during the period of trituration. Net loss of 50gms took place; the reason for which is possibly the spillage out of the kharala during trituration. As the material becomes finer the spillage is more. After Bhavna there was a weight gain of 10gms which might be due to the addition of solid contents from the Vata jata kwath.

Kupipakwa Nirmana: Weight of the starting material-200gms, weight of ras sindura-80gms, Colour-Maroon red. The yield of Rasa Sindura was 40% w/w and the colour was maroon red. Kupipakva nirmana developed in relation to Gandhaka jarana as a means of effective, sustained and controlled heat application. Minute details as selection of apparatus for the process and application of kapadmitti were reviewed and use of gachni mitti and cotton as a homogenous mixture in the ratio of 50:1 is advocated to reduce the cost of preparation of medicine. Use of pyrometer is necessary to standardize the observations on temperature specifications. Iron rods or shalakas should be rust free to avoid iron contamination in the final product especially in case of talasth and ubhayasth rasayana. The heating pattern is of utmost importance; difference in the opinion of various authors on the duration of heat was considered and observations and changes during the procedure have been decisive for further steps as noted in table no.5.

Powdering of Somalata: The yield was 83.33% with 1250gms being the weight of the powder starting material was 1500gms. The yield would be better if a larger sample is taken; there is loss of material in the machine itself. The fineness of powder leads to more dispersion during the process and there is a need to wear cap and mask during the whole procedure.

Som yoga preparation: Wet trituration was done to allow proper distribution of the contents throughout the compound and to bring fineness property in the whole compound. Rasa

Sindura being small in amount, very fine powder could not be made. Trituration time was 4 hrs, prepared Soma yoga weighed-1040gms with a loss of 10gms.

Analytical Study

X-ray Diffraction: The results indicate the formation of mercury sulfide (synthetic cinnabarite) as the major phase in the Rasa Sindura sample. The same finding was noted in case of Soma Yoga which included an herbal powder with Rasa Sindura Soma Yoga had O-H, C-H, C=O and C-N bonds in the fingerprint region of the spectrum along with the presence of an aromatic compound in the same region. Rasa Sindura had lesser organic bonds than soma yoga but C-H, C-N and O-H were seen in the fingerprint region, which are possibly the result of the shodhana of hingula in the lemon juice and the bhavna of vata jata kwath given to the kajjali.

The results indicate the formation of organic bonds amongst the constituent elements.

Particle Size Analysis: The particle size of Rasa Sindura was 115µm which is quite bigger than the size of soma yoga. The reason could be that the amount of Rasa Sindura being small it was not very finely powdered. But to decrease the particle size and allow uniform mixing with the powder of somalata, trituration was done by adding water to it. This may be the reason for the finer particles in the final drug despite the addition of herbal powder.

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Inductively Coupled Plasma Emission Spectrometry: The study revealed the presence of mercury in the sample and the absence of lead and tin indicated the freedom from the naga and vanga doshas in the mercury used. The presence of cadmium in the compound was detected which was 3.0361 mg/kg in Rasa Sindura and 24.823mg/kg in Soma Yoga. It was not detected in soma churna. Soma Yoga contains only two drugs namely Rasa Sindura and Soma churna. Soma churna being free from cadmium, the increase in its concentration from rasa sindura to soma yoga makes the possible source of increase being during the preparation of soma yoga only. For the preparation of soma yoga water was used as a trituration media. This raises the probability of the source of contamination being water. Further confirmatory studies need to be done regarding the same and analysis of the water sample used for drug

preparation should be done in future. The daily intake of cadmium in the drug was found to be below the permissible daily intake limit.[24]

CONCLUSION

It can be fairly concluded from the present study that for Hinguloth parada extraction the method of damru yantra is apparently crude and for Kupipakva nirmana the pattern of administration of heat (duration and intensity) was followed as per the expert guidelines needs to be further standardized. It can be concluded that for uniform distribution of rasa sindura the compound needs to be triturated with the addition of water. The presence of cadmium in the drug needs to be evaluated further to find the source of contamination (possibly water???). The various alchemical procedures result in the formation of organo-metallic compound as is marked by the presence of alcohol groups, nitrogenous bonds and sulfur and hydrogen bonds. These processes also result in reduced particle size and better absorption of the drug. Rasa sindura is chemically, the red sulfide of mercury with the presence of organic bonds.

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