

Pharmaceutico-Analytical Study of Tamra Sindoor Prepared with Asta-Samskarita Parada

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ABSTRACT

Kupipakwa Rasayana is a category of *Rasaushadhies* (herbo-mineral medicines) prepared by unique pharmaceutical process explained in the *Rasashastra*. Manufacturing of quality formulations and to analyze the quality, safety and toxicity concerns are being pharmaceutical and analytical profiles become an important task. *Tamra Sindoor* is a *Kupipakwa Rasayana* prepared with *Astasamskarita Parada*, *Shodhita Gandhaka*, *Shodhita Tamra* and indicated in *Raktajanya Vikaras*, *Vata-Kapha Pradhana Mamsarbuda*. So the proper scientific Validation of fortify *Tamra Sindoor* has become one of the focused research work. In the present study keeping the chief aim of elucidating pharmaceutical and physiochemical analysis of fortify *Tamra Sindoor* are prepared adopting method advocated in *Ayurveda Sara Sangrha*.

KEYWORDS: *Astasamskarita Parada*, *Analytical*, *Kupipakwa Rasayana*, *Pharmaceutical*, *Rasaushadhies*, *Tamra Sindoor*

INTRODUCTION

In *Ayurveda*, *Rasashastra* is the branch, which deals with the pharmaceutical and therapeutic scope of the medicinal product of Mercury, Minerals and Metals. In *Rasashastra*, *Rasaushadhies* have their own importance and major role in day-to-day practice, because of their quick onset of action and higher efficacy in a smaller dosage. There are four varieties of *Rasa Kalpas* explained in classic viz. *Kharaliya Rasayana*, *Parpati Rasayana*, *Kupipakwa Rasayana* and *Pottali Rasayana*.

Among four *Rasa Kalpas*, *Kupipakwa Rasayana* is the unique method of preparation and it deserves special importance because of its minimal dosage, maximum effect, long lasting-potency and synergistic effects in the body¹. *Kupipakwa Rasayana* is very potent in eliminating not only acute disease but also chronic diseases and acts as rejuvenating agents. *Tamra Sindoor* is one of the *Kupipakwa Rasayana* preparations.

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Pharmaceutical is the discipline of pharmacy that deals with the process of turning a new chemical entry (NCE) or old drugs into a medication to be used safely and effectively by patients. It is also called the science of Dosage form design. There are many chemicals with pharmacological properties, but need special measures to help them to achieve therapeutically relevant amounts at their sites of actions. Pharmaceutics helps to relate the formulation of drugs to their delivery and disposition in the body. Pharmaceutics deals with the formulation of a pure drug substance into a dosage form. The procedure adapted here are *Shodhana*, *Bhavana*, *Mardana*, *Nirvapana*, *Kupipakwa Rasayana*.

The quality of final product of medicine is very important in Pharmaceutical industry. Due to high risk of damage to life and side effects to human body regulatory authorities paid special attention to quality of medicine and given many guideline for safety and quality. These analytical parameters give important

information about drug bioavailability and its effect to body. These analytical procedures are more essential in drugs and formulation. However, parameters that are required for different preparation may be different. Analytical standards are the dimensions to evaluate a product. It is compulsory to describe a product in analytical definition especially in the present days.

PARAMETERS:-Fortify *Tamra Sindoor* analysis was carried out under the following section:-

ORGANOLEPTIC PARAMETERS:-Form, Color, Odour, Taste, Appearance

PHYSICO-CHEMICAL PARAMETERS:-pH analysis, Loss on drying, Loss on ignition, Ash value and Solubility.

OTHER PARAMETERS BY ADVANCED TESTS:-Zeta potential, Particle size, SEM-EDX, CHNS, ICP-OES.

MATERIAL AND METHODS:-

MATERIALS:-

1. Collection of major raw drugs
2. Collection of associated raw drugs
3. Main equipments and associated equipments.

1. COLLECTION OF MAJOR RAW DRUGS:-

Tamra, Parada, and Gandhaka is the major raw drugs which were having *Grahya Lakshanas* as mentioned in classical textbooks of *Rasashastra* were procured from the local market.

2. ASSOCIATED RAW DRUGS:-Other raw drugs used in the present study are *Nimbu Swarasa, Godugdha, Tryushana, Lavana, Asuri, Chitraka, Ardraka, Moolaka*, and other drugs used in *Ashta Samskara of Parada*.

3. MAIN EQUIPMENTS AND ASSOCIATED EQUIPMENTS:-

MAIN EQUIPMENTS:-*Yantras* used in the present study were:-

Khalwa Yantra:-Ardhachandrakar Khalwa, Vartula Khalwa, Tapta Khalwa, Dola Yantra, Patana Yantra-Urdhwa, Adho, Tiryaka, Damaru Yantra, Darvi, Valuka Yantra,

ASSOCIATED EQUIPMENTS:-Weighing Machine, Steel Vessels, Spoons, Containers, Clothes, Thread, Measuring Jars, Gas Stove, etc.

METHOD:-

PREPARATION OF ASTA SAMSKARITA PARADA²:-

- *Ashta Samskaras of Parada* was done as per the *Rasa Hridaya Tantra*.
- The total quantity of *Parada* taken for *Asta Samskara*- 500gms.

➤ Weight of *Parada* obtained after *Ashta Samskara* - 350gms.

➤ 30% of loss was found after *Ashta Samskaras*.

TAMRA SAMANYA SHODHANA³:-*Kantakavedhi Tamra Patra* of measuring 6*6" length and width and 0.5mm thickness weighing of 5gms each were taken. *Tamra Patra* was heated up to red hot on a gas stove then it was quenched in 500ml of *Tila Taila*. After 15 minutes, *Tamra Patra* was taken out from *Tila Taila* mopped with cotton cloth and dried.

The same procedure was repeated for further 6 times, each time fresh *Tila Taila* was taken.

After 7th *Nirvapa Ushna Jala Prakshalana* was done, mopped, and dried.

The same procedure was repeated with other four media viz; *Takra, Gomutra, Kanji* and *Kulattha Kwatha* in order.

RESULT:-

Initial weight of Tamrapatra before Samanya Shodhana:-600gms

Final weight of Tamrapatra after Samanya Shodhana:-406gms

Total weight loss:-194gms

VISHESHA SHODHANA OF TAMRA⁴:-*Samanya Shodhita Tamra* was taken in mud pot along with 1/8th part (51gms) of *Saindhava Lavana*. Then the pot was filled with *Gomutra* up to the brim and placed over a fire. *Swedana* was done for 2 *Prahara* (6hours). *Gomutra* was added time by time to maintain a sufficient quantity of *Gomutra*. After 6 hours *Tamra* was taken out and washed with hot water and dried.

RESULT:-

Initial Weight of Samanya Shodhita Tamrapatra:-406gms

Final Weight of Vishesha Shodhita Tamrapatra:-385gms

Weight loss:-21gms

GANDHAKA SHODHANA⁵:-

Weighted quantity of *Ashuddha Gandhaka* was taken and finely powdered in *Khalwa Yantra*. Fine powder of *Gandhaka* was taken in *Loha Darvi* smeared with the ghee and was heated at temperature of 110°C to melt it completely.

In other steel vessel, 500ml of *Go-Ksheera* was taken and its mouth was covered with a piece of cotton cloth properly. Over the vessel, melted *Gandhaka* was poured slowly. The melted *Gandhaka* came in contact with *Go-Ksheera, Gandhaka* again got solidified and remained in granular form. *Gandhaka*

was removed from the *Go-Ksheera*, dried and powdered. Same procedure was repeated for another 6 times then *Gandhaka* washed with hot water mopped with cotton cloth, dried and powdered and store in container for further use.

RESULT:-

Initial weight of *Gandhaka*:-500gms

Final weight of *Gandhaka*:-425gms

Total weight loss:-75gms

PREPARATION OF *KAJJALI*⁶:-

Ashtasamskarita Parada and *Gandhaka* were taken in equal quantity and triturated in *Khalwa Yantra*. After 30 minutes of trituration mixture turned to greyish in color. On continuous trituration it turned to blackish color. Trituration was continued till it got jet black color and loss of shining particles (*Samyaka Kajjali Lakshana*). After 24 hours of trituration it became jet black color (*Kajjalabha*).

RESULT:-

Duration for *Kajjali* preparation:-24hours (6 hrs/day)

Weight of *Kajjali* obtained:-238gms.

Total weight loss:-2gms

*KUPI NIRMANA*⁷:-

Two green color beer bottles of 650 ml capacity was taken and cleaned properly. A circular and rectangular piece of cotton cloth smeared with *Gopichandana* was taken and wrapped base and around the bottles properly. Then the bottles inverted over *Kupi* stand and allowed for drying. Same procedure was repeated for 7 layers and each layer applied only after previous layer dried completely.

*TAMRA SINDOOR PREPARATION*⁸:-

METHOD:-*Bhairdhooma Kupipakwa*

PROCEDURE:-The whole procedure of *Tamra Sindoor* was divided into 3 phases:

1. ***Poorva Karma*:-** a. Preparation of *Kachakupi*

b. Filling of *Kajjali* into *Kachakupi*

c. Placing of *Kupi* in *Valukayantra*.

2. ***Pradhana Karma*:-** a. Heating schedule (*Kramagni*)

b. Observation and recording of temperature

c. Corking of *Kachakupi*

3. ***Paschat Karma*:-** a. Removal of *Kachakupi* from *Valuka*

b. Breaking of *Kupi*

c. Collection of final product

***Poorva Karma*:- Preparation of Cork:-**A conical shaped cork made of wooden piece, with a length of 2 inches and thickness according to the mouth of *Kupi* was made and layered with *Gopichandana* smeared cloth and dried.

b. **Filling of *Kajjali* into *Kachakupi*:-** **Materials:-** *Kajjali*-238gms, *Shodhita.Tamra* 60gms, weighing machine, *Kachakupi*, funnel and spoon.

Procedure:-238gms of *Kajjali* was divided into two equal parts and slowly filled in to two *Kachakupi* with the help of funnel and spoon. After, 30gms of *Shodhita Tamra* in small pieces were added in each bottle.

c. **Placement of *Kupi* in *Valuka Yantra*:-** **Materials:-** *Kupi* filled with *Kajjali*, *Abhraka Patra* and Sand.

Procedure:-At first *Abhrakapatra* (8×10cms) was placed over the hole at the bottom of the *Valuka Yantra* and sand was spread uniformly over it of about 3 *Angula*. Now over this, *Kajjali* filled *Kupi* were kept firmly in center. Remaining portion of the *Yantra* was filled with sand upto neck of the *Kupi*.

2. ***Pradhana Karma*:-**The *Pooja* was done after placing the *Kupi* in *Valuka Yantra*.

Aghora Mantra was chanted and ignited the fire to wood with the help of camphor, spirit and matchbox. Pyrometer was properly placed i.e. 5-6 cm away and 4 cm above from level of base of *Kupi* in *Valuka Yantra*, with this temperature was recorded at regular interval. *Kramagni* was maintained according to the classical reference. For first 15 hours *Mrudhvagni* was given and temperature maintained between 100-250°C. Next 12 hours *Agni* was gradually raised to *Madhyamagni* stage, i.e. 250-500°C. By this time *Sindoor Siddhi Lakshana* were observed, corking was done and subjected for *Teevragni* upto 9 hours and temperature maintained between 500-700°C. Later the apparatus was allowed for self cooling for complete sublimation of product.

***Paschat Karma*:-**a. Removal of *Kupi* from *Valuka Yantra*, Breaking of *Kupi* and collection of *Tamra Sindoor*.

Materials:-Knife, thread, sprit, matchbox, wet cloth and *Kupi* containing final product.

Method:-After complete cooling of the *Bhatti*, Sand surrounding the *Kupi* in *Valuka Yantra* was carefully removed and then *Kupi* was taken out. The mud smeared cloth layers of *Kupi* were scrapped out with knife. A jute thread dipped in spirit was tied to the *Kupi*, 2-3cm below the level of sublimated product, and ignited. When the whole thread got burnt off, wet cloth was wrapped around the ignited thread. The bottle got broken into 2 equal halves with a breaking sound. From the neck region *Sindoor* was collected and at the bottom of *Kupi* black color *Tamra Bhasma* was present. By simple tapping *Sindoor* was collected and stored in clean sterile container.

Result:-Table no.1:-Table showing loss and weight of Tamra Sindoor:-

Total quantity of Ingredients			Weight of Tamra Sindoor	Weight of Talastha Tamra Bhasma	Total weight	Weight loss	Yield
Total weight of Kajjali	Total weight of Shudha Tamra	Total quantity of ingredients					
238gms	60gms	298gms	177gms	99gms	276gms	22gms	60%

ANALYTICAL STUDY:-

1. Organoleptic Characters:-The specific characters which can be identified by using sense organs are included under organoleptic tests. These tests help in providing basic information regarding drugs.

Table no.2:-Table showing the Organoleptic characters of Tamra Sindoor:-

SL.NO.	Tests	Results
1.	Form	Fine powder
2.	Color	Reddish
3.	Odor	Characteristic
4.	Taste	Tasteless
5.	Appearance	Red colour fine powder and presence of shining particles

1. Physico-chemical Characters:-**A. pH value:-****Materials:-**

Tamra Sindoor-1gm

pH meter, glass electrode, beaker, distilled water, buffer solution.

Method:-At first the pH glass electrode was immersed in the standard buffer solutions pH: 4 and pH: 7 and the instrument were calibrated. Then the electrode was immersed in the solution of 1 gm of Tamra Sindoor mixed with 5 ml of distilled water. The reading was noted from the display board.

Table no.3:-Table showing the result of pH of Tamra Sindoor:-

SL.NO.	PARAMETER	RESULT
1.	pH (1% solution)	6.7

A. Loss on drying:-This test was conducted to evaluate the moisture content of Tamra Sindoor.

Materials:-Tamra Sindoor-1gm, Weighing machine, Petri dishes and Hot air oven.

Procedure:-A Petri dish was cleaned in distilled water and dried in oven at 110°C for 2 hours. 500mg of Tamra Sindoor was taken in pre-weighed Petri dish. It was kept in oven for drying at 110°C for 5 hours. After cooling, the weight was recorded. It was again subjected to drying for an hour and then weight was noted.

Table no.4:-Table showing the results of loss on drying of Tamra Sindoor:-

SL.NO	PARAMETER	RESULT
1.	Loss on drying at 110°C	1.592%

C. Loss on ignition:-

Materials:-Tamra Sindoor:-1gm, Silica Crucible, Muffle Furnace, Desiccators and Precision Balance

Procedure:-A silica crucible previously ignited for one hour at a temperature not exceeding 500°C was weighted and cooled in desiccators. Accurately weighed Tamra Sindoor was transferred to the crucible. The crucible was weighted accurately and loaded crucible placed in the muffle furnace and heated the crucible upto 500°C after cooling the loss on ignition was calculated with reference to air dried drug.

Table no.5:-Table showing the result of loss on ignition of Tamra Sindoor:-

SL.NO.	PARAMETER	RESULT
1.	Loss on ignition	99.423%

C. Total ash value:-

Materials:-Tamra Sindoor:-2gm, Silica crucible, Spatula and Muffle furnace.

Procedure:-About 2gms of Tamra Sindoor was weighted exactly in a pre-tared, ignited and cooled silica crucible and kept inside the muffle furnace and Tamra Sindoor was heated at 550°C for 2 hours. After 2 hours,

the furnace was allowed to cool naturally; the crucible was taken out and transferred into a desiccators. After cooling it was weighed at room temperature. The difference in weight was noted and the percentage of total ash was calculated from the formula:-

$$\% \text{ Total ash} = (\text{weight of the ash obtained} / \text{weight of the sample taken}) \times 100.$$

Table no.6:-Table showing the result of total ash value of Tamra Sindoor:-

SL.NO.	PARAMETER	RESULT
1.	Ash value	0.195%

C. Solubility test:-

Materials:-Test Tube, solvents like conc.HNO₃, Aqua regia, Conc. HCl, Spatula and Stirrer.

Procedure:-Water, conc. HNO₃, Aquaregia, conc.HCl, is taken in 4 different test tubes separately, 25mg of Tamra Sindoor was added to each test tubes and continuously stirred with the help of glass rod till it gets dissolved and solubility is noted.

Table no.7:-Table showing the result for Solubility of Tamra Sindoor:-

SL. No	PARAMETERS	RESULT
1.	Water	Insoluble
2.	Conc.HNO ₃	Partially soluble
3.	Conc.HCl	Partially soluble
4.	Aquaregia	Soluble

1. Other advanced parameters:-

i. Zeta potential:-Zeta potential is the potential difference between the dispersion medium and stationary layer of fluid attached to the dispersed particles.

Table no.7:-Table showing Zeta Potential result of Tamra Sindoor:-

Results	Mean(mV)	Area (%)	Width(mV)
ZetaPotential(mV):-28.6	Peak 1: -28.6	100.0	6.24
Zeta SD (mV): 6.24	Peak 2: 0.00	0.0	0.00
Conductivity (mS/cm):0.0187	Peak 3: 0.00	0.0	0.00

ii. Particle size analysis:-

Method:-Laser Diffraction Method:-Sample passes through the laser beam as homogeneous stream of particles and it leads to scattering of light over a wide range of angles. Based on this scattering pattern of sample, particle size distribution is calculated comparing with appropriate optical model.

Particle size has been calculated considering its length density, volume density, and area density. In present study volume density mean is considered for determining the actual particle size of the sample as it covers length and area of the particle. The sizes of particle ranges from 0.0-0.5µm upto 100% of the Particle size measured and finally mean particle sizes were taken for a particular sample.

Table no.8:-Table Showing particle size analysis result of Tamra Sindoor:-

Result	Size (d.nm):	% Intensity	St Dev (d.n...
Z-Averae (d.nm):486.3	Peak 1: 586.6	95.2	343.5
PdI:0.342	Peak 2: 5022	4.8	600.2
Intercept:0.730	Peak 3: 0.000	0.0	0.000

Elemental analysis by SEM-EDX:-

The Scanning Electron Microscopy study is a type of electron microscope that images the sample surface by scanning it with a high-energy beam of electron in a Raster pattern. The electrons interact with the atoms that make up the sample producing the signals that contain information about the sample surface topography, composition and other properties such as electrical conductivity. The most common mode of detection is by secondary electrons is mostly conducted by the sample, but on a tilted surface, the plume is partially exposed and more electron are emitted by scanning the sample and detecting the secondary electrons, an image displaying the topography of the surface is created.

Table no.9:-Table showing the SEM-EDX result of Tamra Sindoor (atomic %, weight % of elements):-

Spectrum	K Shell		L Shell		K Shell		K Shell		L Shell		K Shell	
	S	Wt%	Hg	Wt%	Fe	Wt. %	Al	Wt%	Pb	Wt. %	Cu	Wt%
8	53.1	15.50	45.8	83.61	0.4	0.22	0.4	0.09	0.3	0.59	0.0	0.00
9	44.4	11.61	52.4	85.74	0.0	0.00	1.8	0.40	1.3	2.25	0.0	0.00
10	58.2	18.85	39.4	79.78	0.1	0.06	1.9	0.53	0.4	0.79	0.0	0.00
11	38.3	9.30	59.3	90.06	0.8	0.33	1.6	0.32	0.0	0.00	0.0	0.00
12	47.5	12.79	50.5	85.08	0.0	0.00	0.8	0.18	1.1	1.92	0.1	0.04

CHNS:-Carbon, hydrogen, nitrogen, and sulfur analysis.

Method:-For the CHNS analysis, dried and crushed sample of *Tamra Sindoor* are weighed (5-10mg), and mixed with an oxidizer (vanadium pentoxide [V₂O₅]) in a tin capsule, which is then combusted in reactor at 1000°C at this temperature, nitrogen oxides reduced to N₂. The N₂, CO₂, and SO₂ are transported by the helium to, separate by a chromatographic column and quantify with a thermal conductivity detector (TCD set at 290°C).

Table no.10-Table Showing the CHNS results of Tamra Sindoor:-

Component Name	Area %	Element %
Nitrogen	3.848	0.000
Carbon	0.956	0.030
Sulfur	95.197	33.505

ICP-OES:-

Inductively coupled plasma/optical emission spectrometry is one of the most powerful and popular analytical tool for the determination of trace elements present in the *Tamra Sindoor*. The technique is based upon the spontaneous emissions of photons from atom and ions that have been excited in radio-frequency discharge (RFD).

Table no.11:-Table showing the ICP-OES result of the Tamra Sindoor:-

Metal Contents	Result (mg/kg)
Aluminium (Al)	171.5
Arsenic (As)	83.1
Copper (Cu)	1464.0
Tellurium (Te)	18.8
Iron (Fe)	187.8
Sulfur (S)	92490.0
Mercury (Hg)	1900.0
Selenium (Se)	ND
Zinc (Zn)	82.7
Gold (Au)	ND

DISCUSSION ON PHARMACEUTICAL STUDY:-

I. PARADA ASTASAMSKARASA:-

1. Swedana Samskara:-

The *Kalka Dravyas* which were used for preparing *Pottali* were having *Katu*, *Tikta Rasa* and *Tikshna*, *Ushna Guna*. The *Kanji* which was used as *Swedya Drava-Dravya* is having *Amla Rasa*. When mild heat is provided in the medium of *Kanji* the impurities gets loosened. Organic acids present in the *Kalka Dravya's*, Salts and acidic pH of *Kanji* helps loosening oxidation layer of *Parada*, so it eases the removing of *Doshas* in next *Samskaras*. There was no weight loss of *Parada* even after *Swedana Samskara* (Quantity of *Parada*-500gms).

2. Mardana Samskara:-

Initial weight of *Poorvasamskarita Parada* taken for *Mardana* 500gms and after *Mardana* 497gms was obtained. Weight loss 3gms may be due to mechanical loss during the *Mardana* procedure or due to *Jala Gati*, *Dhum Gati* and *Mala Gati*. *Mala's* which get loosened during *Swedana Samskara* are removed in *Mardana Samskara*. In this process every particle of *Parada* comes in direct contact with the *Kshara* and *Amla Rasa* of drug for longer duration. Here trituration was done with carbon containing drugs like, *Dagdhorna*, *Mandira Dhooma*, *Guda* and Brick powder which contain Silica on mild temperature for longer duration; *Dagdhorna*, *Mandira dhooma* and Brick powder acts as adsorbent and *Guda* acts as reducing agent. Mild temperature and pressure

produced during the trituration plays very important role in reaction between the *Parada* and *Dravya* used in *Mardana Samskara*. Hence loosened *Malas* of *Parada* gets removed with the drugs used in process after washing with hot water or hot *Kanji*.

3. *Murchana Samskara*:-

Initial weight of *Mardita Parada* taken for *Murchana Samskara* was 497gms. In this *Samskara* of *Parada*, *Kumari Swarsa*, *Triphala Churna* and *Chitraka Mula Churna* were used. Here *Parada* was trituated with all these three drugs till it attains the *Nashtapishta* form i.e. at last *Parada* will not be differentiated from the *Kalka*. The weight of *Nashtapishta Kalka* was 640gms (*Parada+Kalka Dravya*). All the three *Dravyas* used in this *Samskara* are having *Katu*, *Tikta* and *Kashaya Rasa*. Due to *Bhedhana*, *Shoshana*, *Kshalana* and *Lekhana* properties of *Katu* and *Kashaya Rasa*'s present in these three *Dravyas*, may removes *Doshas* like *Visha*, *Vahni* and *Mala* of *Parada*.

4. *Utthapana Samskara*:

The *Utthapana Samskara* of *Parada* was performed to regain *Parada* from dissociated form or *Nashtapishta Swarupa* into original state. *Nashtapishta Kalka* was subjected for *Patana Karma* to regain the *Parada*. This *Samskara* should be carefully conducted as there is possibility of more amount of loss of *Parada*. As per opinion of *Rasa* scholars and practical experience the loss of *Parada* can be prevented by just drying in sunlight and *Patana Karma*. It should not be washed with hot water/*Kanji* to avoid its loss in *Jalagati*. The Initial weight of *Nashtapishta Roopi Kalka* taken for *Utthapana Samskara* was 640gms, and after *Utthapana* 485gms was obtained. Weight loss 11gms may be due to mechanical loss during the *Mardana* procedure or may be due to *Jala Gati*, and *Mala Gati*.

5. *Patana Samskara*:

A. *Urdhwa Patana Samskara*:

In *Urdhwa Patana Samskara*, *Parada* was trituated with 1/4th *Shuddha Tamra* with the help of *Nimbu Swarasa* and *Saindhava Lavana*, till formation of amalgam; it was subjected for *Urdhwa Patana Karma*. It was observed that during amalgamation, use of *Nimbu Swarasa* and *Saindhava Lavana* accelerates the formation of Amalgam. This is the 1st *Samskara* where the *Tamra*, a metallic substance is used for procedure; this is may be because being higher in place in electro-chemical series, it is highly reactive and forms amalgam very easily when compared with other metals. *Tamra* having higher boiling point of 2310°C, and impurities like *Naga* and *Vanga* of 325°C and 233°C, gets attached to *Tamra* and don't sublime and remain at bottom, thus only

Shuddha Parada gets sublimated. This property of *Tamra* can be taken as *Vishaghna* in the classics. Total 6 hrs of heat was given. Maximum temperature maintained was 600°C. The initial weight of *Poorva Samskarit Parada* was 485gms and after *Urdhwa Patana* 449gms of *Parada* obtained. 36gms weight loss may be due to *Jalagati* and *Malagati*.

B. *Adha Patana Samskara*:

In *Adha Patana Samskara*, *Parada* was trituated with 1/16th of *Kalka Dravyas* and paste was applied to inner side of upper pot and dried completely, other pot was kept below first pot and *Sandhibandana* was done. From the above, with help of *Vanopalas*, *Agni* is given for 6hours with temperature ranging between 300-800°C. *Parada* got sublimated then collected in the lower pot leaving behind the *Kalkadravya* along with *Doshas*(*Bhujakanchuka Nashanam*). The Initial weight of *Poorva Samskarit Parada* was 449gms and after *Adha Patana* 413gms *Parada* obtained. 36gms weight loss may be due to, mechanical loss or *Jala Gati*, and *Mala Gati*.

C. *Tiryak Patana Samskara*:

In *Tiryak Patana Samskara*, *Parada* was trituated with equal quantity of *Dhanyabhraka* along with *Kanji* till *Parada* becomes *Nashtapishta* form. This *Kalka* was placed in *Tiryak Patana Yantra* and heat was given and *Parada* was collected in another flask. This is considered as best among 3 *Patanavidhi* because; Vaporized and distilled mercury will be completely separated from the *Pishti*. The *Dhanyabhraka* (Mica) a mineral contains plenty of trace elements in it and as it is heat stable mineral it allows the *Shudha Parada* to get distilled completely leaving the impurities behind. Total 3 ½ hrs of heat was given. Maximum temperature maintained was 700°C. The initial weight of *Poorva Samskarit Parada* was 413gms and after *Tiryak Patana* 352gms *Parada* obtained. 61gms weight loss may be due to, mechanical loss or *Jala Gati*, *Dhooma Gati*, and *Mala Gati*.

6. *Rodhana Samskara*:

In *Rodhana Samskara*, *Poorva Samskarita Parada* was kept soaked in the *Saindhava Jala* prepared in the ratio of 1:5 (*Saindhava:Jala*) for 3 days. Due to *Poorva Samskara*'s *Parada* becomes inactive (*Swarnadi Grasa Shakti* becomes reduced). *Saindhava* acts as catalyst in doing *Mukhikarana* of *Parada* because of its *Ushna*, *Tikshna Guna* and *Deepana* and *Pachana Karma*. Initial weight of *Poorvasamskarita Parada* taken for *Rodhana* was 352gms and after *Rodhana* 352gms was obtained. There was no weight loss.

7. Niyamana Samskara:

In *Niyamana Samskara* of *Parada*, it was kept in *Pottali* Containing *Kalka* of specific drugs, and *Dolayantra Swedana* is done in *Kanji* for 1 day. Drugs used for preparation of *Kalka* are having *Ushna*, *Tikshna Guna* due to these properties they are said to be controlling *Chapalata /Chanchalata* properties of *Parada* which was increased due to the increased *Veerya* of *Parada* during *Rodhana Samskara*. Initial weight of *Poorvasamskarita Parada* taken for *Niyamana* was 352gms and after 350gms *Parada* was obtained. 2gms weight loss may be due to, *Jala Gati*, *Dhooma Gati*, and *Mala Gati* .

8. Deepana Samskara:

It is the first *Samskara* in which first time minerals like *Sphatika*, *Kasisa*, *Tankana* along with some herbs have been mentioned. *Kalka* was prepared along with these drugs and *Swedana* is done in *Dolayantra* containing *Kanji* for 3days. All *Dravyas* used here have properties like, *Kshareeya*, *Agnideepaka* and *Pachaka Karma* may be due to these properties Intra orbital space of the *Mercury* increases and helps for increasing *Grasa Grahana Shakti* in gross digestive capacity of *Parada* for *Suvarnadi Dhatus* in it. After all *Ashta Samskara's Parada* loss was 30% more quantity of *Parada* was lost during *Trividha Patana Samskara*. Initial weight of *Poorvasamskarita Parada* taken for *Deepana Samskara* was 350gms and after 350gms *Parada* was obtained. There was no weight loss.

II. Gandhaka Shodhana:-

Gandhaka Shodhana was done by *Dhalana* method, using *Go-Dughdha* as a media. As *Ghrita* media makes *Gandhaka* more *Snigdha* and thus hinders the sublimation process. Milk reacts with molten sulfur remove arsenic like chemical impurities quickly and rearrange the crystal size. Milk is commonly recommended antidote for poisoning; it might help in neutralizing the sulfur poisoning. The change in color of milk from white to yellow and sulfur smell may indicate the dissolution of fat soluble sulfur content in the milk. Seven times procedure was repeated to remove any remnant *Doshas*. After completion of procedure *Gandhaka* was washed with hot water to remove remnants of milk and limpidity. Initial weight of *Gandhaka* was 500gms, and after *Shodhana* 425gms was obtained. 75gms weight loss which shows the concentration of physical impurities like clay, mud, sand, threads etc which are removed by *Galana* procedure. The Chemical impurities like lead, arsenic etc. may be removed by absorbing over to colloidal fatty globules of milk. Smell of *Gandhaka* was totally lost after *Shodhana* with milk. Milk reduces *Ushna*, *Tikshna Guna* of *Gandhaka*. The

Shodhita Gandhaka was observed brittle and dull yellow color may be due to the change in crystalline structure (from mono clinic to rhombic), while passing through the stage of melting.

III. Tamra Samanya Shodhana by Nirvapa method in following Drava-Dravyas:-

1. In *Tila Taila*:-It has *Madhura*, *Tikta*, and *Kashaya Rasa*, *Vyavyi*, *Vikashi*, *Vishada*, *Deepana*, *Lekhana*, *Ushna*, *Guru Gunas*, by these properties it may cause *Snighdhata* (softening) and *Bhedhana* and removal of the *Doshas* present in *Tamra*. 600gms of *Tamrapatras* were taken and after *Nirvapa* 676gms *Tamrapatras* were obtained. There was 76gms weight gain, may be because of adherence of fatty substances. Color of *Tila Taila* was changed to golden brown to brown after *Nirvapa* and pH-5 to 6 may be due to over the surface electro-microscopic study of *Samanya Shodhita Tamra* has shown the presence of media in the intra-molecular space which suggest that media has definite role to play in *Shodhana* and *Marana* to convert it into Bio-available form.

2. In *Takra*:-It is having *Kashaya*, *Amla Rasa*, *Ushna*, *Laghu*, *Deepana*, *Grahi Guna*. By these properties it may cause *Bhedhana* (breaking) effect on the material and help to remove the *Malas* present in the *Tamra*. 676gms *Tamra patras* were taken and after *Nirvapa* 579gms *Tamra patras* were obtained. There was 97gms weight loss may be because of mechanical loss. Color of *Takra* was changed to Milky white to Greyish after *Nirvapa* and pH-4 to 5 may be due to lactic acid could react with the cooper oxides to form cupric lactate ($C_3H_5CuO_3$) which was then reduced to copper in the quenching process.

3. In *Gomutra*:-It has *Katu*, *Tikta*, *Kashaya Rasa*, *Tikshana*, *Ushna*, *Laghu*, *Deepana*, *Kshara* properties. By these properties it may destroyed many undesired substances from the *Tamra*. 579gms *Tamra patras* were taken and after *Nirvapa* 523gms were obtained. 56gms weight loss may be due to mechanical loss. Color of *Gomutra* was changed to light brown to dark brown after *Nirvapa* and pH-8 to 9 may be due to the reaction between ammonia from *Gomutra* and copper to form the cuprammonium ions $[Cu(NH_3)_4]$.

4. In *Kanji*:-It is having *Amla Rasa*, *Tikshana*, *Ushna*, *Laghu Guna*, *Deepana*, *Bhedana* and may cause *Doshanirmulana* as well as introducing *Agneya* and *Akashiya Gunas* in *Tamra*. 523gms *Tamra patras* were taken and 434gms were obtained. 89gms weight loss may be due to physical loss. Color of *Kanji* was changed to white to greyish after *Nirvapa* and pH-3 to 5 may be due to organic acid could chelate the loosened copper and may form precipitate with

Copper ions to change the chemical and structural pattern of copper.

5. In *Kulttha Kwatha*:-It has *Kashaya Rasa, Laghu, Ushna, Vidahana Guna*. By this it may cause *Bhedhana* of *Tamra* and *Tamra* became brittle. 434gms *Tamra patras* were taken and 406gms were obtained. 28gms weight loss may be due to mechanical loss. Color changed from brown to blackish brown and pH-6 to 7 after *Nirvapa*, may be due to organic acid could chelate the loosened copper and may form precipitate with copper ions to change the chemical and structural pattern of copper.

IV. *Tamra Vishesh Shodhana*:-*Samanya Shodhita Tamra* (406gms) was subjected for *Vishesh Shodhana* by *Pachana* procedure, *Tamra patras* were immersed in a vessel containing *Gomutra* and 1/8th part *Saindhava Lavana* kept over fire for boiling till 6 hours. *Saindhava* and *Gomutra* contained *Lekhaniya* and *Kshariya Guna*. They may be removing the alkaline soluble impurities along with trace element present in *Tamra*.

After *Vishesh Shodhana*, observed weight loss (21gms) was may be due to the reaction between ammonia from *Gomutra* and copper to form the cuprammonium ions $[Cu(NH_3)_4]$, a chemical complex gets washed away during washing with hot water.

V. Preparation of *Kajjali*:-

Initial weight of *Ashta Samskarita Parada* was 120gms, and *Shu. Gandhaka* 120gms after the weight of *Kajjali* obtained 238gms. 2gms weight loss may be due to performing the confirmatory test or some quantity of *Kajjali* was adhered to *Khalwa*.

Kajjali acts as base for subsequent *Rasa* preparations. *Kajjali* is a compound of *Parada* and *Gandhaka* which was prepared without using *Agni*, hence it is considered as *Sagandha Niragni Murchana Kalpa* of *Parada*. *Samaguna Kajjali* was prepared by triturating *Ashtasamskarita Parada* and *Shudha Gandhaka*. Trituration was continued till it got jet black color and loss of shining particles (*Samyaka Kajjali Lakshana*). After 24 hours of trituration it became jet black color (*Kajjalabha*). This black color might be due to formation of black sulfide of mercury.

Constant and consistent pressurized trituration has its definite role to play in pharmino-dynamic properties of *Kajjali*. It is accountable to the timed release and sustained release of the active molecules of the drug. Trituration was done till the attainment of *Nischandratwa*. This indicates the reduction in the amount of free mercury in *Kajjali*.

DISCUSSION ON PROCEDURE OF TAMRA SINDOOR KUPIPKWA RASAYANA:-

I. Preparation of *Kupi*:-

The *Kupi* was prepared in Green colored beer bottle as it is chemically inert & it won't allow the sunrays to enter into it, also prevents any reaction. For withstand heat *Gopichandana* smeared cloth was wrapped in 7 layers one after the others to the *kupi*. Application of *Gopichandana* smeared cloth strengthen the bottle and helps in regulation and maintenance of temperature inside the *Kupi* to facilitate the chemical reaction as sudden increase or decrease of temperature may also leads the breakage of *Kupi*.

II. Filling of *Kajjali* and *Shodhita Tamra* Pieces into the *Kachakupi*:-

238gms of *Kajjali* was divided into two equal parts and slowly filled in to two *Kachakupi* with the help of funnel and spoon. After, 30gms of *Shodhita Tamra* in small pieces were added in each bottle as mentioned in classic. Lower 1/3rd of the *Kupi* (after marking) was filled with ingredients, as large quantity may cause clogging of mouth of *Kupi* resulting in incomplete sublimation.

III. Placing of *Kupi* in *Valuka Yantra*:-

Two *Abhraka Patra* width of 4-5cm and thickness of 0.5cm were placed over the central hole of *Valuka Yantra*. Mica is fireproof, incombustible and non-flammable. It has excellent thermal stability and may be exposed to high temperatures without noticeable effect. So, the thin layer of *Abhraka patra* might help in preventing direct heat to the bottom of the *Kupi* which may burst the *Kupi* and dissipate the heat energy appropriately through the sand.

The ingredients (*Kajjali* and *Shu. Tamra* pieces) filled *Kupi* should be placed exactly at the centre of *Valukayantra*. The remaining portion of the *Yantra* was filled by the *Valuka*. The purpose of using the *Valuka* is to maintain the uniform and sustained heat to the *Kupi*.

IV. Preparation of *Tamra Sindoora*:-

Heating pattern in three stages was done because it is the utmost important thing. During graded heating process, control over heating and regulation of temperature according to time duration has to be maintained. The heating pattern followed is – initially gradual increase, then maintenance of the same temperature for specific time, followed by further increase in temperature for sublimation and allowed to self-cooling to room temperature. This heating pattern helps to provide sufficient time for the ingredients to react with each other and form a complex-compound under pressure.

V. Shalaka Sanchalana:- During the procedure 2 types of *Shalaka* are used-

Tapta Shalaka:- To burn extra sulfur deposited at the neck region of *Kupi*.

Sheeta Shalaka:- To know the state of *Kajjali* i.e. whether it is in powder form, melted form or boiling.

VI. Melting of Kajjali:-

After 15½hrs of heating, when temperature is about 250-264°C, HgS compound formed in *Kajjali* might attain the particular temperature of transformation into semisolid form. In the normal pressure, most chemical compounds and elements possess three different states at different temperature. In this case the transition from the solid to the gaseous state requires an intermediate semisolid state.

VII. Chocking of Sulfur at the neck:-

Chocking of the narrow neck of the bottle is observed, because of increased chain reactions and formation of polymorphs of Sulfur. This Sulfur becomes more viscous and produces dense clouds. It chocks the narrow neck of the bottle.

VIII. Boiling of Kajjali:-

Here temperature is around 295-318°C. *Kajjali* tends to attain its boiling point and about to sublime, this is the stage where in the *Kajjali* from semisolid phase attains the gaseous stage and tends to move towards neck part of *Kupi*.

IX. Blue flame at neck of Kupi:-

To clear chocking of Sulfur at neck of the *Kupi* *Tapta Shalaka* was inserted. This process involves burning of excess of Sulfur at the neck region; here Sulfur burns giving blue flame appearance. As soon as excess of Sulfur is burnt blue flame will disappear, here the temperature range was around 392-400°C.

X. Copper coin test:-

After compound formation if heat is continued, then mercury will escape. Hence corking should be done at this period. So to check escaping of mercury copper coin was placed on mouth of the *Kupi* and kept for two minutes, greyish white discoloration of copper coin was observed, it confirms the mercury vapors are coming out means the formed compound has started to disintegrate due to high temperature hence the bottle was corked immediately.

XI. Sublimation of Product at neck of the Kupi:-

Corking was done before the escape of mercury. To facilitate sublimation and collection of the product at cooler part i.e., neck of the *Kupi*. *Valuka* was removed from the neck region of *Kupi*.

XII. Corking of Kupi:-

Copper coin test was done. It was positive. *Suryodaya Lakshana* was clearly seen in the *Kupi*, it means compound was started to collect at neck of the *Kupi*.

Corking was done with the help of *Gopichandana* smeared cloth. Sand surrounding the neck of the *Kupi* was removed it facilitate the condensation of sublimated material at a cooler area i.e. neck of the *Kupi*. At this moment ingredients will convert into gaseous form and starts forming the complex. After corking temperature was maintained between 500-700°C & then allowed for self-cooling. At higher temperature, however, the viscosity of 'S' decreased as de-polymerization of sulfur occurs that's why the product obtained was in a compact crystalline mass at the neck region of the *Kupi* without leaving mercury to evaporate.

XIII. Temperature Pattern:-

Kramagni heating pattern was maintained for 36 hours.

Mriduagni:-150-250°C for 15hrs

Madhyamagni:-250-500°C for 12hrs

Teevragni:-500-700°C for 9hrs

This is the unique specialty of this preparation in which gradual rise of *Agni*, maintenance of the same for specific period, further increases in temperature for sublimation and then self cooling, and might help in breaking of the bonds formed in *Kajjali* and chemical reaction in specific temperature along with re-crystallization.

XIV. Yield of Tamra Sindoor:

Out of 298gms of ingredients (*Kajjali*+*Shu.Tamra*) 177gms *Sindoor* was obtained, and Yield was 60%.

In the present study, *Kajjali* was prepared with *Ashtasamskarita Parada* and *Shu. Gandhaka*. Then flakes of *Shu. Tamra* were added in the *Kupi* and *Kupipakwa* was done. Free *Parada* and *Gandhaka* together forms enough mercuric sulfide and after sublimation yield in the form of *Sindoor* is obtained. Since *Parada* and *Gandhaka* directly combine to form *Kajjali* there is a complete chemical bonding between both hence yield is good. *Tamra* is added as flakes hence its quantity in traces is seen in final product.

DISCUSSION ON ANALYTICAL STUDY:-

I. Zeta potential:- In the present study, Zeta potential of *Tamra Sindoor* is -28.6mV, which suggests that *Tamra Sindoor* carries certain energy may be acquired from *Putra* process.

II. Particle size:- Particle size is one of the factors which affect dissolution and absorption of drug, solubility increases with decreasing particle size, since dissolution and absorption are inversely proportional to each other. The particle size of *Tamra Sindoor* is 486.3nm, as the particle size is less so the

dissolution is fast. That indicate the quality of the *Tamra Sindoor* was good.

III. SEM-EDX:-SEM-EDX study reveals the accurate elemental analysis of the sample, this study of elements enables us to explore major, minor and trace elements present in the sample. Five different spectrum of different wavelength was studied and it was noted that Aluminium, Sulfur, Iron, Copper were seen in K shell, and Mercury, Lead were seen in L shell. Peaks of Mercury (Hg) and Sulfur (S), is in higher concentration and various small peaks of Iron (Fe), Copper (Cu), Mercury (Hg), Aluminium (Al). Lead (Pb) is seen in minimal concentrations. These small peaks may refer to compounds of Mercury and Copper and their respective elements, which are present in small concentration along with mercuric sulfide which is in higher concentration. The concentration of mercury and sulfur is rich in the peaks amounting to approximately around 98% inferring in a compounding of mercuric sulfide.

It is evident by ICP-OES, which estimates rich quantity of Mercury (1900.0mg/kg) and Sulfur (92490.0mg/kg) also evident by SEM-EDX.

IV. CHNS:-This test used to determine the organic materials in the sample. The ratio of Carbon and Nitrogen determines the quality of organic matter. In the present study Carbon/Nitrogen is 0.248 which determines the given sample is completely inorganic.

(Carbon-0.956%, Nitrogen-3.848%)

V. ICP-OES:-During the preparation of *Tamra Sindoor* with *Ashta Samskarita Parada*, *Gandhaka* and *Tamra* was used. The *Abhraka* was made use in *Ashta Samskara* of *Parada* during *Patana* procedures. Hence Aluminium (171.5mg/kg), Arsenic (83.1mg/kg), Copper (1464.0 mg/kg), Tellurium (18.8mg/kg), Iron (187.8mg/kg), Sulfur (92490.0mg/kg), Mercury (1900), Selenium (Not detected), Zinc (82.7mg/kg), Gold (Not detected), elements were selected to estimate their concentration in final product.

The *Tamra Sindoor* is a *Kantastha Kupipakwa Rasayana*. The sublimated product was rich in

Mercury and Sulfur in the proportion of Mercury (1900.0mg/kg), Sulfur (92490.0mg/kg) respectively and Copper was present with concentration of (1464.0mg/kg). Trace of Aluminium (171.5mg/kg), Iron (187.8mg/kg) was seen may be reflecting the impression of *Abhraka* during *Ashtasamskara*. Presence of Arsenic (83.1mg/kg), Tellurium (18.8mg/kg) may have been contributed from *Gandhaka*. Zinc (82.7mg/kg) in meager quantity is seen may be addition due to Copper.

CONCLUSION:-

Ashta Samskarita Parada is free from *Doshas* and also makes it easily digestible, absorbable, and easy for assimilation by the tissue and having *Sarvarogahara*, and *Rasayana* properties. So because of these properties, to fortify *Tamra Sindoor*, *Ashta Samskara* of *Parada* was done. *Ashta Samskaras* of *Parada* was done as per the *Rasa Hridaya Tantra*. 30% of loss was found after *Ashtasamskaras*. *Gandhaka* is 2nd most important drug in *Rasashastra*. *Gandhaka Shodhana* was done as per the *Rasa Ratna Samucchaya*, *Go-dughdha* was used as a media for *Dhalana*. 15 % of loss was found after *Shodhana*. The *Kajjali* was prepared as per *Rasa Tarangini* and *Tamra Sindoor* was prepared and confirmed for *Siddhi lakshana's* as per *Ayurveda Sara Sangrah*. After *Kupipakwa* preparation 60% yield was obtained.

The Physico- chemical parameters like-pH value, loss on drying, ash value, loss on ignition and solubility were within normal limits as per AFI standards. Particle size of *Tamra Sindoor* is 486d.nm, Zeta potential of *Tamra Sindoor* is -28.6Mv, SEM-EDX report shows the atomic% and weight% of Sulfur and mercury are more as compared to other trace elements viz. Aluminium, Copper, Iron and Lead.

The CHNS report shows; Carbon/Nitrogen is 0.248 which determines the given sample is completely inorganic. The ICP-OES report shows, presence of Mercury, Sulfur, Copper, Aluminium, Arsenic, Tellurium, Iron and Zinc. The concentration of Mercury, Sulfur and Copper are higher than other trace elements.

Reports of Physico-Chemical Analysis pH analysis:-

SHRI B M KANKANAWADI AYURVED MAHAVIDYALAYA
 A Constituent Unit of KLE ACADEMY OF HIGHER EDUCATION & RESEARCH (CORPORATE-TO-BE UNIVERSITY)
 An Institute of Yoga & Naturopathy, 1, Heel, near Railway Station, Hubballi
CENTRAL RESEARCH FACILITY
 (AYUSH Approval: ASU) Drug Testing Laboratory Lic. No. TS-4/2011)

Outward No:- BMK/CRF/3/1/2021-22
 Reference No: CRF/FG/254/2021-22
 Submitted by: Dr. Ansum Kurnari
 Sample: Tamra Sindoor
 Batch No.: NA
 Sample Qty: 25 gm
 [*] NA - Not Available

Registration No: 21/06/2021
 Registration No: ---
 Part/Form: Powder
 Report Date: 24/09/2021

TEST REPORT
 Form-50 [See Rule 160-D (1)]
 (The Drugs & Cosmetics Act 1930 and the rules there under)

Description Macroscopic :

TESTS	RESULTS
FORM	: Fine Powder
COLOUR	: Reddish
ODOUR	: Characteristic
TASTE	: Tasteless
APPEARANCE	: Red coloured fine Powder & presence of Shining particles

Physico Chemical Parameters :

TESTS	RESULTS
Loss on Drying at 110 °C	: 1.52%
Loss on Ignition	: 39.42%
Ash Value	: 0.29%

Solubility Test :-

In Water	: Insoluble
In Conc.HNO ₃	: Partially soluble
In Conc.HCl	: Partially soluble
In Acetone	: Soluble

Note: AP1 Standards are not Available Given results are of the submitted sample.

ANALYST: [Signature] AUTHORIZED SIGNATORY: [Signature]

KLE ACADEMY OF HIGHER EDUCATION & RESEARCH
 (CORPORATE-TO-BE UNIVERSITY)
 An Institute of Yoga & Naturopathy, 1, Heel, near Railway Station, Hubballi

Ref. No: KLE/12034-23 Date: 11/11/2024

PHYSICO-CHEMICAL ANALYSIS OF TAMRA SINDOOR
 Dr. Purnam Kumar
 Name of the Centre: Ayurveda Mahavidyalaya, Hubballi
 Department: Rasashastra and Dhanshaya Kalpa

RESULTS

PARAMETER	TAMRA SINDOOR
Color/Form/Appearance	Fine powder
pH (of 1% solution)	6.7 (B 90.9.54.6.68)

pH:
 Unless otherwise specified in the test procedure pH was determined at 25 °C for 1% solution using double distilled water.

References:

- Mukherjee PK. Quality Control of Herbal Drugs. New Delhi (India) Business Horizons, 2002.
- Indian Pharmacopoeia, vol. II. Government of India, New Delhi (India): Ministry of Health and Family Welfare, 1995.

Thanking you,
 Yours faithfully,
 [Signature] PRINCIPAL

Consulting Staff (Dr. H. N. Srinagar)

Approved 'A' Grade by NAAC (2nd Cycle) - Accredited 'A' by MHED (GoI)
 Recognized by Government of Karnataka
 3rd Phase, Centre Accredited by National Board of Accreditation (NBA)
 Approved by Pharmacy Council of India (PCI) & All India Council for Technical Education (AICTE), New Delhi

Zeta Potential:- Particle Size:-

Zeta Potential DTS0059 Diagnostic Report
 Malvern

Sample Details

Sample Name: Tamra Sindoor (Data 1)
 SOP Name: [Blank]
 General Notes: [Blank]

File Name: DTS0059.D
 Record Number: 435
 Date and Time: Friday, August 27, 2021 4:11
 Dispersant Name: Water
 Dispersant pH: 1.330
 Viscosity (cP): 0.0173
 Dispersant Conductivity Constant: 78.5

System

Temperature (°C): 25.0
 Count Rate (cps): 122.1
 Cell Description: Clear Dispersion cell
 Measurement Position (mm): 130
 Attenuation: 3

Results

Parameter	Value	Unit
Zeta Potential (mV)	-29.6	mV
Zeta SD (mV)	4.24	mV
Conductivity (µS/cm)	0.0287	µS/cm

Zeta potential out of range
 Conductivity is out of range - check cell or sample

Zeta Potential Distribution

Size Distribution Report by Intensity
 Malvern

Sample Details

Sample Name: Tamra Sindoor PSL 2
 SOP Name: [Blank]
 General Notes: [Blank]

File Name: DTS0059.D
 Record Number: 435
 Date and Time: Friday, August 27, 2021 4:11
 Dispersant Name: Water
 Dispersant pH: 1.330
 Viscosity (cP): 0.0173
 Dispersant Conductivity Constant: 78.5

System

Temperature (°C): 25.0
 Count Rate (cps): 122.1
 Cell Description: Disposable syringe cuvette
 Measurement Position (mm): 130
 Attenuation: 3

Results

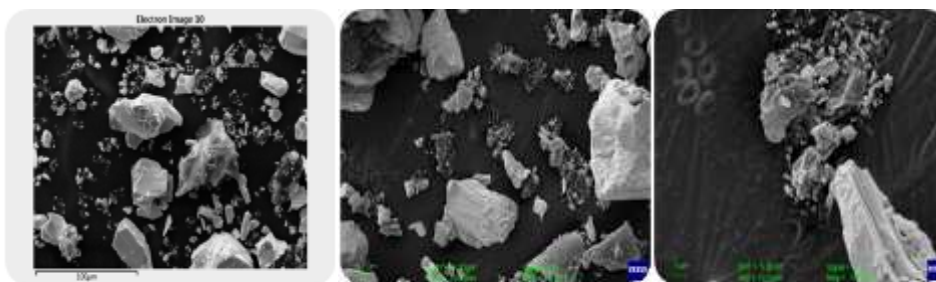
Parameter	Value	Unit
Z-Average (d.nm)	486.2	nm
Intensity (d.nm)	0.3427	
Intercept	0.7320	

Size (d.nm)

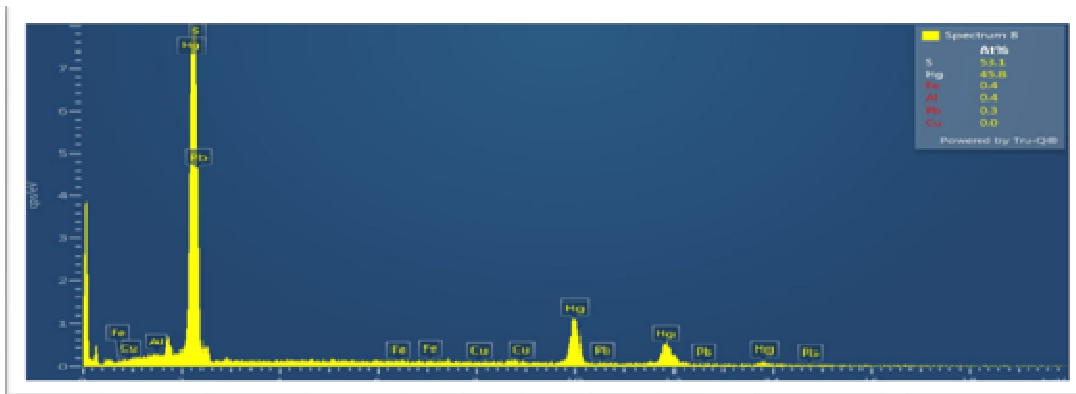
Size (d.nm)	% Intensity	Std Dev (d.nm)
585.6	95.0	143.5
5022	4.8	500.2
0.0000	0.0	0.0001

Result quality: Good

Size Distribution by Intensity



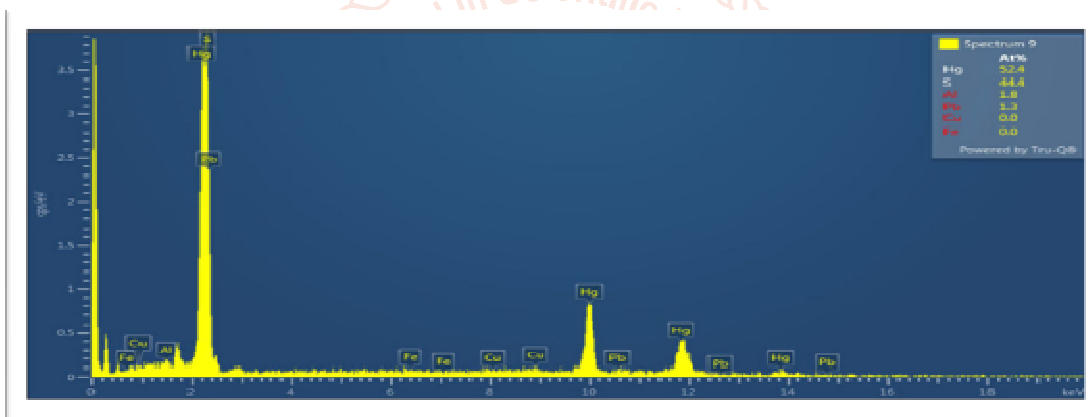
SEM-EDX:-



AUG 10-09-21

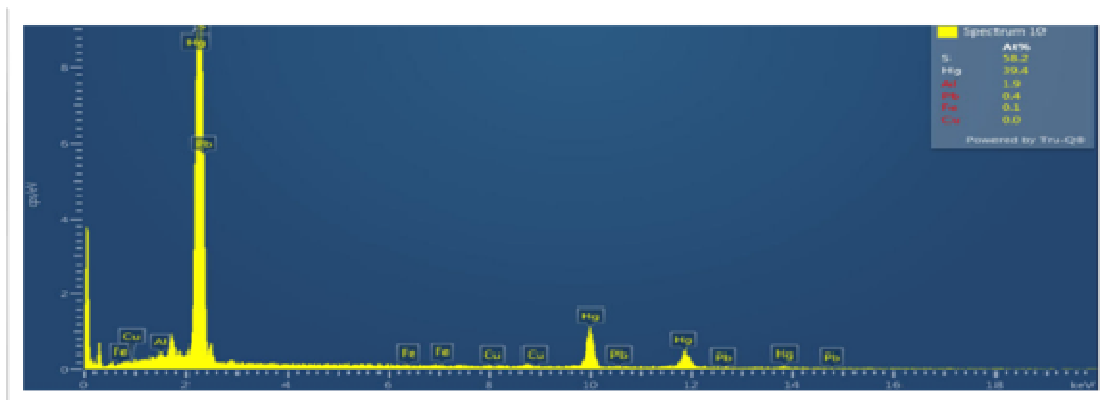
Spectrum 8

Element	Line Type	Apparent Concentration	k Ratio	Wt%	Wt% Sigma	Standard Label	Factory Standard	Standard Calibration Date
Al	K series	0.01	0.00005	0.09	0.22	Al2O3	Yes	
S	K series	1.45	0.01252	15.50	0.88	FeS2	Yes	
Fe	K series	0.08	0.00027	0.22	0.28	Fe	Yes	
Cu	K series	0.00	0.00000	0.00	0.35	Cu	Yes	
Hg	L series	10.20	0.09853	83.61	1.57	HgTe	Yes	
Pb	L series	0.07	0.00069	0.59	1.52	PbTe	Yes	
Total:				100.00				

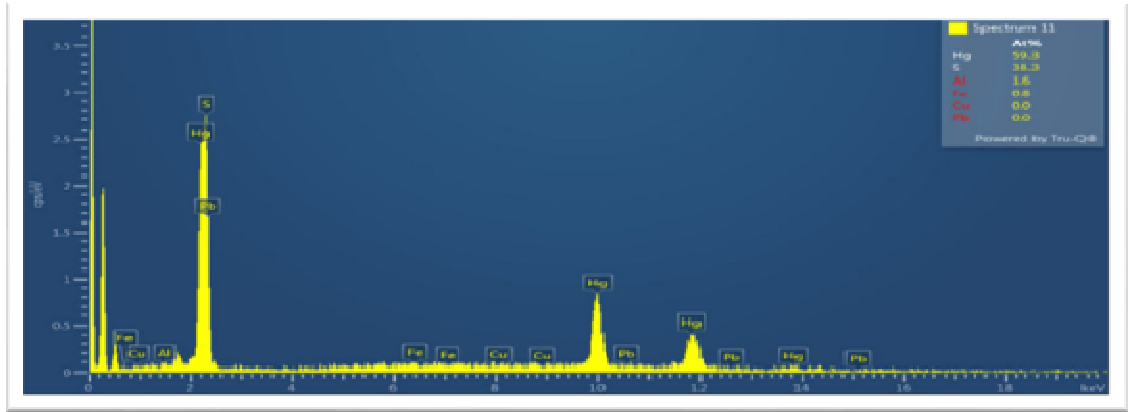


Spectrum 9

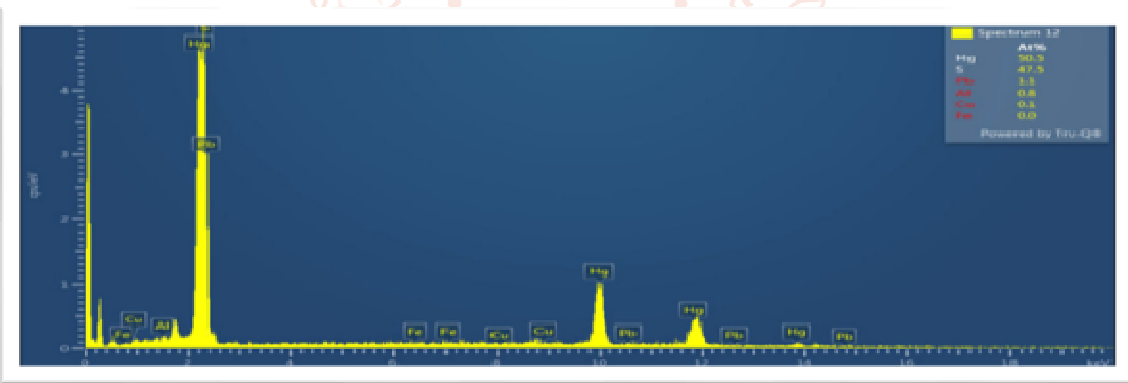
Element	Line Type	Apparent Concentration	k Ratio	Wt%	Wt% Sigma	Standard Label	Factory Standard	Standard Calibration Date
Al	K series	0.02	0.00018	0.40	0.24	Al2O3	Yes	
S	K series	0.77	0.00664	11.61	0.88	FeS2	Yes	
Fe	K series	0.00	0.00000	0.00	0.29	Fe	Yes	
Cu	K series	0.00	0.00000	0.00	0.41	Cu	Yes	
Hg	L series	7.59	0.07337	85.74	1.88	HgTe	Yes	
Pb	L series	0.20	0.00192	2.25	1.88	PbTe	Yes	
Total:				100.00				



Spectrum 10								
Element	Line Type	Apparent Concentration	k Ratio	Wt%	Wt% Sigma	Standard Label	Factory Standard	Standard Calibration Date
Al	K series	0.05	0.00033	0.53	0.27	Al2O3	Yes	
S	K series	1.74	0.01503	18.85	1.00	FeS2	Yes	
Fe	K series	0.01	0.00007	0.06	0.28	Fe	Yes	
Cu	K series	0.00	0.00000	0.00	0.36	Cu	Yes	
Hg	L series	9.38	0.09061	79.78	1.60	HgTe	Yes	
Pb	L series	0.09	0.00089	0.79	1.54	PbTe	Yes	
Total:				100.00				

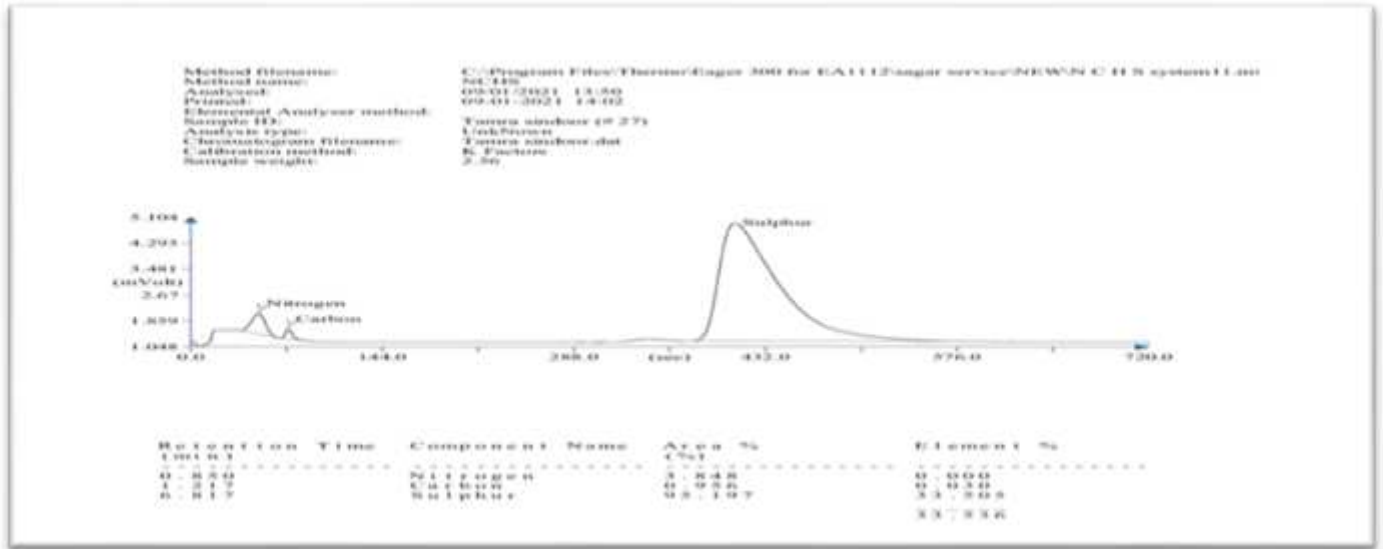


Spectrum 11								
Element	Line Type	Apparent Concentration	k Ratio	Wt%	Wt% Sigma	Standard Label	Factory Standard	Standard Calibration Date
Al	K series	0.02	0.00013	0.32	0.19	Al2O3	Yes	
S	K series	0.56	0.00482	9.30	0.77	FeS2	Yes	
Fe	K series	0.03	0.00027	0.33	0.32	Fe	Yes	
Cu	K series	0.00	0.00000	0.00	0.43	Cu	Yes	
Hg	L series	7.39	0.07139	90.06	0.85	HgTe	Yes	
Pb	L series	0.00	0.00000	0.00	2.03	PbTe	Yes	
Total:				100.00				



Spectrum 12								
Element	Line Type	Apparent Concentration	k Ratio	Wt%	Wt% Sigma	Standard Label	Factory Standard	Standard Calibration Date
Al	K series	0.01	0.00010	0.18	0.20	Al2O3	Yes	
S	K series	1.04	0.00893	12.79	0.82	FeS2	Yes	
Fe	K series	0.00	0.00000	0.00	0.27	Fe	Yes	
Cu	K series	0.00	0.00005	0.04	0.37	Cu	Yes	
Hg	L series	9.13	0.08825	85.08	1.69	HgTe	Yes	
Pb	L series	0.21	0.00198	1.92	1.65	PbTe	Yes	
Total:				100.00				

CHNS:-



ICP-OES:-

Dr Kusumkumari Post Graduate Student, Dept of Rasashastra & Bhaishajya Kalpana, Ayurveda Mahavidyalaya, Hubballi 580024, Karnataka	Date of Receipt : 25/08/2021 Report Date : 04/09/2021
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Report Details : DL/TR/2021/0428

Sample Particulars:

Tamra Sindoor

Batch No : Tamra Sindoor Test required : Heavy Metals
 Qty of sample : 1 g

TEST RESULTS

Test Parameters Metal Content (mg/kg)	Result	Method of Test	Method Detection Limit
Aluminium (Al)	171.5	DIN EN 16711-1 By microwave digestion followed by ICP-OES (ISO-11885)	0.33 mg/kg
Arsenic (As)	83.1		0.1 mg/kg
Copper (Cu)	1464.0		0.1 mg/kg
Tellurium (Te)	18.8		0.12 mg/kg
Iron (Fe)	187.8		0.1 mg/kg
Sulphur (S)	92490.0		1.06 mg/kg
Mercury (Hg)	1900.0		0.04 mg/kg
Selenium (Se)	ND		2.09 mg/kg
Zinc (Zn)	82.7		0.16 mg/kg
Gold (Au)	ND		0.3 mg/kg

ND: Not Detected

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