

## TAMRA SINDOORA – PHARMACEUTICO ANALYTICAL STUDY

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### ABSTRACT

The word *Rasashastra* literally means the ‘Science of Mercury’. However, it is a specialized branch of *Ayurveda* dealing mainly with materials which are known as ‘*Rasa dravyas*’. It is having its own importance because of instant effectiveness, very small dose and extensive therapeutic utility. It deals with various pharmaceutical processes of *Shodhana*, *Marana* and other different formulary methods viz *Khalveeya rasayana*, *Parpati*, *Pottali* and *Kupipakva rasayana*. Numerous *yogas* containing *Sindoora* of metals and minerals are explained in the classics which are having higher therapeutic efficacy. *Tamra Sindoora*<sup>1</sup> is one such preparation composed of *Shuddha Parada*, *Shuddha Gandhaka* and *Shuddha Tamra* in the ratio of 2:2:1. Any drug before its coming to the market it should be assessed with all its pharmaceutical and analytical values. With the same intention going to present the article based on work done over the *Tamra Sindoora*.

**Keywords:** *Tamra Sindoora*, *Kupipakva Rasayana*, Pharmaceutical Study, Analytical Study, etc.

### INTRODUCTION

*Ayurveda*, the science of Life, traces back its origin to the *Vedic* ages in India. Considered a supplement to the *Vedas*, *Ayurveda* is a comprehensive system of health that focuses on leading a healthy life, helping an individual do his righteous duties (*dharma*), acquire wealth (*artha*) and gratification of desires (*kama*) and attain emancipation (*moksha*).

“*Na cha rasashastram dhatuvadarthameveti man-tavyam, Dehavedhadvaara muktireva paramapray-ojanatvat*”<sup>2</sup>

The main foundation being the concept of objective of the science of mercury is not limited to Alchemy (*Dhatuvada*) but also to maintain health and strengthen the body for achieving *mukti* i.e. ultimate salvation.

Even author of *Bhaishajya Ratnavali* quoted that, despite having the knowledge of every science, if one is not knowing about the things of *Rasashastra*, one becomes a laughingstock –like a scholar without righteous behaviour.

“*Sarvashastrarthatatvagy na janati rasam yada | Sarvam tasyopahasaya dharmameeno yatha budhah ||*”<sup>3</sup>

The *Rasadavyas* are broadly classified into *Maharasa*, *Uparasa*, *Sadarana rasa*, *Dhatu*, *Upadhatu*, *Ratna*, *Uparatna*, *Visa* and *Upavisa*. Here *dhatu*s and *upadhatu* refers to the metals. These metals supplement several essential elements in the tissues of human body. The metal-based formulations are particularly effective

in curing diseases related to organs where such metals naturally present.

There are basically 4 preparations in the *rasashastra* ie, *Kharaliya Rasayana*, *Parapati Rasayana*, *Pottali Rasayana* and *Kupipakva Rasayana*. *Kupipakva rasayana* is the one where in the drugs are prepared in a *kupi* using a special *yantra* called as *bhatti*. These are mainly called as *sindoor kalpana* as they are in red color. They are having a very quick action at a very small dose because of which it is having its own importance.

### Objectives

- Up to date review of *Tamra Sindoor*, *Tamra*, *Parada*, *Gandhaka* and other associated drugs.
- Preparation of *TamraSindoor* as per classical reference.
- To carryout Physico-chemical analysis of T.S.K. and T.S.T.
- To carryout analytical study of *Tamra Sindoor*.

### Materials and Methods

**Parada Shodhana<sup>4</sup>:** 450gms of *ashuddha parada* was taken in the *khalva yantra*. To it equal amount of *sudha curna* is added. It was triturated for 3 days continuously. Later it is collected in a vessel containing water and washed properly. Then *parada* is collected from the bottom of the vessel. Then *nistusha lashuna* equal to *Parada* and half of that *saindava lavana* has been taken in *khalva* and triturated to make a paste. To this paste *Parada* should be added carefully. It should be triturated continuously till *lashunas* color changes to blackish. Then wash it with warm water to remove the *lashuna*. At last after complete washing *Parada* has been collected and stored in an airtight glass container.

**Gandhaka Shodhana<sup>5</sup>:** *Gandhaka* was coarsely powdered in a *Khalva yantra*. In a big iron pan *gogrita* was poured and melted. Into the melted *gogrita* the coarsely powdered *gandhaka* was added and heat was given till it gets melted completely. Meanwhile in a vessel 1liter *godugdha* was poured and covered with a cotton cloth and tied with a thread. The melted *gandhaka* was then poured into the vessel containing *godugdha*. Then the solidified *gandhaka* was taken out from the vessel and washed with a warm water. Then it was pounded and made into coarse powder. The same procedure was repeated for another 2 times.

**Tamra Samanya Shodhana<sup>6</sup>:** The *Tamra* was heated on fire, directly by holding it with holder till it became red hot. The red hot *Tamra* was dipped into a vessel containing *Tila taila*. After *Tamra* become cool they were taken out and washed with warm water then dried using clean cloth. The same procedure of heating and dipping in the oil was repeated for 6 more times. Finally, *Tamra* was dried well in shade. The whole procedure was repeated with *Takra*, *Gomutra*, *Kanji* and *Kulatta Kwatha* 7 times with each liquid media.

**Tamra Vishesha Shodhana<sup>7</sup>:** A mud pot was taken and in that 2 litres of *Gomutra* and *Saindava lavana* was added, mixed well. In the same mud pot the *samanya shodita Tamra* was added. The mud pot was kept on a gas stove and heat was given for 3 hours. Later the *tamra* was taken and washed well and dried.

### Preparation of Kajjali<sup>8</sup>:

*Shoditha Gandhaka* was taken in a *khalva yantra* and pounded well to make fine powder. To this equal quantity of *Shoditha Parada* was added and started trituration. Continuous trituration was carried slowly by *peshani* using more pressure. Above mixture was triturated slowly with uniform speed till all the *Kajjali Lakshanas* were observed i.e. the whole mixture converts into a fine, smooth, lustreless black powder.

### Preparation of Tamra Sindoor by Kupipaka:

The whole procedure of *Tamra Sindoor* was divided under 3 headings as follows:

#### 1. Purva karma:

- a. Preparation of *Kachakupi*.
- b. Filling of *Kajjali* into *Kachakupi*
- c. Placing of *Kachakupi* in *Valuka Yantra*.

#### 2. Pradhana karma:

- a. Heating schedule (*Kramagni tapa*)
- b. Observation and Recording of Temperature
- c. Corking *Kachakupi* and self-cooling of the Apparatus.

#### 3. Paschat karma:

- a. Removal of *Kacha kupi* from *Valuka Yantra*
- b. Breaking of *Kacha kupi*
- c. Collection of Final product.

A *kupi* was prepared by taking a glass bear bottle. It was washed with a warm water and dried. Then it was applied with 7 layers of cloth smeared with

*multhanimiti*. Each layer was applied after complete drying of the previous layer. The prepared *kupi* was filled 1/3<sup>rd</sup> with the *kajjali* (200gms) and *shuddha tamra curna* (50gms). Then this *kupi* was placed inside the *valuka yantra*. *Valuka* was filled till the neck of the *kupi*. This *valuka yantra* was placed in the *bhatti*. The heat was started to give in raising order. For the first 07 hours *Mrudhvagni* was given i.e., temperature maintained between 100°C – 250°C. Next 13 hours *Agni* was gradually raised to *Madhyamagni* stage i.e., 250°C-450°C. *Tivragni* was given for 17 hours i.e., temperature maintained between 450°C- 600 and above. By this time *Sindoor Siddha Lakshana* were observed, corking was done again heat was given for 5 hours for

complete sublimation of product. Later the apparatus was allowed for self-cooling. After complete cooling of the *Bhatti*, *Valuka Yantra* was removed out from the *Agni Bhatti*. Sand surrounding the *Kupi* in *Valuka Yantra* was carefully removed and then *Kupi* was removed. The mud smeared cloth layers of the *Kupi* were scrapped out with a knife. A jute thread dipped in kerosene was tied to the *Kupi* 2-3cm below the level of sublimated product and ignited. When the whole thread gets burnt off, wet cloth was wrapped around that. The bottle gets broken into 2 equal halves with a breaking sound. From the neck region *Sindoor* was collected as a single block with a central hole by a simple tapping and was stored in a clean sterile container.

### Physio Chemical and Analytical Tests:

#### Physical Tests

**Table 1:** Organoleptic Characters

Physical test	<i>Shuddha Tamra Curna</i>	<i>Kajjali</i>	<i>T.S.K</i>	<i>T.S.T.</i>
Colour	Reddish brown	Black	Vermilion	Dark brown
Odour	Odorless	Sulphur like	Mild sulphur	Mild sulphur
Taste	Tasteless	Tasteless	Tasteless	Tasteless
Touch	Metal particles	Amorphous	Amorphous	Amorphous

#### Chemical Test

Quantitative analysis of *S.T*, *Kajjali*, *T.S.K* and *T.S.T*

**Table 2:** Percentage of Copper, Mercury and Sulphur

Sample	<i>S.T</i>	<i>Kajjali</i>	<i>T.S.K</i>	<i>T.S.T.</i>
Total Hg	-	45.60%	31.95%	0.35%
Total S	-	28.05%	3.15%	4.25%
Copper	99.67%	-	15.24%	36.95%

**Table 3:** XRD of *Ashuddha Tamra*

Peak No	Identified		Standard		
	Angle 2 θ	d space [Å]	Angle 2 θ	d space [Å]	Intensity [%]
1	44.034	2.05478	44.044	2.05433	100
2	51.164	1.78392	51.17	1.78373	78.9
3	74.309	1.27540	74.304	1.27547	60.2
4	74.691	1.26982	74.706	1.2696	74.3
Name of standard: Cu, Crystal structure: Cubic					

**Table 4:** XRD of *Shuddha Tamra*

Peak No	Identified		Standard		
	Angle 2 $\theta$	d space [Å]	Angle2 $\theta$	d space [Å]	Intensity [%]
1	37.317	2.40772	37.284	2.40978	9.7
2	44.267	2.04450	44.268	2.04445	100
3	51.330	1.77853	51.361	1.77755	45.8
4	74.803	1.26820	74.803	1.2682	54
Name of standard: Copper (Cu), Cuprite (Cu <sub>2</sub> O), Crystal structure: Cubic JCPDS No:					

**Table 5:** XRD of *Ashuddha Gandhaka*

Peak no	Identified		Standard		
	Angle 2 $\theta$	d space [Å]	Angle2 $\theta$	d space [Å]	Intensity [%]
1	15.963	5.54768	15.973	5.54414	11.9
2	22.372	3.97079	22.376	3.97004	16
3	23.568	3.77180	23.556	3.77376	100
4	26.333	3.38173	26.323	3.38297	33.5
5	27.176	3.27876	27.174	3.27892	60.9
6	28.176	3.16472	28.182	3.16398	41.1
8	31.853	2.80716	31.866	2.80608	10.7
9	34.625	2.58849	34.625	2.58851	11
10	36.383	2.46736	36.388	2.46708	13.4
11	37.493	2.39687	37.477	2.3978	11.9
12	38.331	2.34632	38.343	2.34563	9.9
13	43.220	2.09159	43.213	2.0919	13.2
15	51.644	1.76845	51.643	1.76851	14.8
16	52.463	1.74276	52.474	1.74242	22.1
17	53.471	1.71227	53.478	1.71204	17.7
18	54.312	1.68771	54.319	1.68753	24.2
Name of standard: Sulphur (S) Crystal structure: Triclinic, Monoclinic JCPDS No: 26 – 0476					

**Table 6:** XRD of *Shuddha Gandhaka*

Peak no	Identified		Standard		
	Angle 2 $\theta$	d space [Å]	Angle2 $\theta$	d space [Å]	Intensity [%]
1	15.953	5.55103	15.952	5.55123	13.7
3	23.570	3.77158	23.574	3.77089	100
4	25.425	3.50039	25.444	3.4978	8.8
5	26.355	3.37892	26.351	3.37951	26.8
6	27.219	3.27365	27.221	3.27343	29.2
7	28.221	3.15967	28.228	3.15891	50.1
10	34.669	2.58532	34.675	2.5849	12.8
11	36.421	2.46490	36.423	2.46474	10.1
12	37.531	2.39448	37.534	2.39432	15
13	43.241	2.09061	43.237	2.0908	10.7
15	51.699	1.76669	51.698	1.76673	10.9
Name of standard: Sulphur (S) Crystal structure: Triclinic JCPDS No: 26 – 0476					

**Table 7:** XRD of *Kajjali*.

Peak no	Identified		Standard		
	Angle 2 $\theta$	d space [Å]	Angle2 $\theta$	d space [Å]	Intensity [%]
2	27.036	3.29540	27.029	3.29623	100
4	31.816	2.81030	31.813	2.81065	14
5	44.250	2.04525	44.262	2.04471	69.3
6	52.254	1.74924	52.255	1.74921	62.4
10	72.471	1.30315	72.475	1.30309	12.8
Name of standard: Hypercinnabar, Mercury Sulphide, Meta cinnabar (HgS) Crystal structure: Hexagonal, Cubic JCPDS No: 26 – 0476					

**Table 8:** XRD of *Tamra Sindoora Kantasta*

Peak no	Identified		Standard		
	Angle 2 $\theta$	d space [Å]	Angle2 $\theta$	d space [Å]	Intensity [%]
1	26.761	3.32858	26.767	3.32787	100
2	28.429	3.13700	28.435	3.13641	35.3
3	31.478	2.83974	31.482	2.83941	52.8
4	38.124	2.355862	38.119	2.35889	6.3
7	46.050	1.96940	46.058	1.96908	14.9
8	51.950	1.75876	51.948	1.75884	5.3
9	52.971	1.72725	52.981	1.72693	18.5
11	58.455	1.57758	28.465	1.57733	6.3
12	59.281	1.55756	59.271	1.5578	6.2
15	69.294	1.35492	69.291	1.35498	4.6
18	74.891	1.26692	74.889	1.26695	8.6
Name of standard: Mercury Sulphide (HgS ) Crystal structure: Hexagonal JCPDS No: 26 – 0476					

**Table 9:** XRD of *Tamra Sindoora Talasta*

Peak no	Identified		Standard		
	Angle 2 $\theta$	d space [Å]	Angle2 $\theta$	d space [Å]	Intensity [%]
2	29.557	3.01977	29.546	3.02094	9.2
3	32.187	2.77880	32.191	2.77846	40
4	41.869	2.15588	41.865	2.15609	10.2
5	46.173	1.96447	46.176	1.96431	100
Name of standard: Digenite (Cu <sub>7</sub> S <sub>4</sub> , Cu <sub>9</sub> S <sub>5</sub> ) Crystal structure: Cubic, Rhombo H Axes JCPDS No: 26 – 0476					

**Table 10:** SEM-EDX of *Tamra Sindoora Kantasta and Tamra Sindoora Talasta*

Elements found	Concentration in %	
	T.S.K	T.S.T
Hg	20.51	-
S	25.52	7.73
Cu	-	27.66
O	-	42.66
C	53.97	21.96

**Table 11:** FT-IR Observations of *Tamra Sindooroora Kantasta*

Absorption Peak Frequency Cm <sup>-1</sup>	Standard Peaks Frequency Cm <sup>-1</sup>	Specific Type of Bond	Bond	Functional Group
3695.73	3584-3700	Medium, Sharp	O-H (stretch)	Alcohol
3527.92	3200-3550	Strong, Broad	O-H	Alcohol
2715.86	3200-2700	Weak Broad	O-H (stretch)	Alcohol
1919.24	2000- 1650	Weak	C-H (bend)	Aromatic compound
1687.77	1690-1640	Medium	C-N (stretch)	Imine / Oxime
1614.47	1620-1610	Strong	C-C (stretch)	$\alpha$ , $\beta$ - unsaturated ketone
1591.33	1650-1580	Medium	N-H (bend)	Amine
1548.89	1550-1500	Strong	N-O (stretch)	Nitro compound
1435.09	1440-1395	Medium	O-H (bend)	Carboxylic acid
1379.15	1415-1380	Strong	S=O (stretch)	Sulphate
1315.50	1390-1310	Medium	O-H (bend)	Phenol
1294.28	1310-1250	Strong	C-O (stretch)	Aromatic ester
1209.41	1210-1163	Strong	C-O (stretch)	Ester
1105.25	1150-1085	Strong	C-O (stretch)	Aliphatic ether
977.94	980-960	Strong	C=C (bend)	Alkene
869.92	880 $\pm$ 20	Strong	C-H (bend)	1,2,4-trisubstituted
837.13	840-790	Medium	C=C (bend)	Alkene
796.63	785-540	Strong	C-X	Chloride

**Table 12:** FT-IR observations of *Tamra Sindooroora Talasta*

Absorption Peak Frequency Cm <sup>-1</sup>	Standard Peaks Frequency Cm <sup>-1</sup>	Specific Type of Bond	Bond	Functional Group
3676.45	3700-3584	Medium, Sharp	O-H (stretch)	Alcohol
3458.48	3550-3200	Strong, Broad	O-H (stretch)	Alcohol
2956.97	3000-2840	Medium	C-H (stretch)	Alkane
2115.98	2140-1990	Weak	C=C (stretch)	Alkyne
694.40	785-540	Strong	C-X	Chloride
466.79	$\leq$ 667	Strong	C-X	Bromide

## DISCUSSION

**XRD:** According to XRD reports the chemical compositions of samples is discussed below. A.G showed peaks as 15.963, 22.372, 23.568, 26.333, 27.176, 28.176, 31.853, 34.625, 36.383, 37.493, 38.331, 43.220, 51.644, 52.463, 53.471, 54.312 which was compared with standard – 2theta values. Peaks of the sample confirmed the presence of S, beta S with Triclinic, Monoclinic crystal structure.

S.G showed peaks as 15.953, 23.570, 25.425, 26.355, 27.219, 28.221, 34.669, 36.421, 37.531, 43.241, 51.699 which was compared with standard – 2 theta values. Peaks of the sample confirmed the presence of S with Triclinic crystal structure.

A.T showed peaks as 44.034, 51.164, 74.309, 74.691 which was compared with standard – 2theta values. Peaks of the sample confirmed the presence of Cu with cubic crystal structure.

S.T showed peaks as 37.317, 44.267, 51.330, 74.803 which was compared with standard – 2 theta values. Peaks of the sample confirmed the presence of Cu, Cu<sub>2</sub>O with cubic crystal structure.

Kajjali showed peaks as 27.036, 31.816, 44.250, 52.254, 72.471 which was compared with standard – 2 theta values. Peaks of the sample confirmed the presence HgS with Hexagonal and Cubic crystal structure.

T.S.K. showed peaks as 26.761, 28.429, 31.478, 38.124, 46.050, 51.950, 52.971, 58.455, 59.281,

69.294, 74.891 which was compared with standard – 2 theta values. Peaks of the sample confirmed the presence of HgS with Hexagonal crystal structure.

T.S.T showed peaks as 29.557, 32.187, 41.869, 46.173, which was compared with standard- 2 theta values. Peaks of the sample confirmed the presence of Digenite ( $\text{Cu}_9\text{S}_5$ ,  $\text{Cu}_7\text{S}_4$ ) with cubic and RhomboH axes crystal structure.

The XRD pattern of all the 3 samples showed peaks with sharp lines indicating the crystallinity of the samples. The crystalline form of the drug has inherent stability both physically and chemically.

Here from *Kajjali* to T.S change in chemical nature is seen which might be because of heat and specific procedure adopted in *Kupipaka*, resulting in the chemical reaction and recrystallization of the compound in the form of HgS.

#### SEM EDAX

The elements present in T.S.K., and T.S.T in percentage are as follows:

‘Hg’ in T.S.K is 20.51%

‘S’ in T.S.K is 25.52%, in T.S.T is 7.73%

‘C’ in T.S.K is 53.97%, in T.S.T is 21.96%

‘Cu’ in T.S.T is 27.66%

‘O’ in T.S.T is 42.66%

The Major element present in T.S.K. are Hg, S and C. Major elements present in T.S.T are Cu, C, S, and O

#### FTIR

FTIR analysis of T.S.K., and T.S.T. reveals the presence of many functional groups which confirms the entity of herbal compounds used for the *Shodhana*. T.S.K. comprises of functional groups like alcohol, aromatic compound, aromatic, imine, oxime,  $\alpha\beta$  unsaturated ketone, amine, nitro compound, carboxylic acid, sulphate, phenol, aromatic ester, easter, aliphatic ester, primary alcohol, alkene, benzene derivatives, The functional groups observed in T.S.T. are alcohol, alkene and alkyne Phenols and aromatics are primarily the functional group present in hippuric acid (constituent of *Gomutra*). Amines which are the main functional group of all proteins might be present due to *Kulatha* and *Godugdha* which are rich sources of proteins. Apart from this, uric acid and urea which are the constituents of *gomutra* also contains amines as their

functional group. Alcohols and aldehyde are the functional groups of carbohydrates. Lactose present richly in *Godugdha* and the carbohydrates present in *kulatha* might define its detection in the samples. *Tilataila* which is nothing, but a fatty acid has esters as its functional group which is detected in the samples.

#### CONCLUSION

*Kupipakva rasayana* is unique because of long standing gradual heat pattern, the potency of drug is significantly increased, stability is attributed by lattice energy and hence enhanced bio availability reaches the target area instantaneously. The *Kajjali* of *Parada* and *Gandhaka* and *Shuddha Tamra curna* are together subjected to *kupipaka* in *valukayantra* for 39hrs through *kramagni*. The yield of *Tamra Sindoor* was 47.2%. Based on Physico-chemical test *Kajjali* contains Total Hg – 45.60%, Total S – 28.05%. T.S.K contains Total Hg – 31.95%, Total S – 3.15%, Copper – 15.24% T.S.T contains Total Hg – 0.35%, Total S – 4.25%, Copper – 3.95% *Shuddha Tamra* contains Copper – 99.67% As per XRD reports *Shuddha Gandhaka* is in the form of Sulphur (S) with Triclinic crystal structure, whereas *Ashuddha Gandhaka* is in the form of S, beta S with Triclinic, Monoclinic crystal structure. *Shuddha Tamra* is in the form of Copper, Cuprite ( $\text{Cu}$ ,  $\text{Cu}_2\text{O}$ ) with cubic crystal structure, whereas *Ashuddha Tamra* is in the form of Copper (Cu) with cubic crystal structure. *Kajjali* is in the form of Hypercinnabar, Mercury Sulphide, Meta cinnabar (HgS) with Hexagonal, cubic crystal structure. T.S.K. is in the form of Mercury Sulphide (HgS) with Hexagonal crystal structure. T.S.T is in the form of Digenite high, Digenite ( $\text{Cu}_7\text{S}_4$ ,  $\text{Cu}_9\text{S}_5$ ) with Cubic, Rhombo H axes crystal structure. Based on SEM-EDAX study, T.S.K contains Hg – 20.51%, S – 25.52% and C – 53.97% T.S.T contains Cu – 27.66%, S – 7.73%, C – 21.96% and O – 42.66% The FTIR analysis of T.S.K shows the presence of functional groups like Alcohol, Aromatic compound, Imine, Oxime,  $\alpha\beta$ -unsaturated Ketone, Amine, Nitro compound, Carboxylic acid, Sulphate, Phenol, Aromatic ester, Ester, Aliphatic Ester, Primary Alcohol, Alkene, 1,2,4, trisaturated, Benzene derivatives. Functional groups present in T.S.T are Alcohol, Alkene and Alkyne.

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