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COMPARATIVE PHARMACEUTICAL ANALYTICAL STUDY OF MADANODAYA RASA PREPARED BY CONVENTIONAL AND CONTEMPORARY METHOD

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ABSTRACT

Introduction: *Madanodaya Rasa* is a *Sardha Samaguna Bahirdhuma Kupipakwa Rasayana* which is mentioned in *Rasa Manjari* having *vrishya* property. *Kajjali* is prepared by adding *Shudha Hingulotha Parada* and *Shudha Gandhaka* in the ratio of 1:1½ and the *bhavana dravya* is *Rakta Kamala pushpa swarasa*. **Aim and Objective:** The present study was carried out to compare the pharmaceutical preparation by *Valuka yantra* method and VMF method. Both these samples were subjected to XRD, FTIR and SEM-EDS analysis. **Materials and Methods:** Purified *Hingulotha Parada* and purified *Gandhaka* in the ratio 1:1 was utilized to prepare *Kajjali*, then levigated with *Rakta Kamala pushpa swarasa* Then ½ part *Shudha Gandhaka* was added and triturated till all moisture content evaporated. The *Kajjali* was processed by *Valuka yantra* and VMF. Physico-chemical and Instrumental analysis were carried out for both the samples. **Results and Conclusion:** *MDR* was prepared in 36 hrs. and 22 hrs. with *Valuka yantra* and VMF method and yield was 10.66% and 28% respectively. XRD report revealed Cubic crystalline structure with HgS compound in *MDR Kajjali* and showed Hexagonal Crystalline structure with Mercury Sulphide compound in *MDR*. In SEM report smallest particle size of *MDR* prepared by *Valuka yantra* method (Batch-I) is 18.46 nm and by VMF

method (Batch-II)is 30.47 nm. EDS report shows that *MDR* prepared by Batch-I has Hg (84.55 %) and S (15.45%) and MDR prepared by Batch-II has Hg (84.64 %) and S (15.36%) as major elements and C and O_2 as trace elements. FTIR report revealed the presence of organic functional groups. **Conclusion:** VMF is more convenient than the *Valuka yantra*.

KEYWORDS: *Kupipakwa Rasayana*, *Madanodaya Rasa*, *Valuka yantra*, VMF, XRD, SEM-EDS, FTIR, *Vrishya.*

INTRODUCTION

Rasaushadhies are the Herbo mineral preparations which plays an important role in the treatment aspects of *Ayurvedic* system of medicine due to its quicker action in a small dosage,[1] increases the bioavailability and reduces the dose of the other by *Yogavahi* property as well as synergistic effect of mercurial preparations.

Kupipakwa Rasayana is one among *Chaturvidha Kalpana* which is more potent than *Kharaliya Rasayana* and *Parpati Kalpana* and have strong chemical bond.[2] It is a unique pharmaceutical preparation prepared in a glass bottle (*Kacha Kupi*) with *Kramagni paka* traditionally in *Valuka yantra* and contemporary in EMF. The main process involved is sublimation and heat given in an order of *Mridvagni* (150-250˚C), *Madhyamagni* (250-450˚C) and *Tivragni* (450-650˚C).[3] Due to the gradual heating for a longer period, *Gandhaka Jarana* takes place and during sublimation only definite proportion of Mercury is combined with other metals and minerals to form a strong chemical bond in the presence of lattice energy which reduces the toxicity and increases the stability of the product. *Madanodaya Rasa* is a variety of *Sardha Samaguna bali jarita Rasa Sindura* with a unique *bhavana dravya Rakta kamala pushpa swarasa* which provide *Vajikarana* property to the drug. The complicated chemical reaction and the *bhavana dravya* induces *Rasayana* and *Vajikarana* property to the product. Three varieties of *Madanodaya rasa* are available in classics and in this study, reference from *Rasa Manjari* was taken.

Until date there is no reported data available pertaining to the standardization and characterization of *Madanodaya Rasa* and its Spermatogenic activity. Hence an attempt made to standardize the pharmaceutical preparation of *MDR* as per *Rasa Manjari*[4] by conventional and contemporary method to explore the structure and composition through Physico-chemical analysis and sophisticated instrumental analysis such as XRD, SEM-EDS, FTIR.

MATERIALS AND METHODS

Collection of raw materials

1½ Kg *Hingula* was procured from All India Kirana Stores, Mumbai, 1½ Kg *Gandhaka* was procured from Kajarekar Ayurvedic raw drug depot, Belgaum and confirmed their authenticity based on the classical parameters and SEM-EDS and XRD were done before preparation. *Hingulotha Parada nirmana* was done in the Dept. of Pg and PhD studies in Rasashastra and Bhaishajya Kalpana, G.A.M.C, Bengaluru. *Rakta Kamala Pushpa* was collected from K. R. Market, Bengaluru. Associated drugs like *Nimbu, Milk, Ghee, Haridra churna* were collected from local market Bengaluru. Equipments like *Kupi* (green & amber coloured beer bottle of 650 ml capacity covered with mud smeared cloth), *Valuka yantra* (Iron vessel), *Valuka*, Gas burner, VMF of 230 volts power supply, copper foil, K-type thermocouple, Komi bricks, Ceramic wool, Multani mitti, cloth, torch, *Tapta* and *Shita shalaka* were collected as per requirement.

Methods

The pharmaceutical study was carried out at Department of Pg and PhD studies in Rasa Shastra & Bhaishajya Kalpana, Government Ayurveda Medical College and Hospital, Bengaluru, Karnataka.

The preparation of MDR involves the following steps:-

1) ***Purva karma*** includes collection & purification of raw drugs, preparation of *MDR Kajjali, Kacha Kupi nirmana, Kupi* filling and placing of *Kupi.*
2) ***Pradhana Karma*** involves processing of *MDR* in *Valuka yantra* and VMF by *Kramagni tapa*.
3) ***Paschat Karma*** includes breaking of *Kupi*, collection and storage of the product.

Purva karma

Procurement of raw drugs

Main raw drugs such as *Hingula* and *Gandhaka* were purchased from an authenticated source ensuring *Grahya lakshana* mentioned in classics and SEM-EDS and XRD were carried out before study.

1. Hingulotha parada nirmana

Hingulotha Parada Nirmana was done by *Urdhwa Patana* method.[5] Initially 780 gm *Hingula* was purified by *Nimbu swarasa bhavana* (~ levigating with juice of Citrous lemon)

7 times,[6] fine powder was spread evenly in an earthen pot, covered with another pot and *Sandhibandhana* was done with seven layered mud smeared cloth. *Jaladhara* was made on the upper pot and heat was given for 9 hours. Total 3 batches of *H. Parada nirmana* was carried out, and total yield was 303gm.

Heating pattern	Time	Temperature
Mandagni	0-3 hrs.	Room temp. to 350°C
Madhyamagni	3-6 hrs.	350°C to 500°C
Tivragni	6-9 hrs.	500°C to 650°C

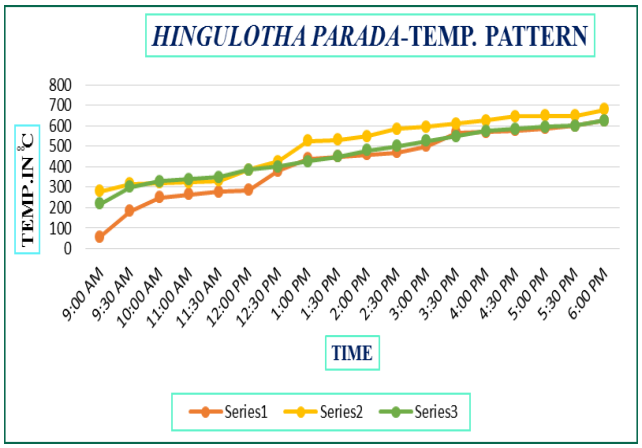


Table No. 1: Shows *Kramagni* pattern categorised in three stages.

Table No. 2: Shows the observations during *Hingula Satva Patana.*

Batch No.	Q. of *Hingula*	*Agni* Given	*Parada* Extracted	*Parada* Extracted in%	Total Yield in %
1st	150 gm	9 hrs.	85 gm	56.6%	63.789 %
2nd	150 gm	9hrs.30 min.	99 gm	66 %	
3rd	175 gm	9hrs. 30min.	119gm	68%	

H. Parada was purified by grinding with *Haridra Churna* (Curcuma longa. Linn) for 24 hrs.[7] and then washed thoroughly with hot water, filtered through cloth, dried and stored in an air tight glass container.

2. *Gandhaka shodhana*

650 gm *Gandhaka* was purified by *Galana* method.[8] Unpurified *Gandhaka* was finely powdered and melted with ghee in an iron vessel, filtered through a cloth tied around the mud pot filled with milk. The obtained product was washed thoroughly with hot water and dried under sun light, this process was repeated for 7 times. After purification it was powdered and stored in an inert glass container. This purified *H. Parada* and *Shudha Gandhaka* was used for the preparations of two batches of *Madanodaya Rasa*.

Table No. 3: Shows observations of *Gandhaka Shodhana.*

Purification	Q. of Milk	Q. of Ghee	Q. of *Gandhaka* after purification	Wt. Loss
1st	2 Lit	100ml	636 gm	14 gm
2nd	2 Lit	100ml	606 gm	30 gm
3rd	2 Lit	100ml	582 gm	24 gm
4th	2 Lit	100ml	564 gm	18 gm
5th	2 Lit	100ml	547 gm	17 gm
6th	2 Lit	100ml	534 gm	13 gm
7th	2 Lit	100ml	525 gm	9 gm

3. Preparation of *Sardha Samaguna MDR Kajjali*

Sama guna Kajjali was prepared first by adding 300 gm *Shudha H. Parada* and 300 gm *Shudha Gandhaka* and grinded till it attains *Kajjali siddha lakshanas* and then *bhavana* was done with *Rakta Kamala Pushpa Swarasa* (juice of petals and stamens of Nelumbo nucifera). After complete drying 150 gm *Shudha Gandhaka* was added and triturated till whole *Gandhaka* was completely mixed with *Kajjali.* Then once again *bhavana* was done with *Raktakamala pushpa Swarasa*. This *Kajjali* was used to prepare *Sardha Sama Guna MDR.*

4. Preparation of *kacha kupi*

Two Green-coloured and amber coloured Kingfisher premium Beer bottles of 650 ml capacity was taken, cleaned and dried under sunlight. At the base of the bottle paste of Multani Mitti was applied to make it an even surface covered with multani mitti smeared cloth measuring 6 cm in width and breadth. A cloth smeared with Multani Mitti measuring, 110 cm in length and 7 cm in breadth was covered in circles, starting from the bottom of the bottle up to the neck of the bottle. Another piece of cloth measuring 2-inch breadth and 90 cm in length was smeared with Multani Mitti and was wrapped starting from the upper portion of the bottle towards the body in layers avoiding overlapping of layers. After complete drying of all the three layers other cloths smeared with Multani Mitti, was applied over the formal layers. In this way, 7 layers were covered over the surface of the bottle and dried properly. Cork was prepared with mud smeared cloth applied over chalk piece which fits to the neck of the *Kupi* and dried under sun light.

5. Placement of the *kupi* in *valuka yantra*

A *Loha Banda* (Iron Vessel) of conical shape with a measurement of 25 cm height and circumference of 29 cm at the top and 23.5 cm at the bottom, which had a hole of 5.5 cm at the bottom of the vessel was taken. Dry, clean and mud less sand was collected. At first, over

the hole at the bottom 2-3, *Abhraka Patras* with a length of 13.5 cm and thickness of 1 cm were placed. Then added a thin layer of sand over this around 2 *Angula* height and spread evenly. Over this, 150 gm *Kajjali* filled *Kupi* was kept firmly and centrally, mouth was closed with cork in order to avoid falling *Valuka* into the *Kupi.* The remaining portion of the *yantra* was filled with sand up to the neck of the *Kupi*. Total 21.5 Kg of sand was filled in the *Valuka Yantra.* K- type thermocouple was placed 5-6 cm away from *Kupi* and 2cm above the bottom of *Valuka yantra*.

6. *Kupi* placement in VMF

Half portion of one Komi brick (Insulation brick) measuring 11 cm. in length & width and 6 cm. height, kept inside the bottom of the heating element of VMF, to adjust the height of the *Kupi*, so that the neck of the *Kupi* was to be at the same level to that of the upper part of the VMF. The depth of the heating element is 30 cm, and the diameter is 15 cm**.** 200 gm *Kajjali*-filled *Kacha Kupi* had been kept at the centre of the heating element chamber at ½ inch from the sides and small pieces of bricks were holding the *Kupi* firmly without any movement. A hole was made in the centre of the ceramic wool and placed over the neck of the *Kupi* so that to allow the passage of the *Kupi* and used to cover the furnace opening to avoid escaping heat from the furnace. K- type Thermocouple and *Tapta Shalaka* were placed inside the furnace nearer to the wall of the furnace by making two holes in the wool without disturbing the *Kupi.*

Pradhana karma

***MDR* Batch I - *Valuka yantra* method**

The 150 gm *Kajjali* filled *Kacha Kupi* kept in *Valuka yantra* was placed on a big sized Gas burner, cork was removed and *Kramagni paka* was maintained throughout the procedure. Total time taken was 36 hrs. and corking were done in 33 hrs after complete cessation of Sulphur fumes and observation of *Sindura siddhi lakshana* like *Suryodaya lakshana*, copper coin test positive. Once again *Tivragni* was given for 3 hrs and then whole apparatus was left for complete cooling.

***MDR* Batch II - VMF method**

Total time taken for the process was 22 hrs and after 18 hrs of heat corking were done. After corking, one more Komi brick with length and width of 11 cm and a height of 6 cm was placed above the already placed Komi brick at the bottom of heating element of the VMF. The *Kupi* was placed over the brick so that the neck of the *Kupi* was above the upper part of

the VMF. This helps to cool the upper part of the *Kupi* neck and 4 hrs *Tivragni* was given and then left for self-cooling.

Paschat karma

Kupi was removed carefully from *Valuka yantra* and VMF and the mud smeared cloth layers of the *Kupi* were scrapped out with a knife. *Kupi* was cleaned properly. 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 burning thread where it was tied. The bottle gets broken into 2 equal halves with a breaking sound. *MDR* collected from the neck region was stored in a clean sterile inert container.

OBSERVATIONS AND RESULTS

Different phases of desired characteristics were observed during the process as follows:-

White fumes were observed with Sulphur odour in the range of 225˚C-378˚C, after 3½ hr in Batch-I and 200˚C-254˚C, after 2½ hrs in Batch -II. **Dense yellow fumes** appeared after 4½ hrs in Batch -I and after 3½ hrs in Batch-II. **Blue flames** started appearing while inserting *Tapta shalaka* at 594.9˚C, after 10½ hrs in Batch-I and at 243.8˚C, after 3 hrs in Batch-II. **Golden globules** seen at the bottom of the *Kupi* at 589.6˚C after 13hrs in Batch-I and at 291.5˚C, after 4 hrs in Batch-II. ***Kajjali* started melting** after 9 hrs at 569˚C in Batch-I and after 13 hrs at 509˚C in Batch-II. Reddish golden deposits at the neck appeared after 30 hrs at 702˚Cin Batch -I and after 5½ hrs at 390.4˚C in Batch-II. ***Suryodaya lakshana*** seen after 31 ½ hrs at 706˚C in Batch-I and after 17 hrs at 578.5˚C in Batch-II. **Copper coin test positive** after 33 hrs at 700˚C in Batch-I and after 18 hrs at 580.3˚C in Batch-II. **Corking** was done within 15 minutes and 10 minutes in Batch-I and II respectively. After corking *Tivragni* was given for 3 hrs and 4 hrs in Batch I and II respectively.

Results of pharmaceutical study

Table No. 4: Shows the results of *Hingula Shodhana.*

Time taken for practical	7 days.
Quantity of *Asudha Hingula*	780 gm
Quantity of *Shudha Hingula*	801 gm
Weight gain	21 gm
Total Yield	102.69%

Table No. 5: Shows the results of *Gandhaka Shodhana*.

Time taken for Practical	18 days.
Quantity of *Asudha Gandhaka*	650 gm
Quantity of *Shudha Gandhaka*	525 gm
Total wt. loss	125 gm
Total Yield	80.77%

Table No. 6: Shows the results of *Hingulotha Parada nirmana.*

Time taken for the Practical	40 days.
Initial weight of *Shudha Hingula*	475 gm
Total quantity of *Parada* extracted	303 gm
Total yield	63.789 %

Table No. 7: Shows the results of Purification of *Hingulotha Parada.*

Time was taken for Purification	7 days
Hingulotha Parada	303 gm
Shudha Parada	300 gm
Loss of weight	3 gm
Total Yield	99 %

Table No. 8: Shows results of *Sama Guna Madanodaya Rasa Kajjali.*

Time taken for *MDR Kajjali nirmana*	39 days(130hours)
Hingulotha Parada + *Gandhaka* mixture	600 gm.
Weight of *MDR Kajjali*	595 gm
Total weight loss	5 gm
Total Yield	99.16%

Table No. 9: Shows results of Preparation of *Rakta Kamala Pushpa Swarasa.*

Time taken for *RKP Swarasa* preparation	3 hours
Total no. of *Pushpa* taken	50
Total *Swarasa* obtained	230 ml

Table No. 10: Shows results after *Rakta Kamala Pushpa Swarasa bhavana.*

Time taken for *Bhavana*	8 days (24 hours)
Initial weight of *MDRK*	595 gm.
Weight of *Kajjali* after *bhavana*	601 gm.
Weight gain	6 gm.
Total Yield	101%

Table No. 11: Shows results of *Sardha Sama Guna MDR Kajjali.*

Time taken for *mardana*	51 days.(71 hours)
Sama Gandha Kajjali + Shu. Gandhaka mixture	750 gm.
Final weight of *Sardha Sagandha MDR Kajjali*	735 gm.
Weight loss	15 gm
Total Yield	98 %

Table No. 12: Shows *S.S.G.MDR*- Batch I by *Valuka Yantra* method.

Time taken for the preparation	36 hours
The amount of *Kajjali* taken	150 gm
The amount of *MDR* obtained	16 gm
Residue present at the bottom	42 gm
Loss	134 gm
Total Yield	10.66 %

Table No. 13: Shows *S.S.G.MDR* – Batch II by VMF method.

Time taken for the preparation	22 hours
The amount of *Kajjali* taken	200 gm
The amount of *MDR* obtained	56 gm
Residue presents at the bottom	4 gm
Loss	145 gm
Total Yield	28 %

Analytical study

Organoleptic study was carried out in the P.G & PhD studies of Department in Rasa Shastra and Bhaishajya Kalpana, G.A.M.C, Bangalore. Physico-Chemical analysis was carried out at Govt. of Karnataka Drug Testing Lab for Ayush drugs, Jayanagar, Bangalore. Instrumental analysis such as XRD, SEM-EDS & FT-IR of *MDR Kajjali* and two batches of *MDR* were conducted at IISC, Bangalore.

RESULTS

Table No. 14: Shows ancient parameters for analysis of *MDR Kajjali.*

Swarupa	Powder
Varna	Greyish black.
Sparsha	Smooth and soft.
Gandha	Slight Sulphur smell
Rasa	Tasteless
Rekha Purnatva	When fine powder of *Kajjali* was rubbed between the thumb and index finger it entered the furrows of the fingers.
Varitaratva	When finely powdered *Kajjali* was carefully sprinkled into a glass vessel containing water, *Kajjali* was floating over the water.
Unnama	When finely powdered *Kajjali* was carefully sprinkled into the glass vessel and few grains were placed carefully over to the *bhasma*, grains of paddy was floating over the water.
Nischandratva	Lustreless i.e., no shining particles were observed.

Table No. 15: Shows ancient parameters for analysis of *Madanodaya Rasa.*

Test	**Observation**
Swarupa	Powder form
Varna	*Pakwa Jambu Phala varna* or colour of tender leaves of mango tree.

Sparsa	*Slakshna* and *Mridu*
Gandha	Odourless
Rasa	Tasteless
Rekha Purnatva	When finely powdered *MDR* was rubbed between the thumb and index finger it enters the furrows of the fingers.
Varitaratva	When finely powdered *MDR* was carefully sprinkled into a glass vessel containing water, *MDR* floats on the surface of the water.
Nischandratva	There were no shiny particles in the finely powdered *Madanodaya Rasa* even when it was rubbed between wet thumb and index finger observed in the bright sunlight.
Nirdhoomatva	The *MDR* didn't emit any smoke when sprinkled over red-hot coal.

Table No. 15: Shows Organoleptic characters of *Kajjali* and *Madanodaya rasa.*

Organoleptic characters	***MDRK***	***MDR***
	Properties	**Properties**
Colour	Black	Reddish brown
Touch	Fine and smooth	Smooth and fine
Odour	Odourless	Odourless
Taste	Tasteless and palatable	Tasteless and palatable

Table No. 16: Shows Physico-chemical parameters.

Parameter	***S.S.G. MDR K***	***S.S.G.MDR* Batch I**	***S.S.G. MDR* Batch II**
pH	4.4	5.02	5.01
Total ash	0.5045 % w/w	0.6297 % w/w	0.3243 % w/w
Acid- insoluble Ash	0.2249 %	1.1924 %	0.1314 %
Water soluble ash	0.5644%	0.2995%	0.0999%
LOD	0.4392 %	0.0132%	0.1794%

Table No. 17: Shows XRD Analysis of *MDR Kajjali.*

Peak No.	**Standard**			**Identified**	
	Angle 2Θ	**D space**	**Intensity**	**Angle 2Θ**	**D space**
7	26.35	3.380	100%	26.304	3.3854
12	30.52	2.927	30.9%	30.530	2.9257
23	43.70	2.070	39.3%	43.704	2.0695
JCPDS NO: 00-089-0432 CSD: 081917 (ICSD) Name of standard: Mercury sulphide (Hg S) Crystal system: Cubic Space group: F-43M(216)					

Table No. 18: Shows XRD reports of *MDR* Batch-I.

Peak No	**Standard**			**Identified**	
	Angle 2Θ	**D space**	**Intensity**	**Angle 2Θ**	**D space**
3.	26.51	3.359	100%	26.465	3.3652
6.	31.22	2.863	95%	31.170	2.8671
10.	45.79	1.980	35%	45.743	1.9819

JCPDS NO : 00-006-0256 Name of standard : Mercury Sulphide (Hg S) Crystal system : Hexagonal Space group : P3221 (154) Lambda : 1.5405

Table No. 19: Shows XRD reports of Batch-II.

Peak No	Standard			Identified	
	Angle 2Θ	D space	Intensity	Angle 2Θ	D space
3	26.51	3.359	100%	26.370	3.3771
5	31.22	2.863	95%	31.057	2.8773
9	45.79	1.980	35%	45.660	1.9853
ICDD PDF NO: 00-080-2192 Name of standard: Mercury sulphide (Hg S) Crystal system: Hexagonal Space group: P3221(154)					

Table No. 20: Shows SEM report of all the Samples.

NO	Sample	Smallest particle size (in nm)	Largest particle size (in nm)
1.	***Hingula* -I**	64.00 nm	254.7 nm
2.	***Hingula* -II**	83.47 nm	227.6 nm
3.	***Gandhaka***	61.35 nm	455.3 nm
4.	***S.S.G.MDR K***	36.57 nm	206.0 nm
5.	***S.S.G.MDR* I**	18.46 nm	322.2 nm
6.	***S.S.G.MDR* II**	30.47 nm	322.3 nm

Table No. 21: Shows EDS reports of Raw drugs.

Element	*Hingula*-1		*Hingula*- II		Sulphur	
	Weight%	Atomic %	Weight%	Atomic%	Weight%	Atomic%
SK	14.65	51.79	23.48	65.75	100.00	100.00
Hg M	85.35	48.21	76.52	34.25	-	-

Table No. 22: Shows EDS reports of *MDR Kajjali* and *MDR*.

Element	*MDR Kajjali*		*MDR*-Batch I		*MDR*- Batch II	
	Weight %	Atomic %	Weight %	Atomic%	Weight %	Atomic %
S K	36.71%	78.39%	15.45%	53.34%	15.36 %	53.18 %
Hg M	63.29%	21.61%	84.55%	46.66%	84.64 %	46.82 %
CK	Traces	Traces	Traces	Traces	Traces	Traces
OK	Traces	Traces	Traces	Traces	Traces	Traces

Table No. 23: Shows FTIR reports of *MDR Kajjali.*

No	Peak	Standard Peak	Strength 0f Bond	Bond/ Type 0f Vibration	Functional Group
1.	462.25 cm	600-500	Strong	C-I Stretching	Halo Compound
2.	526.89 cm	690-515	Strong	C-Br Stretching	Halo compound

		600-500	Strong	C-I Stretching	Halo compound
3.	1066.96 cm	1070-1030 1400-1000 1085-1050	Strong Strong Strong	S=O Stretching C-F Stretching C-O Stretching	Sulphoxide Fluro compound Primary alcohol
4.	1384.84 cm	1420-1330 1390-1380 1385-1380 1415-1380 1410-1380	Medium Medium Medium Strong Strong	O-H bending C-H bending C-H bending S=O Stretching S=O Stretching	Alcohol Aldehyde Alkane Sulphate Sulphonyl Chloride
5.	1637.21cm	1662-1626 1648-1638 1650-1580 1650-1600	Medium Strong Medium Medium	C=C Stretching C=C Stretching N-H bending C=C Stretching	Primary Amines Alkene Amine Conjugated alkene
6.	2851.82 cm	3200-2700 3000-2800	Weak bond Strong bond	O-H Stretching N-H Stretching	Alcohol Amine salt
7.	2921.77 cm	3200-2700 3000-2840 330-2500	Weak bond Medium Strong bond	O-H stretching C-H Stretching O-H Stretching	Alcohol Alkane Carboxylic acid
8.	3436.16 cm	3550-3200 3500	Strong bond Medium	O-H Stretching N-H Stretching	Alcohol Primary amide

Table No. 24: Shows FTIR reports of *MDR* Batch-I.

No	Peak	Standard Peak	Strength of Bond	Bond or Type of Vibration	Functional Group
1.	612.82	690-515	Strong	C-Br Stretching	Halo compound
2.	952.01	980-960	Strong	C=C Bending	Alkane
3.	1085.25	1150-1085 1085-1050	Strong Strong	C-O Stretching C-O Stretching	Aliphatic ether Primary alcohol
4.	1123.37	1400-1000 1124-1087	Strong Strong	C-F Stretching C-O Stretching	Fluro compound Secondary alcohol
5.	1184.54	1250-1020 1210-1163 1205-1124	Medium Strong Strong	C-N Stretching C-O Stretching C-O Stretching	Amine Ester Tertiary alcohol
6.	1384.39	1415-1380 1410-1380 1390-1380 1385-1380 1310-1390	Strong Strong Medium Medium Medium	S=O Stretching S=O Stretching C-H Bending C-H Bending O-H Bending	Sulphate Sulphonyl chloride Aldehyde Alkane Phenol
7.	1406.70	1420-1330 1440-1395	Medium Medium	O-H Bending O-H Bending	Alcohols Carboxylic acid
8.	1631.88	1662-1626 1650-1580 1650-1600 1650-1566 1648-1638	Medium Medium Medium Medium Strong	C=C Stretching N-H Bending C=C Stretching C=C Stretching C=C Stretching	Alkene Amine Conjugated alkene Cyclic alkene Alkane
9.	2852.13	3200-2700	Weak broad	O-H Stretching	Alcohol

		3000-2840 3000-2800 3300-2500	Medium Strong bond Strong broad	C-H Stretching N-H Stretching O-H Stretching	Alkane Amine Salt Carboxylic acid
10.	2922.61	3200-2700 3000-2840	Weak bond Medium	O-H Stretching C-H Stretching	Alcohol Alkane
11.	2971.03	3200-2700 3000-2800 3300-2500	Weak bond Strong bond Strong broad	O-H Stretching N-H Stretching O-H Stretching	Alcohol Amine Salt Carboxylic acid
12.	3435.65	3550-3200	Strong bond	O-H Stretching	Alcohol

Table No. 26: Shows FTIR reports of *S.S.G.MDR*- Batch II.

No	Peak	Standard Peak	Strength of Bond	Bond/Type of Vibration	Functional Group
1.	548.76	690-515 850-550 600-500	Strong Strong Strong	C-Br Stretching C-CI Stretching C-I Stretching	Halo compound Halo compound Halo compound
2.	953.07	980-960	Strong	C=C Bending	Alkene
3.	1162.90	1250-1020 1210-1163 1205-1124	Medium Strong Strong	C-N Stretching C-O Stretching C-O Stretching	Amine Ester Tertiary alcohol
4.	1384.25	1390-1380 1385-1380 1400-1000 1415-1380 1410-1380	Medium Medium Strong Strong Strong	C-H Bending C-H Bending C-F Stretching S=O Stretching S=O Stretching	Aldehyde Alkane Fluro compound Sulphate Sulphonyl chloride
5.	1459.07	1465	Medium	C-H Bending	Alkane
6.	1637.27	1650-1600 1662-1626 1650-1580 2000-1650 1650-1566	Medium Medium Medium Weak Medium	C=C Stretching C=C Stretching N-H Bending C-H Bending C=C Stretching	Conjugated alkene Alkane Amine Aromatic compound
7.	2345.99	2349	Strong	O=C=O Stretching	Carbon dioxide
8.	2922.88	3000-2840 3300-2500	Medium Strong broad	C-H Stretching O-H Stretching	Alkane Carboxylic acid
9.	2973.25	3200-2700	Weak broad	O-H Stretching	Alcohol
10.	3435.77	3550-3200	Strong broad	O-H Stretching	Alcohol
11.	3779.96	4000-3000	Medium sharp	O-H Stretching	Phenol-alcohol

Figure 1*: Hingula*

Figure 2: Gandhaka

Figure 3: Hingula Shodhana

Figure 4: Gandhaka Shodhana

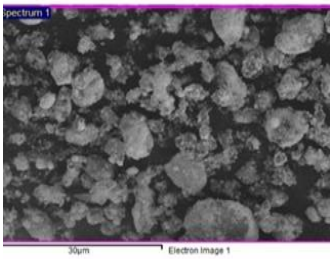
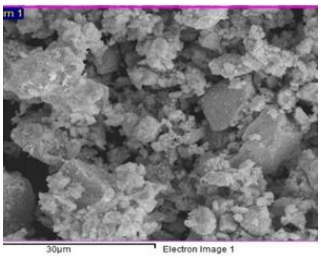
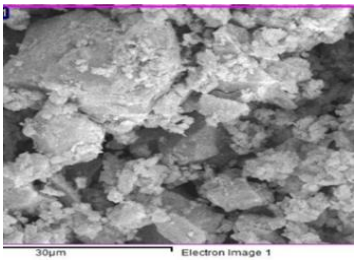
Figure 5: H. P. Nirmana	*Figure 6: H. P. Shodhana*	*Figure 7: Kajjali nirmana*	*Figure 8: Kajjali mardana with RKP*	*Figure 9: Kacha Kupi Nirmana*

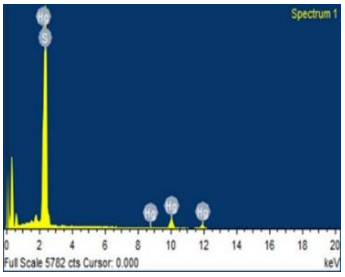
Figure10: Rekhapurnatva	*Figure 11. Unnama*	*Figure 12. Valuka yantra*	*Figure 13 VMF*

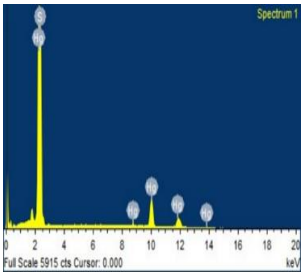
Figure 14. Blue flame	Figure 15*: Golden globules*	Figure 16*: Suryodaya Lakshana*	Figure 17*: Copper test +ve*

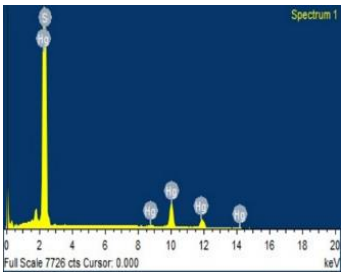
Figure 18: *Corking*	Figure 19: *Kupi breaking.*	Figure 20: *MDR*

S.S.G.MDR Kajjali ***MDR*-Batch I** ***MDR*-Batch II**

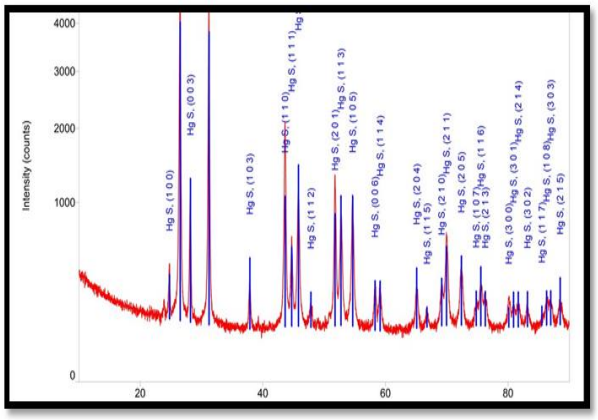




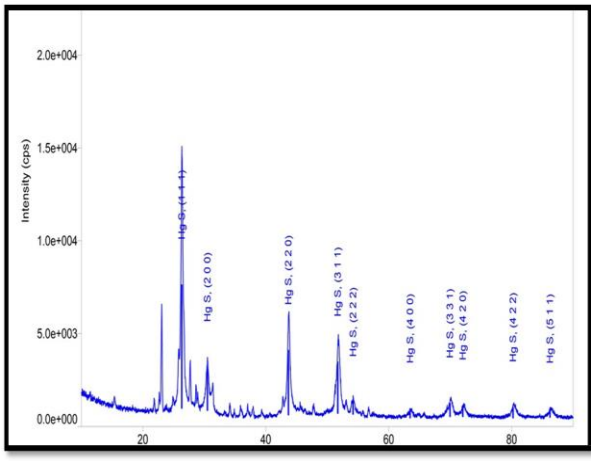


XRD Report

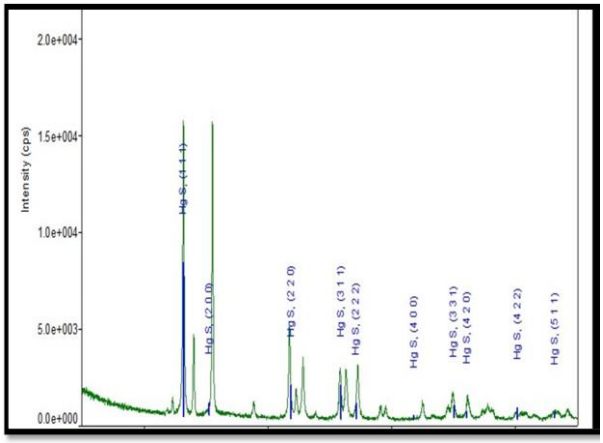
Hingula



MDR Kajjali

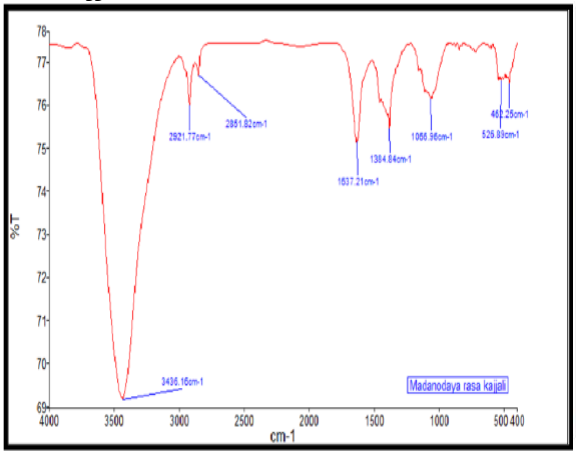


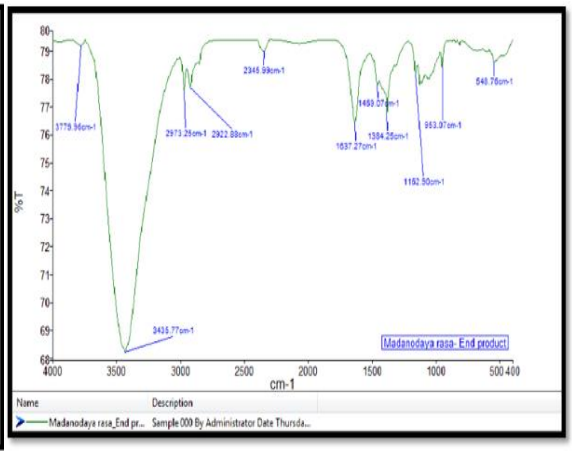
MDR



FTIR Report

MDR Kajjali MDR





DISCUSSION

Kupi Pakwa Rasayanas have disease curing property, *Rasayana* and *Vajikarana* properties. *Kupipakwa Rasayana* having *Vajikarana* property have not been studied much and are not available in the market also. Some *Rasa Sindura* preparations having different names and different ratios are available in the ancient *Rasashastra* texts with *Vajikarana* property. Two varieties of *Madanodaya Rasa* are available in *Rasa yoga Sagara. MDR- Prathama*[9], ratio of Hg and S is 1:2 and *bhavana dravya* is *Rakta kamala pushpa swarasa*. *MDR-Dwitiya* ingredients are *3 Masha bhasma*'s of Hg, *Vaikranta, Kanta Loha, Abhraka, Swarna, Naga 1 Masha bhasma* of *Vajra* and *bhavana dravya* is *Amlaki, Shatavari, Musali, Salmali, Kapikachu.*[10] In the present study the ratio of Hg and S is 1:1½ and *bhavana dravya* is *Rakta Kamala Pushpa swarasa* .It was taken from *Rasa Manjari* reference. Similar preparations are available in *Rasa Ratna Samucchaya*[11] and *Bharata Bhaishajya Ratnakara*[12] in the name *Madana Sundara Rasa* and the ratio of *Parada* and *Gandhaka* is 1:1 with *bhavana dravya,*

Rakta Kamala pushpa swarasa. *Ananga Sundara Rasa* is mentioned in *Rasendra sara Samgraha*[13] and *Bhaishajya Ratnavali*[14] in the ratio 1:1 and *bhavana dravya's* are *Rakta Agastya pushpa swarasa* and *Sita kamala pushpa swarasa*.

During the preparation of *MDR* by two methods, it was noted that the time taken for VMF method was lesser than that of *Valuka yantra* method and yield was more. Even though the fire given was maximum in Batch I after corking, the temperature was fluctuating and not good enough for uniformly sublimating the product. Total of 12 *Yama* heat was given (36 hrs) for completing the procedure, the product obtained from the *Valuka Yantra* method was less and the temperature was not sustained as needed throughout the procedure. In comparison with *Valuka yantra* while using Gas stove method, a steady and continuous rise of temperature was well maintained in VMF method and produced better yield. Traditional method is more time consuming and heat radiating through *Madhyamagni* and *Tivragni* is very high, which in turn will harm the personal if exposed for a long time of duration and it's a very difficult task to maintain a desired temperature in the preparation of *MDR*.VMF has more advantages such as maintenance of temperature, less human effort and environment friendly. By comparing organoleptic characters, Physico chemical and instrumental analysis it is clear that **the traditional method can be effectively replaced by VMF**.

pH Value represents the degree of acidity and alkalinity of the sample which helps to analyze the place of absorption. The result shows that both the batches of *MDR* are weakly acidic in nature and therefore these are better absorbed from the stomach. Any temperature change will change the hydrogen ion concentration and hence the pH value.[15]

The total Ash Value represents the presence of inorganic substances in the drug. This includes both physiological ash (plant tissue) and non-physiological ash (sand and oil). Reduced ash value represents the purity of the drug. The total ash value of the *Kajjali* compared to the product shows that *MDR* contains the least ash value, which represents a lesser number of physiological substances in the drug.[16]

Acid Insoluble Ash measures the amount of contaminants like soil, silica and other foreign materials present in it, especially the amount of sand and siliceous earth. Acid insoluble ash of the product *Madanodaya Rasa* of all the batches is lesser than *Kajjali* which represents the purity of the drug, and a considerable amount of the drug is soluble in acidic media of the stomach.[17]

Water Soluble Ash represents the presence of water-soluble material present in the drug. The product has less water-soluble ash compared to *Kajjali*. The value shows that water is not a suitable medium for the product and the salivary secretions or the gastric enzymes play an important role in its dissolution.[18]

Loss on drying represents the amount of moisture content and volatile content in the drug. If LOD is very less then, it is understood that the drug has very less hygroscopic activity with **less chance of contamination.** Compared to *S.S.G.MDR Kajjali* end products of both the batches show lesser moisture content and thereby **increased shelf life.**[19]

In XRD analysis of ***MDR* Batch I**, a total of **27 peaks** were identified at different angles from 23.84 to 88.43, 10 strong peaks were chosen as strong with their relative intensity and was compared with Standard Joint Committee Powder Diffraction File (JCPDS) of Mercury sulphide (HgS). The d-values of standard Mercury sulphide (3.359,2.863,1.980) are similar to the identified *MDR* Batch- I values (3.3652,2.8671,1.9819) and thus it is identified as **Mercury sulphide (HgS) with a crystalline system, Hexagonal in nature**. **Batch-II** shows **25 peaks** at different angles (2Ɵ) from 23.75 to 88.32, out of these, 10 strong peaks were selected and compared with the JCPDS file of Mercury sulphide. The d values of standard Cinnabar/Mercury sulphide (3.359,2.863,1.980) are almost similar to the identified MDR-Batch-II values (3.3771 , 2.8773, 1.9853). Thus, it is confirmed that the Batch II also shows the presence of **Mercury sulphide (HgS) in the Hexagonal crystalline system**.

The peaks of the **FTIR** graph were compared with the Sigma Aldrich IR spectrum table and the organic functional groups were identified. A total of **8 peaks** were there in *S.S.G.MDR K*, **12 peaks** in *S.S.G.MDR*-batch-I, **11 peaks** in batch -II. FTIR reports shows the presence of organic compounds like Fluro compound, alkane, amine, alcohol, aldehyde ether, amine salt, carboxylic acid etc. which may add during purificatory processes and this will reduce the toxicity and increases the bioavailability of the product.

SEM report shows reduced particle size in the product which suggests that this will be helpful in easy drug delivery and thereby increasing the bioavailability of the drug. EDS report reveals that percentage of Hg and S in *MDR* of Batch I and II are stoichiometrically accurate to that of Mercuric sulphide (HgS). This is due to evaporation of extra sulphur and proves Law of definite proportion and Law of conversion of mass.

CONCLUSION

Madanodaya Rasa was prepared by both contemporary and conventional methods with the time duration of 36 hrs and 22 hrs and a yield of 10.66% and 28% was obtained respectively. Black sulphide of Mercury gets converted into red sulphide of Mercury as proven in analytical studies. Traditional method is more time consuming and heat radiating through *Madhyamagni* and *Tivragni*, which in turn will harm the person if exposed for a long duration and it's a very difficult task to maintain a desired temperature in the preparation of *MDR*. VMF has more advantages such as maintenance of temperature, less human effort and is environment friendly. By comparing organoleptic characters, and by Physico chemical and instrumental analysis it is clear that **the traditional method can be effectively replaced by VMF**.

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