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COMPARATIVE STUDY OF PHYSICOCHEMICAL CHARACTERISTICS OF RASASINDOOR BY TWO DIFFERENT FORMULATIONS WSR TO RASATARINGINI

Harshala Mhatre*[1] Mangala Jadhav[2] and Vd. Shriram Savrikar

[1]P.G Scholar, Department of Rasashashtra and Bhaishajya Kalpana, R.A.Podar Medica (Ayurved) College, Worli, Mumbai, Maharashtra, India.

[2]Asso. Professor Department of Rasashashtra and Bhaishajya Kalpana, R.A.Podar Medica (Ayurved) College, Worli, Mumbai, Maharashtra, India.

[3]HOD and Professor, Rasashastra and Bhaishajya Kalpana dept, R.A.Podar medical college (Ayu), Worli, Mum.-18.

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***Correspondence for Author**
Dr. Harshala Mhatre
P.G Scholar, Department of Rasashashtra and Bhaishajya Kalpana, R.A.Podar Medica (Ayurved) College, Worli, Mumbai, Maharashtra, India.

INTRODUCTION

The preparations in Rasashastra are mainly of four types i.e Kharaliya rasayana, Parpati, Kupipakwa rasayana and Pottali. From all these Kupipakwa rasayana have special importance as they have wide therapeutic utility and are required in low doses. Rasasindoor (HgS) is an example of sagandha saagni murcchna. It is unique mercurial preparation widely used in Ayurvedic therapeutics having Parada (Mercury) and Gandhaka (Sulphur) in it. There are various combinations of Parada and Gandhaka(1:1/2 to 1:1000) given in different Ayurvedic texts for making Rasasindoor.It is said that as the proportion of Gandhaka used in jarana in Parada increases e.g 1:1,1:2,1:3,1:4 etc more is the therapeutic utilities of Parada. Samaguna Rasasindoor(1:1) is said to be samanya roganashaka, Dwiguna Rasasindoor(1:2) is said to be maharoganashaka, Triguna Rasasindoor(1:3) is said to be punsatva prakashanam and so on. Depending on different proportions of sulphur used in the formulation, the therapeutic effects of these formulations are also different. These differences can be due to difference in their physico-chemical characterization. Hence in present study physico-chemical comparison of Rasasindoor prepared by two different formulations is done.

METHODS

1) mÉÉUS zÉÉåkÉlÉ- Reference : R.T 5/27-30

Total time required : 54 hrs **Total days required :** 20 days

Procedure : Ashuddha Parada is triturated with Sudharaja(CaO powder) for 3 days i.e 36 hrs. Then Parada is obtained by filtering through two layered cloth. Then Parada is triturated with equal quantities of Lashuna kalka and Saindhav till black paste is formed. Shuddha Parada is obtained from washing the paste with warm water.

Ashuddha Parada-1000 gms Shuddha Parada-720 gms

2) aÉlkÉMü zÉÉåkÉlÉ Reference: R.T 8/7-12

Total days required: 8 days

Procedure

Ashuddha Gandhaka was weighed and its fine powder was made. Then the powder was taken in iron vessel(kadhai) with ghee and heated on low flame. When Gandhaka was totally melted, it was immediately poured into milk in another steel vessel filtered through the cloth. Gandhaka was obtained from the bottom of vessel (containing milk) in cake form.It was then washed with hot water, dried and powdered . The same process was repeated for 3 times. Shoddhita Gandhaka was stored in clean dry glass jar.

Ashuddha Gandhaka-1000 gms Shuddha Gandhaka- 945 gms

3) lÉuÉxÉÉSU zÉÉåkÉlÉ Reference : R.T 14/3-4

Total days required: 1 day

Procedure

1 part of Navsadar and 3 parts of water are taken in an steel vessel till whole Navsadar gets dissolved in it and filter the water.

2. Filtrate is then kept on high flame to evaporate all the water content from it. Shuddha Navasadar is thus obtained from the bottom of the vessel as white powder.

Ashuddha Navasadar- 500 gms Shuddha Navasadar- 350 gms

SamaGandhaka kajjali nirmaan: Reference: R.T 6/185

Ingredients	Quantity
Shuddha Parada	280 gms
Shuddha Gandhaka	280 gms
Shuddha Navasadar	70 gms
Obtained Kajjali	618 gms
Total duration required	75 Hrs and 40 days

DwiGandhaka kajjali nirmaan: Reference: R.T 6/186

Ingredients	Quantity
Shuddha Parada	200 gms
Shuddha Gandhaka	400 gms
Raktakarpaas pushpa swaras	60 ml
Obtained Kajjali	606 gms
Total duration required	86 Hrs and 40 days

Rasasindoor Nirmaan

SamaGandhaka JaaritRasasindoor- Rasa Tarangini (96/185)

DwiGandhaka JaaritRasasindoor- Rasa Tarangini (96/186)

Kajjali was taken as 200gms standard in each batch .Beer bottle (Kingfisher) brown colored of 750ml was taken as standard Kupi which was covered by 7 layers of multanimitti smeared cotton cloth to obtain uniform 1inch thick layer around and it was dried well before use .

Temperature pattern

Temperature pattern	SamaGandhaka Rasasindoor	DwiGandhaka Rasasindoor
Mrudu Agni(30-250^{0}C)	4 hrs	8 hrs
Madhyam Agni(250-450^{0}C)	5 hrs	8 hrs
Teevra Agni(450-650^{0}C)	3 hrs	4 hrs

OBSERVATIONS

Table No 1 Showing observations of SamaGandhaka Rasasindoor Nirmaan

Time in hr	Observations	Temperature			Shalaka Sanchalan	Tamra patra/ Coin test
		B 1	B 2	B 3		
10.00am	Kupisthapana	30^{o}C	32^{o}C	32^{o}C	-	-
11.00am	Kajjali was totally dry. Slightly white fumes started	134^{0}C	140^{0}C	140^{0}C	-	-
11.30am	Dense white fumes started	154^{0}C	180^{0}C	165^{0}C	-	-
12.00am	Melting of Kajjali along with yellowish fumes started	185^{0}C	185^{0}C	185^{0}C	-	-
2.00pm	Kajjali liquified and yellow fumes started	220^{0}C	200^{0}C	200^{0}C	-	-
2.30pm	Dense yellow fumes increased	280^{0}C	220^{0}C	264^{0}C	+	-
03.45pm	Fumes decreased gradually	330^{0}C	364^{0}C	354^{0}C	-	-

03.55pm	Slight orange background was seen behind yellow fumes	383^{0}C	380^{0}C	384^{0}C	-	-
04.30pm	Fumes disappeared and flames started	390^{0}C	380^{0}C	384^{0}C	+	-
04.50pm	Flames increased to 5-6 inches	400^{0}C	385^{0}C	386^{0}C	+	-
06.45pm	Flames gradually decreased	440^{0}C	448^{0}C	448^{0}C	+	-
07.00pm	Flames disappeared and boiling stage of kajjali (Honeycomb) was visible in Kupi	456^{0}C	476^{0}C	476^{0}C	+	
07.00pm	Bottom of kupi was seen red.Tamra patra/coin test showed particles of Mercury. Cork was done immediately	460^{0}C	480^{0}C	480^{0}C	-	+
07.10pm - 10.10pm	Teevra agni given for 4 hrs and left for swangasheeta for 24 hrs	460^{0}C - 650^{0}C	480^{0}C - 650^{0}C	480^{0}C - 650^{0}C	-	-

Table No 2 Showing observations of DwiGandhaka Rasasindoor Nirmaan

Time in hr	Observations	Temperature			Shalaka Sanchalan	Tamra patra/ Coin test
		B1	B2	B3		
10.00am	Kupisthapana	30^{o}C	30^{o}C	30^{o}C	-	-
11.00am	Kajjali was totally dry	100^{0}C	100^{0}C	100^{0}C	-	-
11.30am	Whitish fumes started with smell of ammonia	133^{0}C	133^{0}C	134^{0}C	-	-
12.00pm	Dense white fumes	154^{0}C	152^{0}C	154^{0}C		
1.00pm	Melting of Kajjali along with yellowish white fumes started with smell of sulphur.	180^{0}C	190^{0}C	180^{0}C	-	-
3.00pm	Light yellow fumes continued.	200^{0}C	200^{0}C	200^{0}C	-	-
6.00pm	Kajjali becomes semi-liquid.Fumes still coming out	240^{0}C	250^{0}C	245^{0}C	-	-
8.15pm	Dense yellow fumes increased	286^{0}C	280^{0}C	286^{0}C	-	-
9.00pm	Dense yellow fumes continued	330^{0}C	340^{0}C	340^{0}C		

10.30pm	Fumes decreased gradually	390^{0}C	390^{0}C	390^{0}C	-	-
10.45pm	Slight orange background was seen behind yellow fumes	396^{0}C	396^{0}C	392^{0}C	+	-
11.00pm	Fumes disappeared and flames started	410^{0}C	406^{0}C	410^{0}C		
11.45pm	Flames increased to 5-6 inches	420^{0}C	454^{0}C	420^{0}C	+	-
1.05am	Flames gradually decreased	452^{0}C	455^{0}C	465^{0}C	+	-
1.20am	Flames disappeared and boiling stage of kajjali (Honeycomb) was visible in Kupi	470^{0}C	468^{0}C	470^{0}C	-	-
1.25am	Bottom of kupi was seen red.Tamra patra/coin test showed particles of Mercury. Cork was done immediately	472^{0}C	474^{0}C	470^{0}C	-	+
1.30am-4.30am	Teevra agni given for 3 hrs and left for swangasheeta for 24 hrs	472^{0}C - 650^{0}C	474^{0}C-650^{0}C	470^{0}C-650^{0}C	-	-

Table No 3 Showing yeild of Rasasindoor

Samples	Kajjali	RS	Yield in %	Residue
SamaGandhaka Rasasindoor	200 gms	76 gms	38%-41%	-
DwiGandhaka Rasasindoor	200 gms	76 gms	36%-38%	2 gms-5gms

Table No 4 Showing organoleptic characteristics of Rasasindoor

Samples	Color	Touch	Appearance	Taste
SamaGandhaka Rasasindoor	Brick red	Soft	Crystalline	Tasteless
DwiGandhaka Rasasindoor	Dark red	Soft	Crystalline	Tasteless

Table No 5 Showing TLC of Raktakarpaas pushpa swaras and water soluble part of Dwigandhaka Rasasindoor

Extraction: Hexane extract Adsorbent used: Silica gel G_{60} F_{254}
Mobile phase: Toluene : Ethyl acetate: Formic acid (5 : 5:1)

UV 254nm: Spot	RF Value	RKF	RS
Yellow	0.72	√	-
Yellow	0.98	-	√
UV 365nm:Spot	**RF Value**	**RKF**	**RS**
Yellow	0.98	√	√
Gray	0.98	-	√
Yellow	0.62	√	-

Pink	0.60	√	-
Iodine Chamber :Spot	**RF Value**	**RKF**	**RS**
Yellow	0.98	√	√
Yellow	0.63	√	-
Yellow	0.62	√	-
Yellow	0.60	√	-

Table No 6 Showing XRPD (X-ray powder diffraction) analysis of Rasasindoor

Samples	HgS	Sylvine sodian	Free Sulphur	Crystal Structure
SamaGandhaka Rasasindoor	√	√	-	Hexagonal
DwiGandhaka Rasasindoor	√	√	√	Hexagonal

Table No 7 Showing SEM(Scanning electron microscope) analysis of Rasasindoor

Samples	Magnification	Particle size
Samagandhaka Rasasindoor	×2000	6.24µm to 9.8µm
Dwigandhaka Rasasindoor	×1500	2.40µm, 3.11µm to 812nm

XRD Graph of SamaGandhaka Rasasindoor and DwiGandhaka Rasasindoor respectively

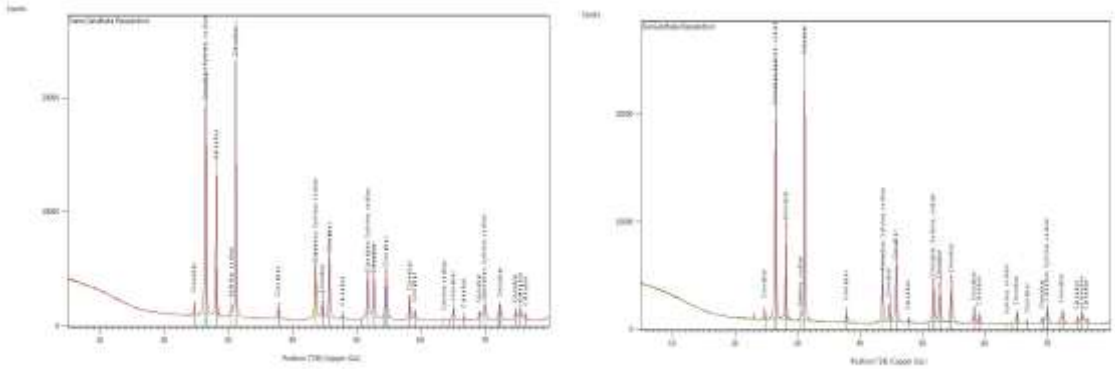


Table No 8 Showing Hg% ,S% and Cl% of Samagandhaka Rasasindoor and Dwigandhaka Rasasindoor by gravimetric analysis method of API

Elements	SamaGandhaka Rasasindoor	DwiGandhaka Rasasindoor
Hg%	74.84%	62.36%
S%	24.8%	1.31%
Cl %	33.20 ppm	8.12 ppm

DISCUSSION

Rasasindoor Preparation

1. Duration required for SamaGandhaka Rasasindoor was 12 hrs and 20 hrs for DwiGandhaka Rasasindoor preparation but the temperature pattern was same for all. Due to Navasadar the duration of Samagandhaka Rasasindoor was less as it acts as catalyst.

2. Due to addition of Navasadar in Sama Gandhaka kajjali, white fumes of navasadar were seen coming out from the bottle at early stage of mruduagni i.e within 45mins than DwiGandhaka Rasasindoor which took 1hr 30 mins.
3. There wasn't any residue left in SamaGandhaka Rasasindoor batches, but residue was found from 2-5 gms in DwiGandhaka Rasasindoor batches in the kupi. This could be Sulphur left which was not sublimed during teevragani stage. Here it shows that teevragni given was not sufficient because of which whole contents of the formulation were not sublimed and got deposited inside the neck of the kupi.
4. Color of Rasasindoor obtained was metallic grey on side at the innerside of bottle. It was smooth, plain. While the opposite side was rough having shinning greyish red crystalline appearance. RS was obtained by scraping the sides of the neck of the bottle as it was adherent to the bottle being less in quantity and was in the form of thick layers rather than single dome shaped structure. SamaGandhaka Rasasindoor were brick red in color, DwiGandhaka Rasasindoor was dark red. Both Rasasindoor were tasteless and crystalline.

Comparison of TLC of Raktakarpaas pushpa Swaras and TLC of Water Soluble part of DwiGandhaka Rasasindoor sample

The Rf value of yellow spot 0.98 in UV 254nm, yellow spot of Rf value 0.98 in UV 365nm and yellow spot of Rf value 0.98 in iodine chamber were found to be same in samples of swaras and DwiGandhaka Rasasindoor. This shows that the some alkaloids have been transferred from Raktakarpaaspushpa swaras to DwiGandhaka Rasasindoor which were heat stable. While other yellow spot of Rf value 0.72 in UV 254nm, yellow spot of Rf value 0.62, pink spot of Rf value 0.60 in UV 365nm and yellow spots of Rf value 0.63, 0.62 and 0.60 in iodine chamber which was present in swaras and absent in DwiGandhaka Rasasindoor may be because that alkaloid was destroyed by heat given during the preparation of DwiGandhaka Rasasindoor being heat liable.. Further study is required to find out that alkaloid which was heat stable and which was heat liable.

XRD (X-ray powder diffraction technique) analysis of Rasasindoor

1. XRD analysis of all the samples showed presence of HgS as the major compound along with sylvine sodian(KCl and Na) in small proportion. This can be due to presence of Navasadar (NH_4Cl) in the formulation of SamaGandhaka Rasasindoor,Bhavana dravyas, NaCl used in Parada shodhana may have retained to small extent even after repeated washing

of Parada and while Shalaka sanchalana some contamination from ash of bhrashti adhering to iron rods used for sanchalana. Hence glass rods should be used.

2. Free sulphur was found only in DwiGandhaka jaarit Rasasindoor. Some amount of sulphur was not combined with mercury an it remained as free sulphur. The crystal structure was found to be hexagonal in all formulations.

SEM analysis of Rasasindoor

There is lot of variation in particle size from 812 nm to 6.24 µm. Further magnification will be required to find exact particle size. As our product is not uniform so exact size of particles cannot be determined.

Gravimetric Analysis of Rasasindoor

Hg% was 74.84% and 62.36% in Samagandhaka and Dwigandhaka Rasasindoor respectively.While S% was 24.8% and 1.31% and also Cl% was found in ppm levels in Samagandhaka Rasasindoor as 33.20ppm due to use of Navasadar and 1.31% in Dwigandhaka Rasasindoor due to NaCl used in Parada shodhana may have retained to small extent even after repeated washing of Parada and while Shalaka sanchalana some contamination from ash of bhrashti adhering to iron rods used for sanchalana. Hence glass rods should be used for shalaka sanchalana.

CONCLUSION

Hence it can be concluded that there is difference in Rasasindoor prepared by two different formulations even though the end product is HgS. No free mercury was seen in XRD anaylsis hence it can be said that though Rasasindoor is made by using heavy metal(mercury),it is processed such that it gets converted into compound HgS which is safe to use and has wide therapeutic index if used in proper dose with proper anupan as per classical Rasagranthas. Further higher technical study is required to study the difference in these formulations in more detailed manner.

RASASINDOOR FORMATION

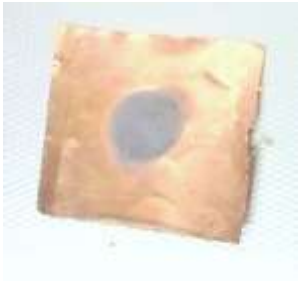
Bhrashti

Yellow fumes

Boiling of Kajjali

Flames of Sulphur


Flames of Sulphur


Tamrapatra test


Coin test


Corking


TeevraAgni


Breaking of Kupi


Bottom of kupi


SamaGandhaka


Rasasindoor


DwiGandhaka


Rasasindoor