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ANALYTICAL STUDY OF KAJJALI IN DIFFERENT RATIOS (W.S.R.to RASTARANGINI)

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ABSTRACT

The black fine powder formed by triturating (drudhmardan) purified mercury and purified Sulphur is "KAJJALI". Different ratios of Mercury and Sulphur for the preparation of Kajjali have been suggested in Rastarangini viz.

Ardhabhag (1:1/2,) 1unit -Mercury with ½ units -Sulphur

Sambhag (1:1) 1 unit Mercury with 1unit Sulphur

Dwigun- (1:2) 1unit Mercury with 2units Sulphur

Chaturgun – (1:4) 1unit Mercury, 4units Sulphur

The objectives of the present study is to clarify the possibilities of chemical reaction between Mercury and Sulphur to form third compound and to determine the variation in chemical and physical characteristic of KAJJALI Prepared with different proportions of MERCURY (Parada) AND SULPHUR (Gandhaka) with the help of modern sophisticated analytical instruments.

KEYWORDS: Kajjali, Yogavahi, ASTM Data, X-ray Diffraction, Melting point, Flame test, Extraction of Sulphur, Mercuric Sulphide.

INTRODUCTION

Ayurvedic medicine has its own importance in the therapeutic uses. Ayurvedic medicines are time tested and safe when used as per the references mentioned in Granthas. Rasshastra the part of Ayurved mainly concern with the study and analysis of Herbo-metallic and Herbo-mineral medicinal materials, purification as well as preparation of medicine and their

therapeutic uses in various diseases. Most of the Ayurvedic medicines contains KAJJALI (combination of Mercury and Sulphur) as an active ingredient, are safely being consumed under various treatment guidelines. Kajjali is yogavahi and tridoshhara if taken with proper anupana. There are references that Kajjali can be prepare with the deferent ratios of Mercury and Sulphur viz. **Ardhabhag-**(1:1/2) 1unitof Mercury with ½ unit of Sulphur , **Sambhag-**(1:1) 1 unit of Mercury with 1unit of Sulphur, **Dwigun-**(1:2) 1unit of Mercury with 2unit of Sulphur, **Chaturgun-**(1:4) 1unit of Mercury,4unit of Sulphur.

"अर्धसमान द्विगुणमिताद्या गन्धकचूर्णात पारदकस्य |

मर्दनजन्य मसृणकाया कज्जलरूपा कज्जलिका सा ||"

(रस तरंगिणी ६/१०७)

The analysis here will bring out:

- The chemical reactivity between Mercury and Sulphur in samples of kajjali with different ratios of mercury and sulphur.
- The possible compound present in all samples of kajjali, identified by modern technologies like XRD.
- Melting Point of all samples of kajjali.
- Flame test of all samples of kajjali.
- Amount of free Sulphur/ unreacted Sulphur present in all samples of kajjali.

AIMS AND OBJECT

The Prime aim of this study is to prepare 4 samples of KAJJALI in different ratios of Mercury and Sulphur Viz. Ardhabhaga (1:1/2,) 1unit -Mercury with ½ unit Sulphur, Sambhaga (1:1) 1 unit Mercury with 1unit Sulphur, Dwigun-(1:2) 1unit Mercury with 2unit Sulphur, Chaturgun –(1:4) 1unit Mercury,4unit Sulphur The study of all the 4 samples carried out under, Simple Microscope, XRD Instrument, compared by ASTM Data, Flame test, Melting point and Chemicals analysis.

OBJECTIVES

- Organoleptic study of KAJJALI in different Ratio (i.e. Nishchandrikaran parikshan).
- To study the chemical reactivity between Mercury and Sulphur in KAJJALI.
- To analyze KAJJALI in modern analytical laboratory for identification of ingredients present in it.

- To separate the free or unreacted Sulphur from KAJJALI.

MATERIALS AND METHODS

Materials used for the Preparation of KAJJALI is Mercury (Purity 99.99 E-Merck) and Sulphur (Purchased from Local market) are purified and used in different ratios to prepare 4 samples of KAJJALI by drudhmardan.

Purification of Mercury

Purification of Mercury has been carried out as per the reference in Rastarangini 5/27-29, mercury in equal quantity of Lime (Khatika) is triturated for 48 hours and filtered under Double folded cloth (mess size 200) , Collected Mercury then measured and triturated with exactly half quantity of peeled Garlic buds. After Triturating the Mixture then washed with water and cleaned obtained Mercury is collected as Purified Mercury.

Purification Sulphur

Sulphur is purified as per the procedure explained in Rastarangini 8/7-12, Sulphur is heated with cow's ghee till it melts completely, then filtered in cow's milk, throwing out the impurities after filtration the solid Sulphur then washed with hot water to obtain purified Sulphur, this procedure is repeated seven to get a good purification level.

Preparation of KAJJALI

Pure Mercury from E-Merck India is again purified as per the reference in Rastarangini R.T. (/27-29), is taken for the preparation of KAJJALI. In same manner the Purified Sulphur in powdered and taken for the preparation of KAJJALI, the chart below shows the quantity of Mercury and Sulphur taken for the preparation of different samples.

Table 01:

No.	Sample	Mercury In Gms	Sulphur In Gms	Ratios	Kajjali Obtained in Grams
1	A	10	05	1: 1/2	13.750
2	B	10	10	1:1	18.900
3	C	10	20	1:2	28.800
4	D	10	40	1:4	49.00

Samples are prepared by the method explained in Rastarangini. Each sample prepared by triturating Sulphur and Mercury in Khalva Yantra (Mortar and pestle). It has taken 10 hours

of trituration to obtain a smooth lusterless black colored powder. No Mercury globules were visible in the samples.

Organoleptic Observation

Colour: Black.

Smell: Sulphur like.

Touch: Smooth. (amorphous feel)

Taste: Tasteless.

Appearance: Lusterless. (*निष्चन्द्रीकृत*), as like KAJJALI

Observation under Simple Microscope: Each Sample Named sample 'A', sample 'B', sample 'C', Sample 'D', tested under simple microscope , slide prepared with help of Glycerin.

Observation: Fine Black Powder seen over the slide, no mercury particles are seen, hence it confirm the samples are *निष्चन्द्रीकृत*

Test for Melting Point: Each sample is tested for its melting point by the common procedure in laboratory and the temperature difference is shown as under.

Table 02:

SAMPLE	RATIO	MELTING POINT °C
A	1:1/2	80 °C
B	1:1	62 °C
C	1:2	110 °C
D	1:4	121 °C

Flame test: Following the common procedure, flame test of each sample done and observed for any variation, it is compared with the flame test of Sulphur which is blue and flame test of Hgs which is orange red with sparkles. Results are as below in table 03.

Table 03:

SAMPLE	FLAME COLOUR
A - 1:1/2	Orange red with little sparkles
B - 1:1	First Blue then Orange red with little sparkles
C - 1:2	Blue flame
D - 1:4	Blue flame

Study with X-ray diffraction (XRD): XRD is an experimental Methodology to study the inside matter structure of a material. This method is very much supportive in study of Atomic and Molecular structure of a metal. XRD study here support to understand the materials present in KAJJALI.

Each samples of Kajjalli is kept one by one under XRD machine (Regaku Geigerflex - Japan Made) with copper target = 1.542 A . The XRD pattern obtained and the calculated XRD data for each sample is shown in the table below.

Table 04:

Sample (A)			
2 Theta	**d/A**	**I %**	**FWHM**
22.996	3.86	17.6	0.138
26.281	3.38	100	0.443
30.2	2.93	17	0.503
43.719	2.06	33	0.503
51.72	1.76	23.1	0.576
Sample (B)			
2 Theta	**d/A**	**I %**	**FWHM**
22.962	3.87	26.2	0.239
26.26	3.39	100	0.42
30.48	2.93	18.5	0.511
43.7	2.07	33.1	0.423
51.341	1.76	21	0.607
Sample (C)			
2 Theta	**d/A**	**I %**	**FWHM**
22.98	3.87	53.2	0.153
26.28	3.39	100	0.43
30.598	2.92	15.3	0.693
43.699	2.07	30.8	0.396
51.7	1.76	21.8	0.639
Sample (D)			
2 Theta	**d/A**	**I %**	**FWHM**
23.039	3.86	97.5	0.183
26.321	3.38	100	0.434
43.76	2.06	32.1	0.503
51.74	1.76	25.9	0.448

RESULT

During data comparison it is observed that the reflection at around “3.86A” corresponds to “3.89A” in ASTM data sheet for Rhomboidal Sulphur further it is observed that the reflection at around “3.38A” “2.93A” “2.07A” “1.76A” matches with the patterns in ASTM data sheet for black cubic Hgs (Mercuric sulphide) . It is concluded that there is presence of

Rhomboidal Sulphur In all the Samples and its intensity increases gradually from sample A to sample D. Also there is presence of black cubic Hgs in the all the samples and the intensity decreases from sample A to D.

Extraction of Sulphur

The above studies indicates that there is presence of free/unreacted Sulphur and Mercuric sulphide (Hgs) in the every samples of Kajjali .To confirm the quantity of both the materials the extraction of free Sulphur has been carried out with the help of liquid carbon disulphide.

3gm of kajjali from each sample is taken and Sulphur is extracted with carbon disulphide and weighed, the remaining black material Hgs is also weighed, the observed value is as under.

Table 05:

Sample	Amount of Sulphur	Amount of HGS
A	0.82	2.13
B	1.28	1.64
C	1.87	1.09
D	2.22	0.67

Note: During the process of extraction little loss to be considered.

DISCUSSION

Four Samples were prepared by the method explained in Rastarangini. Each sample prepared by triturating Sulphur and Mercury in Khalva Yantra (Mortar and pestle). It has taken 10 hours of trituration to obtain a smooth lusterless black coloured powder (Kajjali).

Organoleptic Test:

Each sample Underwent organoleptic test and results were characteristic of a good quality of Kajjali. Examination under Microscope confirmed that there was no mercury globules present in any sample.

Melting point of all the samples tested to observe the variations, and the result come out with a huge variations viz. A- 80°C, B- 62°C, C- 110° C, D- 121° C . Sample B (Sambhaga kajjali) melts at low temperature than other samples. This may be the one reason why it is mentioned in text that Sambhaga Kajjali is to be considered where quantity of Mercury and Sulphur Not Mentioned.

Flame Test also shows some kind of variations, Sample A- burns with Orange red with little sparkles, Sample B- First Blue then Orange red with little sparkles, Sample C- Blue flame, Sample D- Blue flame. Here again the special character of sample B appear which shows Blue flame and then orange- red with Sparkles.

XRD Analysis carried out for all the samples under expert supervision, obtained XRD patterns are then compared with X-ray diffraction Data card of Rhomboidal Sulphur, Monoclinic Sulphur, Black cubic Hgs and Red hexagonal Hgs, in ASTM Data sheet. During data comparison it is observed that the reflection at around "3.86A" Is corresponds to "3.89A" Of ASTM data sheet for Rhomboidal Sulphur further it is observed that the reflection at around "3.38A" "2.93A" "2.07A" "1.76A" matches with the patterns of black cubic Hgs. It is concluded that there is presence of Rhomboidal Sulphur In all the Samples and the amount increases gradually from sample A to sample D. Also there is presence of black cubic Hgs in all the samples and the amount decreases from sample A to D.

CONCLUSION

It is concluded that the method of preparation of kajjali is responsible for formation of black cubic Hgs i.e. mercuric sulphide as a result of chemical reaction between Mercury with some quantity of Sulphur, rest of the Sulphur remain unreacted in all the samples.

The free/ unreacted Sulphur remains amalgamated with Black cubic Hgs and adopt the black colour. Hence it is concluded that kajjali is a mixture of Black Hgs and Sulphur.

The free or unreacted sulphur from each sample has been extracted and weighed, the sambhag kajjali shows the amount of sulphur and the amount of Murcuric sulphide (Hgs) are very close to each other.

Presence of Black Hgs in all the samples are near about same where as the free Sulphur increases as the ratio increases gradually from sample A to D.

When focused on sample B the sambhag Kajjali, it is observed that sambhag Kajjali have a Special presentation in following manner.

1. Melting pint

During analysis melting point it is noted that sambhag kajjali sample melts at 62 °C, which is a lowest among all the four samples.

2. Contain of Kajjali

In sample B the amount of Black Hgs and Sulphur remains near to each other. This way the effect of both the material as a drug will be of same strength without overlapping each other.

3. Flame test

Flame test of Sample 'B' Shows First Blue colour then orange red with sparkle that indicate the presence of Both Sulphur and black Hgs in same strength.

This may be the reason why it is advised that sambhag kajjali to be used (*विशेषोक्त ग्रहण)*, if there is no specification about the ratio of Sulphur and mercury is mentioned for the preparation of drug.

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