



COMPARISON OF *KAJJALI* PREPARED BY TRADITIONAL AND MODERN METHODS

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**ABSTRACT**

**Background:** In the present study, *Kajjali* (black sulphide of mercury) has been prepared by two different methods. The first method is the traditional method in which the purified mercury and sulphur are rubbed in a clean *khalva* (earthen vessel) for approximately 24 – 30 hours until the *Kajjali* is formed. The second method which is also referred to as the modern method involves the use of a grinder to facilitate the formation of *Kajjali*.

**Aim & Objective:** The products from the two methods are then compared by assessing different organoleptic, alchemical and physicochemical parameters.

**Materials & Methods:** There are different proportions of purified *Parada* (Mercury) and *Gandhaka* (Sulphur) mentioned in the Ayurvedic texts for the preparation of *Kajjali*. The present work was aimed at the preparation and standardization of *Samagunabaliyarita Kajjali* (equal parts of purified Mercury and Sulphur) by both the traditional and the modern methods.

**Result and conclusion:** It was found that both the methods yielded *Kajjali* possessing similar attributes and qualities.

**KEYWORDS:** *Samagunabaliyarita Kajjali*, *Parada yoga*, *Khalva yantra*, *Rasashastra*.

**INTRODUCTION**

In the Ayurvedic system of treatment, Mercury plays a vital role. The ancient authors described *Rasa-Chikitsa* as the best treatment.<sup>[1]</sup> *Rasashastra*, the pharmaceutical science, deals mainly with the processing and therapeutic utilization of Mercury, metals and minerals.<sup>[2]</sup> It aims at designing novel drugs with better curative attributes at minimal doses.<sup>[3]</sup>

There are two classes of thoughts as far as the pharmacology of *Kajjali* is concerned.<sup>[4]</sup> One is by considering the proposals that Mercury and mercurial compounds such as *Kajjali* are not absorbed though the GI tract and the other way considers mercurial absorption.

When the theories stipulate that *Kajjali* is not absorbed in the GI tract, it is postulated that it eventually acts as GI stimulant, locally also as neuro-chemical irritant for the intestinal mucosa.<sup>[5]</sup> It also acts as catalyst and hence through its catalytic activity, better absorption of herbal pharmacological molecules is achieved. Hence, the net resultant activity of *Kajjali* is that it eventually increases the bioavailability of ingested drugs.

Internal administration of *Kajjali* pacifies the *Tridosha* (disorder of the three humours of the body) and acts as *Vrushya* (an aphrodisiac). Furthermore, it is also used as *Sahapana* (taking together with the medicine) and *Anupana* (as a vehicle taken after the medicine). In addition to that,

*Kajjali* is also one of the prime ingredients in various *Rasayoga* (herbo-mineral formulations) and is used as a medicine separately.<sup>[6]</sup>

The process of constant trituration of *Parada* (mercury) and *Gandhaka* (sulphur) will eventually pack the Sulphur molecules in between the layers of Mercury molecules.<sup>[7]</sup> As the trituration continues, the compact placement of Sulphur becomes more fixed.

Thus, owing to this compact structure, after oral administration of *Kajjalikalpa*, the sustained release of active molecules takes place. Hence, also in clinical practice, it is observed that “timed release and sustained release” theories of drugs triturated with *Kajjali* are more than the drugs administered without *Kajjali*.

## MATERIALS AND METHODS

### Ingredients:

1. *Shuddha Parada* (Purified Mercury)
2. *Shuddha Gandhaka* (Purified Sulphur)

The ingredients were procured from Punarvasu Aushadhshala Pvt Ltd. Shiv Kamal industrial estate, Shivanegaon, Pune, India and all the materials were thoroughly screened by *rasashastra* experts based on the *GrahyaLakshanas* (characteristics) mentioned in the classics.

The study was conducted at Sinhgad College of Pharmacy, Vadgaon (Bk), Pune – 41. However, the SEM and the determination of the % of Mercury and Sulphur by AAS (Atomic Absorption Spectroscopy) were carried out at Diya Labs, Mumbai.

### Purification of the Ingredients

#### Purification of *Parada* (Mercury)<sup>[8]</sup>

The purification of *Parada* (Mercury) was achieved using garlic juice. The impure Mercury, procured from the market by Punarvasu Aushadhshalam Pvt Ltd, was taken in a clean and dry *khalva* and fresh garlic juice was added. Quantity of which should be sufficient to cover the entire mercury surface.

The Mercury was triturated in a slow and steady fashion till the garlic juice turned

dark in color. And at this moment, the juice was said to be saturated with impurities from the impure Mercury. The juice was taken out of the *Khalva* and the surface of the Mercury was washed with water and cleaned with cotton.

Fresh garlic juice was then added and the trituration process continued. Ayurvedic texts stipulate that this step should be repeated at least 7 times. In other words, there should be at least 7 trituration cycles with fresh garlic juice.

After that, Mercury is eventually washed with warm water till a clear, mirror like surface is obtained. Then only, the Mercury could be assumed to be purified. The actual purification process of the Mercury used for the study was done over a period of 3 days comprising of 8 hours of trituration daily.

It is important to note that only purified Mercury can be employed in Ayurvedic treatment, as per the texts; because impure Mercury can be the cause of various imbalances and hence lead to the advent of toxicity. (Fig. 1)

#### Purification of *Gandhaka* (Sulphur)<sup>[9]</sup>

A wide mouth *Ghata* (earthen vessel) was taken and filled with *Goghrita* (Cow's ghee), then the mouth of the vessel was covered by a cloth and tied by iron wire. Coarse powder of *Gandhaka* was spread upon the cloth and closed with another earthen vessel by placing upside down.

The edges of both the vessels were sealed with *Multanimitti* (Fuller's earth). The cloth was then smeared for ten minutes and allowed to dry under sunlight. This *Yantra* (apparatus) was kept inside a pit (1.5 feet) beneath the surface of the soil in such a way that the brim of the vessel was at ground level. Empty spaces of the pit around the apparatus were filled with soil. Cow dung cakes were kept on the brim of the vessel and set on fire.

The Sulphur, after melting by fire, flows down through the cloth into the vessel, which contained milk and ghee. After *Svangasita* (self – cooling), the apparatus is

taken out of the pit and *Sandhibandhana* (seal) was opened carefully. Purified *Gandhaka* (in granule form) was collected from the bottom of the vessel and washed with hot water. (Fig. 2)

### Preparation of The *Kajjali*

Four types of *Kajjali* can be prepared in a ratio of weight of Mercury to weight of Sulphur and these types are categorized into four different groups as per the ancient Ayurvedic texts. They are as follows:-

Group 1= 1:1

Group 2= 1:2

Group 3= 1:3

Group 4= 1:6

Group 1: *Samagunabali jarita Kajjali* was taken for study.

This group of *Kajjali* was chosen as it is the most frequently used in Ayurvedic treatment.

Within this group two methods of *Kajjali* preparation were tried.

#### 1<sup>st</sup> method: Traditional method (Rubbing)

350g of purified Mercury and 350 g of purified sulphur were taken in a *Khalva* and

rubbed for a specific time period (24 – 30 hours) till a fine black powder was obtained. This was done over a period of three days comprising of eight hours of rubbing continuously for each day.

The process was stopped after three days as the *Kajjali* was confirmed to have been formed. (Fig. 3 and Fig. 4)

#### 2<sup>nd</sup> method: Modern (Grinding) Method

500 g of purified Sulphur was taken in a *Khalva* and rubbed for 15 minutes and then 500g of purified Mercury was added and rubbed for 45 minutes till a coarse faint black powder was obtained and the mixture was ground in a mixer grinder for 30-60 seconds. This procedure was repeated with an interval of 10-15 minutes till a black powder was obtained and rubbed for 12 hours in a *Khalva*. (Fig. 5)

**Note:** For both the methods, the completion of the process was confirmed when there was no sign of *Chandrika* (shiny particles of Mercury) in the black powder obtained. This was checked by assessing the presence of shiny particles, if any, under sunlight.

The general procedure and the timing have been tabulated below.

**Table 1: Preparation of *Kajjali* by 1<sup>st</sup> Method**

S. No.	Group of <i>kajjali</i>	Total rubbing time	No. of days required
1	1	30 hours	6

**Table 2: Preparation of *Kajjali* by 2<sup>nd</sup> Method**

S. No.	Group of <i>kajjali</i>	1 <sup>st</sup> rubbing time	Grinding time	2 <sup>nd</sup> rubbing time	Total time required
1	1	1 hour	1 hour	11 hours	13 hours

### EVALUATION PARAMETERS & RESULTS

**Table 3: Weight and Yield of Traditional and Modern Method**

Method	Weight of Mercury (g)	Weight of Sulphur (g)	Weight of <i>Kajjali</i> (g)	% Yield
1 <sup>st</sup> : Conventional Method	350	350	692	98.8%
2 <sup>nd</sup> : Modified Method	500*	500*	995	99.5%

\*The minimum capacity of the grinder is 1000g

**Table 4: Results of Organoleptic Tests<sup>[10]</sup>**

S. No.	Parameters	Observations for Group 1 <i>Kajjali</i> prepared by 1 <sup>st</sup> method	Observations for Group 1 <i>Kajjali</i> prepared by 2 <sup>nd</sup> method
1.	Texture	Dull, no shiny particles	Dull, no shiny particles
2.	Colour (after trituration)	Black	Black
3.	Taste	Tasteless	Tasteless
4.	Smell	Indistinct	Indistinct
5.	Touch	Smooth and soft fine powder	Smooth and soft fine powder

**Table 5: Results of Alchemical Tests**

S. No.	Parameters	Observations for Group 1 <i>Kajjali</i> prepared by 1 <sup>st</sup> method	Observations for Group 1 <i>Kajjali</i> prepared by 2 <sup>nd</sup> method
1.	<i>Rekhapurnatva</i> (should enter furrows of finger)	Passed	Passed
2.	<i>Varitaratva</i> (should float on still water)	Passed	Passed
3.	<i>Nishchandratva</i> (free from glittering particles)	Passed	Passed
4.	<i>Mridutva</i> and <i>Slakshanatva</i> (softness and smoothness on touch)	Passed	Passed
5.	<i>Kajjalabhasa</i> (smooth and black powder)	Passed	Passed
6.	<i>Apunarbhava</i> (should not regain its initial metallic luster)	Passed	Passed
7.	<i>Gatarasatva</i> (should retain its tastelessness)	Passed	Passed
8.	<i>Visistavarnotpothi</i> (specific colour)	Passed	Passed

**Table 6: Results of Physicochemical Tests<sup>[11,12,13]</sup>**

S. No.	Parameters	Observations for Group 1 <i>Kajjali</i> prepared by 1 <sup>st</sup> method	Observations for Group 1 <i>Kajjali</i> prepared by 2 <sup>nd</sup> method
1.	pH of suspension	7.0	7.2
2.	Ash value	0.12%	0.15%
3.	Acid-insoluble ash	0.10%	Nil
4.	Water-soluble ash	0.03%	Nil
5.	Loss on drying	Nil	Nil
6.	% mercury	83.4%	82.6%
7.	% free mercury	Nil	Nil
8.	% sulphur	85.3%	85.7%
9.	% free sulphur	0.07%	0.07%
10.	Carr's index	30	27.3
11.	Angle of repose	23°	27°

SEM Results: Fig. 6 &amp; 7

## DISCUSSION

There were no differences noted in the two *Kajjali* samples prepared by the two different methods as far as the organoleptic characteristics are concerned. They were found to be the same. As mentioned by the Ayurvedic texts, the powder should be black in color, tasteless, with no shiny particles in addition to being soft and smooth on touch. Yet, the time taken for the powder to change color to black varies for the traditional and the modified method. Undoubtedly, it did not take much time for the powder to turn into a black and fine powder using the grinder and eventually it took less time for the shiny particles to disappear in the grinder. One reason for that may be due to the difference in the application of pressure during manually triturating.

As far as the alchemical properties are concerned, the first one is the criteria pertaining to which the *Kajjali* powder should easily enter and be fixed in between the furrows (depressions) of the fingers. In that respect, both the samples complied with the test because of the very fine nature of the particles owing to long hours of trituration.

Ayurveda stipulates that the *Kajjali* sample should pass the *Varitaratva* test which means that the particles should be able to float on still water. And it is common sense that if the first test was passed then there should be absolutely no difficulties for the particles to float on still water because of the very fine particle size distribution of the powder. This property can be correlated with the density of the particles, which has to be less than that of water for it to be able to float on it. In turn, density is associated to the mass to volume ratio of the *Kajjali* particles.

*Nishchandratva* is a confirmatory test of whether the *Kajjali* has been formed or not. This test confirms the absence of shining particles in the powders. This was an indication of the completion of the *Mardana* (trituration process). The powders were observed in both sunlight and torch light.

*Mridutva* and *Slakshnatva*, *Kajjalabhasa*, *Gatarasatva* and *Visistavarnotpothi* are similar to the organoleptic characters of the powders. Both of the powders were smooth and soft, black and tasteless.

*Apunarbhava* pertains to the ability of the metal to regain its metallic luster such that the original raw material is obtained. And this should not happen as far as the *Kajjali* powders are concerned. True is that Ayurveda says that the bond between mercury and sulphur is bound to break over a certain period of time, but as far as it is used when the *Kajjali* is still formed, there would be no harm.

*Anjanabhasa* refers to the suitability of the *Kajjali* samples to be used as a coryllium. However, *Kajjali* is not used as a coryllium. It is just a way to depict that the *Kajjali* particles are fine enough so as not to cause any kind of irritation to the eyes. As the particle size of both the samples meet the requirements, no questions were raised about this property.

## CONCLUSION

A modern method, involving grinding, was employed to prepare *Kajjali*. Simultaneously, another *Kajjali* sample was prepared by the traditional method. The two *Kajjali* samples were then compared and assessed taking into consideration organoleptic traits, alchemical properties and physicochemical characteristics for the same.

Both of the *Kajjali* samples were found to possess similar alchemical properties as per the Ayurvedic classics.

One important observation is that both the methods yielded *Kajjali* samples which did not have any trace of free mercury, which remains a primary requisite to conclude that they will not be exhibiting any kind of toxicity due to free mercury.

Also, the SEM results indicate that the particle size distribution for both the samples was falling in the same micrometer ranges.

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**PHOTOGRAPHS**



**Fig 1: Ashuddha Parada (Impure Mercury)**



**Fig 2: Purification of Mercury with garlic juice**



**Fig 3: Purified Mercury**



**Fig 4. Purified Sulphur**



**Fig 5. Mixture of purified Mercury and Sulphur at 0 hours of trituration**



**Fig 6. Mixture of purified Mercury and Sulphur at 6 hours of trituration**



**Fig 7. Mixture of purified Mercury and Sulphur at 12 hours of trituration**



**Fig 8. Mixture of purified Mercury and Sulphur at 24 hours of trituration**



Fig 9. *Kajjali* being prepared in grinder



Fig 10. *Kajjali* being prepared in grinder

**SEM ANALYSIS OF KAJJALI**

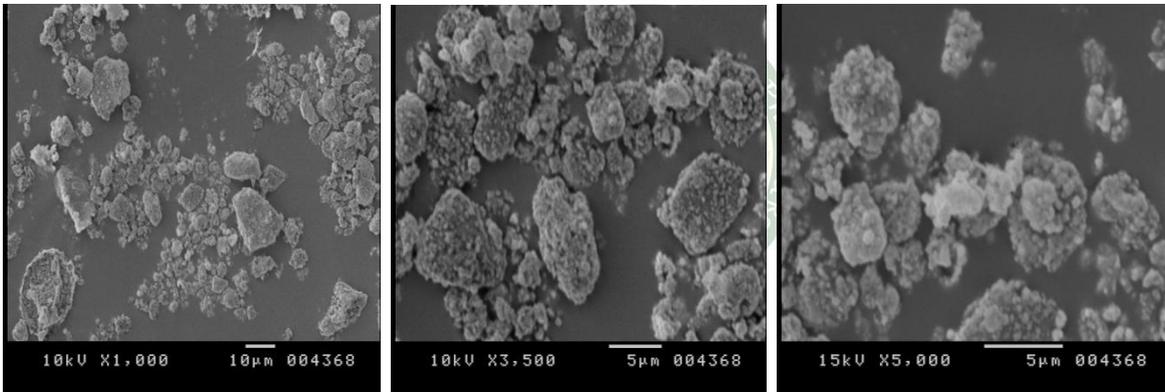


Fig 11. SEM of *Kajjali* prepared by 1<sup>st</sup> method

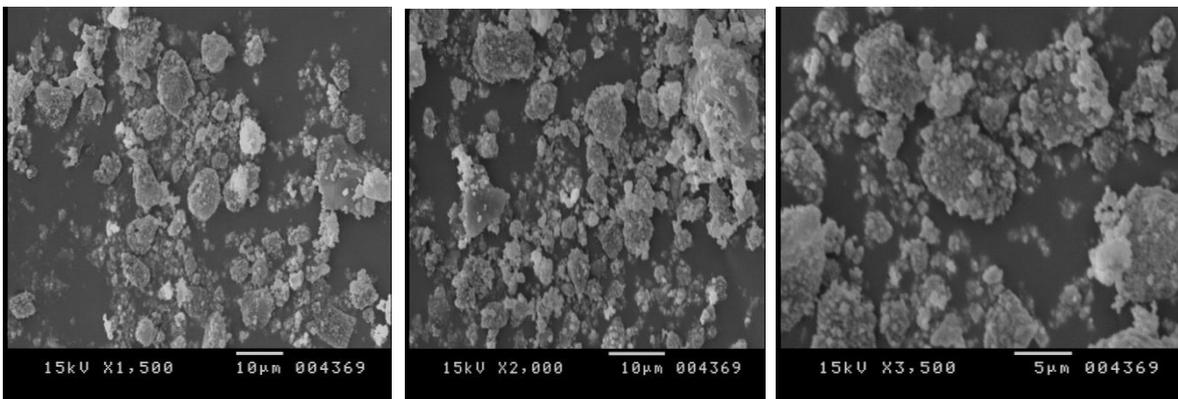


Fig 12. SEM of *Kajjali* prepared by 2<sup>nd</sup> method