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PHYSICO-CHEMICAL ANALYSIS OF *SAMAGUNABALIJARITA KAJJALI*- AN AYURVEDIC DRUG

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ABSTRACT

Several compounds of *Parada* (Mercury) and *Gandhaka* (Sulphur) are extensively used in *Ayurvedic* therapeutics for a wide variety of ailments and conditions. *Kajjali* is one such compound which is the most predominant amongst them. *Kajjali*, an Indian traditional drug has been used in the treatment of various disorders. There are different proportions of purified *Parada* (Mercury) and *Gandhaka* (Sulphur) mentioned in the Ayurvedic texts for the preparation of *Kajjali*. In our study, *Kajjali* (Black sulphide of mercury) has been prepared by traditional method. In which the purified mercury and sulphur were triturated in a clean *Khalva yantra* (Mortar & Pestle) for approximately 72 hours until the *Kajjali* is formed. The product was assessed by different organoleptic, alchemical and physicochemical parameters, viz. Analytical study, *X-ray diffraction* (XRD), *Scanning electron microscopy* (SEM). The present work is aimed at the preparation and Physico-chemical analysis of *Samagunabalijarita Kajjali* (equal parts of purified Mercury and Sulphur) prepared by traditional method.

KEYWORDS: *Samagunabalijarita Kajjali, Parada, Gandhaka, Rasashastra, Ayurvedic* therapeutics, *Physico-chemical analysis.*

INTRODUCTION

Kajjali is used as medicine in *Rasashastra* since 8th Century AD; during the period of *Nagarjuna*, promoter of *Rasashastra*. *Parada* and *Gandhaka* are therapeutically used since the period of *Charaka Samhita* and *Sushruta Samhita* which are dated 7th 8th century B.C. [1] Taditional method of *Kajjali* preparation follows *Shodhanavidhi* (Purification process) and *Kajjalikarana* (Preparation of *Kajjali*) of *Parada* and *Gandhaka*. When *Parada* and *Gandhaka* separately undergo *Shodhanavidhi* whereby they are expected to be purified, detoxified and potentized.[2] *Shuddha* (Purified) *Parada* and *Gandhaka* are taken in equal weight and triturated till the shiny globules of *Parada* are no longer visible; Which is called as *Kajjali*.[3] *Kajjali* is used in *Ayurvedic* therapeutics in a significant way for medicinal purpose also as a part of other medicine. It is a prime ingredient of the majority of *Rasa aushadhi* (Medicines prepared from Mercury). *Kajjali* cures many diseases by the virtue of its quality of pacifying the *Tridoshas* (three basic entities of body), and it is also used as *Vrushya* (an aphrodisiac), *Sahapana* (taking together with medicine), and *Anupana* (a vehicle taken after medicine) the addition of sulphur in the drug is supposed to counteract the toxicity of mercury.[4] Thus to understand the physico-chemical properties of this formulation it was felt necessary to standardize this *Ayurvedic* drug compound. Very few publications for complete standardization of *Samagunabalijarita Kajjali* have been reported. So, in our study we aimed to evaluate the Standardization of *Samagunabalijarita Kajjali.*

MATERIALS AND METHODS

Ingredients

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

The ingredients were procured from local authenticate market, Nagpur,Maharashtra, India and all the materials were thoroughly screened by *Rasashastra* experts based on the *Grahya Lakshanas* (characteristics) mentioned in the classical texts. Pharmaceutical and Analytical study was conducted at Shri Ayurved Mahavidyalaya, Nagpur, Maharashtra, India. However, the SEM was carried out at Diya Labs, Mumbai, Maharashtra, India, XRD study at VNIT, Nagpur, Maharashtra, India.

Purification of the Ingredients

Purification of *Parada* (Mercury)[5]

The purification of *Parada* (Mercury) was achieved with the help of a *Kwath* (decoction) of *Kumari* (*Aloe vera*), *Chitrak* (*Plumbago zelanica*), *Ratksarshap* (*Brassica alba*), *Brihati* (*Solanum indicum*), *Triphala* (Combination of *Phyllanthus* emblica, *Terminalia chebula, Terminalia bellirica*). 500 g of *Ashuddha* (Impure) *Parada* was taken in *Khalvayantra*. *Ashuddha Parada* was triturated with the freshly prepared *Kwath.* Quantity of which should be sufficient to cover the entire mercury surface. The Mercury was triturated in a slow and steady manner; trituration was done 6 hrs daily For consequent 12 days. Every next day freshly prepared *Kwath* was used for trituration. On 13th day *Kwath* was removed from *Khalva yantra* without disturbing the settled *Parada* was collected. *Parada* was washed with warm water till a clear; mirror like surface was obtained. Total 460gm of *Parada* was obtained and stored in airtight glass bottle.

Purification of *Gandhaka* (Sulphur)[6]

Godugdha (Cow's milk) 1 litre was taken in a stainless steel vessel covered with dry clean cotton cloth tied at neck. Required *Goghrita* (Clarified Butter) 250 gm was taken in a steel pot, heated on mild flame till it gets completely melted; then powdered *Gandhaka* 500gm was added to it. Melted *Gandhaka* and *Goghrita* were poured through cloth in vessel containing *Godugdha.* Stones and clay were remained on cloth and *Gandhaka* filtered in *Godugdha*. Mixture was continuous stirred to avoid blockage of cloth pores due to cooling of *Gandhaka.* After 15 minutes *Dhalit* (Poured) *Gandhaka* was taken out from *Godugdha* which appeared as fresh yellow granules like structure. *Shuddha* (Purified) *Gandhaka* was washed out with hot water, till it gets free from *Goghrita* and *Godugdha.* This process was repeated for seven times total 470gm *Gandhaka* was obtained. For one *Dhalan* (Melting & Quenching) 15 minutes of time was required. For each *Dhalan* new and fresh *Goghrita* and *Godugdha* were used.

Preparation of the *Kajjali* [7]

Samagunabalijarita Kajjali was chosen as it is the most frequently used in Ayurvedic medicines. 400 g of *Shuddha Parada* was taken in a clean *Khalva yantra* (Mortar & pestle); equal amount of *Shuddha Gandhaka* was added to it and triturated for a specific time period 5 hours daily for 15 days. Gradually the white colour of *Parad* and yellow colour of *Gandhak* disappeared and a black powder was formed. *Mardan* (Trituration) was continued till the

powder became black in colour, very fine in consistency and passes all alchemic tests. Total 750gm of *Kajjali* was obtained after processing.

RESULTS

Physical Parameters of *Kajjali*.

Table No. 1: Results of Organoleptic Tests[8]

Test	Analysis of *Kajjali*
Appearance (*Rupa*)	Fine powder
Colour (*Varna*)	Black
Touch (*Sparsha*)	Smooth
Smell (*Gandha*)	Not Specific

Table 2: Results of Alchemical Tests[9]

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

Table 3: Results of Physicochemical Tests[10,11,12,13]

S.No.	Parameters	*Kajjali*
1.	pH of 1% and 10% suspension	4.6
2.	Loss on drying	1.12% w/w
3.	% mercury	33.50%
4.	% sulphur	26.09%

Table No. 4 Quantitative Estimation of Mercury in various Samples.

Sr. No.	Sample	Mean Titration end point (Mean)	Amount of Mercury in 500mg of Sample	% of Mercury in Sample
1.	*Ashuddha Parada*	48.1	482.443	96.49
2.	*Shuddha Parada*	49.2	493.476	98.70
3.	*Kajjali*	16.7 ml	167.501	33.50

Table No. 5 Quantitative Estimation of Sulphur in various samples.

Sr. No.	Sample	Wt. of Ash obtained (Mean)	Amount of Sulphur in 1 g	% of Sulphur in Sample
1.	*Ashuddha Gandhaka*	6.94g	953.14	95.31
2.	*Shuddha Gandhaka*	7.14g	981.22	98.13
3.	*Kajjali*	1.90 g	260.95	26.09

X-ray Diffraction (XRD),

XRD pattern shows HgS along with free Mercury are the crystalline phase present in *Samagandhak Kajjali*. HgS is present in cubic and hexagonal form. Free Mercury present in ortho-rhombic form. SEM photomicrograph of *Samagunabalijarita Kajjali* particles shows the appearance of particles of 10 um and less than 5 um size particles.

Table No. 6 Peak List.

Pos. [°2Th.]	Height [cts]	FWHM [°2Th.]	d-spacing [Å]	Rel. Int. [%]
23.1600	15.77	0.2880	3.83737	8.93
26.3487	176.65	0.3840	3.37977	100.00
30.4653	30.52	0.4800	2.93180	17.27
43.7334	53.56	0.3840	2.06820	30.32
51.6787	46.21	0.4320	1.76735	26.16
54.1400	7.33	0.7680	1.69267	4.15
69.9775	11.03	0.5760	1.34335	6.24
72.1065	9.41	0.3360	1.30884	5.32

Table No. 7 Pattern List

Visible	Ref. Code	Score	Compound Name	Displacement [°2Th.]	Scale Factor	Chemical Formula
	00-001-0643 00-0011- 017	74 3	Cinnabar Mercury	-0.112	0.898	Hg S Hg

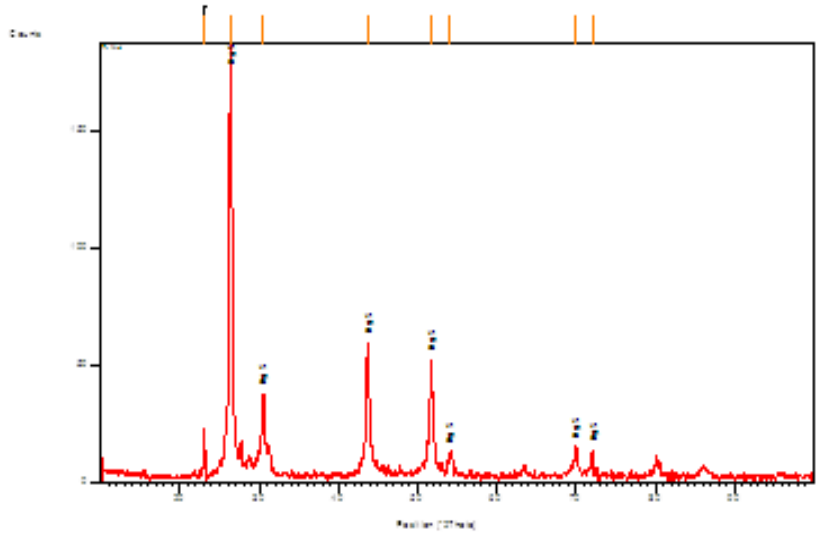

Figure No.1: X-ray diffraction graph of *Kajjali.*

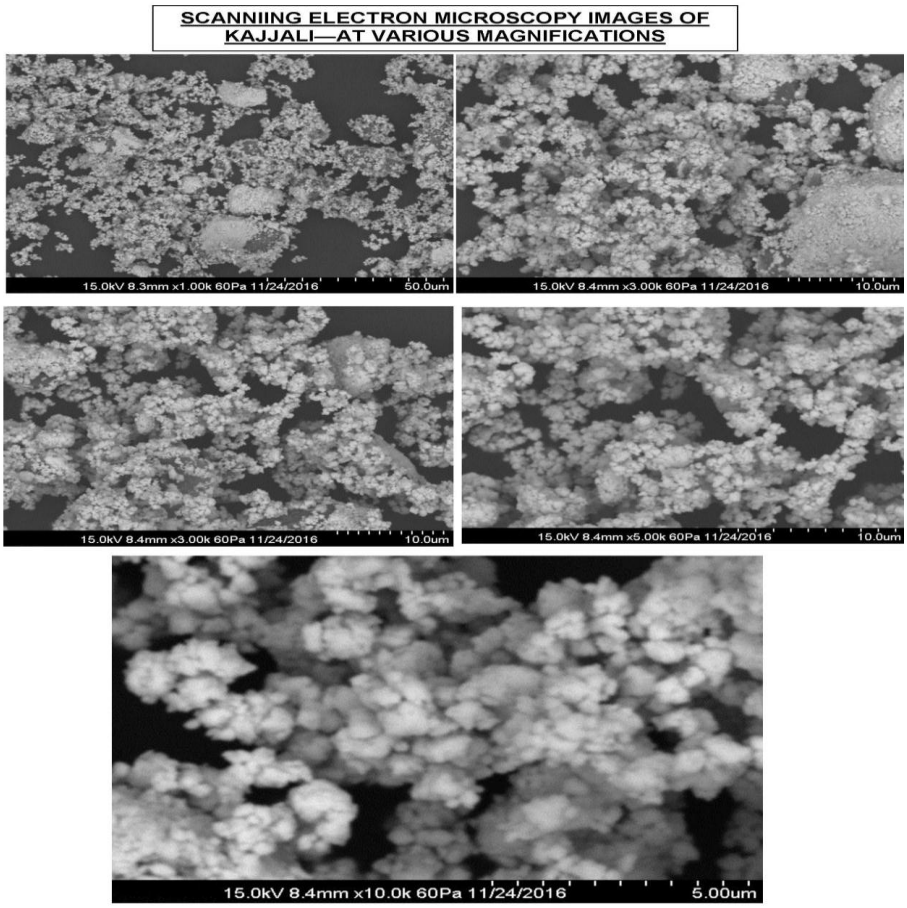

Figure No.2: SEM study of *Kajjali.*

Scanning electron microscope (SEM)

SEM was used to find out particle size of substance and also to aid EDAX for elemental analysis. Images were captured at different magnifications ranging from 300X to 10000X.

The image generated gives an idea about the sample surface topography. These images have shown the presence of micro fine particles in *Kajjali* up to 5 microns and agglomeration of particle is observed**.**

DISCUSSION

In Pharmaceutical preparation of *Samagunabalijarita Kajjali,* by traditional method, it was observed time required was much more than, *Shodhan and Kajjalikarana* process mentioned in classical text. *Samagunabalijarita Kajjali* was further analysed on various analytical parameters such as LOD (Loss on drying), pH, % of mercury and sulphur, XRD, SEM. Other analytical studies like L.O.I (Loss on ignition) and Ash value of *Kajjali* could not be done as it chemical formula is HgS. whereas, boiling point of Mercury (Hg) is 356.7^0C and that of Sulphur (S) is 444.6^0C and in the analysis of L.O.I we have to maintain temperature up to 450^0C. XRD was used for the characterization of compound through the crystalline phase identification. XRD pattern of *Kajjali* is shown in Fig. 1. Sample identification was done by matching; d spacing with the standard JCPDS database (Table 6). XRD pattern shows (Figure No. 1); HgS along with free Mercury are the crystalline phase present in *Samagandhak Kajjali.* HgS is present in cubic and hexagonal form. Free Mercury present in ortho-rhombic form. SEM photomicrograph of *Samagandhak Kajjali* particles shows the appearance of particles of 10 um and less than 5 um size particles. SEM image (Figure No. 2) of the drug sample shows cubic shape like structure with the particle size lying in the micro range. Particles with Rhombohedral features were observed. From the image it is clear that several crystallites are agglomerated in a particle giving rise to microcrystalline structure as shown in Fig No.2. *Shuddha Parada, Ashuddha Parada* and *Shuddha Gandhaka, Ashuddha Gandhaka* was analysed for % of Mercury and Sulphur to analysed the proper purification process of raw material used in preparation of *Samagunabalijarita Kajjali*.

CONCLUSION

Samagunabalijarita Kajjali can be prepared by textual method as described in *Rasatarangini* and it requires 72 hours by traditional method. The crystallographic study suggests that the compound is mixture of Sulphur (S), Mercury (Hg) and Mercuric Sulphide (HgS) also it has nano particles. Analytical study suggest that raw material before and after *Shoddhan* process and final product *kajjali* have different chemical constituent; which supports the chemical changes occurred during *Shoddhan* mentioned in classical texts of *Rasashastra.*

REFERENCES

1. Dr.Siddhinandan Mishra, Ayurvediya Rasashastra, edition 2013, Varanasi: Chaukhamba Orientalia, 2013; Chapter 3: 141.
2. Shastri K. Rasatarangini. 11th edition, Motilal Banarsida, 2009; Chapter. 2 Shlok 52: pp. 22.
3. Shastri K. Rasatarangini. 11th edition, Motilal Banarsidas, 2009 Chapter. 6, Shlok 107: Pg. 124.
4. Dr.Siddhinandan Mishra, Ayurvediya Rasashastra, edition 2013, Varanasi: Chaukhamba Orientalia, 2013; Chapter 3: 263.
5. Sadanand Sharma, *Rasatarangini*, edited by Pt. Kashinath shastri, Delhi: Motilal Banarasidas: Reprint, 2004; 511.
6. Achraya Vagbhatta, *Rasa Ratna Samuchaya*, Edited by Dattatreya Anantha Kulkarni Meharchand Lachmandas Publication, New Delhi, 1998; 30.
7. Sadananada Sharma, *Rasa Tarangini*, Motilal Banarasidas, Varanasi, 2004; 524.
8. Singh SK, Chaudhary A, Rai DK, Rai SB. Preparation and characterization of a mercury based Indian traditional drug- Ras-Sindoor. Indian Journal of Traditional Knowledge, 2009; 346-351.
9. Dr.Siddhinandan Mishra, Ayurvediya Rasashastra, edition 2013, Varanasi: Chaukhamba Orientalia, 2013; Chapter 2: 93.
10. Ayurvedic Pharmacopoeia of India Part 1 Vol 7, 1st edition, Delhi: The Controller of Publications, 2007; 73.
11. Ayurvedic Pharmacopoeia of India Part 2 Vol 1, 1st edition, Delhi: The Controller of Publications, 2007; Chapter 2.2.10: 141.
12. Ayurvedic Pharmacopoeia of India Part 1 Vol 7, 1st edition, Delhi: The Controller of Publications, 2007; Chapter 5.2.7: 345.
13. Ayurvedic Pharmacopoeia of India Part 1 Vol 7, 1st edition, Delhi: The Controller of Publications, 2007; Ch 5.2.11: 346.