



Research Article

PHARMACEUTICAL & ANALYTICAL STUDY OF SAMAGUNA BALIJARITA RASA SINDURA

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ABSTRACT

Rasasindura is a one of *Kupipakva Rasayana* a unique method of preparation and is one such imperative *Kupipakva Rasayana*, referred to be Elixir of life. It is formulated by two fundamental substances of *Rasashastra* i.e., *Shudha Parada* and *Shudha Gandhaka*. It is said to be prepared by same process but with different proportion of *Gandhaka*, and accordingly various forms of *Rasasindura* are named as *Ardhaguna*, *Samaguna*, *Dviguna*, *Triguna*, *Chaturguna*, *Panchaguna*, *Shadguna balijarita Rasasindura*, where in, the therapeutic merits of *Rasasindura* and pharmaceuticals of *Rasasindura* changes according to quantum of *Gandhaka*.

Rasasindura is a *Sagandha*, *Sagni* and *Bahirdhooma Kupipakva Rasayana*. *Samaguna balijarita Rasasindur* was prepared with equal quantities of *Parada* and *Gandhaka* by *Kupipaka* method in 20 hours and physicochemical analysis was carried out.

Ash values in *Samagunabalijarita Rasasindur* were found to be 0.02%. Free mercury was nil in *Samagunabalijarita Rasasindur* where as its traces were present in the *Kajjali*. Free sulfur traces were present in *Samagunabalijarita Rasasindur*. Total mercury percentage in *Samaguna Kajjali* was 36.02%. Total mercury percentage in *Samagunabalijarita Rasasindoor* was 83.15%. Total sulfur percentage in *Samagunabalijarita Rasasindoor* was 13.06%. By XRD analysis *Samagunabalijarita rasasindur* was identified as Cinnabar having Hexagonal crystal structure with primitive lattice.

KEYWORDS: *Samaguna Balijarita Rasa Sindura, Samaguna Kajjali.*

INTRODUCTION

*Rasasindur*¹ is a mineral preparation prepared in a glass bottle called *Kupi* in *Kupipakva* method. For this, *Kajjali* is prepared from purified *Parada* and *Gandhaka*. *Gandhaka Jarana* plays an important role in enhancing the potency of *Parada*. It has been claimed in the text that *Parada* treated with the process of *Gandhaka Jarana*, becomes highly potentiated i.e. it acquires several pharmacological and therapeutic properties. Different textual reference also supports the above statement.

Rasa Sindura (Samaguna & Shadguna) will be prepared according to the guidelines of *Rasa Tarangini* [1] and its physico-chemical analysis will be done.

To understand this, change in the structural and chemical behavior prepared formulation has to be studied. Hence in this study "Pharmaceutical and Analytical Study of *Samaguna Balijarita Rasasindura*" a sincere effort will be made to elicit the structural changes brought about during the preparation of

formulations and interpret on its pharmacological properties

AIMS AND OBJECTIVES

1. To prepare *Samaguna balijarita Rasasindura* as per classical reference.
2. Physico-chemical analysis of *Samaguna balijarita Rasasindura*,

Preparation of *Samaguna balijarita Rasasindura*

1. *Parada Samanya Shodhana*[2]
2. *Gandhaka Shodhana*[3]
3. *Samaguna Kajjali* Preparation[4]
4. *Samaguna Rasasindura* Preparation[5,6]

Parada Samanya Shodhana

Ashodhita Parada 500gm was taken in *Khalwa yanta*, *Sudha churna* was slowly added with continuous trituration. All the said quantity of *Sudha churna* exhausted and trituration process was continued for 5 days till mass turned to black. Then mixture of *Parad* and *Sudha churna* is immersed in *Ushnodhaka*. Then water is decanted and *Parada* was separated cautiously, washed with *Ushnodhaka* for 4

to 5 times. Water was separated by using blotting papers and kept under sunlight.

Parada which was treated with *Sudha churna* was taken and mixed with *Lashuna kalka*; triturated well and then *Saindhva lavana* was added, triturated

well till whole mass became fine paste form and became bright black in colour. Initially fine mercurial particle were observed at the end and it gets mixed with *Lashuna kalka*.

Table 1: Showing weight changes before and after Shodhan

Weight of <i>Parada</i> before <i>Shodhan</i>	Weight of <i>Parada</i> after <i>Shodhan</i>	Loss of <i>Parada</i>
450gm	360gm	90gm

Gandhaka Shodhana

4 liters of fresh cow's milk and 500gm of *Goghrita* was taken in earthen vessel, mouth of which was covered with a single layer of clean cotton cloth and tied properly with a thread.

Powdered 500gms of *Ashodita Gandhaka* was then spread over this cloth and placed *Shrava* over it and *Sandhibandhana* is done, pot was kept in a pit having the sufficient depth to fit the pot up to its

neck. 25 cow dung cakes were spread over this *Sharava* and *Agni* was set.

After *Swangasheetha*, the pot was removed from the pit, cloth tied over the mouth was removed, granules of *Shodhita Gandhaka* which were immersed in the milk and *Goghrita* were separated, washed with hot water thoroughly and dried under shade.

Table 2: Showing observations during Gandhaka Shodhana

Date	Quantity of <i>Godugda</i> taken	Quantity of <i>Goghrita</i> taken	No. of <i>Vanoplas</i> used	<i>Gandhaka</i> taken	<i>Gandhaka</i> obtained	Time for <i>Swangsheetsa</i>
17/05/13	4 ltrs	500gm	25	500gm	450gm	4 hrs

Samaguna Kajjali Preparation

Shodita Parada and *Shodita Gandhaka* were taken in equal quantity and triturated in iron *Khalva Yantra*. Gradually the white color of *Parada* and greenish yellow color of *Gandhaka* disappear and a black powder is formed. Trituration was continued till the powder became jet black in color and very fine like *Kajjali* and also fulfilled all the criteria of *Kajjali*.

Table 3: Results

Weight of <i>Shodhita Parada</i>	120gm
Weight of <i>Shodhita Gandhaka</i>	120gm
Weight of <i>Kajjali</i> obtained	205gm
Total weight loss	35gm

Samaguna Rasasindura Preparation⁸⁹

Procedure

A clean and dry *Kachakupi* with narrow mouth having capacity around 700ml was taken (green colour beer bottle).

A clean cloth was taken that was smeared with *Multhanimiti* and is wrapped around the *Kupi* from all the sides to cover it uniformly. After drying, the whole procedure was repeated for 7 times, each wrapping was done after complete drying of previous layer. It will take maximum 4 hours for drying one layer of wrapped *Multanimitti* cloth.

Kupipoorna¹⁷

A clean funnel was placed over the mouth of the *Kachakupi* and mixture was slowly added into it. Mouth of the *Kupi* was temporary covered by using cork.

Kupisthapana¹⁸

Procedure

A big, thick cast iron vessel with small hole was placed over *Bhatti*. Over the hole *Abhraka patra* was placed thoroughly. Four *Angulas* of *Valuka* was filled initially at the bottom of iron vessel.

The *Kajjali yukta kupi* was then placed on it at the center of iron vessel.

Later *Valuka* was filled in the vessel which covered around the neck of *Kuppi* and then cork was removed.

Pradhana Karma

The temperature and was gradually increased for 1 hr interval and recorded till it reaches 250°C. When the temperature reached around 350°C to 400°C, fumes of *Gandhaka* started evolving. During the course of heating the red hot *Shalaka* (iron rod) was

repeatedly inserted into the mouth of *Kachakupi* to clear accumulated *Gandhaka* at the neck of the bottle to prevent blocking.

The temperature was gradually decreased. After the disappearance of blue flame, the bottom of

Kachakupi becomes red hot. *Tivra agni* was started at this stage and was maintained up to 600°C to 650°C. The mouth of *Kachakupi* was sealed and sand around was removed. Then it is allowed for *Swangsheeta*.

Table 4: Showing Temperature recorded along with observation

Time in hour	Temperature	Specific Observation
9 am	32°C	<i>Kupisthapana</i>
10am	106°C	<i>Kajjali</i> was dried
11am	150°C	Sand start heating
12.45pm	177°C	<i>Kajjali</i> was dried
1pm	204°C	Few fumes
2pm	258°C	Dense white fumes appeared
3pm	260°C	<i>Kajjali</i> starts melting
4pm	270°C	Dense white fumes appeared
5pm	309°C	Melting of <i>Kajjali</i> along with yellowish white fumes started
5.30pm	354°C	Dark yellow coloured fumes Increased
6pm	401°C	<i>Kajjali</i> liquefied and Fumes Increased
7pm	427°C	Fumes gradually decreased
8pm	450°C	Fumes disappeared and flame Started
9pm	504°C	Flame increased
10pm	540°C	Flame increased about 5-6 inches
12am	580°C	Flame disappeared and boiling stage of <i>Kajjali</i> (Honey comb like appearance) visible in <i>Kupi</i> with the help of torch.
3am	650°C	Bottom of <i>Kupi</i> was found red hot. <i>Shita Shalaka</i> test and copper coin tests showed presence of <i>Parada</i> particles. Then cork was applied <i>Kupi</i> immediately.
5am	700°C	Temperature was increased after sealing the <i>Kupi</i> for 1 hour.

RESULTS

Total time taken for preparation: 20 hrs.

Total Wt. of *Kajjali* taken: 120gm

Total wt. of *Samaguna Rasasindura* obtained:70gm

Total wt. of residue obtained: 6gms

Classical Parameters

Table 5: Showing Classical Parameters for analysis of *Samaguna*

Test	Observation
<i>Varna</i>	<i>Sindur</i>
<i>Sparsh</i>	<i>Slakshnamrdu</i>
<i>Gandha</i>	Slight sulphur smell
<i>Rekhapurnatva</i>	When fine powder of <i>Rasa Sindur</i> was rubbed between the thumb and index finger it entered the furrows of the fingers.
<i>Varitaratva</i>	When finely powdered <i>Rasa sindur</i> was carefully sprinkled, <i>Kajjali</i> was floating over the water.
<i>Nischandratva Luster less</i>	No shining particles were observed.

Physical Tests**Organoleptic Characters****Samaguna Kajjali**

Colour: Black
 Odour: Odour less
 Touch: Fine powder
 Taste: Tasteless

Samagunabalijarita Rasasindura

Colour: Reddish brown
 Odour: Odourless
 Touch: Fine powder
 Taste: Tasteless

Table 6: Showing Result of pH

Sample	pH
<i>Samaguna Kajjali</i>	6
<i>Samagunabalijarita Rasasindura</i>	5

Table 7: Showing Result of Ash Value

Sample	Ash Value
<i>Samaguna Kajjali</i>	0.11%
<i>Samagunabalijarita Rasasindura</i>	0.02%

Table 8: Showing Result of Acid Insoluble Ash

Sample	Acid In Soluble Ash
<i>Samaguna Kajjali</i>	0.06%
<i>Samagunabalijarita Rasasindura</i>	0 nil

Table 9: Showing Result of Water Soluble Ash

Sample	Water Soluble Ash
<i>Samaguna Kajjali</i>	0.01%
<i>Samagunabalijarita Rasasindura</i>	Nil

Table 10: Showing Result of Loss on Drying

Sample	Loss on Drying
<i>Samaguna Kajjali</i>	0.012%
<i>Samagunabalijarita Rasasindura</i>	0.02%

Table 15: Showing XRD of Samagunabalijarita Rasasindur

Identified			Standard	
Peak no.	Angle 2θ	Intensity	Relative Intensity %	Relative Intensity %
2	26.540	4692.00	100	100
3	28.20	2080.00	30	30
4	31.22	5170.00	98	98
6	43.68	1312.50	25	25
8	45.78	1135.00	21	20
10	51.76	947.50	18	25

Chemical Tests**Table 11: Showing Result of Total Mercury**

Sample	Mercury
<i>Samaguna Kajjali</i>	36.02%
<i>Samagunabalijarita Rasasindura</i>	83.15%

Table 12: Showing Result of Free Mercury

Sample	Free Mercury
<i>Samaguna Kajjali</i>	Traces
<i>Samagunabalijarita Rasasindura</i>	Nil

Table 13: Showing Result of Total Sulphur

Sample	Sulphur
<i>Samaguna Kajjali</i>	39.76%
<i>Samagunabalijarita Rasasindura</i>	13.06%

Table 14: Showing Result of Free Sulphur

Sample	Free Sulphur
<i>Samaguna Kajjali</i>	15.12%

X-Ray Diffraction Study Materials

Bruker's D-8 Advance X-ray diffract meter and is equipped with Cu K-alpha (Lambda-1.5 406) radiation and graphite monochromator operated at 40KV/30mA.

Samaguna Rasa Sindur each 1 gm.

Method: Sample was well grounded to 200mesh and air dried. The X-ray diffractometer scans were made on randomly oriented samples from 3-650 2-theta (d=29.42 to 1.43angstrom) with a step size of 0.020 and one second time per step.

The 2-theta value and intensity of the peak (counts) are represented on X and Y-axis respectively. Higher the value of counts represents higher the crystallinity of the phase.

For identification of each phase, minimum 6 strong peaks were chosen and compared with standard X-ray Powder Diffraction file (XPDF).

Name of Standard: Cinnabar (Hgs)

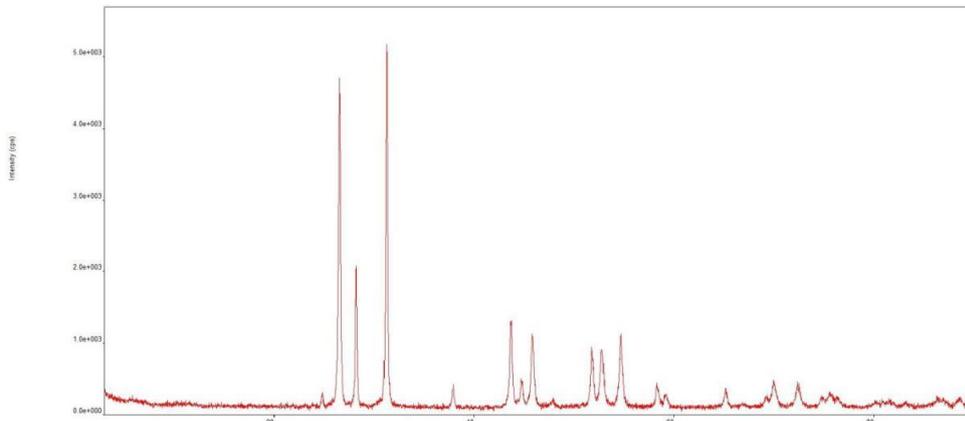
Crystal Structure: Hexagonal

Lattice: Primitive

Note:

- Around 20 peaks were identified in *Samagunabali jarita Rasasindura* sample at different angles (2θ) from 24.64 to 88.5.
- 6 strong peaks were chosen with their relative Intensity and compared to standard X- ray powder diffraction file (XPDF).
- 4th peak with relative intensity of 98% was considered as significant at 31.22.
- The intensity % of Cinnabar (100, 30, 95) was approximately matching with the intensity % of sample (100, 30, 98) respectively.

Graph of XRD



Graph Showing XRD of Samagunabali jarita Rasasindur

EDAX/EDS STUDY

Samaguna Rasasindur

Spectrum processing: No peaks omitted

Processing option: All elements analyzed (Normalised)

Number of iterations = 2

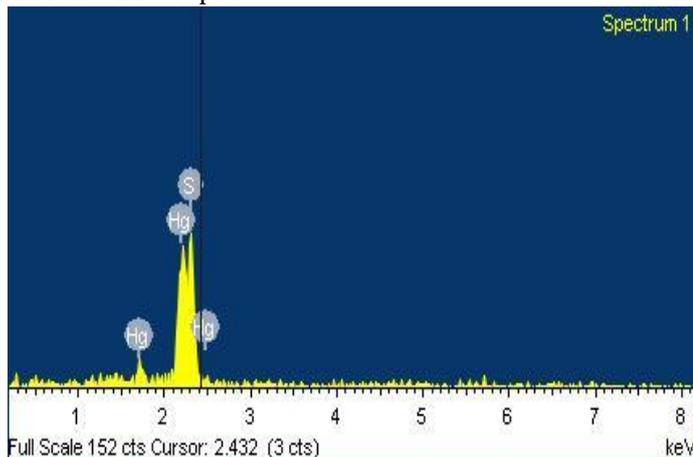
Standard:

S FeS2 1-Jun-1999 12:00 AM
 Hg HgTe 1-Jun-1999 12:00 AM

Element	Weight%	Atomic%
S K	15.78	53.97
Hg M	84.22	46.03
Totals	100.00	100.00

SEM Study

SEM and EDS reports



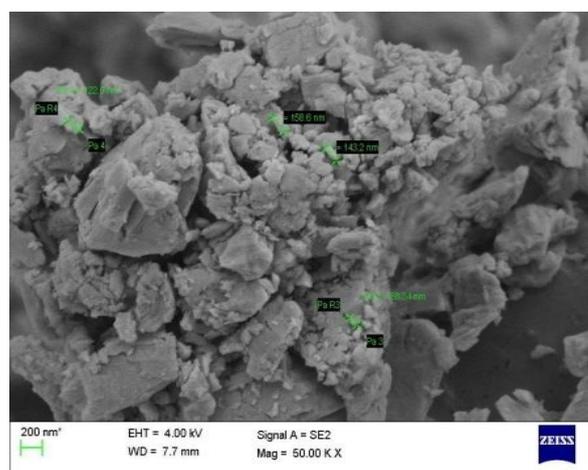
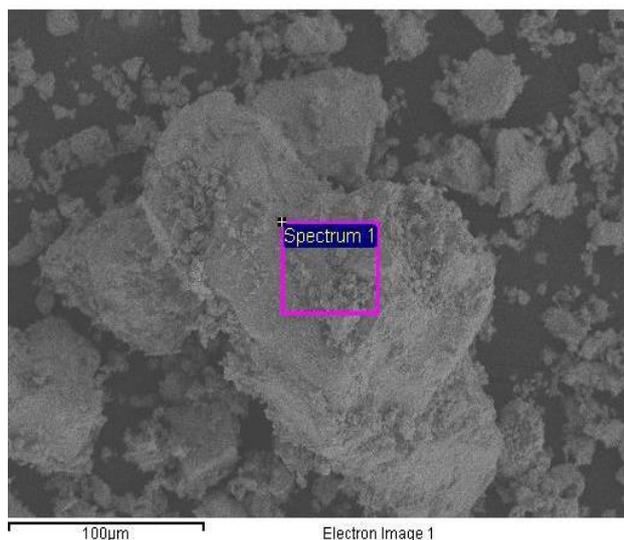
The SEM (Scanning Electron Microscopy) image formed is the result of the intensity of the secondary electron emission from the sample at each x, y data point during the rastering of the electron beam across the surface. From the images morphology and particle size can be calculated.

Along with the secondary electron emission, which is used to form a morphological image of the surface this electron scanning provide elemental analysis by the attachment of an Energy Dispersive Spectrometer (EDS). X-ray emission results from inelastic scattering between the beam electrons and the electrons of the sample atoms. The x-rays are then detected by either a lithium-drifted silicon detector for an EDS system and can be used to identify the chemical composition.

Here the SEM pictures with EDS were recorded using Ultra 55 Field emission scanning electron microscope with EDS (Karl Zeiss).

Samaguna Bali jarita Rasasindura

The morphology is uniform. The particles ranged from 120nm to several μm. The EDS shows the chemical composition consist of mercury and sulphur.



SEM of Samagunabali jarita Rasasindur

Physico analysis Study

Table 16: Showing comparative Results of physical tests

Contents	Samaguna Kajjali	Samagunabali jarita Rasasindur (SMBRS)
Color	Black	Reddish brown
Odour	Odourless	Odourless
Touch	Smooth	Fine powder
Taste	Tasteless	Tasteless
Ph value	6	5
Ash value	0.11%	0.02%
Water soluble ash	0.01%	Nil
Loss on drying	0.012%	0.02%

Table 17: Showing comparative Results of Chemical test

Contents	Samaguna Kajjali	Samagunabali jarita Rasasindur (SMBRS)
Free Mercury	Traces	Nil
Total Mercury	36.02%	83.15%
Free Sulphur	15.12%	Traces
Total Mercury	39.76%	13.06%

Table 18: Showing comparative XRD results of Samagunabali jarita Rasasindur

Angle 2 θ	Intensity count/sec	Intensity
26.540	4692.00	100
28.20	2080.00	30
31.22	5170.00	98
43.68	1312.50	25
45.78	1135.00	21
51.76	947.500	18

Table 19: Showing comparative results of Zeta Potential

Sample	Zeta Potential (mV)	Stability behavior of sample
<i>Samaguna Rasasindur</i>	-31.14	Moderate stability

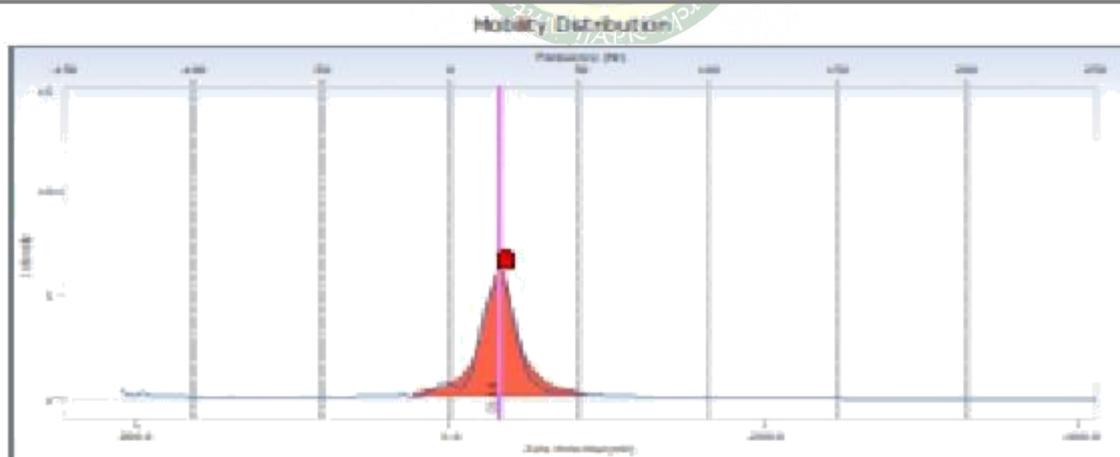
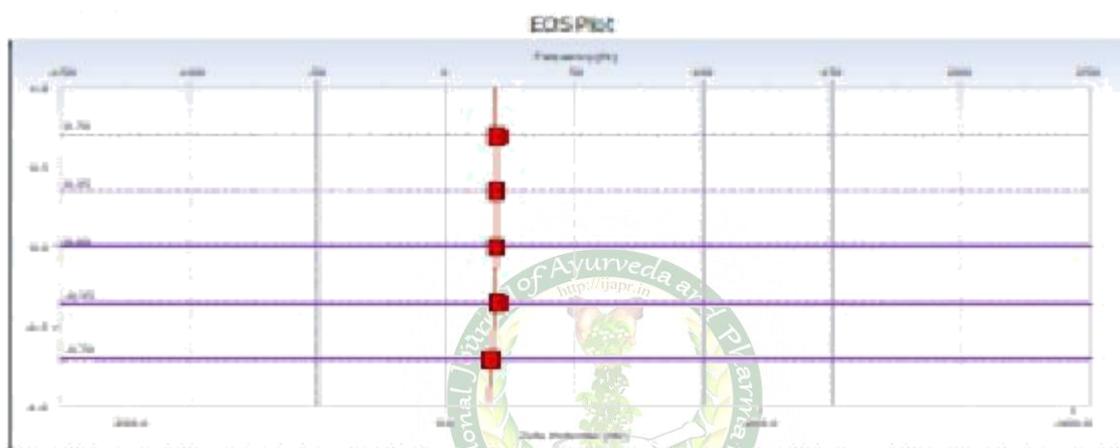
Interpretation of Zeta Potential

Zeta potential is the potential difference between the dispersion medium and the stationary layer of fluid attached to the dispersed particle. Stability of colloidal dispersions (dispersed systems, multi particulate, multi charge systems) can be predicted by Zeta potential value.

Zeta potential indicates the degree of repulsion between adjacent, similarly charged particles (likely charged particles) in dispersion. A high Zeta potential value will indicate stability for

molecules and particles that are small enough (i.e. the solution or dispersion will resist aggregation/ do not flocculate).

When Zeta potential is low attraction exceeds, repulsion and the dispersion will break and flocculate. Colloids with high Zeta potential (negative or positive) are electrically stabilized while colloids with Low Zeta potential tends to coagulate or flocculate.



Zeta Potential (mV)	Stability behavior of colloid
From 0 to ± 5	Rapid coagulation or Flocculation
From ± 10 to ± 30	Incipient instability
From ± 30 to ± 40	Moderate stability
From ± 40 to ± 60	Good stability
More than ± 61	Excellent stability

Table 20: Sample has the following zeta potential value

Sample	Zeta Potential (mV)	Stability behavior of sample
<i>Samaguna Rasasindur</i>	-31.14	Moderate stability

Samaguna Rasasindur has a -31.14 (Negative Zeta Potential) moderate stability.

DISCUSSION

Time duration mentioned as per texts for the preparation of *Samaguna balijarita Rasasindhura* is 20 hours,

Discussion on Analytical study

Physical appearance of both the *Kajjali* and the *Rasasindhura* was same as ingredients and method of preparation was same.

Kajjali: The obtained *Kajjali* was black fine powder and possessed *Slakshnatva* and *Sukshmatva* which indicates the fineness of *Kajjali* attained by doing pressurized, uniform and continuous *Mardana*. *Rekhapurnatva* denote the fineness in particle size i.e., size has been reduce so as to enhance bio-availability. *Nishchandravta* denote the absence of free mercury state in *Kajjali*.

Rasa Sindura: *Samaguna balijarita Rasasindhura* were obtained as brownish red shiny conical blocks. The color of finely powdered *Sindura* was reddish brown. *Nishchandravta* indicate absence of mercury in elemental form. *Varitaravta* confirmed the fineness of the product.

Physical Parameters

Discussion on PH

pH of *Samaguna Kajjali* and *Samaguna balijarita Rasasindhura* was 6 and 5 respectively, indicating mild acidic nature of the sample and absorption of *Samaguna balijarita Rasasindhura* may be easy.

Discussion on Ash value

Ash value of *Samaguna Kajjali* were 0.11%

Ash value of *Samaguna balijarita Rasasindhura* were 0.02%

Discussion on Acid insoluble ash

Acid insoluble ash value of *Samaguna Kajjali* is 0.01%. Acid insoluble ash value of *Samaguna balijarita Rasasindhura* is nil.

Discussion on Loss on drying at 110°C

The test is used to detect the moisture and volatile content in the sample. Loss on drying value of *Samaguna Kajjali*, *Samaguna balijarita rasasindur* were 0.012%, 0.02% respectively. This value was comparatively more in both the *Kajjali*, might be due to free sulfur.

Chemical Tests

Discussion on Free mercury

In *Samaguna Kajjali*, free mercury was in trace levels, where as in *Samaguna balijarita rasasindur* free mercury was nil, which proves the *Nishchandravta* of *Kajjali* and *Rasasindhura* and indicates that all procedures were properly carried out.

Discussion on Total mercury

Percentage of total mercury in *Samaguna Kajjali*, *Samaguna balijarita rasasindur* was 36.02%, 83.15% respectively. During the preparation of *Rasasindhura* extra sulfur will be burned off, hence Hg% is more in the *Rasasindhura*; more mercury concentration in *Rasasindhura* indicates that corking was done at proper time. Less quantity of sulfur in *Samaguna Kajjali* was found, hence Hg% was also less in *Samaguna balijarita rasasindur*.

Discussion on Free sulfur

Percentage of free sulfur in *Samaguna Kajjali* was 39.76%. As mercury forms a stichiometric compound with the sulfur, free sulfur traces were found in *Samaguna balijarita rasasindur*, which implies proper *Paka* has lead to proper compound formation and also indicates that corking was done after complete *Jarana* of *Gandhaka*.

Discussion on Zeta potential Studies

In present studies *Samagunabalijarita Rasasindhura* (SMBRS) Zeta potential values recorded were 31.14mv. *Samagunabalijarita Rasasindur* seems to be remains in colloidal state for longer duration.

Discussion on XRD

- The *Rasasindhura* was identified as Cinnabar with Hexagonal crystal system having primitive lattice.
- Highest peak count in *Samaguna balijarita Rasasindhura* was 5170.0
- Even though *Samaguna balijarita Rasasindhura* was identified as Cinnabar. Thus it can be inferred that there is in crystallinity and cell volume of *Samagunabalijarita Rasasindhura* crystals.
- Thus it can be considered that there was a difference in all the three i.e., Standard Cinnabar, *Samagunabalijarita rasasindur*, XRD pattern.
- When the particle size is more and the molecular aggression is rich, the crystallinity of a material is bound to increase. The crystallinity is more *Samagunabalijarita Rasasindur*.

CONCLUSION

Rasasindura is a *Sagandha*, *Sagni* and *Bahirdhooma* *Kupipakwa Rasayana*.

Samaguna balijarita Rasasindur was prepared with equal quantities of *Parada* and *Gandhaka* by *Kupipaka* method in 20 hours.

Difference was there in the ratio of ingredients, total duration of heat and quantity of yield in case of *Samagunabalijarita Rasasindur*, duration of *Paka* was less but the yield was more.

References

1. Sri Sadananda Sharma, *Rasa Tarangini*, edited by Kashinatha Shastri, 11th edition, New Delhi, Motilala Banarasidas publication, 1979, 6/168-176, 6/189.
2. Sri Sadananda Sharma, *Rasa Tarangini*, edited by Kashinatha Shastri, 11th edition, New Delhi, Motilala Banarasidas publication, 1979. 5 / 13-17
3. Sadananda Sharma, *Rasa tarangini*, PtKaashinaath shaastri. Motilal banarasidas publication Delhi.11th edition, 1979.P-177, Sloka-13,14,15,16,17.
4. Sri Sadananda Sharma, *Rasa Tarangini*, edited by Kashinatha Shastri, 11th Edition, New Delhi, Motilala Banarasidas publication, 1979, 6th Chapter, verse 162-167.
5. Pranacharya Sri Sadhananda Sharma. *Kasinath Shastri. Rasa Tarangini. Srihari datta shastri's prasadani commentary*, New-Delhi. Motilal Banarasidas Publishers.2009.p. 136, shloka 168-176.
6. Sri Vagbhatacharya, *Rasa Ratna Samuchchya*, Edited by Indradev Tripathi, 3rd edition, Varanasi, Caukamba Sanskrit bhavan, 2006, *Kupi Nirmana*, R.R.S.- 9/33 – 34
7. Sri Vagbhatacharya, *Rasa Ratna Samuchchya*, Edited by Indradev Tripathi, 3rd edition, Varanasi, Caukamba Sanskrit bhavan, 2006, 9/33 – 34.
8. Pranacharya Sri Sadhananda Sharma. *Kasinath Shastri. Rasa Tarangini. Srihari datta shastri's prasadani commentary*, New-Delhi. Motilal Banarasidas Publishers.2009 R.T. 4/ 29 – 30.

Cite this article as:

Sorab Gaiind, Pradeep Agnihotri. Pharmaceutical & Analytical Study of Samaguna Bali jarita Rasa Sindura. International Journal of Ayurveda and Pharma Research. 2020;8(10):108-116.

Source of support: Nil, Conflict of interest: None Declared

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