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Pharmaceutico- Analytical Study of *Abhra Sindoora*

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ABSTRACT

Background: *Abhra Sindoora*[1] (ABS) is a unique *Rasa Yoga* with having more potent and indication in *Tridoshahara, Swasa, Kasa* etc. It is one of the important classical *Kupipakva Rasayana* containing *Hingulotha Parada* (purified mercury), *Shuddha Gandhaka* (purified sulfur) and *Dhanyabhraka* in 1:1:1 proportion. **Aim:** Pharmaceutico-Analytical study of *Abhra Sindoora*. **Materials and Methods:** *Hingulotha Parada* (purified mercury), *Shuddha Gandhaka* (purified sulfur) and *Dhanyabhraka* are used to prepare *Kajjali* and lavigated with *Vatankura* (leaf buds of *Ficus bengalensis*), *Swarasa* (juice) and *Arka* (*Calotrapis procera*) ksheera (milk). This *Kajjali* is processed by *Kupipakva* method. **Results & Conclusion:** The current trend in applied instrumental medical research encourages good medical practice, clinical and research based drug analysis. The main aim of analytical study is to find out working standards for the formulations and safe use of therapeutics. *Abhra Sindoora* was prepared in 48 hours with 28% yield. It was also characterized by using modern instrumental analysis like XRD, SEMEDX, EDXRF, FTIR and PARTICLE ANALYSIS. The SEM analysis evaluated that prepared *Abhra Sindoora* has particles in nanometers, least being 14.87nm. SEMEDX study confirmed the presence of C, O, Si, S, K, and HgM. XRD study confirmed the presence of $Hg_{3.00}S_{3.00}$ in hexagonal crystal system. The EDXRF analysis evaluated the presence of K, Ca, Ti, Mn, Fe, S, Br and Hg. FTIR analysis shows organic compounds with functional groups like secondary amines, Nitro, Carboxylic acids, Bromine, Esters, Alkines, and Iodides etc.

Key words: *Abhra Sindoora, Kupipakva Rasayana, XRD.*

INTRODUCTION

Today man has achieved high peaks in the field of medicine with the development of various techniques. However Ayurveda, the ancient Indian system as medicine which has its roots in Vedas is still enjoying high profile in serving mankind. Indian alchemy developed a wide variety of chemical processes for the transmutation of metals and preparation of elixir of life, in which mercury occupied a prime position. The literature of *Rasashastra* is perceptibly voluminous and methodical in the presentation of a variety of processes whose number is exhaustless. Of these processes, *Kupipakva Rasayana* deserves special mention because of its minimal dosage, augmenting effect and long lasting potency. *Parada Kalpas* are said to be of 4 types viz. *Khalvi*, *Parpati, Kupipakva* and *Pottali Rasayanas.* Among these, *Kupipakva Kalpas* play a major role and is said to be more potent and quick acting when compared to *Khalvi* and *Parpati Kalpanas*.[2] *Kupipakva Rasayana* is a unique pharmaceutical preparation where, the medicine is prepared in a *Kupi* (glass bottle) and the processing is done in the *Valuka Yantra* with the gradual increase of temperature.[3] *Abhra Sindoora* contains *Hingulotha Parada* (purified mercury), *Shuddha Gandhaka* (purified sulfur), *Dhanyabhraka, Vatankura* (leaf buds of *Ficus bengalensis*), *Swarasa* (juice), *Arka* (*Calotrapis procera*), *Ksheera* (milk) having therapeutic potential

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ranging in diseases such as *Tridoshahara, Swasa, Kasa* etc. and also possesses *Rasayana* (rejuvenation) property.[4] Until date,no reported studies are available pertaining to standardization of *Abhra Sindoora*. The main aim of analytical study is to find out working standards for the formulations and safe use of therapeutics.[5] It was also characterized by using modern instrumental analysis like X-ray Diffraction (XRD), Scanning Electron Microscope coupled with Energy Dispersive Spectroscopy (SEMEDX), X-ray Fluroscence (XRF), Forier Transform Infrared Spectroscopy (FTIR) and Particle size Analyzer.

Materials and Methods

Raw Materials

Krishnavajra Abhraka, Hingula and *Gandhaka* were selected according to *Grahya Lakshanas* (acceptable quality) as well as modern specifications. *Vatankura* (leaf buds of *Ficus bengalensis*) *Swarasa* (juice) and *Arka* (*Calotrapis procera*), *Ksheera* (milk) were collected from botanical garden of the institute. Also, Cow's milk, *Kanji* (sour gruel), Paddy were collected.

Equipments like *Khalwa Yantra, Urdhwa Patana Yantra, Sharava, Valuka Yantra,* Gas stove, Vessels, *Kupi* (glass bottle) coated with 7 layers of mud smeared cloth with capacity of 650 ml, etc.

Methods

Abhraka Shodhana[6]

2000 gms of *Abhraka* in stratified form was weighed. In a steel vessel, 3 liters of milk was taken with the help of a measuring cylinder. Large chips of *Raw Abhraka* were kept directly on stove using metal tongs till they became red hot (Figure 1). The chips of *Abhraka* were turned up and down with the help of metal tongs to give equal exposure of heat to both the surfaces. When the *Abhraka* chips became completely red hot in colour, they were plunged quickly into the milk with the help of metal tongs. After few minutes, the milk was separated by filtering it through iron sieve and soft pieces of *Abhraka* were collected in an iron pan to subject it for next *Nirvapa*. This same method was followed for seven times. Then it was completely dried (Figure 2).

Dhanyabhraka[7]

1800 gms purified *Abhraka* in powder form and 450 gms of *Shali* (unhusked) are tied in *Kambala Vastra*, and *Pottali* is prepared and soaked in *Kanji* for 3 days i.e. 72 hours. After 72 hrs the *Pottali* was removed from bucket and kept in an enamel tray. Later a larger steel vessel containing water was taken. *Pottali* was dipped in it and rubbed between palms protected by gloves. Every time the colour of water changes to deep black, another vessel with water was taken to give fresh media for the faster withdrawal of *Dhanyabhraka*. This process was continued till complete extraction of *Dhanyabhraka* occurred. This was confirmed by chafing the bag between hands and getting some hard particles inside, which were nothing but stones and tough particles of *Abhraka*. In total, 8-9 vessels were required to extract *Dhanyabhraka* completely in water. All the vessels were kept stable for overnight. The next day morning, the upper clear water in all the vessels was decanted till a streak of sedimented *Dhanyabhraka* appeared in it. Residue in all the vessels was collected in a steel vessel (50 lit capacity) and kept for evaporation. The mixture was stirred constantly to achieve drying rapidly. At last we got a lustrous black colored coarse powder of *Dhanyabhraka* (Figure 6).

Hingulotha Parada Nirmana[8]

600gms of *Ashodita Hingula* was taken in a *Khalwa Yantra*, and finely powdered. 330 ml of *Nimbu Swarasa* was added to powdered *Hingula* and triturated uniformly at a rate of 30 strokes / min for 3 *Yama* / 7 *Bhavanas* and then allowed to dry in shade. Weight of dried *Hingula* powder after *Bhavana* was 650gms. Out of it, 600gms powder was placed in a earthen pot and another large sized earthen pot was placed over it inversely. Upper pot is made with an adjustment of *Toyadhara*. *Sandibandhana* was done with a cloth smeared with Multani Mitti and dried. Seven similar layers were applied after drying of the earlier cloth. *Urdhwa Patana Yantra* was kept over the *Agni Chullika*, *Madhyamagni* was given for 4 hrs

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and then *Tivragni* was given for 2 hrs. On self cooling, the next day *Sandibandhana* was carefully removed and the two pots were separated. Mercury globules were collected from the upper pot by scraping with a plastic spoon and brush. *Parada* was filtered through double fold cloth to get clear mercury (Figure 4).

Hingulotha Parada Shodhana[9]

360gms of *Hingulotha Parada* was taken into a porcelain mortar and 22gms of *Haridra Choorna* is added and rubbed well. On second Day, trituration was done by adding required quantity of *Nimbu Swarasa* after which *Parada* turns into fine molecules and becomes homogenous with the paste. Filteration was carried out after drying of the mixture. Finally the collected mercury was silvery white (Figure 5).

Table 1: Showing observations during *Samanya Shodhana* of *Parada*.

Hingulotha Parada	*Haridra Choorna*	*Nimbu Swarasa*	*Saindhava Lavana*	*Shuddha Parada*	Loss during *Shodhana*
360gms	22.5gms	100ml	22.5gms	358gms	2gms

Gandhaka Shodhana[10]

Earthen pot was smeared with *Ghrita* and 3 liters of fresh cow's milk was poured, mouth of which was covered with a single layer of white cotton cloth and tied properly with a thread. 1kg *Gandhaka* was spread over the cloth uniformly and covered with *Loha Sharava*. Border of *Loha Sharava* was covered with sand and 1kg cow dung cakes were spread over the *Sharava* and fire was set with camphor. After *Swanga Sheeta* the pot was removed out from the pit and cloth tied over the mouth was removed. Granules of *Shodhita Gandhaka* (Figure 3) which were immersed in milk were separated, washed with hot water thoroughly and dried under shade. This procedure was repeated for 2 more times by using fresh cow's milk.

Abhra Sindoora Kajjali[11]

It is a *Sagandha, Saagni, Bahirdhooma* and *Kantastha Kupipakva Rasayana*. Preparation containing 100gms *Hingulotha Parada* and 100gms *Shuddha Gandhaka* (Figure 7) is made. Trituration is done upto *Kajjali Siddhi Laxana* is seen. After *Kajjali Siddha Laxana*, 100gms of finely Powdered *Dhanyabhraka* is added (Figure 8) and triturated for about 16 hours to get homogeneous mixture of *Abhra Sindoora Kajjali*. This is lavigated with 350ml of *Vatasringa* (leaf buds of *Ficus bengalensis*) *Swarasa* (juice) (Figure 12), 280ml of *Arka* (*Calotrapis procera*), *Ksheera* (milk) (Figure 10). The trituration was done for 6 hours each and then allowed to dry.

Figure 1: *Pratapta Abhraka*

Figure 2: *Shodhita Abhraka*

Figure 3: *Gandhaka* after *Shodhana*

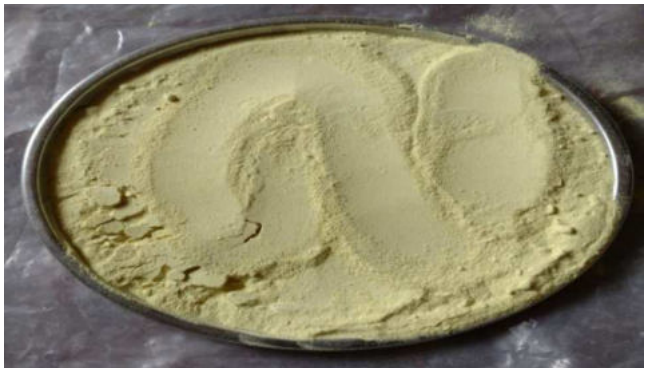

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Figure 4: *Hingula Mardana*

Figure 5: *Hingulotha Parada*

Figure 6: Rubbing of *Dhanyabhraka*

Figure 7: Adding of *Parada* to *Gandhaka*

Figure 8: Adding of *Dhanyabhraka* powder to *Kajjali*

Figure 9: *Arka Ksheera*

Figure 10: *Arka Ksheera Bhavana* of ABS

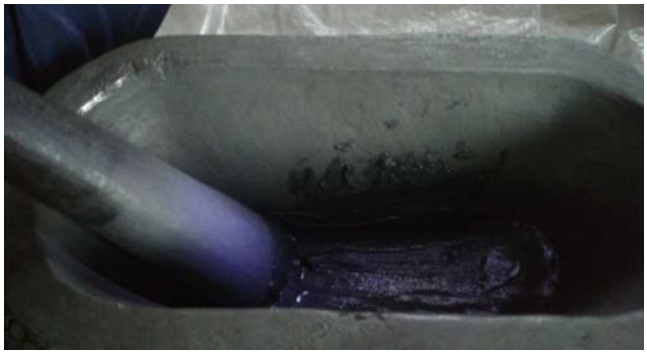

Figure 11: *Vata Sringa Kashaya*

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Figure 12: Adding of *Vata Sringa Rasa* to ABS

Abhra Sindoora by classical *Kupipakva*[12]

The whole procedure of *Abhra Sindoora* is divided under 3 headings as follows:

A. **Purvakarma**

B. **Pradhanakarma**

C. **Paschatkarma**

PURVA KARMA

Preparation of *Kacha Kupi* [13]

Amber coloured glass bottles of 650ml were taken. The bottles were cleaned and completely dried. At the base of the bottles, paste of *Gopichandana* was applied. A cloth smeared with *Gopichandana* measuring 6cms width and breadth was used to cover the base and then dried completely. A cloth smeared with *Gopichandana* measuring 116cms x 4cms length and breadth was covered in circles, starting from bottom of the bottle upto mouth of the bottle and was allowed to dry completely. Next day after complete drying, another cloth smeared with *Gopichandana*, having same measurement was applied over the previous layer. After completion of seven such layers, one layer of red clay is smeared. Later one more layer of *Gopichandana* smeared cora cloth is applied and kept for drying. In this way nine layers were covered over the surface of the bottle.

Filling of *Abhra Sindoora Kajjali* into *Kacha Kupi*[14]

The lower 1/3rd of the *Kupi* was marked with the help of a scale and 225gms of *Abhra Sindoora Kajjali* was slowly filled in to *Kacha Kupi* (Figure 13) with the help of a funnel and a glass rod.

Placement of *Kupi* in *Valuka Yantra*[15]

A mud pot of conical shape with a measurement of 24cm height and circumference of 93cm at the top and 80cm at the bottom, and having a hole of 2cm at the centre of the bottom of the vessel was taken. Over the hole at the bottom of the mud pot, two *Abhraka Patras* with a width of 8cm and thickness of 0.5cm were placed. Over this, a thin layer of sand (2 *Angula*) was spread evenly and upon this, *Kajjali* filled *Kupi* was kept firmly and centrally. Remaining portion of the *Yantra* was filled with sand (18 kg) up to the neck of the *Kupi*.

Preparation of cork: A conical shaped cork made of very fine *Valuka*, Multani mitti, triturated with water for 5 hrs, with a length of 2 inches and width of 1.5 cm which could fit the mouth of the *Kupi* was made and hardened by placing over red hot coal.

PRADHANA KARMA

Preparation of *Abhra Sindoora*[16]

The *Kajjali* filled *Kacha Kupi* kept in the *Valuka Yantra* was placed in the *Agni Bhatti*. Pyrometer (Figure 14) was properly placed i.e. 5-6cm away from the Kupi in *Valuka Yantra* and 4cm above the bottom of *Valuka Yantra.* Fuel was put into the *Bhatti* and *Pooja* was done with the chanting of 'Aghora Mantra'. Fire was set with the help of camphor and temperature reading was carried out with the help of pyrometer with a thermocouple for every thirty minutes. *Kramagni Tapa* was maintained according to classical reference. For the first 16 hours *Mrudvagni* was given i.e. temperature is maintained between 100°C-250°C. Next 16 hours *Agni* was gradually raised to *Madhyamagni* stage i.e., 250°C - 450°C. *Tivragni* was given for 16 hours i.e. temperature is maintained between 450°C-650°C and above. By this time *Sindoora Siddha Laxana* is observed and corking was done again. Heat was given for 8 hours for complete sublimation of product. Later the apparatus was allowed for self-cooling.

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Table 2: Showing observations during the preparation of Abhra Sindoora (Figure 15-19)

Time Hrs	Temperature °C	Observations
2 *Mrudvagni* started	157	No fumes inside *Kupi*, bottom of *Kupi* can be seen clearly with torch
4	208	No fumes are seen inside *Kupi*
6	225	Slight white fumes are seen inside *Kupi*
8	230	The fumes became dense, can't see the bottom of *Kupi* with torch.
10	252	Mild sulphur smell appreciated. Slight yellowish fumes +
12	258	Yellow fumes +
14	253	Sulphur smell +
16	260	Sulphur smell appreciated. Yellowish dense fumes +
18 *Madhyamagni* started	288	Strong sulphur odour appreciated.
20	326	*Sheeta Shalaka* is inserted inside *Kupi*. The *Kajjali* was little bit sticky in consistency
22	368	Dense *Gandhaka* fumes found. Bottom cannot be seen with torch
24	424	Yellowish particles deposited around the neck of *Kupi*
26	452	Blackish yellow colour fumes observed at bottom of *Kupi*
28	445	Black particles deposited around the neck of *Kupi*
30	462	*Sheeta Shalaka* inserted in *Kupi*. At this level liquefied *Kajjali* adhered - *Kajjali* is boiling.
32	458	Adhering of liquefied *Kajjali* at the mouth of *Kupi*
34	492	Deposition of *Kajjali* at the *Mukha*
Tivragni started		*Bhaga*
36	572	*Sheeta Shalaka* inserted - *Kajjali* started boiling
38	585	Hot *Shalaka* was inserted to clear the block. Black fumes observed with Sulphur smell.
40	600	*Sheeta Shalaka* is inserted and some adhered product is taken from the neck of *Kupi*. *Mardhana* is done in *Khalwa Yantra*, it was slight *Sindoora* colour.
42	595	Bluish flame of 2-4cm height at the mouth of *Kupi* was present. Block was cleared off.
44	605	*Suryodaya Laxana* +
46	645	Copper coin test was done. It was positive i.e. copper coin was kept over mouth of the bottle, the surface of the coin turned into grayish white in colour. No flames observed.
48	630	Preparation for corking - wood removed, *Valuka* surrounding the neck region of *Kupi* is removed. Corking is done with the help of *Gopichandana* smeared cloth. It took about 45 minutes. Fire is given after corking

PASCHAT KARMA

Removal of *Kupi* from *Valuka Yantra*, Breaking of *Kupi* and collection of *Abhra Sindoora.*[17]

After complete cooling of the *Bhatti*, *Valuka Yantra* was removed out from the *Agni Bhatti*. Sand surrounding the *Kupi* in *Valuka Yantra* was carefully removed and then *Kupi* was removed. The mud smeared cloth layers of the *Kupi* were scrapped out with a knife. A jute thread dipped in kerosene was tied to the *Kupi* 2-3cm below the level of sublimated product and ignited. When the whole thread gets burnt off, wet cloth was wrapped around that. The bottle gets broken into 2 equal halves with a breaking sound. From the neck region *Sindoora* was collected as multiple blocks, because the product was very hard

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to remove as a single block and was stored in a clean sterile container. (Figure 20 - 24)

Table 3: Showing weight of *Abhra Sindoora*

Total Wt. of *Kajjali*	Wt. of ABS	Wt. of ABS. Residue	Yield
225gms	59 gms	71 gms	26%

Figure 13: *Kupi Bharna* of ABSK

Figure 14: Placing of Pyrometer in Valuka yantra

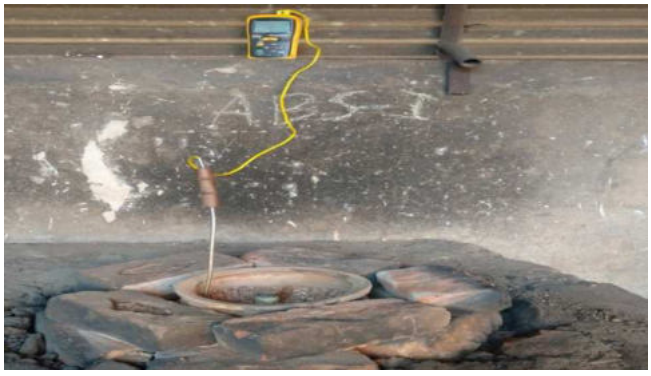

Figure 15: Fumes inside Kupi ABS

Figure 16: Appearance of flame - ABS

Figure 17: Suryodaya Laxana - ABS

Figure 18: Copper Coin Test - ABS

Figure 19: Kupi Mudrana - ABS

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Figure 20: Kupi after Swangasheeta - ABS

Figure 21: Kupi after scraping ABS

Figure 22: After breaking Kupi - ABS

Figure 23: Kantastha product of ABS

Figure 24: Abhra Sindoora powder

OBSERVATIONS

Hingulotha Parada Nirmana[18]

Table 4: Observations during *Hingulotha Parada*

Initial weight of *Hingula*	*Parada* extracted	*Agni* given in hrs	Unburnt *Hingula* left in lower pot
600gms	360gms	6hrs	80gms

After 2 hours of heating, the bottom of the lower pot appeared red hot and Sulphur smell was observed near the junction of *Sandibandhana*. After *Swanga Sheeta*, when the *Sandibandhana* was opened, the mercury globules with the soot were found in the central portion of upper pot. Unburnt *Hingula* was found in the lower pot and weight of it was 80gms.

Abhraka Shodhana[19]

As soon as the pieces of *Abhraka* were plunged in milk, typical 'hissing' sound was produced with dense fuming. Seething was seen in milk due to expulsion of water vapors. Temperature of milk was suddenly raised and its colour became slightly brown / whitish brown. After each *Nirvaka* the crammed structure of *Abhraka* was destroyed to form small pieces and particles due to increased brittleness. The colour of *Abhraka* becomes more black after each *Nirvaka*. Silver luster of *Abhraka* went on increasing after each *Nirvaka*. Observation of the process is presented in the following table.

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Table 5: Observations during *Abhraka Nirvaka*

Total weight of *Krishna Vajra Abhraka*	**2000 gms**	**Average Time Duration for 1 *Nirvaka***	**60 Minutes**
Soditha Abhraka	1900	Total weight gain of wet *Abhraka* after 7 *Nirvapa*	2625gms (before evaporation)
Yield of *Soditha Abhraka*	95%	Average weight gain of *Abhraka* in wet stage per *Nirvapa*	90gms
Loss of *Abhraka* after *Sodhana* Procedure	100gms (5%)	Total loss of *Gudagdha* for 7 *Nirvapa*	7140
Average quantity of *Godugdha* per *Nirvapa*	3000ml (3 litre)	Average loss of *Godugdha* per *Nirvapa*	1020
Total time duration for 7 *Nirvapa*	420 min	Total used *Godugdha* for 7 *Nirvapa*	21,000ml (21 litre)

Dhanyabhraka[20]

While rubbing the *Pottali*, initially rate of extraction of *Dhanyabhraka* remains at peak. But later it gradually tapers down which can be judged by the reduction in the size of *Pottali*, from time to time. At this stage one must switch on to fresh media instantaneously. Fine particles of *Dhanyabhraka* also remain entangled in jute cloth. So, completion of *Mardana* must be followed by removal of residue, achieved by soaking the jute cloth in water and collecting its sediments. This reduces the quantitative loss of *Dhanyabhraka*. Observations during this process are showed in the table 6

Table 6: Data of duration and yield during *Dhanyabhrakarana*

Duration (Days)	***Shodhita Abhraka* (gm)**	***Shali* (gm)**	***Kanji* (ml)**	**DAR yield**	**Loss (gm)**	**Yield %**
4	1800	450	25000	1530	270	85

1. Duration of *Mardana* for complete extraction - 6 hrs 30 min (390 min)
2. Duration of sedimentation - 19 hrs 20 min.
3. Duration of evaporation - 4 hrs 10 min.

Gandhaka Shodhana[21]

All mud particles and dust which were present in *Gandhaka* was separated out over the cloth during the first procedure. *Shodhita Gandhaka* was of pale yellow colour with greenish tinge and shiny. *Shodhita Gandhaka* was in granular form and few were streak like, fully immersed in the milk. Few granules were seen floating on the milk. Table 7 & 8 shows the observations made during *Gandhaka Shodhana*.

Table 7: Observation during *Gandhaka Shodhana.*

Quantity of milk taken	**No. of *Vanopalas* used**	**Weight of S taken**	**Weight of Shuddha S obtained**	**Time taken for *Swanga Sheeta***
3 liters	16	1000gms	855gms	4.5Hours
3 liters	17	855gms	805gms	4.0 Hours
3 liters	16	805gms	750gms	4.5Hours

Table 8: Observation of before and after *Gandhaka Shodhana*

Particulars	**Before *Shodhana***	**After *Shodhana***
Smell of milk	No smell	Smell of Sulphur
Colour of milk	White	Yellow
Colour of Sulphur	Yellow	Pale yellow

Preparation of *Kajjali* by adding *Parada* and *Gandhaka*[22]

Bigger mercury globules were broken into smaller globules. *Rekhapurnata*, *Nirdhoomatva*, *Shlakshnatva* and *Varitaratva* tests were conducted and found positive. Other observations are listed in the table 9.

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Table 9: Observations during *Kajjali* trituration

Day	Observations
1st day	Bigger mercury globules were broken into smaller globules.
	Yellowish colour of *Gandhaka* started turning into a slightly greenish tinge. Compared with Surfex Paint Acrylic Emulsion it is appreciated with Frost Green* colour.
	Mixture appeared in yellowish green colour and tailing of mercury was seen. Compared with Asian Paints Acrylic Emulsion / opcolite, it is appreciated with Vanctian Green - 262*
	Mixture compared with Opcolite Super Acrylic Emulsion, it is appreciated with Moss Green* colour.
	Mixture turning to greyish tinge with small shiny globules
	Mixture appeared Greyish coloured between which yellow streaks were seen while triturating
	Yellow streaks in the mixture reducing gradually.
2nd day	No mercury globules seen but shining was present. It is appreciated with Light Grey-608* in colour.
3rd day	Mixture appeared blackish grey coloured. It is appreciated with Chassis Grey* colour.
	Mixture appeared blackish coloured, shining particles were observed.
4th day	Mixture appeared black coloured.
	Mixture of *Parada* and *Gandhaka* turned to soft smooth black compound.
	Test of *Kajjali Nishchandratwa* was absent.
	Tests of *Kajjali* i.e. *Rekhapurnatva*, *Varitaratva* and *Shlakshnatva* were absent.
5th day	Mixture became very soft & fine, while trituration of it was spilling out of the *Khalwa*.
	Rekhapurnatva and *Shlakshnatva* were observed in the compound.
6th day	*Kajjali* was taken between wet thumb and index fingers and rubbed. Few shining particles of mercury were seen under bright sunlight.
	Varitaratva test conducted for *Kajjali*, it showed partially positive.
7th day	Shining particles of mercury were reduced than before.
	Rekhapurnatva, *Nirdhoomatva, Shlakshnatva* and *Varitaratva* tests were conducted and found positive. Light shining particles positive.
8th day	*Nishchandratwa* test for *Kajjali* was conducted. No shining particles seen when exposed to sunlight, *Nishchandratwa* test positive.

Abhra Sindoora Kajjali [23]

Initially after adding powdered *Dhanyabhraka*, colour of *Kajjali* becomes blackish. After complete *Mardhana*, the *Kajjali* becomes black in colour. Total weight of *Abhra Sindoora Kajjali* is 294gm.

Bhavana to *Abhra Sindoora Kajjali*

During bhavana colour of Abhra sindoora kajjali looks ash in colour. After complete drying of Abhra sindoora kajjali total weight is 315gms. Total weight gain after bhavana is 21gms. Out of this, 30gms of Abhra sindoora kajjali is kept for Test.

Removal of *Kupi* from *Valuka Yantra*, Breaking of *Kupi* and Collection of *Abhra Sindoora*[24]

The colour of the outer layer of the *Kupi* was orange brown in colour when removed from the *Valuka Yantra*. The whole block of *Sindoora* was grayish red shiny with smooth outer surface. No glass piece was seen along with the medicine. There was a collection of residue at the bottom of the bottle.

RESULTS

Table 10: Classical parameters for Analysis of raw *Abhraka* (AR) & *Dhanyabhraka* (DAR)

SN	Physical test	AR	DAR
1.	*Varna*	*Krishna*	*Krishna*
2.	*Chandrika*	Positive	Positive
3.	*Rekhapurnatva*	Negative	Negative

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4.	*Shlakshnatva, Mridutva*	Light	Positive
5.	*Varitara*	Negative	Negative
6.	*Unama*	Negative	Negative

Table 11: Classical Parameters for Analysis of *Abhra Sindoora Kajjali* (ABSK) & *Abhra Sindoora* (ABS)

SN	Test	ABSK - Observations	ABS - Observations
1.	*Sparsha*	Smooth and soft.	*Slakshna* and *Mrudu*
2.	*Gandha*	Characteristic Smell.	*Nirgandha*
3.	*Rekhapurnatva*	When fine powder of *Kajjali* was rubbed between the thumb and index finger it entered the furrows of the fingers.	When the ABS was rubbed between the thumb and index finger it entered the furrows of the fingers.
4.	*Varitaratva*	When finely powdered *Kajjali* was carefully Sprinkled into a test tube containing water, *Kajjali* was floating on the surface of water.	When finely powdered ABS was carefully Sprinkled into a test tube containing water, it was floated on water.
5.	*Nishchandratwa*	Luster less i.e., No shining particles were observed.	There was no shining particle in the finely powdered ABS even when it was rubbed between thumb and index finger and made wet, observed in the bright Sunlight.

Modern Parameters

Table 12: Organoleptic characters of AR, DAR, ABSK, & ABS

	Colour	Odour	Touch	Taste
AR	Shiny-grey	Odorless	Amorphous	Tasteless
DAR	Shiny-grey	Odorless	Amorphous	Tasteless
ABSK	Jet black	Sulphur smell	Amorphous	Astringent
ABS	Vermilion	Odorless	Amorphous	Tasteless

AR - Raw Abhraka, **GR** - Gandhaka Raw, **HR** - Hingula Raw, **DAR** - Dhanyabhraka, **ABSK** - Abhra Sindoora Kajjali, **ABS** - Abhra Sindoora.

Table 13: Results of qualitative and quantitative comparative analytical study of AR, GR, HR, DAR, ABSK & ABS.

Contents	AR	GR	HR	DAR	ABSK	ABS
P^H Value	3.45	4.53	4.94	4.77	4.71	4.08
Ash Value	BDL	BDL	BDL	84.00 %	27.00 %	BDL
Acid insolubl e ash	BDL	BDL	BDL	30.00 %	15.00 %	BDL
Water soluble ash	BDL	BDL	BDL	22.00 %	11.75 %	BDL
Loss on drying	3.00 %	0.3	0.4	BDL	1.00%	2.00

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						%

AR - Raw Abhraka, **GR** - Gandhaka Raw, **HR** - Hingula Raw, **DAR** - Dhanyabhraka, **ABSK** - Abhra Sindoora Kajjali, **ABS** - Abhra Sindoora.

Table 14: Showing XRD Results of raw *Abhraka*

Sample	Compound Name	Chemical Formula	Crystal System
AR	Silicon dioxide	O_2Si_1	Hexagonal
	Nonapotassium Oxoferrate	$Fe_2K_9O_7$	Cubic
	Iron oxide	Fe_2O_3	Tetragonal

Table 15: XRD Results of *Dhanyabhraka*

Sample	Compound Name	Chemical Formula	Quantitative Results
DAR	Silicon dioxide	O_2Si_1	82%
	Nonapotassium Oxoferrate	$Fe_2K_9O_7$	0.00%
	Iron oxide	Fe_2O_3	18%

Table 16: XRD Results of *Abhra Sindoora Kajjali*

Sample	Compound Name	Chemical Formula	Crystal System	Quantitative Result
ABSK	Sulphur			75.4%
	Annite	$Si_{5.10}Al_{6.90}Fe_{6.00}K_{1.98}Na_{0.02}O_{24.00}$	Monoclinic	22.5%
	Mercury Sulfide (1/1)			1.6%
	Mercury Sulfide-Hp			0.5%

Table 17: XRD Results of ABS (*Abhra Sindoora*)

Sample	Compound Name	Chemical Formula	Crystal System	Quantitative Result
ABS	Cinnabar	$Hg_{3.00}S_{3.00}$	Hexagonal	100%

Table 18: Comparative EDXRF Results of AR, DAR, ABSK & ABS.

AR			DAR		ABSK		ABS	
Elements	C %	N %	C %	N %	C %	N %	C %	N %
K	15.63	15.63	14.38	14.38	6.62	6.62	0.71	0.71
Ca	0.642	0.642	---	---	0.66	0.66	0.03	0.03
Ti	3.230	3.230	3.201	3.201	0.816	0.816	0.08	0.08
Mn	0.477	0.477	1.189	1.189	0.299	0.299	0.005	0.005
Fe	79.16	79.16	79.22	79.22	11.268	11.268	0.108	0.108
Cu	0.0519	0.0519	1.232	1.232	0.093	0.093	0.00	0.00
Zn	0.3784	0.3784	0.776	0.776	0.00	0.00	0.00	0.00
S	0.42	0.42	------	------	53.8	53.8	64.8	64.8
Br	0.0056	0.0056	------	------	1.41	1.41	2.032	2.032
Hg	0.0013	0.0013	------	------	25.04	25.04	32.27	32.27

C% - Concentration%, N% - Normalized%

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Table 19: SEM-EDX Results of ABS (*Abhra Sindoora*)

Elements	Weight%	Atomic%
CK	12.80	51.05
OK	4.78	14.30
Si K	0.77	1.31
SK	11.02	16.47
HgM	70.64	16.87

Table 20: Results of FTIR Peaks of ABS (*Abhra Sindoora*)

Sample Peak Frequency Cm^{-1}	Standard Peaks Frequency Cm^{-1}
3961, 3923, 3598, 3509, 3281	4000 - 3200
3281,1652,983,782,689	3200 -1500

Table 21: Particle Size of ABS (*Abhra Sindoora*)

Name of the Sample	Particle size Range		Mean Particle Size
ABS	Diameter at 10%	7.25 µm	14.87µm
	Diameter at 50%	14.87 µm	
	Diameter at 95%	23.59 µm	

Fig. 25: XRD - ABS Abhra Sindoora

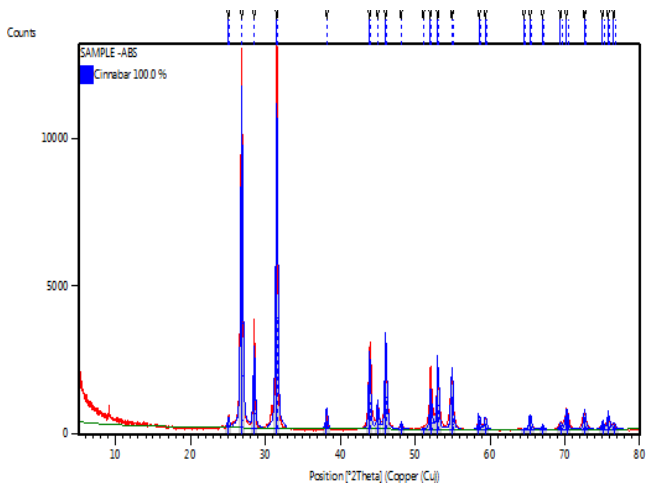


Fig. 26: Quantitative Results

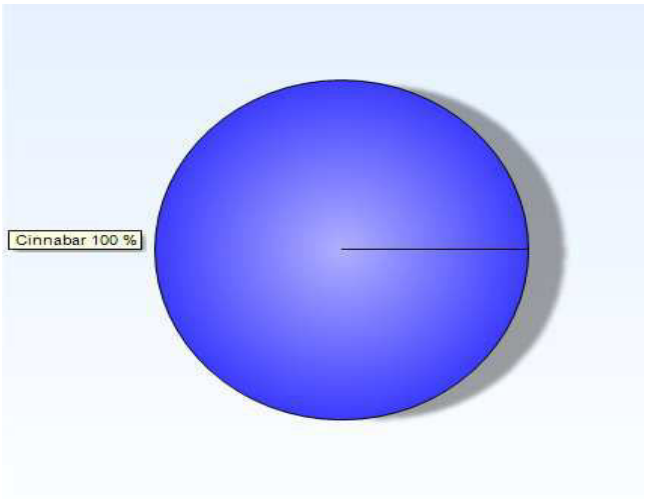


Fig. 27: FTIR report of ABS Abhra Sindoora

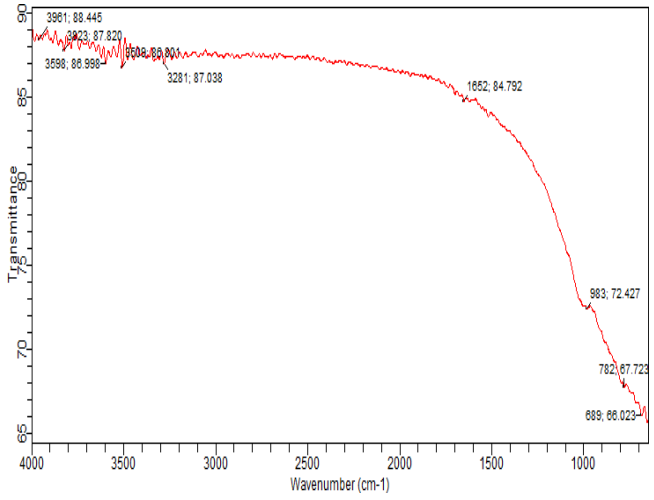
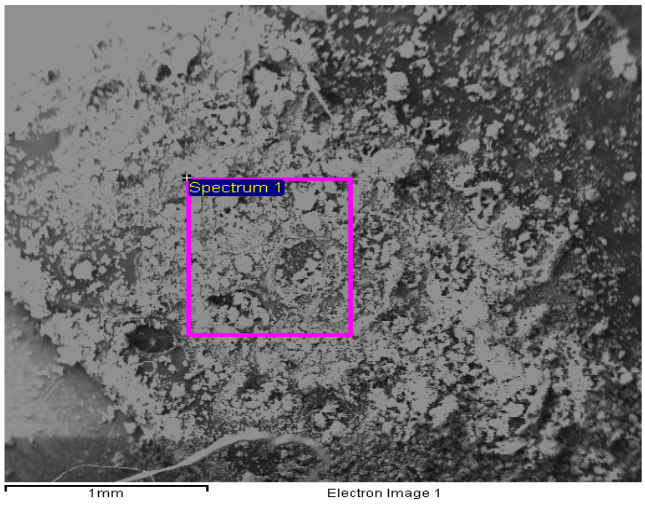


Fig. 28: SEM – EDX – REPORT OF ABS



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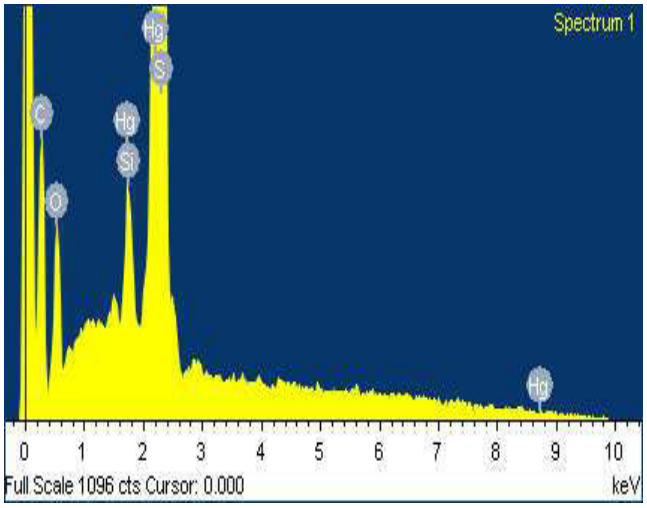

DISCUSSION

Pharmaceutical Study

The heat resistance properties and stratified structure of *Abhraka* persuaded the *Acharyas* to follow mainly *Nirvapa* for *Abhraka Shodhana* as *Shodhana* is described before any kind of use of *Abhraka* either in *Dehavada* or *Lohavada* i.e. for *Dhanyabhrakarana*. So the main purpose of *Shodhana* of *Abhraka* is removal of both water soluble impurities and destruction of stratified structure of *Abhraka* by converting it to a granular form especially before *Dhanyabhraka*. *Godugdha* is known to be a weak acid which plays an important role in the structural changes in *Abhraka* as well as impose their properties on it. During 1st *Nirvapa*, at 1st and 2nd stage *Abhraka* showed a colour change of silver black colour. During 6th and 7th *Nirvapa*, at 1st stage *Abhraka* showed golden black colour and at 2nd stage showed silver black colour. After each *Nirvapa*, the crammed structure of *Abhraka* was destroyed to form small pieces and particles due to increased brittleness. Colour became black and silver luster of *Abhraka* kept on increasing. Yield of *Shodhita Abhraka* was 95%. Loss may be because of flying of particles immediately after *Nirvapa* and light weight of fine particles. Also, loss occurs during decantation, filtering and also during evaporation.

Dhanyabhrakarana is a unique process described only for *Abhraka*, named after the use of *Dhana* i.e. unhusked rice in its preparation. Interaction between the solid and the liquid media is described by explaining the role of *Amla Rasa* through *Tiksna, Jarana* and *Ksalana* properties supported by its pH indicating its acidic nature and validating the earlier explanation. While *Dhana* due to its structural ability acts as a doer in this process; its external jagged surface grates the soften *Abhraka* into coarse powder form. The pressure of the hands enhances this process by increased friction and increased area of exposure by the movement of *Pottali*. The pores of jute bag prove to be a perfect sieve, yielding and expelling out the standard sized particles of *Dhanyabhraka*. Yield of *Dhanyabhraka* is 85%. Loss of *Abhraka* may be due to remaining impurities and hard particles of *Abhraka* in the *Pottali* and loss of particles during decantation of water and evaporation.

Extraction of Mercury and *Hingula* yielded 60%. The reason of loss may be due to mercurial vapors escaping out during the procedure. During the purification of sulphur, 25% of loss was observed.

In *Kupipakva Rasayana* the heating pattern plays an important role to obtain a quality product. As per classic text, *Kramagni* is adopted during the process. The heating pattern was divided into three stages *Mridhuagni* (120°-250°) *Madhyamagni* (250°-450°) *Tivragni* (450°-650°). The first stage of heating represents the melting of *Abhra Sindoora Kajjali*, whereas in second and third stage boiling of *Abhra Sindoora Kajjali* and sublimation of the product towards the neck of the *Kupi* was evident. Various tests like blue flame test, copper coin test, *Sheeta Shalaka* test were conducted to confirm the absence of free sulphur. Testing of the product collected at the neck was also done to ensure proper formation of compound. Self pooling of *Kupi* was ascertained before procuring the product as it has a major role to play in recrystallization.

Analytical Study

The *Abhra Sindoora* particle size is 14.87nm, the particle size reduces significantly which may facilitate the absorption and assimilation of the drug into the body system. The SEM-EDX study confirmed the presence of Ce, OO, Si, S, Al and HgM. FTIR analysis of

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Abhra Sindoora shows organic compounds with functional groups like amines, Alkynes, Bromide, Iodide etc. The XRD result of the *Abhra Sindoora* shows compound name cinnabar, Chemical formula $Hg_{3.00}S_{3.00}$ in hexagonal crystal system. EDXRF study confirmed the presence of S, Br, Hg, and trace elements like K, Ca, Ti, Mn, and Fe.

CONCLUSION

Abhra Sindoora can be prepared in 48 hours by following gradual rise of temperature i.e. 16 hours each of *Mridhuagni* (120°-250°) *Madhyamagni* (250°-450°) *Tivragni* (450°-650°) stages with 26% yield *Abhra Sindoora* is a mercurial compound possessing $Hg_{3.00}S_{3.00}$ hexagonal crystal structure with Hg (32.27%) and S (64.8%) as major elements and K, Ca, Ti, Mn, Fe and Br as minor elements.

REFERENCES

1. Sri Pandita Viswanatha Dwivedi Vaidya Rachita Rasendra Sambhava, Publishers Krishna Das Academy – Varanasi, reprinted 1997, 4th Patala, Sloka 38-39,P.NO. 483
2. Madhava, Ayurveda Prakasha, 1/137, Chaukhamba Bharati Academy, Varanasi, 2007; 80-1
3. Sri Pandita Viswanatha Dwivedi Vaidya Rachita Rasendra Sambhava, Publishers Krishna Das Academy – Varanasi, reprinted 1997, 4th Patala, Sloka 38-39,P.NO. 483
4. Singh SK, Chaudhary AK, Rai DK, Rai SB. Preparation and Characterization of a mercury based Indian traditional drug Rasasindo or. Indian J Tradit Knowl 2009;8:346-57
5. Dr.K.Raghunathan, Pharmacopoeial Standards for Ayurvedic Formulations, 1stEdn, Delhi, published by CCRIM & H, 1976, prologue.
6. Anonymous-The Ayurvedic Formulary of India, second revised English edition, Govt. of INDIA Ministry of Health and Family Welfare, Department of Indian Systems of Medicine and Homeopathy , NEW DELHI, Published by The Controller of Publications Civil Lines Dehli, 2003, Part-1 ,18th Section , 230pp.
7. Sri.Vagbhatacharya, Rasaratna samucchaya, edited by Dattatreya Ananth Kulkarni, New Delhi, Meherchaand Lachamandas publications, ,1998,10th chapter, 48-50th verse, 187pp.
8. Pranacharya Sadananda Sharma virachita, Rasa Tarangini, Hindi translation, edited by Pandit Kashinath Shastri, 11thEdn Varanasi, Motilal banarasidasa Publication, reprint 2004, 5th Taranga, 38-42stverse, 82pp.
9. Pranacharya Sadananda Sharma virachita, Rasa Tarangini, Hindi translation, edited by Pandit Kashinath Shastri, 11thEdn Varanasi, Motilal banarasidasa Publication, reprint 2004, 5th Taranga, 38-42stverse, 82pp.
10. Acharya Shri Madhava, Ayurveda Prakasha, Hindi commentaries, edited by Vaidya Vachaspati Shri Gulrajsharma Mishra, Varanasi, Chaukhambha Bharati Academy publication, reprint 1999, 2nd chapter, 19th verse, 260pp.
11. Sri Pandita Viswanatha Dwivedi Vaidya Rachita Rasendra Sambhava, Publishers Krishna Das Academy – Varanasi, reprinted 1997, 4th Patala, Sloka 38-39,P.NO. 483
12. Sri Pandita Viswanatha Dwivedi Vaidya Rachita Rasendra Sambhava, Publishers Krishna Das Academy – Varanasi, reprinted 1997, 4th Patala, Sloka 38-39,P.NO. 483
13. Sadananda Sharma, Rasa Tarangini, Edited by Kasinatha Shastri, 11thEdition, Varanasi, Motilal Banarasi Das publication, 1979, 4th Taranga, 53rd shloka, 60 pp.
14. Sri Pandita Viswanatha Dwivedi Vaidya Rachita Rasendra Sambhava, Publishers Krishna Das Academy – Varanasi, reprinted 1997, 4th Patala, Sloka 38-39,P.NO. 483
15. Sri Pandita Viswanatha Dwivedi Vaidya Rachita Rasendra Sambhava, Publishers Krishna Das Academy – Varanasi, reprinted 1997, 4th Patala, Sloka 38-39,P.NO. 483
16. Sri Pandita Viswanatha Dwivedi Vaidya Rachita Rasendra Sambhava, Publishers Krishna Das Academy – Varanasi, reprinted 1997, 4th Patala, Sloka 38-39,P.NO. 483
17. Sri Pandita Viswanatha Dwivedi Vaidya Rachita Rasendra Sambhava, Publishers Krishna Das Academy – Varanasi, reprinted 1997, 4th Patala, Sloka 38-39,P.NO. 483

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18. Pranacharya Sadananda Sharma virachita, Rasa Tarangini, Hindi translation, edited by Pandit Kashinath Shastri, 11thEdn Varanasi, Motilal banarasidasa Publication, reprint 2004, 5th Taranga, 38-42stverse, 82pp.
19. Anonymous-The Ayurvedic Formulary of India, second revised English edition, Govt. of INDIA Ministry of Health and Family Welfare, Department of Indian Systems of Medicine and Homeopathy , NEW DELHI, Published by The Controller of Publications Civil Lines Dehli, 2003, Part-1 ,18th Section , 230pp.
20. Anonymous-The Ayurvedic Formulary of India, second revised English edition, Govt. of INDIA Ministry of Health and Family Welfare, Department of Indian Systems of Medicine and Homeopathy , NEW DELHI, Published by The Controller of Publications Civil Lines Dehli, 2003, Part-1 ,18th Section , 230pp.
21. Acharya Shri Madhava, Ayurveda Prakasha, Hindi commentaries, edited by Vaidya Vachaspati Shri Gulrajsharma Mishra, Varanasi, Chaukhambha Bharati Academy publication, reprint 1999, 2nd chapter, 19th verse, 260pp.
22. Anonymus, Rasatantrasara va Sidhaprayoga Sangraha, 17th Edition, Rajasthan, Krishna Gopala Ayurveda Bhavana, 2006, volume 1, 264pp
23. Sri Pandita Viswanatha Dwivedi Vaidya Rachita Rasendra Sambhava, Publishers Krishna Das Academy – Varanasi, reprinted 1997, 4th Patala, Sloka 38-39,P.NO. 483
24. Sri Pandita Viswanatha Dwivedi Vaidya Rachita Rasendra Sambhava, Publishers Krishna Das Academy – Varanasi, reprinted 1997, 4th Patala, Sloka 38-39,P.NO. 48

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