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A comparative pharmaceutical study of *Abhrasindoora* by traditional and contemporary Method

Research Article

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Abstract

Background: *Rasashastra* is a Pharmacotherapeutics of Mercurial, Metallic, and Mineral preparations *Abhrasindoora* (AS) is a unique Herbo-Metallic-Mineral Compound, which is mainly indicated in respiratory diseases. Method: AS contains *Dhanyabhraka* (Bio-purified Black Mica Powder), *Shodhita Parada* (Bio-purified Mercury), and *Shodhita Gandhaka* (Bio-purified Sulphur) in equal proportion. These mixtures were subjected to trituration in *Kharal* till *Kajjali* formation (ABS-72 hrs) followed by impregnation of latex of *Arka* (Calotropis procera linn*)* (QS) (16 hrs) and *Vatashunga* (Ficus benghalensis linn*)* (QS) (15 hrs). Then Batch-A & Batch-B were prepared separately in *Valuka Yantra* and Electric Muffle furnace by maintaining mild (150 ^{0}C-250 ^{0}C), (150 ^{0}C - 300 ^{0}C) moderate (250 ^{0}C -400 ^{0}C), (300 ^{0}C -450 ^{0}C) and intense temperature (400 ^{0}C - 550 ^{0}C), (450 ^{0}C -650 ^{0}C) respectively. Observation: Batch A AS was prepared in 37 hours and the total yield of the product obtained was 54 grams. Batch B AS was prepared in 21 hours and the total yield of the product obtained was 25 grams. Jet black colour *Kajjali* of AS turned to dark red which was sublimated at the neck of *Kachkupi*. Conclusion: The yield of Batch A was more than Batch B but it took more time. Hence, the preparation of *Kupipakva Rasayana* in a sand bath should be done repeatedly to conclude it is a more economic and convenient process.

Keywords: Herbo-Metallic-Mineral Compound, *Abhrasindoora, Kupipakwa Rasayana, Valuka yantra*, Electric muffle furnace.

Introduction

Abhrasindoora (AS) is a *Sindoora Kalpa* (Herbo-Metallic-Mineral Compound [HMMC]), mentioned under *Kupipakwa Rasayana* having therapeutic uses in *Rajayakshma* (Tuberculosis), *Rasayana* (Rejuvenation) and *Vajikarana* (Aphrodisiac) (1). The description of four varieties of AS having different methods of preparation with different ingredients have been mentioned in two treatises, namely *Rasendra Sambhava* and *Rasayoga Sagara* (RYS) (2). In *Rasendra Sambhava*, AS is prepared by the *Kupipakwa Rasayana* method, with a proper sequence from bio-purification of Mercury, Sulphur and Black mica followed by preparation of *Kajjali* (Jet-black coloured powder purified mercury and Sulphur), *Bhavana* process (impregnation) and the process of *Kupipakwa* (3), whereas RYS mentioned only the *Marana* (incineration process) for the same. From the available literature, it has been observed that most of the *Sindoora Kalpa* such as *Rasa Sindoor*, (4) *Malla Sindoora* (5) are prepared by following the *Kupipakwa* method (KPM) and thus in this study KPM is preferred over the *Bhasmikarana* method (BKM) for the standard outcome.

It is believed that the narrow-mouth glass bottle is the most suitable container for the preparation of all types of *Sindoora kalpa* because of the convenience of collecting the final product either from the neck or from the bottom (6). As per the classics, *Valuka Yantra* (VY) is commonly used for manufacturing of AS, which is filled with *Valuka* (Sand), filled in a container (Iron bucket or Vessel), as a heating media, heating device is *Bhrashti* (furnace), where firewood is used as a fuel. Uncontrolled temperature, bulk quantity of firewood consumption, exposure to heat, and air pollution are the disadvantages of the traditional method. In place of furnace, the electric muffle furnace (EMF) is to be

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considered, which has many advantages like easy handling, temperature regulation, minimal air pollution, and involvement of less manpower. But the overall advantage of EMF over the traditional method can only be assessed after doing a comparative study. Thus, the study was conducted in both the furnace and vertical EMF to evaluate the temperature range, total duration of heating, variation in the processes, and total yield (7).

Aim

- Comparative pharmaceutical study of AS prepared in VY and EMF.

Objective

- To evaluate the temperature range, total duration of heating, variation in the processes, and total yield.
- To compare traditional and contemporary methods of preparation of AS.

Material and Methods

Raw materials were procured from S.V. Ayurvedic Bhandar, Mumbai and GY Hakim and Sons, Vadodara, (Bill no. 577). Authentication of mercury, sulfur, and black mica was done from Parul Ayurved Pharmacy, Parul University, Vadodara (19.01.21). Raw mica was authenticated by the XRD-EW method from SICART, Anand, Gujarat (ID.NO.: 216/2021-25). Fresh plant materials were procured from Botanical Garden PIAR, Vadodara, and authenticated from the Dept of Dravyaguna, PIA, Vadodara. The method of preparation of AS followed and referred from *Rasendra Sambhava.* AS was prepared by using two different methods and analyzed on classical and physicochemical parameters.

Table 1: Ingredients of AS: (1)

S.N.	Name of ingredients	Scientific/English Name	Quanti ty
1	*Shodhita Parada*	Purified Mercury	1 part
2	*Shodhita Gandhaka*	Purified Sulphur	1 part
3	*Dhanyabhraka/ Abhraka Bhasma*	Powder of purified Mica	1 part
4	*Arka ksheera*	Latex of *Calotropis procera linn.*	Q.S.
5	*Vatashunga swarasa*	Fresh Juice of *Ficus benghalensis linn*	Q.S.

Procedure: Flow chart of method of preparation of AS (8)

- Identification of Raw drug on classical and physicochemical parameters
- Purification of Mercury, Sulfur and Mica
- Purification and preparation of fine powder of Black mica known as *Dhanyabhraka*
- Purified Mercury, Sulfur and *Dhanyabhraka* is triturated to make Jet-black powder known as *kajjali*
- Levigation of the powder with latex of *Calotropis procera linn*. and fresh Juice of *Ficus bengalensis linn.*
- Putting the dried levigated mixture inside the glass bottle which was prepared initially by wrapping 7 layers of mud smeared cloth and dried and VY and EMF are arranged
- Cooking in mild, moderate, and high-intensity of heat till the formation of the AS in VY and EMF
- Breaking and collection of AS from the neck of glass bottle
- Trituration process of the final product
- AS is to be used orally for therapeutic purposes.

Observations

Table 2: *Shodhana* of Raw drugs of AS

Sr. No.	Raw Drug	Initial weight	Final weight	Media	Observation	
					Before Purification	After Purification
1	Mercury (9)	400 g	280 g	Limestone powder, garlic paste and rock salt powder	Layers of dirt over the surface of liquid mercury	State: Liquid Colour: Bright metallic silver
2	Sulfur (10)	500 g	465 g	Cow milk, Clarified butter	Yellow crystals having the odour of rotten eggs.	Small pieces of light yellow coloured sulfur having the odour of ghee.
3	Black mica (11)	1000 g	930 g	*Triphala Kwatha*	Lustrous black stoney layered sheets	Small clean shiny particles.
4	Dhanyabhraka (12)	500 g	420 g	*Kanji*	Very fine black shiny powder of purified mica which is prepared by the *dhanyabhrakikarana* process.	

Table 3: Preparation of AS *Kajjali*

SN	Ingredients	Total duration of trituration	Initial Qty.	Qty. of media for levigation	Initial weight	Final weight
1	Purified mercury+ *Dhanyabhraka* + purified sulphur (100 g each)	72 hr	300 g	----	300 g	296 g
2	Levigation of *Kajjali* of AS with latex of *Arka*	16 hr	----	300 ml	296 g	308 g
3	Further levigation *Kajjali* of AS with fresh juice of *Vatashunga*	15 hr	---	225 ml	308 g	309 g

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Table 4: Observation of Preparation of AS by two different methods

Preparation of AS by VY				Preparation of AS by EMF			
Time	**Temperature**	**Duration**	**Observation**	**Time**	**Temperature**	**Duration**	**Observation**
Date: 17/04/2021				**Date: 13/03/2021**			
11:21 am	Room temperature 30^{0}C		Commencement of KR	10:00 am	Room temperature 32^0 C		Commencement of KR
12:30 pm	155^{0}C	1 hr	No specific observation was noted	10:41 am	100^{0}C	1 hr	Very mild fumes of *Kajjali* were coming out, the odour of sulphur fumes was observed
12:55 pm	175^{0}C	2 hrs	Mild white fumes were seen coming out from glass bottle	11:15 am	150^{0}C	1 hr	Predominantly *Bhavana dravya (Arka ksheera)* odour was felt
1:41 pm	192^{0}C	3hrs	Mild Sulphur odour was observed along with strong odour of *Bhavana dravya (Arka ksheera)*	11:23 am	150^{0}C	2 hrs	Mild Sulphur odour was observed along with strong odour of *Bhavanadravya (Arka ksheera)*
4:06 pm	200^{0}C	5hrs	Yellowish fumes clearly seen at the neck of glass bottle	11:43 am	150^{0}C	2 hrs	Yellowish fumes clearly seen at *glass bottle* neck
7:57 pm	250^0 C	9 hrs	Fumes of *Kajjali* increased slightly, yellow powder was seen at neck of bottle.	1:51 pm	150^{0}C	4 hrs	Minimal increase in the fumes of *Kajjali*
8:42 pm	259^0 C	10 hrs	Dense yellow fumes seen within glass bottle	2:10 pm	Temp. Set for 200^{0}C	4 hrs	Minimal increase in the fumes of *Kajjali*
10:08 pm	250^0 C/	11 hrs	Yellowish fumes were observed along with the odour of sulphur and burning odour of organic material *(Bhavana dravya)*	3:10 pm	Temp. Set for 250^{0}C	5 hrs	Fumes observed which was yellowish in colour, along with the odour of Sulphur fumes and burning odour of organic material (Bhavana dravya)
11:15 pm	306^0 C	12 hrs	Dense fumes inside the glass bottle	3:20 pm	250^{0}C	5hrs	Accumulation of Sulphur was observed at neck of glass bottle
12:50 pm	347^0 C	14 hrs	Golden yellow fumes inside the bottle was seen	3:50 pm	250^{0}C	6 hrs	Increase in accumulation of sulphur
Date: 18/04/2021							
1:21 am	374^0 C	15 hrs	*Sheeta Shalaka* (Iron probe having room temperature) inserted into glass bottle, *Kajjali* was started to melt and sticking to the probe	4:30 pm	250^{0}C	6 hrs	Blockage at the mouth of glass bottle due to accumulation of sulphur and organic material which was removed with the help of *tapta shalaka*

3:38 am	417^0 C	17 hrs	Brownish yellow fumes inside the glass bottle. Probing was done with *sheeta shalaka*, moderate melting of *Kajjali* was observed	4:57 pm	250^{0}C	7 hrs	Neck of glass bottle was cleared with *tapta shalaka*
5:02 am	460^0 C	19hrs	Dense yellow fumes were observed at bottle	5:45 pm	250^{0}C	8 hrs	Sulphur particles adhering to *tapta shalaka* when inserted in glass bottle.
6:25 am	460^0 C	20 hrs	Orange-Brownish yellowish material deposited at the neck of glass bottle was observed	6:00 pm	Temp. set at 300^{0}C	8hrs	Orange yellowish material deposited at the neck of the bottle was observed
7:15 am	480^0 C	21 hrs	When the iron probe at room temperature was inserted, blackish brown material was seen to adhere to the probe. The middle of the bottle was blocked due to the accumulation of sulphur which resulted in golden yellow fume in the bottle.	7:00 pm	Temp. set at 350^{0}C	9 hrs	When *sheeta shalaka* was inserted in glass bottle, the melting of *Kajjali* powder was noted .
8:21 am	500^0 C	22 hrs	Accumulation was seen	8:00 pm	Temp. set at 400^{0}C	10 hrs	Accumulated material became brownish at the neck of a glass bottle.
11:30 am	470^0 C	25hrs	Due to accumulation of sulphur, blockage was removed with the help of hot probe	8:00 pm	400^{0}C	10 hrs	Yellowish-orange Colour fumes and deposition was observed.
2:00 pm	471^0 C	28 hrs	Blockage removed by inserting red hot iron probe. The material stuck at the neck was removed and rubbed on the crucible which was red in colour. Fumes were observed continuously.	8:45 pm	400^{0}C	11 hrs	Yellowish orange colour fumes and deposition continued
4:30 pm			Mild whitish fumes were continuously observed	9:00 pm	Temp. set at 450^{0}C	11 hrs	When hot iron probe was inserted in glass bottle flame was continued. Blue colour flame height measured about 2-3 cm
7:00 pm	490^0 C	33 hrs	Iron probe inserted in bottom of glass bottle. Mixture of *Kajjali* in powder consistency adhered to the probe. *Copper coin test was positive	9:30 pm	450^{0}C	12 hrs	*sheeta shalaka* was inserted in glass bottle, black powder stuck on the probe from bottom
7:30 pm	505^0 C	33 hrs	No fumes inside the glass bottle No flame seen throughout the making AS. *Suryodaya lakshana* (colour resembling the sky during dawn) was seen at the bottom of bottle.	10:00 pm	450^{0}C	12 hrs	Blue flame reduced, which can be seen inside of bottle only. Deposition of material observed. *Tapta Shalaka* (hot iron rod) was inserted for removal of neck deposition.

7:45 pm	535⁰ C	34 hrs	Before corking sand was removed near about 2-3 inches to provide proper condensation to take place. Corking was done by smearing the cloth with a mixture of jaggery, lime, *Multani mitti*, and chalk.	11:02 pm	450⁰C	13 hrs	Flame was reduced
11:00 pm	535⁰ C	37 hrs	Temperature was maintained till 11 pm and after that stopped adding firewood in furnace.	12:00 am	Temp. set at 500⁰C	14 hrs	Brown golden yellowish colour, shiny particles like emitting light dispersible particles were observed at the bottom of bottle. It was looking like honey comb but reflecting light from that particles.
Date: 19/04/2021				**Date: 14/03/2021**			
9:00 am	105⁰C		Temperature noted	12:30 am	500⁰C	14 hrs	The copper coin test was positive, and the flame completely subsided. Floating of shiny particles with the movement and bright red colour was observed at the bottom of glass bottle.
Self-cooling 30⁰ C (on 19-04-2021)			AS collected from neck of glass bottle and triturated in fine powder form. The final product obtained in solid crystals which was red bright colour.	1:15 am	500⁰C	15 hrs	Heating was continued at 650⁰C till 7:30 am/21 Hr.
				Self-cooling 30⁰ C		15-03-2021	Glass bottle was broken and AS was collected from neck of bottle and triturated in fine powder form. Final product obtained in solid crystals which was red bright Colour

Copper coin test: Deposition of sublimated mercury on copper coin after keeping coin over kupi mouth indicates the time of kupi mouth corking, Sheeta shalaka: Iron probe at room temperature, Tapta Shalaka: Iron probe maintained at a temperature same like the glass bottle.

Results

Graph 1: Showing Temperature pattern by Bhatti (VY) and EMF

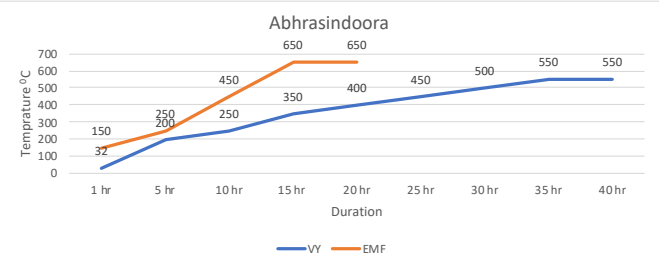


Table 5: Physical characteristics of AS

SN	Parameters	AS (VY)	AS (EMF)
1	Initial weight	150 g	150 g
2	Final Weight	54 g	25 g
3	Loss of weight	96 g	125 g
4	Total duration for preparation	37 hrs	21 hr
5	*Rekhapurnata*	+	+
6	*Varitara*	+	+
7	*Nischandra*	+	+

Note: + = Test passed, VY= *Vakuka Yantra*, EMF= Electric muffle furnace.

***Rekhapurnata and Varitara*:** These tests shows the fineness and lightness of the final product

***Nischandrata*:** This test confirms the absence of shiny particles which signifies the absence of free metal/ minerals.

Table 6: Comparative Physicochemical Characteristics of AS

Test name	AS (VY)	AS (EMF)
Colour	Dark red (Bright red after trituration)	Dark red (Bright red after trituration)
Odour	Odourless	Odourless
Texture	Crystal	Crystal
Touch	Smooth and soft	Smooth and soft
pH	6	6.5
Ash value	0.90%	0.64%
Acid insoluble ash	Nil	0.03%
Water soluble ash	0.53	0.39%
Loss on drying	0.02%	0.04%
Total mercury	83.15%	84.17%
Free mercury	Nil	Nil
Total sulphur	11.06%	12.14%

Discussion

AS is a Herbo-Metallic-Mineral Compound (HMMC), prepared by *the Kupipakwa Rasayana* method and the final products become bright red colour, hence it is called *Sindoora Kalpana* (8). The four methods of preparation of AS were explained under the heading of *Kupipakwa rasayana*. In this study the *Rasendra Sambhava* method has been followed and it is the most suitable method for preparation according to the given definition of *Kupipakwa Rasayana* (2).

To prepare this kind of *Sindoor Kalpa,* many processing technologies to be adopted. Purification of metal and minerals using organic *Shodhana* media is a primary and important *Samskara* to remove physical and chemical impurities (13). It makes *Rasadravya* brittle and to a certain extent helps to convert it into small particles. *The Shodhana* process helps to make it in Herbo-metallic-mineral compound form (14). After *Dhanyabharaka process,* the *Shodhita Abhraka* was obtained in uniform, very small particle size and the *Dhanyabhraka* was directly used to prepare AS *Kajjali*. Preparation of *Kajalli* is an important intermediate stage of AS where *Shodhita* material is converted into a very fine powder that must be devoid of any shiny particles and obtained in jet black colour.

Very smooth and black coloured powder of AS *Kajjali* impregnated with latex of *Calotropis procera linn* latex and *Ficus benghalensis linn* juice. The presence of organic matter on the surface of the drug suggests that this organic matter is the coating material on the surface of the metallic compound present in the drug and the metal compound acts as a carrier of the organic matter derived from herbs used while preparation (15). (Table 2)

In the context of AS, the pharmaceutical method such as duration of heating and pattern have not been properly mentioned. Therefore, the objective of this pharmaceutical study is to compare the pharmaceutical processes by traditional method and EMF; to assess the most convenient process based on its classical parameters and physicochemical parameters.

Bio-purification of mercury results in reduction of weight (400 g to 280 g) and change of colour to bright metallic silver lustre. (Fig 7) The loss of mercury was observed significantly in the first step and less in the second step. While in case of sulphur, after performing *dhalana* (pouring of molten *Gandhaka* into liquid media e.g.cow milk), the purificatory method for seventh time rotten egg smell was reduced and dark yellow colour turned into light yellow having the fragrance of ghee. The melting point of *Gadhaka* was also seen raising in successive *dhalana* processes (119^{0}C to 123^{0}C) which indicates the adherence of organic material to sulfur. (Fig 8) Bio purification of *black mica* was carried out in decoction of *Triphala for* seven times. (16) (Table 2) Which helped in achieving clean shiny black thin pieces of mica. After that, the *Dhanyabhraka process* (Fine powder of bio-purified *abhraka*) was carried out to obtain uniform particle size of purified mica *(*Fig 9). After completion of the bio-purificatory methods, the ingredients were initially subjected to dry trituration in a mortar and pestle (*Khalva yantra)* for approx. 72 hrs till it became non-shiny, smooth jet-black coloured powder, which is known as *AS Kajjali*. The prepared *Kajalli* was initially impregnated with the latex of *Calotropis procera linn* and subjected to levigation for 16 hours followed by the juice of *Ficus benghalensis linn* for 15 hours. (Fig 11,12, 13). The particle size of *Kajjali* obtained was 16 µm to 180 µm. (Table 3) The incorporation of herbal media into the metallic-mineral compound helps to increase the body's acceptance. The *AS* was prepared by adopting the open method in *VY* and EMF. (Fig 16, 17) In VY method after the first 2 hours of mild temperature, light white fumes were observed which increased gradually. When iron rod was inserted to check the consistency of *the Kajali*, the molten *Kajjali* was observed at around 417°C in VY, whereas the same stage was observed at 374^{0}C in the EMF. On increasing the temperature, profuse yellow colours fumes were observed, *Kajjali* started to boil and the deposition of sulphur at the neck was increased. Dense fumes, followed by flames were observed in VY and EMF methods at a range of 450 °C – 475°C and 450°C – 458°C, respectively. At intense heat, the bluish colour flame was observed at the neck of glass bottles for *a* duration of 2 hours 50 minutes and 2 hours 30 minutes respectively. Some confirmatory tests like disappearance of flame, *Sheeta Shalaka* test (Fig 18), and copper coin tests were performed before corking the mouth of *the glass bottle*. The disappearance of flame and the positive *Sheeta Shalaka* test (17) during the process indicated no free sulphur available inside the bottle. The reddish colour at the bottom of the *glass* indicated that the material was converted into

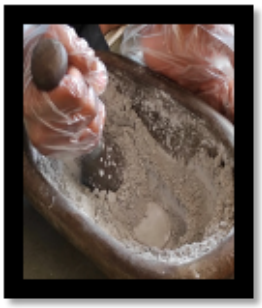
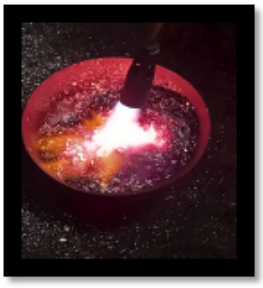
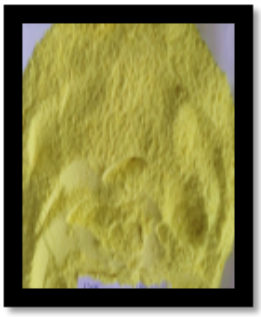
compound form. Positive copper coin test is an indication of the sublimation of mercury. (Table 4) After confirming all the parameters corking was done and intense heat was given. After self cooling, *AS* was collected from the neck of glass bottle (Fig 19, 20, 21, 22) and the final product was triturated fine in mortar and pestle. The fine powder of each AS-VY and AS-EMF was very smooth, fine, light, tasteless and dark red in colour. It was tested on textual analytical parameters i.e., *Varna* (Colour), *Varitara* (Floating over water), *Unam* (Grain floating over *Sindoora* place in water), and *Rekhapurnata* (Fineness). (Table 5) (Fig 23). The total duration of heating required to prepare AS by VY method was 37 hours and EMF was21 hrs only which might be may be due to automatic, continuous, and uniform heating patterns. The heating media was entirely different in both methods, in one place indirect heating (sand) and another place direct heating. In VY method, the heat supply to the bottle was through *Valuka* which regulates a continuous uniform temperature pattern throughout the process which was different in EMF. In the traditional method, the difference in temperature intensity from the bottom, body and neck of the bottle was observed, whereas in EMF, the heat directly passed to glass bottle and heat distribution was uniform from bottom to the neck of glass bottle. Therefore, the *Kramagni paka* (gradual increasing heating pattern) is mentioned in the text which is interpreted as gradually increasing the temperature and equal amount of heat to be applied in all three steps of heating, mild and moderate stages.(18) Practically, moderate, and intense stages are essential in the heating process, as in this stage, maximum chemical reaction and compound formation take place. *Kupipakwa Rasayana* prepared by the VY is more convenient for observing the gradual increasing heat pattern. In comparison with yield and observation, the traditional VY method has convenient over EMF, but in terms of cost-effectiveness, workforce, and eco-friendly, EMF is a better way. The final compound prepared by the traditional method and contemporary method was not differentiated on physicochemical analytical parameters. It can be differentiated after instrumental sophisticated analysis whereas the efficacy study can be differentiated on a rationality ground base (19). (Table 6)

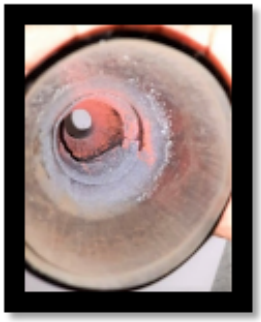
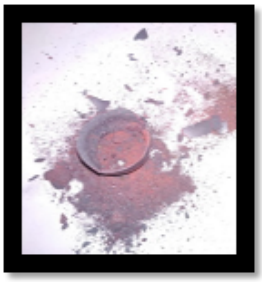
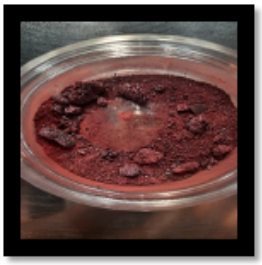
Conclusion

Batch A *AS* was prepared in 37 hours and the total yield of the product obtained was 54 g. Batch B *AS* was prepared in 21 hours and the total yield of the product obtained was 25 g. The yield of Batch A was more than Batch B but the total duration of preparation hours is double. The traditional VY method is better in terms of yield, but EMF has advantages such as better maintenance of temperature, saving of energy, cost-effectiveness, less human effort, and it is environment friendly. By comparing yield, and organoleptic and physicochemical analysis, it can be concluded that the traditional method can be effectively replaced by EMF. However, multiple attempts should be done by following both methods to conclude the superiority of the Muffle furnace or Sand bath over the traditional one.

Figures: 1-21: Showing Pharmaceutical Procedure of AS

1-3: Raw Drugs, 4-6: *Shodhana* of Raw Drugs, 7-8: *Shodhita* Raw Drugs, 9-*Dhanyabhraka*, 10- *Kajjali*

(1) Raw Mercury (*Ashodhita Parada*)	**(2) Raw Sulphur (*Ashodhita Gandhaka*)**	**(3) Raw Black mica (*Krishna Vajrabhraka*)**	**(4) *Shodhana* of *Parada***	**(5) *Shodhana* of *Gandhaka***
				
(6) *Nirvapana* Procedure of *Abhraka*	**(7) *Shodhita Parada***	**(8) *Shodhita Gandhaka***	**(9) *Dhanyabhraka***	**(10) AS *Kajjali***
				

(11) *Arka Ksheera*	(12) *Vatashunga Swarasa*	(13) Bhavana process	(14) Kajjali of AS after bhavana process	(15) *Kachakupi* (650 ml)
				
(16) *Valuka Yantra* with *Bhrashti*	**(17) Electric muffle furnace**	**(18) *Sheet Shalaka*test**	**(19) Sublimated AS at neck (EMF)**	**(20) Sublimated AS at neck (VY)**
				
	(21) AS final product (VY)	**(22) AS Final product (EMF)**	**(23) AS for administration**	
				

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