



Research Article

PHYSICO CHEMICAL ANALYSIS OF SHILAJATU (SHODHITA, MARITA AND SATWAPATHITA)

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ABSTRACT

Shilajatu analysis is conducted as it is rare, controversial and herbo mineral drug. Conventional literature reveals that only *Shodana* is sufficient enough and no need to go for further processes like *Marana* and *Satwapatana*. Unlike *Rasaratna samuchhaya*, the need for research on physical and chemical properties of *Shilajatu* is essential and unavoidable. *Shilajatu* is mineral pitch found in Himalaya rocks as exudations in the form of resin, hence the name *Shilajatu*. The work focuses on physical and chemical components present in four different forms of *Shilajatu* in the form of *Raw*, *Shodhita*, *Marita*, *Satwapatita*. The study is undertaken to assess organoleptic characters, pH, specific gravity, ash value, percentage of acid insoluble ash value and % of water soluble ash, moisture content, solubility in distilled water, and % of solubility. Now a day's stressful lifestyle, unhealthy diet, polluted environment, extremely pressurized work culture have created havoc among people affecting their physical and mental health leading to *Medho vridhi vikaras* (Hyperlipidemia). *Shilajatu* when used with proper *Anupana* can cure many diseases as said in *Charaka chikitsa stana*. Analytical study reveals presence of Elements like K, Ca, O, Cl, S, Na, Mg, Si, Al, Pb and oxides like K₂O, CaO, SO₃, MgO, Na₂O, Al₂O₃, SiO₃, P₂O₅, PbO, CuO, Cl in all the samples. Phytochemicals flavonoids, tannins, steroids triterpenoids, saponin, proteins were present in raw and *Shodhita shilajatu*.

INTRODUCTION

Shilajatu is one among *Maharasa*, indicated for many diseases including *Sthoulya*, *Kusta*, *Prameha*, *Medogna*^[1]. The *Shilajatu*, an exudation from the rock surface in the lower Himalayan hills used in ancient Ayurvedic system of medicine to treat obesity, diabetes, hyperlipidemia and several other ailments. The administrations of *Shilajatu* at proper time with proper *Anupana* cure almost all the curable diseases in the world^[2]. It has properties like *Jwarahara* (antipyretic), *Pandughna* (cures anemia), *Pramehagna* (antioliabetu) and *Medachedaka* (which clears fat) etc., are mentioned in *Rasa ratna samuchaya* therefore it is used to treat hyperlipidemia.

Hence to provide the scientific data, the study on physico chemical analysis of *Shodita*, *Marita* and *Satwapathita Shilajatu* and its effect on the serum lipids on albino rats fed with high fat diet are undertaken.

To analyze the physico chemical changes in *Shodita Shilajatu*, *Marita Shilajatu* and *Satwapatita Shilajatu*

MATERIALS AND METHODS

To propose the methodology, following literature survey is carried to find the state-of- the- art methods in the related study specific to *Shodita*, *Marita* and *Satwapathita*, *Shilajatu* and anti-hyper lipidemic effect.

Screening of free radical scavenging activity and immunomodulatory effect of *Shilajatu* was proposed. *Shodita Shilajatu* was subjected for physicochemical analysis. Shiny black color, *Gomutra Gandhi* lump in appearance, pH was 4.80, specific gravity 0.997, ash value 17.4% w/w, 74% solubility in distilled water flavanoids, tannins triterpenoides, saponin, steroids, caratinoids is presented.

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Effect of *Shilajatu* on memory, anxiety and brain monoamines in rats is taken. The observed neurochemical effects are induced by *Shilajit*, indicating a decrease in rat brain 5-hydroxytryptamine turnover, associated with an increase in dopaminergic activity, helps to explain the observed non tropic and anxiolytic effects of the drug.

Practical-1

Shilajatu shodana

- 1) Raw *Shilajitu*- 1kg
- 2) *Triphala kwatha*- 4lt
- 3) *Goghrita* to smear on plate during drying the *Shodita Shilajatu*.

Method of Preparation of *Shodhita Shilajitu Shilajatu shodana*

Procedure (1000gms)

Shilajatu churna was prepared in *Khalwa yantra*, powdered *Shilajatu* added in *Triphala kwatha* with constant stirring. Mixture was kept on stove, heated on *Mandagni* with constant stirring the mixture. When mixture attains syrup consistency it was poured on ghee smeared plate and kept for drying in sunlight. After complete drying *Shilajatu* removed from plate, powdered and stored in container

Table 1: Materials and Time Taken for the *Shodana* Process

Quantity of <i>Shilajatu</i>	Quantity of <i>Triphala</i>	Time taken to complete the process
1 kg	4ltrs	3 hours

Table 2: Weight of *Chakrikas* before *Putra* and weight of *Basma* after *Putra*

Name of the <i>Putra</i>	Wt. of <i>Chakrikas</i>	Wt. of C.C.A (<i>Vanyopala</i>)	Total weight of the <i>Basma</i> after each <i>Putra</i>
<i>Kapotaputa</i>	750 Grams	525 Grams	710 Grams

Practical-2

Shilajatu Marana^[3]

Materials

1. *Shodita Shilajitu* - 200gm
2. *Shodita Harthala* - 200gm
3. *Shodita Manashila*- 200gm
4. *Shodita Gandhaka*- 200gm
5. *Nimbu Swarasa* - 400ml
6. *Sarava*- 3pairs

Above said drugs were taken one by one in *Kalwayantra* and mix thoroughly with spatula,

Nimbuswarasa was added to mixture, *Chakrikas* were prepared and dried under shade.

Dried *Chakrikas* were placed in *Sharava samputa* and sealed by using *Gopichandana* such 3 *Sharava samputas* prepared, dried under shade later it was subjected to *Putra* separately by using 8 or 12 cow dung cakes.

Sharavasamputa were allowed to *Swanga sheeta* after completion of *Putra*. Then carefully opened, collected the *Chakrikas*, powdered in *Kalwayantra* and stored in container.

Table 3: Materials Required for Giving *Putra*

No. of <i>Putra</i> (<i>Kapota</i>)	No. of <i>Sarava Samputa</i>	No. of <i>Chakrikas</i>	No. of Cow dung caps		Time taken for <i>Putra</i>
			No. C.C	Wt. of	
1 st <i>Putra</i>	1	35	12	150 grams	20 min
2 nd <i>Putra</i>	1	35	12	150 grams	20 min
3 rd <i>Putra</i>	1	25	11	140 grams	20 min

Table 4: Quantities of *Vanyopala*, number of *Putra* and weight of *Bhasma* after *Marana*

No. of <i>Kapota putra</i>	No. of <i>Chakrikas</i> in the <i>Sarava</i>	No. of <i>Chakrikas</i>	Wt. of C.C.A (<i>Vanyopala</i>)	Time taken for each <i>Putra</i>	Total weight of the <i>Basma</i> after each <i>Putra</i>
1 st	35	12	12 x 150 gm	20 min	260 grams
2 nd	35	12	12 x 150 gm	20 min	260 grams
3 rd	25	11	11 x 150 gm	20 min	230 grams

Practical-3

Shilajithu satvapatana

Materials (*Drava Varga*)

- Shudda Gunja*- 100grams
Shudda Madhu - 100grams

- Shuddaguda*- 100grams
Shudda Grita- 100grams
Shudda Tankana- 100grams
Shudda Guggulu- 100grams

Shudda Shilajitu- 100grams

Nimbu Swarasa- 400ml

Procedure

Above mention drugs were taken one by one in Kalwayntra. Mixed thoroughly, to this mixture Nimbuswarasa was added with continuous stirring till whole drug gets completely immersed in Swarasa. Triturating process was carried out continuously and constantly until mixture turns to semisolid pill mass

like state. After drying the mixture made into powder. The dried powder was kept in Mushas and its mouth sealed by lid using Gopichandana. Musha was placed on blower & Teevragni given for period of 40 min maintaining temp of 400°C. Next day morning the Musha was taken out carefully from blower and seal was opened. Solid mass of Shilajatusatwa collected from Musha, powdered and stored in container



Table 5: Materials Required For Giving Puta

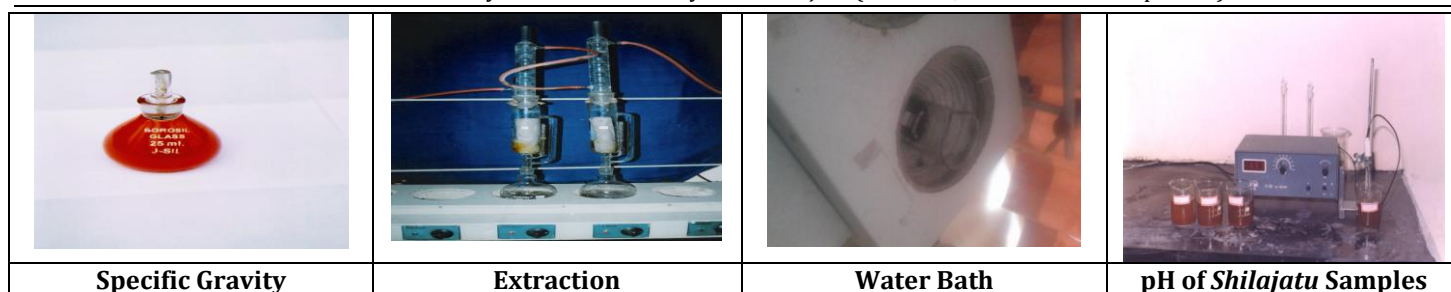
No's of Musha	Qty before Satwapatan	Qty after Satwapatan
1	270gm	170gm
2	220gm	115gm
	Total wt before Satwapatan	Total wt after Satwapatan
	490gms	285gm

Shodhana process of Shilajatu

			
Raw Shilajatu	Triphala kwath with Shilajatu	Shodhita shilajatu	Churnita shodhita shilajatu

Marana process of Shilajatu

			
Shodhita Haratala	Shodhita Manashila	Shodhita Gandhaka	Chakrikas after Puta
			
Shodhita Tanka	Shodhita Guggulu	Shodhita gunja	Satwa of Shilajatu
			
Solubility Test	Percentage of Solubility	Ash value of Shilajatu	Moisture Content of Shilajatu



Specific Gravity	Extraction	Water Bath	pH of <i>Shilajatu</i> Samples
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Physical and chemical analytical Study

Samples of *Shilajatu*

Raw *Shilajatu*, *Shodhita Shilajatu*, *Marita Shilajatu* and *Satwapatita Shilajatu*

A. Organoleptic characters

B Physico chemical analysis

C Phyto-chemical analysis

A. Organoleptic characters of *Shilajatu*

Four samples of *Shilajitu* were subjected for organoleptic characters tests and results are given in table no: 06

B. Physico chemical analysis

1) Solubility test

Solubility test of 04 samples of *Shilajatu* was conducted with the following solvents

- | | |
|---------------------|-----------------------------|
| i) Distilled water | ii) Ethyl alcohol |
| iii) Methanol | iv) Acetone. |
| v) Xylem. | vi) Toluene |
| vii) Benzene | viii) Carbon tetra chloride |
| ix) Petroleum ether | x) Chloroform |
| xi) Normal Saline | |

Procedure (Solubility test)

A pinch of *Shilajatu* was taken in a dry test tube with 1ml of solvent and shaken for 1 min. Then observed for solubility, non-solubility and sparingly solubility. The results are noted and displayed in Table No: 07

Different solvents were used in different proportion and solubility was noted and displayed in Table No: 07

2) Percentage of Solubility

5gm of fine powder of *Shilajatu* was mixed with 100 ml of distilled water and stirred well. It was kept for 24 hours and filtered through Whatman filter paper no. 42. The filtrate was poured in china dish and then china dish was kept on water bath for drying. The filter paper along with residue was dried and weighed. The china dish was weighed along with sample. Percentage of solubility was calculated as per the standard formula.

W_1 - Weight of Crucible, W_2 -Weight of Solution after drying along with crucible: $W_2 - W_1 / 5 \times 100$

i. Raw *Shilajatu* Sample: $W_1 = 45.75$, $W_2 = 51.130$

% of solubility of raw *Shilajatu* Sample = $51.130 - 45.75 / 5 \times 100 = 17.6\%$ in D.W

Same procedure was followed for *Shodhita*, *Marita* and *Satwapatita Shilajatu*.

ii. Percentage of solubility of *Shodhita Shilajatu* was 74% in D.W.^[50,51]

iii. *Marita shilajitu* was 16.6% in D.W.

iv. *Satwapatita Shilajatu* was 15.8% in D.W.

3) Determination of pH

The pH meter was calibrated by using standard buffers of known pH 1.2, 4.0 and 9.2m. The reference electrode was thoroughly washed with distilled water every time and water was drained by using filter paper. 1% of *Shilajatu* solution (1 pH value of *Shodhita Shilajatu* 1gm of *Shilajatu* in 100ml of distilled water) was prepared. Then the tip of electrode was dipped and recorded.

1. pH value of raw *Shilajatu* sample = 4.6
2. pH value of *Shodhita Shilajatu* sample = 4.80
3. pH value of *Marita Shilajatu* sample = 5.6
4. pH value of *Satwapatita Shilajatu* sample = 8.5

4) Acidic and Alkaline Neutralizing Activity of *Shilajatu*

Three different pH Solution of having pH 1.2, 7.4 and 9.2 were prepared 1gm of *Shilajatu* was dissolved in 100ml of each of three pH media, and the change in pH of the solution was monitored of an interval of one hour from the time of addition of *Shilajatu* upto 12 hours, by using digital calibrated pH meter. The results were tabulated in Table No. 8 to 11.

5) Ash Value of *Shilajatu*

Air-dried powder of *Shilajatu* 5gm was taken in silica crucible incinerated in an electric burner till carbon free ash obtained. The percentage of total ash was calculated as follows.

Formula:

% of total ash = $W_2 - W_1 / 5 \times 100$

Wt. of empty crucible (W_1)

Wt. of crucible ash (W_2)

Raw *Shilajatu* Sample: $W_1 = 24.21$, $W_2 = 25.83$

Ash value of raw *Shilajatu* = $W_2 - W_1 (25.83 - 24.21) = 1.62$

Ash value of raw *Shilajatu* = $1.62 / 5 \times 100 = 32.5\%$.

Same procedure was followed for *Shodhita*, *Marita* and *Satwapatita Shilajatu*

- *Shodhita Shilajatu* sample = 17.4%
- *Marita Shilajatu* sample = 9.4%
- *Satwapatita Shilajatu* = 4%.

6) Determination of Acid Insoluble Ash

Total ash obtained above was treated with 100ml of 6 N dilute hydrochloric acid and boiled, insoluble matter was collected on ash less filter paper (Whatman No. 42). The residue was repeatedly washed with hot water/, dried well, ignited in electric burner, cooled and weighed, the percentage of acid insoluble ash was calculated as follows -

$$[W_1] \text{ Wt of crucible} = 24.820\text{gm}$$

$$[W_2] \text{ Wt of the silica crucible + sample} = 29.870\text{gm}$$

$$[W_3] \text{ Wt. of Acid insoluble ash + crucible} = 24.870\text{gm}$$

$$W_3 - W_1 = \text{acid insoluble ash of } Shodhita \text{ Shilajatu} = 0.05 \text{ w/w}$$

$$\% \text{ of acid insoluble ash of } Shodhita \text{ Shilajatu} = 0.05 \times \frac{100}{5} = 1\%$$

Same procedure was followed for raw, *Marita* and *Satwapatita Shilajatu*

ii. % of acid insoluble ash of raw *Shilajatu*.

iii. % of acid insoluble ash of *Maritata Shilajatu*.

iv. % of acid insoluble ash of *Satwapatita Shilajatu*.

Preparation of 6N HCL with 100ml distilled water,
 $N_1V_1 = N_2V_2$

Where N_1 = Conversion factor (For HCL it is 36.5)

V_1 = Volume of HCL needed

N_2 = Required dilution

V_2 = Volume of distilled water used.

$$36.5 * V_1 = 6 * 100$$

$$V_1 = \frac{6 * 100}{36.5} = 16.44\text{ml}$$

16.44ml HCL is needed to prepare 6N HCL with 100ml distilled water.

$$\% \text{ of acid insoluble ash} = \frac{W_2 - W_1}{5} * 100$$

7) Determination of water insoluble ash

Total ash obtained from procedure E was boiled with 25ml of distilled water and filtered through ash less filter paper (Whatman No. 42). The residue was washed with hot water and dried well, ignited in electric burner cooled and weighed, the % of water insoluble ash

$$[W_1] \text{ Wt of empty crucible} = 24.820\text{gm}$$

$$[W_2] \text{ Wt of the silica crucible + sample} = 29.870\text{gm}$$

$$[W_3] \text{ Wt. of water insoluble ash crucible} = 25.500\text{gm}$$

$$\text{Wt of water insoluble ash } (W_3 - W_1):$$

$$0.68\text{gm}$$

$$\text{i. \% of water insoluble ash of } Shodhita \text{ sample} = \frac{0.68}{5} * 100 = 13.6\%$$

Same procedure was followed for raw, *Marita* and *Satwapatita Shilajatu*

ii. % of water insoluble ash of raw sample = 6.6%

iii. % of water insoluble ash of *Marita* sample = 5.8%

iv. % of water insoluble ash of *Satwapatita* sample = 13.84%

8) Determination of specific gravity

Empty specific gravity bottle was weighed
 Bottle filled with distilled water was again weighed
 same bottle was then filled with 1% of sample (100ml distilled water + 1gm of *Shodhita Shilajatu*) was weighed.

The specific gravity of the sample was calculated as,

$$\frac{W_3 - W_1}{W_2 - W_1}$$

Where, W_1 = Wt of empty bottle

W_2 = Wt of bottle filled with distilled water

W_3 = Wt of bottle filled with 1% sample solution.

$$\text{Raw } Shilajatu \text{ Sample: } W_1 = 19.290, W_2 = 42.080, W_3 = 42.390$$

$$\text{Sp gr} = \frac{42.390 - 19.290}{42.080 - 19.290} = \frac{23.10}{22.79} = 1.0136$$

Specific gravity of raw *Shilajatu* = 1.0136

Same procedure was followed for raw, *Marita* and *Satwapatita Shilajatu*

Specific gravity of *Shodhita Shilajatu* = 0.9973

Specific gravity of *Marita Shilajatu* = 1.00834

Specific gravity of *Satwapatita Shilajatu* = 1.0136.

9) Determination of moisture content

A clean and dry petri dish was weighed 5gm of dried sample powder was taken in the petri dish and the petri dish was kept in hot air oven and weighed. Again petri dish was kept in hot air oven for one more hour at 105°C The procedure was repeated until the constant weight of petri dish containing the powder of sample was obtained % of moisture content =

$$\frac{\text{Difference of weight}}{\text{Wt of sample}} \times 100$$

$$= \frac{W_2 - W_3}{W_1} \times 100$$

$$\text{Initial weight of Petri dish} = 81.4\text{gm}$$

$$W_1 = \text{Initial wt of the sample} = 5\text{gm}$$

$$W_2 = \text{Initial wt of petri dish with sample} = 86.4\text{gm}$$

$$W_3 = \text{Final wt of petri dish with sample (after drying)} = 86.3$$

$$\text{Moisture content raw } Shilajatu \text{ Sample} = \frac{86.400 - 86.300}{5} \times 100 = 2\%$$

$$\% \text{ of moisture content of raw } Shilajatu = 2\%$$

$$\% \text{ of moisture content of } Shodhita \text{ Shilajatu} = 1.4\%$$

$$\% \text{ of moisture content of } Marita \text{ Shilajatu} = 0.2\%$$

$$\% \text{ of moisture content of } Satwapatita \text{ Shilajatu} = 0.2\%$$

Phyto-Chemical Analysis [24, 25, 26]

All the 4 samples of *Shilajatu* were subjected for phyto-chemical analysis

1. Detection of Alkaloids

Test drug sample solution + Wagner's reagent (KI solution). Reddish brown colored ppt was not observed in test drug sample. It indicates the absent of alkaloids

2. Detection of Carbohydrates

Benedict's test: (test for reducing sugars)

5ml of Benedict's reagent was heated in a test tube. 8 - 10 drops of test drug sample solution was added. Brick red ppt was not observed in sample. It indicates the absence of carbohydrate.

3. Detection of Tannins

Test drug sample solution + FeCl₃, blue colour ppt was observed in test drug sample. It indicates the presence of tannins.

4. Detection of Steroids

Salkowskis test, test drug sample Solution + concentrated H₂SO₄+ Chloroform, blood red ppt was observed in the tested drug sample. It indicates the presence of steroids.

5. Detection of Triterpenoids

Salkowski's test. test drug sample solution + concentrated H₂SO₄ + chloroform + water (10ml choroform 90ml water i.e., 1:9) yellow ppt was observed in a sample. It indicates the presence of Triterpenoids.

6. Detection of Flavonoids

Sodium Hydroxide solution test: Test drug sample Solution + 10% NaOH solution, yellow ppt was observed in sample. It indicates the presence of flavonoids.

7. Detection of Proteins

Million's Biurct test: Test drug sample Solution + 2ml 10% NaOH solution + 2m110% CuSO₄. Blue colour ppt was observed in sample. It indicates the presence of proteins.

Detection of Saponins (Foam Index Test)

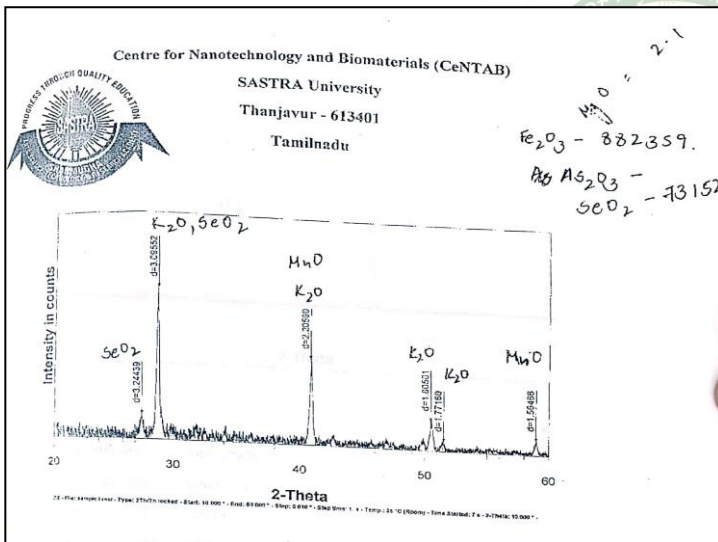
1 ml extract of test drug solution + 20ml distilled water (shaked 15 minutes), foam was observed in a sample. It indicates the presence of saponins

HPTLC, XRD and Elemental Analysis by XRF

Four samples of *Shilajatu*: Raw *Shilajatu*, *Shodita Shilajatu*, *Marita Shilajatu*, *Satwapatita Shilajatu* are subjected for the above mentioned analysis. XRD graphs of raw, *Shodhita*, *Marita*, *Satwapatita Shilajatu* are shown below.

Lemental analysis graphs by XRF

Raw Shilajatu



Shodita shilajatu

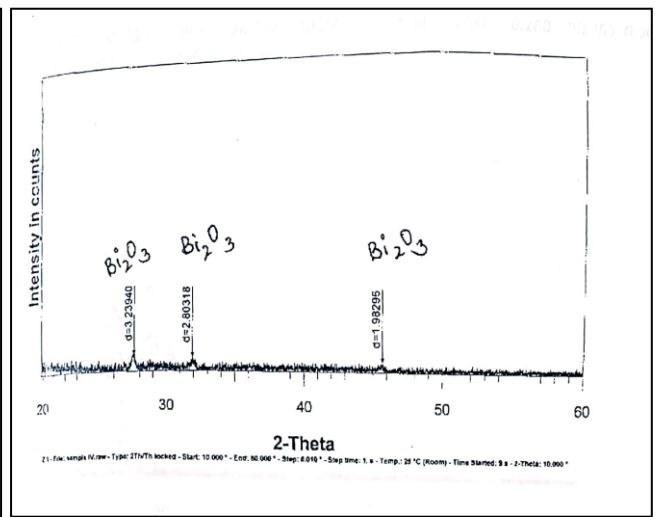
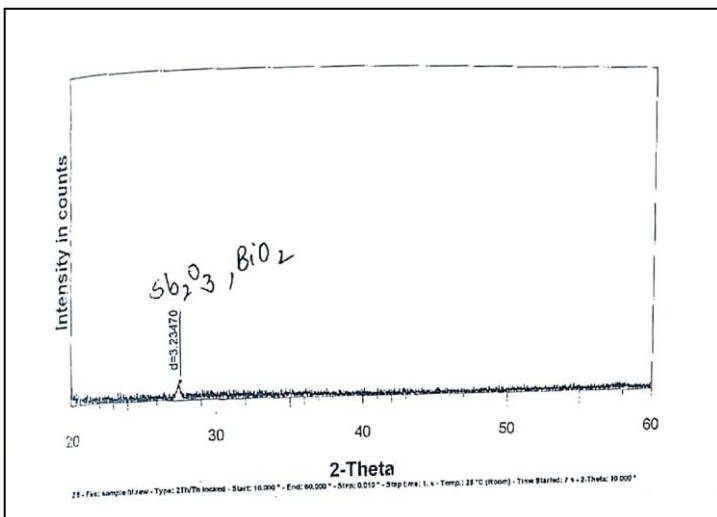
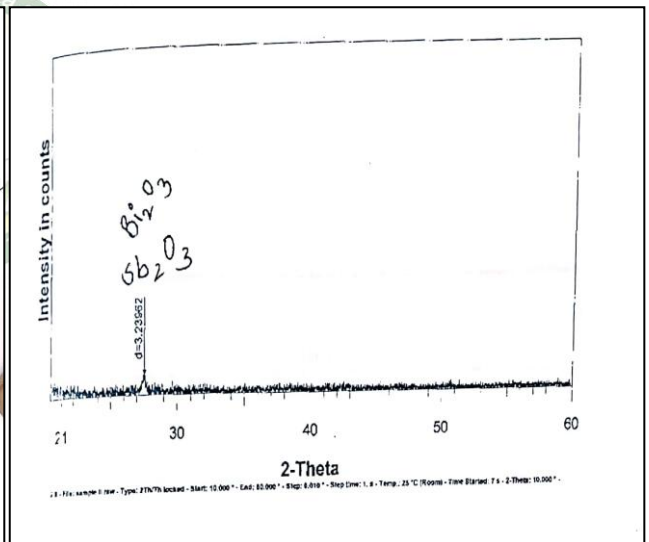


Table 6: Organoleptic Characteristics of Samples of Shilajatu

S. No	Organoleptic Characters	Raw <i>Shilajatu</i>	<i>Shodhita Shilajatu</i>	<i>Marita Shilajatu</i>	<i>Satwapatita Shilajatu</i>
1	Colour	Shiny black	Shiny Black	Shiny Black	Black,
2	Odour	<i>Gomutra Gandhi</i>	<i>Gomutra Gandhi</i>	Odourless	Odourless
3	Taste	Astringent	Astringent	Tasteless	Tasteless
4	Touch	Smooth	Smooth	Smooth	Smooth
5	Appearance	Lump	Lump	Powder form	Powder form

Table 7: Physical Constants of 04 Samples of Shilajatu

S. No	Physical Constants	Raw	<i>Shodhita</i>	<i>Marita</i>	<i>Satwapatita</i>
1	pH	4.6	4.80	5.6	8.5
2	Specific gravity	1.014	0.997	1.0083	0.998
3	Ash value	32.5%	17.4%	9.4%	4%
4	% of acid insoluble ash	1.8%	1%	1.5%	2.3%
5	Water insoluble ash	6.6%	13.6%	5.8%	13.84%
6	Moisture content	2%	1.4%	0.2%	0.2%
7	Solubility in DW	S	S	NS	S
8	% of Solubility	17.4%	74%	NS	15.8%

Table 8: Shows Phytochemical Constituents of Samples of Shilajatu

Phytochemical constituents	Raw Sample	<i>Shodhita</i> sample
Alkaloid	-ve	-ve
Carbohydrates	-ve	-ve
Flavonoids	+ve	+ve
Tannins	+ve	+ve
Triterpenoids	+ve	+ve
Steroids	+ve	+ve
Proteins	+ve	+ve
Saponins	+ve	+ve

Table 9: Percentage of Elements in all the Four Samples

Elements	Sample-I	Sample-II	Sample -III	Sample - IV
O	4.43 %	8.07%	11.6%	9.17%
K	0.442%	0.468%	1.65%	0.576%
Ca	0.649%	1.08%	1.14%	0.870%
Cl	0.660%	0.725%	2.48%	0.736%
S	0.602%	0.776%	0.183%	0.760%
Na	1.82%	2.08%	3.52%	0.733%
Mg	1.08%	2.18%	1.46%	
Fe	0.966%	1.25%		0.835%
Si	2.22%	2.88%	2.20%	1.69%
Hg	3.15%	-	-	-
Al	4.67%	5.14%	4.40%	3.89%
Pb	8.22%	2.33%	9.69%	6.31%

P	6.16%		5.74%	2.18%
Pd	12.6%			
Mn	10.2%		-	10.9%
Sr	3.97%	-		
Cr	18.5%	-	-	-
Mo	14.4%			
Cu	12.8%		3.35%	3.04%
Zn		12.5%		
Rb			0.0565%	
As			0.0565%	0.364%
Ti				9.40%

Table 10: Percentage of Oxides in all the Four Samples

Oxides	Sample-I	Sample-II	Sample -III	Sample - IV
K ₂ O	0.442%	0.468%	1.65%	0.576%
CaO	0.649%	1.08%	1.14%	0.870%
SO ₃	0.602%	0.776%	0.183%	0.760%
MgO	1.08%	2.18%	1.46%	1.80%
Na ₂ O	1.81%	2.08%	3.52%	0.733
Fe ₂ O ₃	0.966%		1.61%	0.835%
SiO ₂	2.22%	2.88%	2.20%	1.69%
Al ₂ O ₃	4.67%	5.14%	4.40%	3.89%
P ₂ O ₅	6.16%	2.33%	5.74%	2.18%
PbO	8.22%	5.14%	9.69%	6.31%
MnO	10.2%	16.2%		10.9%
MoO ₃	14.4%			
Cr ₂ O ₃	18.5%			
SrO	3.97%			
CuO	12.8%	15.7%	3.35%	3.04%
ZnO		12.5%		
Rb ₂ O		14.7%		
AS ₂ O ₃			0.0565%	0.364%
TiO ₂				9.40%
Cl	0.660%	0.725%	2.48%	0.736%

RESULTS AND DISCUSSION

Raw, *Shodhita*, *Marita* and *Satwapatita Shilajatu* all these four samples were subjected to organoleptic, physical constants, chemical, HPTLC, XRD and elemental analysis. (XRF)

Gomutra Gandhi in odour, smooth in touch, astringent in taste, appearance in lump form and was black colour observed in raw and *Shodhita Shilajatu*. Shiny black in colour was observed in *Marita Shilajatu*. Black colour was observed in *Satwapatita Shilajatu*. Odourless, tasteless, smooth in touch, powder form in

appearance was observed in *Marita Shilajatu* and *Satwapatita Shilajatu*.

Raw *Shilajatu* was subjected for physical constants specific gravity of raw *Shilajatu* was= 1.0136 *Shodhita Shilajatu*= 0.9973, specific gravity of *Marita Shilajatu*= 1.00834, specific gravity of *Satwapatita Shilajatu*= 1.0136.

All the four samples (raw *Shilajatu*, *Shodhita Shilajatu*, *Marita Shilajatu* and *Satwapatita Shilajatu*) were subjected for solubility test by using different solvents. All the three samples raw, *Shodhita*,

Satwapatita were soluble only in distilled water and were not soluble in any of the solvent but *Marita Shilajatu* was not soluble in any of the solvents.

Phytochemical Analysis: Raw and *Shodhita Shilajatu* was subjected to phytochemical analysis and showed presence of flavanoids, proteins, tannins, triterpenoids, saponins, steroids.

Element analysis of four samples (raw, *Shodita*, *Marita*, *Satwapatita Shilajatu*): Elements like K, Ca, O, Cl, S, Na, Mg, Si, Al, Pb and oxides like K_2O , CaO , SO_3 , MgO , Na_2O , Al_2O_3 , SiO_3 , P_2O_5 , PbO , CuO , Cl were noted in all the samples. Pd, Sr, Cr, MO were only noted in raw *Shilajatu*. Zn was noted in sample II, Cu noted in all samples except II sample

Sample I (Raw *Shilajatu*): Pd, Hg, Cr, Mo, Sr noted only in this sample.

Sample II (*Shodita Shilajatu*): This sample which was subjected to *Shodhana* with *Triphala kwatha*: Zn (12.5%), Rb (14.7%) presence of these two noted and Pd, Hg, Cr, Mo, Sr were disappeared.

Sample III (*Marita Shilajatu*): This sample is obtained from incineration process with addition of arsenic and sulphur compounds to obtain fine powder. The analysis shows the presence of Cu, arsenic as As_2O_3 (0.0565) (arsenic oxide) and SO_3 (0.183) sulphur trioxide. But Pd, Rb, Cr, Sr, Hg, which were noted in raw sample, absent in this sample.

Sample IV (*Satwapatita Shilajatu*): The *Shodhita Shilajatu* sample was mixed with honey, jaggery *Guggulu*, ghee, borax powder and subjected for intense heat to get extract. This sample contains an extra element Cu, titanium (Ti) (9.40%) and its oxide TiO_2 (9.40%). But Pd, Rb, Cr, Sr, Hg, which were noted in raw sample, absent in this sample.

XRD reports of 4 samples: In XRD analysis of four samples (Raw *Shilajatu*, *Shodita Shilajatu*, *Marita Shilajatu*, *Satwapatita Shilajatu*) spherical shape were detected in all the four samples (raw, *Shodhita*, *Marita* & *Satwapatita Shilajatu*).

Raw *Shilajatu* : 4.49 μ m minimum size and 11.08 μ m maximum size of particle was noted.

***Shodhita Shilajatu*:** 3.20 μ m minimum size and 21.00 μ m maximum size of particle was *Marita Shilajatu*: 18.59 μ m minimum size and 64.80 μ m maximum size of particle was noted. *Satwapatita Shilajatu*: 5.11 μ m minimum size & 19.07 μ m maximum size of particle was noted.

Sample I (Raw *Shilajatu*): Elements Hg, Pd, Sr, Cr, Mo and oxides MoO_3 and Cr_2O_3 are significantly noted only in this sample but absent in other three samples

Sample II (*Shodita Shilajatu*): Elements Rb, Zn and its oxides Rb_2O and ZnO are found only in this sample but absent in other three samples. Al_2O_3 , SiO_2 , MgO increased than in other sample.

Sample III (*Marita Shilajatu*): Elements P, Al, Pb and oxides K_2O , Na_2O , Fe_2O_3 , are increased only in this sample but absent in other two samples.

Sample IV (*Satwapatita Shilajatu*): Elements Al, Pb, Mn and oxides TiO_2 , and As_2O_3 are increased only in this sample than other samples.

Elements Al & Pb are noted in all the 4 samples (Raw *Shilajatu*, *Shodita Shilajatu*, *Marita Shilajatu*, *Satwapatita Shilajatu*), whereas Hg, Pd, Sr, Cr, Mo are found in only raw *Shilajatu* but absent in other 3 samples. Mn is significantly increased in *Satwapatita Shilajatu* Rb & Zn have significantly increased in *Shodita Shilajatu*. P was found in sample-1 raw *Shilajatu* which was decreased in *Marita Shilajatu* and *Satwapatita Shilajatu*.

Na, Mg, Si have slightly increased in all the sample i.e., (*Shodita Shilajatu*, *Marita Shilajatu* & *Satwapatita Shilajatu*) but Sr is slightly found in only Raw K, Ca, Cl, S,. Fe are present in traces in all the samples.

Oxides PbO & MnO are noted in major percentage in all the samples except III sample MoO & Cr_2O are found in raw *Shilajatu* but absent in all the other 3 samples, where as ZnO & Rb_2O are significantly noted in *Shodita Shilajatu* but absent in all the other 3 samples. TiO_2 is found in *Satwapatita Shilajatu* but absent in all the other 3 samples.

Oxides MgO , SiO_2 & Al_2O_3 are noted in all the samples. K_2O , Na_2O & Fe_2O_3 are increased in only *Marita Shilajatu* but found in traces in all the other samples but SrO is noted in only raw *Shilajatu* but absent in all the other 3 samples)

Four samples were subjected to HPTLC

Sample 1 (Raw *Shilajatu*): As the raw sample contains water, nitrogenous matter, calcium and mica. The HPTCL shows various peaks might be of various nitrogenous compounds. The calcium and aluminium oxide might have formed some complexes with nitrogenous matter. This may be assumed from XRD & XRF reports. Sample 2 (*Shodita Shilajatu*) The HPTLC of purified sample that is purified by *Agnitapi* process, *Shilajatu* was subjected for *Shodana* with *Triphala kwatha* where nitrogenous matter might have evaporated in the form of different gases remaining oxides of calcium, aluminium in the residue it may be considered from the XRF and XRD reports. Rf values and area % of the peak reveals the components of fulvic acid, bioflavonoids and taroid complex, the *Amalaki* peak with maximum rf value 0.18 area % 2.38 and *Bibitaki* peak with maximum rf value 0.45 area % 13.35 were also noted. HPTLC of sample 3 preparation from purified sample II is mixed with *Shodhita Harathala*, *Manashila* and *Gandhaka*. During the process the sulphur content of the above three drugs evaporated mostly in the form of sulphur oxide (SO_2) and the residue *Basma* contains mostly oxides of

calcium, magnesium, iron, copper, zinc and some other oxides of arsenic. This may be assumed from the XRD & XRF reports

Sample 4 (Satwapatita Shilajatu): The *Shodhita Shilajatu* was mixed with *Guda, Gunja, Guggulu, Godugda, Ghrita* and *Tankana* and subjected for *Satwapatana* (heating the mixture upto 400°C).

During this process most of the carbohydrates, fatty material were evaporated in the form of CO₂, moisture etc. The residue mineral (*Shilajatu*) is rich in oxides of calcium, iron, sodium, boron etc this also may be considered from XRF and XRD reports.

From qualitative & quantitative of components like elements, phyto-chemical constituents, preparation and economic, therapeutic activity point of view *Shodhita Shilajatu* considered better.

CONCLUSION

As the raw sample contains water, nitrogenous matter, calcium and mica, the HPTCL shows various peaks might be of various nitrogenous compounds. *Shodhita Shilajatu* components of oxides of calcium, aluminium remains in the residue of purified sample. *Marita Shilajatu* residue *Bhasma* contains mostly oxides of calcium, magnesium, iron, copper, zinc and some other oxides of arsenic. The mineral (*Shilajatu*) is rich in oxides of calcium, iron, sodium, boron.

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