Standard Operating Procedure Of *Naga Shodhana* and Study Of Chemical Changes In The Media And *Shodhita Naga*

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Abstract:

Introduction: *Shodhana* (purification) of metals and minerals is a most important step before preparing their *bhasma* (incinerated powder). *Shodhana* treatment removes the soluble, evaporable and washable impurities from metal/mineral and also adds some organic materials which from chemical point of view may be considered as impurities but pharmacological point of view prove beneficial by reducing their toxicity to the great extent. There is need to develop some standard parameters to ensure proper *shodhana*. This can be achieved by developing standard operating procedure (SOPs) for every step of *shodhana*. Thus an attempt has been made to introduce SOPs for *Naga shodhana*.

Aim: To develop SOP for *Naga shodhana*, to study the physic-chemical changes in the media used for *shodhana* and assess the chemical change in *shodhita Naga.*

Method: *Naga Samanya* and *Vishesha shodhana* was done according to the reference of *Sharangadhara samhita* and *Rasatarangini* respectively. Physico-chemical analysis of *shodhana* media was done before quenching and after quenching of melted *Naga*. Analysis of *ashuddha Naga* (raw lead) and *Vishesh shodhit Naga* was done by purity testing, FTIR (Fourier Transform Infrared Spectrometry) and TGA (Thermogravimetric Analysis).

Result and conclusion: *Ashuddha Naga* was 99.80 % pure whereas *Shodhita Naga* was 99.40 % pure. pH, Specific gravity and total solid content of each media was increased after quenching of melted *Naga*. Up to complete *shodhana* average loss occurred was 6.26 %. Melting point of *Naga* slightly increased from 327.46 ^{0}C to 328.42 ^{0}C. FTIR analysis of *ashuddha Naga* showed sharp peaks indicating stretching vibrations between various inorganic molecules while in *shodhita Naga* stretching vibrations between C-H and C-N were observed which are assigned to presence of alkyl compounds specifically methyl bond. The report of TGA shows the presence of non-volatile organic compounds in the *shodhita Naga* due to repeated quenching in different media.

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Introduction:

Historically *shodhana* concept was in existence since the time of *Charaka samhita* as while enumerating the fundamentals necessary of *Gunantaradhana*.[1] The concept has further developed after the development of *Rasashastra* in the field of *Ayurvedic* medicine. As in *Rasashastra* generally the metals/minerals and some time few drugs of poisonous nature are found used which are likely to contain some toxic effect also. Hence with a view to remove or minimize their toxicity and to make them suitable for further process a number of *shodhana* procedures have been found evolved which are considered helpful in reducing the toxic effect of these drugs. The metallic preparations occupies significant seat in *Ayurvedic* pharmacopoeia. The frequently used metals in *Ayurveda* includes *Parada* (mercury), *Swarna* (gold), *Rajata* (silver), *Tamra* (copper), *Loha* (iron), *Naga* (lead) and *Vanga* (tin). The metallic preparations are used in the form of *bhasma* (incinerated powder) and *shodhana* is first and most important step before preparing their *bhasma*. S*hodhana* of metals is divided in two steps viz *samanya shodhana* (general purification) and *vishesha shodhana* (special purification). *Samanya shodhana* is mostly performed by heating the metal up to red hot stage or up to complete melting then quenching for either three or seven times in each liquid media viz *Til taila* (sesame oil), *Takra* (clarified butter), *Gomutra* (cow urine), *Kanji* (sour gruel) and *Kulattha kwatha* (decoction of *Dolichos biflorus Linn*) respectively. *Vishesha shodhana* involve similar procedure of heating or quenching but the liquid media is different for different metals.

Conversion of *Naga* into *bhasma* form is quite difficult process due to low melting point of *Naga*. *Shodhana* help either in the disintegration of molecules or particles of metal to divide them into finest division and to expose maximum surface area of metal/mineral for further process. It means a well did *shodhana* will definitely helpful for the preparation of *Naga bhasma*. Hence, in present work an attempt has been made to develop SOP of *Naga shodhana*.

Aim and objective: To develop SOP of *Naga shodhana*, to study the effect of *shodhana* on *shodhit Naga* and to study the physico-chemical changes in the liquid media used for *shodhana*.

Materials and Methods:

Ashuddha Naga, Tila taila, Takra, Gomutra, Kanji, Kulattha seeds, and *Churnodaka* were used as raw materials. Lead is considered as *Naga* for their similar characteristics and was collected from Pharmacy, Gujarat Ayurved University, Jamnagar and authenticated as per classical texts mentioned.[2,3,4] *Ashuddha Naga* taken for *shodhana* was tested for *Ayurvedic grahya* (acceptable) parameters like quick melting, heavy, have bright black surface and gives black line on rubbing over white paper. (Figure 1) The *ashuddha Naga* was 99.80 % pure. (Table 1) *Til taila, Gomutra* and *Kulattha* seeds were procured from local market of Jamnagar. *Takra, Kanji, Kulattha kwatha* and *Churnodaka* were prepared by adopting the reference of *Sushurata Samhita*[5] *Parada Vidyaniya*[6], *Sharangadhara Samhita*[7] and *Rasatarangini Tarangini*[8] respectively. (Table 2) 6 kg *Naga* was taken for *shodhana* and divided into 6 equal batches. It is advised that liquid media should be taken eight times to that of metal [9] but in present study it was not comfortable due to capacity of available instruments, hence each liquid media were taken double to the *Naga* (gravimetrically). Quenching was done after complete melting of *Naga* and caution were taken to avoided physical injury due to bumping of molten *Naga*. Protection from smoke of media (mainly *Tila taila*) during heating process was taken by wearing mask. Analysis of all samples (liquid media) was done immediately after the process as they are liable to get spoilt. Time taken for complete melting of *Naga* was recorded and analysis of each media was done immediately after completing *shodhana*. DTGA, FTIR and purity of *ashuddha* and *shodhit Naga* was tested to access the changes caused due to *shodhana* .

***Samanya shodhana*:** *Samanya shodhana* was carried out by three times quenching of melted *Naga* in *Til taila, Takra, Kanji, Gomutra* and *Kulattha kwatha* respectively.[10] Each time new liquid media was taken. For 1 kg *Naga* 2 L liquid media was taken. (Figure 1)

Observation and result: During *shodhana* of *Naga* flame caught from second time of quenching in *Tila taila*. (Figure 2 and 3) Pungent smell, hissing sound and a rush of black fumes were observed after quenching and iron ladle turned yellow in colour. (Figure 4) Before first quenching in *Takra*, flam coughed in melted *Naga* due to presence of *Tila Taila*. No significant change in test and odour of all liquid media were observed after quenching. Some part was converted into yellowish powder form after each quenching. Melting time of *Naga* was gradually increased after *shodhana* in each media. Shining of *Naga* was decreased after quenching in *Kanji* and *Gomutra*, while it was significantly decreased and blackish ash was observed floating over melted *Naga* after *shodhana* in *Kulattha kwatha*. (Figure 5) Average time taken for melting of *Naga* in *Tila taila, Takra, Kanji, Gomutra,* and *Kulattha kwatha* were 5.24, 5.92, 6.63, 6.74, and 8.33 min respectively. (Table 3 A and B) Slight changes were observed in the colour, odour, pH, SG and total solid content of all media. (Table 4 to 8)

Vishesh shodhana: *Vishesh shodhana* was done by seven times quenching of melted *Naga* in *Churnodaka* .[11]

Observation and result: Hissing sound was heard while pouring of melted *Naga*. Slight shinning was appeared after *shodhana* in *Churnodaka*. (Figure 6) 84 L *Churnodaka* was utilized for complete *shodhana* of six batches. Average time taken for melting of *Naga* in *Churnodaka* was 8.41 min. Slight changes in colour, odour, pH, SG and total solid content of *Churnodaka* was observed. (Table 9)

Discussion:

The *Shodhana* treatments include media of acidic (eg. *Takra, Kanji*) and alkaline nature (eg.*Churnodaka*) and performed by heating followed by quenching into cold liquid media. This makes the metal brittle, reduces particle size and thus exposes maximum drug to the purifying medium. *Naga* was heated and after melting it was poured for 3 times in *Tila taila, Takra, Gomutra, Kanji and Kulattha Kwatha* in order. In some texts seven times quenching is advised. More the number of quenching more will be brittleness and physico-chemical changes in the metal. For seven times quenching more liquid media, time and human effort is required. Therefore an attempt made to reduce the expenditure, time and human effort by adopting the reference of three times quenching.

The media used are slight acidic, acidic, acidic, slight basic, basic and strong basic in order. The order of quenching is changed by various a*charyas* so the exact reason behind the particular sequence is not explainable. During quenching it was observed that 2 lit. liquid media was sufficient enough for complete immersion of 1 kg *Naga*. *Naga* acquired silver luster after each quenching. This may be because impurities of *Naga* may get attracted towards the chemical components present in the media forming a bond with them. Thus they may get separated. So each time new liquid media was taken. Liquid media may also impart disintegration of which improve the quality of *bhasma*. Intense heating and sudden dipping may create changes in physical as well as chemical properties of *Naga* making it suitable for *bhasma* formation. Gradual increase in melting time is seen while quenching in various liquid media. This may be due to conversion of some part of *Naga* into powder form (PbO). This powdered *Naga* absorbs the liquid media during quenching. The liquid media forms a layer around the metallic *Naga*. When this *Naga* is heated again, liquid media evaporates first which cause delay in rise of temperature. While heating, powder form of *Naga* settles at the bottom of the iron ladle. So there is delay in heat transfer from iron ladle to metallic lead causing delay in rise of temperature. According to *Ayurvedic* point of view, after repeated quenching, the heat stability of *Naga* may increase, causing an increase in time for melting. Some scholars opine that there is increase in melting point of *Naga*, but analytical study proves that there is no significant increase in the melting point. Although *Naga*, which gets converted into powder form (PbO) during *shodhana*, has melting point 888^{0}C. pH, specific gravity and total solid content of each liquid media was slightly increased after quenching of *Naga*, this may be due to slight alkaline nature of *Naga* and dissolution of some part of melted *Naga* or some impurities. Detail analytical study is needed to know the exact reason.

Average 29 gm weight gain was observed after *shodhana* in *Til taila* due to adhesion of *Til taila* while average 41.66, 14.83, 18.05, 15 and 12.66 gm weight loss was noted after *shodhana* in *Takra*, *Kanji*, *Gomutra*, *Kulattha kwatha* and *Churnodaka* respectively. (Table 10 A and B) *Naga* is slightly soluble in alkaline and acidic media and the strong heating converts some particles of *Naga* into PbO, this may be reason behind weight loss.

The purity of *Naga* is slightly decreased from 99.80 to 99.40 (Table 11) while the melting point is slightly increased from 327.46 ^{0}C (Graph 1) to 328.42 ^{0}C (Graph 2) but these differences are not significant. FTIR analysis of *ashuddha Naga* showed various sharp peaks ranging from 3894 to 444 cm^{-1} but they are at low transmittance. (Graph 3) These peaks indicate stretching vibrations between various inorganic molecules. While no such sharp peaks are observed in *shodhita Naga* which indicate significant change in the physico-chemical nature of *Naga*. (Graph 4) The weak peaks between 1398 to 1400 cm^{-1} observed in *shodhita Naga* are assigned to C-H stretching vibration indicative of presence of alkyl compounds specifically methyl bond. A small peak in VSN at 1019.78 cm^{-1} is due to stretching vibration between C-N and assigned to aliphatic amines. Medium C-H stretching vibration peaks of vinyl compounds are appeared in *Shodhita Naga* at 838.26 and 872.39 cm^{-1} respectively are indicative of trisubstituted alkenes. TGA revealed increase in the melting point of *Naga*. The delta Y value for *ashuddha* and *shodhit Naga* are 0.146 (Graph 5) and 3.950 (Graph 6) respectively. The delta Y calculation is used to determine the percentages of organic component. Oxidation of organic compounds present in the *shodhit Naga* samples is indicated by increased value of Delta Y as well as decline occurred in the weight of *Naga* on heating. The endothermic peaks obtained in *ashuddha Naga* at 307.05 is due to different gas evolution while no such peak is obtained in *shodhita Naga*. The report of TGA shows the presence of non-volatile organic compounds in the *shodhita Naga* due to repeated quenching in different media.

Thus, it is understood that Ayurvedic processing of metals/minerals leads to impartation of organic compounds in respective metal/mineral. Present work is related with development of SOP of *Naga shodhana*, the effect of *shodhana* on *shodhit Naga* and physico-chemical changes in the liquid media used for *shodhana*, but to demonstrate the effect of ayurvedic methods of processing of metals/ minerals and to elaborated presence of organic compound in metals/minerals processed through Ayurvedic method, it is essential to mention some latest research works on *Naga bhasma*. Mrudula Wadekar *et al* conducted a comparative study of some representative samples of *Naga bhasma* from chemical and structural point of view by using XRD, IR and UV spectroscopy and thermogravimetry is reported here. This study showed that the *bhasama* samples were predominantly crystalline i.e. mixture of PbO Pb_3O_4. XRD data reveled OH and $(CO_3)_2$ group in all samples.[12,13] S. K. Sing *et al* found that Naga bhasma contains lead in nano-crystalline (~60 nm) lead sulfide form (Pb^{2+}) associated with the organic contents and different nutrient elements coming from the herbs used during the preparation. X-ray diffraction pattern of the *Naga bhasma* showed presence of sharp diffraction peaks indicating highly crystalline nature of the drug. Thus the XRD study concludes the presence of nano-crystalline structure of the drug. The TEM image of the drug sample shows spongy like structure with the irregular particle size in the submicron range. The reason is the use of the organic materials. Due to the organic materials from the herbal source in the preparation of the *bhasma* and heat treatments, the nano size crystallite get agglomerated and give rise to the micro sized particles. These studies confirm that the *bhasma* are nano-crystallte with submicron size particle.[14] S. K. Singh and B. Rai in their research work concluded identified the presence of carbonaceous material (hydrogenated amorphous carbon) *Naga Bhasma*. This study showed that the Ayurvedic process involving repeated heating leads to volatilization of organic compounds (derived from the natural precursors used in the preparation of the medicine) and later conversion into gaseous form, hydrocarbon gases, which first physisorbed and then chemisorbed on to the metallic-particles and thus making organo-metallic compound form.[15]

Conclusion:

Average loss of 6.26 % occurred in *Naga* during the process. Six liters each liquid media is required for *samanya shodhana* and 14 liters for *vishesha shodhana* of 1 kg *Naga*. Percentage of *Naga* before and after *shodhna* differed from 99.80 to 99.40. Increase in SG and total solid content of *shodhana* media indicate dissolution of some particles of *Naga* or some impurities. Time taken for melting of *Naga* after *shodhana* in each media increased, which was evident by increase in melting point before and after *shodhana* i.e. 327.46 ^{0}C to 328.42 ^{0}C respectively. The report of TGA showed the presence of non-volatile organic compounds in *shodhita Naga*. FTIR analysis of *ashuddha Naga* was evident of inorganic molecules while in *shodhita Naga* various organic functional groups like C-H and C-N were found. Analytical finding of *shodhita Naga* were suggestive of organo-metallic complex formation.

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Table 1:- Purity of *Naga* before *shodhana*

Element	**Sn %**	**Sb %**	**Bi%**	**Cu %**	**As %**	**Ag %**	**Zn %**	**Cd %**	**Ni %**
Value	0.131	0.432	0.130	0.033	0.0023	0.0036	0.0004	0.0007	<0.0001

Element	**Ca %**	**Al %**	**Au %**	**Fe %**	**Na %**	**P %**	**S %**	**Pb %**
Value	0.0003	<0.0001	<0.0002	<0.0001	0.0002	0.0068	<0.0015	99.80

Table 2: Ingredients with quantity for preparation of *Kanji, Takra, Kulattha kwatha* and *Churnodaka*:

Sr.no	**Media**	**Name of Ingredient**	**Quantity of Ingredient**	**Yield**
1.	*Kanji*	Rice grains	4 kg	36 lit
2.		Water	50 L	
3.		Mustard oil	50 ml	
4.	*Takra*	Curd	8 L	40 lit
5.		Water	32 L	
6.	*Kulattha kwatha*	*Kulattha* seeds	10 kg	40 Lit
7.		Water	160 L	
8.	*Churnodaka*	*Sudha* (Lime) *churna*	10 kg	85 L
9.		Potable Drinking water	80 L	

Table 3 (A): Average time taken for quenching of *Naga* during *Samanya* and *Vishesh Shodhana* (min)

Batch	Til Taila			Takra			Kanji		
	1st Q	2nd Q	3rd Q	1st Q	2nd Q	3rd Q	1st Q	2nd Q	3rd Q
1	10	5.10	5.05	12.05	6.12	5.25	10.15	6.20	6.10
2	5.15	4.50	5.15	5.10	5.14	5.10	6.40	6.35	6.45
3	5.10	5.10	4.35	6.05	5.45	5.30	6.25	6.30	6.45
4	5.25	5.20	5.12	5.40	6.10	6.10	6.40	7.00	6.50
5	4.55	5.10	5.10	5.35	5.30	5.55	6.45	6.20	6.50
6	5.10	4.45	5.10	5.40	6.40	5.55	7.00	6.30	6.35
Average	**5.85**	**4.90**	**4.97**	**6.55**	**5.75**	**5.47**	**7.10**	**6.39**	**6.39**

*Q=Quenching

Table 3 (B) Average time taken for quenching of *Naga* during *Samanya* and *Vishesh Shodhana* (min)

Batch	Gomutra			Kulattha kwatha			Churnodaka						
	1st Q	2nd Q	3rd Q	1st Q	2nd Q	3rd Q	1st Q	2nd Q	3rd Q	4th Q	5th Q	6th Q	7th Q
1	11.00	6.50	6.45	13.00	7.36	8.00	14	7.45	8.23	8.35	9.00	8.45	8.58
2	7.00	6.40	6.45	8.10	8.12	8.35	9.05	9.10	8.85	9.15	9.10	8.90	9.2
3	6.50	6.55	7.00	7.55	8.05	8.15	8.40	8.5	9.10	8.40	8.55	8.45	8.5
4	6.20	6.35	6.30	8.00	8.15	8.00	8.45	8.60	9.25	8.90	8.90	8.70	9.85
5	6.45	6.32	6.57	8.20	8.10	8.25	9.22	8.60	8.50	9.30	8.95	8.90	8.95
6	6.45	6.32	6.57	8.16	8.20	8.37	9.15	8.90	9.20	9.35	9.37	9.50	9.55
Average	**7.26**	**6.40**	**6.55**	**8.83**	**7.99**	**8.18**	**9.71**	**8.52**	**8.85**	**8.90**	**8.97**	**8.81**	**9.10**

Table 4: Physicochemical properties of *Tila taila* before and after *Shodhana* :

Test	Colour		Odour		pH		Refractive index		Acid value		S.G.		Total solid content	
	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ
1st Q	Brown	Blackish Brown	Typical	Slight Burning	6.66	6.11	1.614	1.615	4.70	4.32	0.9188	0.9201	0.006	0.065
2nd Q	Brown	Blackish Brown	Typical	Slight Burning	6.66	6.09	1.614	1.616	4.70	4.36	0.9188	0.9217	0.006	0.060
3rd Q	Brown	Blackish Brown	Typical	Slight Burning	6.66	6.08	1.614	1.167	4.70	4.35	0.9188	0.9201	0.006	0.068

***BQ=Before quenching, AQ=After quenching, S.G.=Specific gravity**

Table 5: Physico-chemical properties of *Takra* before and after *Shodhana* :

Test	Colour		Odour		Taste		pH		S.G.		Total solid content	
	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ
1st Q	Milky	Slight Blackish	Typical	Typical	Acidic	Acidic	5.08	5.09	1.0067	1.0088	0.07	0.110
2nd Q	Milky	Slight Blackish	Typical	Typical	Acidic	Acidic	5.08	6.2	1.0067	1.0091	0.07	0.114
3rd Q	Milky	Slight Blackish	Typical	Typical	Acidic	Acidic	5.08	6.1	1.0067	1.0092	0.07	0.112

Table 6: Physico-chemical properties of *Kanji* before and after *Shodhana* :

Test	Colour		Odour		Taste		pH		S.G.		Total solid content	
	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ
1st Q	Transparent milky	Turbid milky	Amla Gandha	Amla Gandha	Acidic	Acidic	3	3	1.009	1.0112	0.102	0.138
2nd Q	Transparent milky	Turbid milky	Amla Gandha	Amla Gandha	Acidic	Acidic	3	3.5	1.009	1.0115	0.102	0.141
3rd Q	Transparent milky	Turbid milky	Amla Gandha	Amla Gandha	Acidic	Acidic	3	3.5	1.009	1.0119	0.102	0.140

Table 7: Physicochemical properties of *Gomutra* before and after *Shodhana* :

Test	Colour		Odour		Taste		pH		S.G.		Total solid content	
	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ
1st Q	Pale Yellow	Slight blackish	Typical	Slight burning	Slight Salty	Slight Salty	7.5	7.5	1.0252	1.0269	0.086	0.115
2nd Q	Pale Yellow	Slight blackish	Typical	Slight burning	Slight Salty	Slight Salty	7.5	7.5	1.0252	1.0274	0.086	0.121
3rd Q	Pale Yellow	Slight blackish	Typical	Slight burning	Slight Salty	Slight Salty	7.5	7.5	1.0252	1.0279	0.086	0.118

Table 8: Physico-chemical properties of *Kulattha Kwatha* before and after *Shodhana* :-

Test	Colour		Odour		Taste		pH		S.G.		Total solid content	
	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ
1st Q	Brown	Blackish Brown	Typical	Slight burning	Kashaya	Kashaya	5.2	5.7	1.0359	1.0356	0.136	0.184
2nd Q	Brown	Blackish Brown	Typical	Slight burning	Kashaya	Kashaya	5.2	5.5	1.0359	1.0361	0.136	0.190
3rd Q	Brown	Blackish Brown	Typical	Slight burning	Kashaya	Kashaya	5.2	6.00	1.0359	1.0368	0.136	0.185

Table 9: Physico-chemical properties of *Churnodak* before and after *Shodhana*

Test	Colour		Odour		pH		S.G.		Total solid content	
	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ	BQ	AQ
1st Q	Mild Milky	Slight Blackish	Non-specific	Non-specific	10.75	10.98	1.0019	1.0023	0.095	0.177
2nd Q	Mild Milky	Slight Blackish	Non-specific	Non-specific	10.75	10.87	1.0019	1.0031	0.095	0.185
3rd Q	Mild Milky	Slight Blackish	Non-specific	Non-specific	10.75	10.90	1.0019	1.0030	0.095	0.180

Table 10 (A):- Weight of *Naga* before and after *Samanya* and *Vishesha Shodhana*

Batch no.	*Tila Taila*			*Takra*			*Kanji*		
	BS (g)	AS(g)	% change	BS	AS(g)	% change	BS	AS	% change
I	1000	1000	0	1000	979	0.9	979	970	0.91
1I	1000	1009	0.9	1009	930	0.93	930	910	0.21
III	1000	1069	6.9	1069	994	0.92	994	972	1.20
IV	1000	1030	3.0	1030	985	0.95	985	979	0.60
V	1000	1020	2.0	1020	993	0.97	993	981	0.90
VI	1000	1046	4.6	1046	997	0.99	997	982	1.30
Average	**1000**	**1029**	**2.9**	**1029**	**979.6**	**0.943**	**979.6**	**965.6**	**0.853**

BS=Before *shodhana*, AS=After *shodhana

Table 10 (B):- Weight of *Naga* before and after *Samanya* and *Vishesha Shodhana*

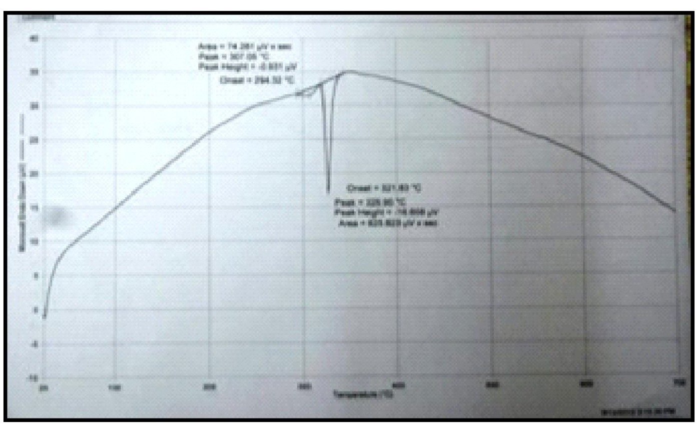
Batch no.	Wt. of *Naga* before and after *shodhana*								
	Go-mutra			**Kulattha Kwatha**			**Churnodak**		
	BS	**AS**	**% change**	**BS**	**AS**	**% change**	**BS**	**AS**	**% change**
I	970	946	2.47	946	940	0.52	940	935	0.53
1I	910	887	2.52	887	876	1.24	876	872	0.45
III	972	963	0.92	963	921	4.06	921	988	0.72
IV	979	961	1.83	961	948	1.25	948	944	0.42
V	981	964	1.73	964	950	1.45	945	940	0.52
VI	982	962	2.03	962	951	0.93	950	945	0.52
Average	**965.6**	**947.16**	**1.916**	**947.16**	**931**	**1.57**	**930**	**937.33**	**0.526**

Table 11:- Purity testing of *Naga* after *shodhana*

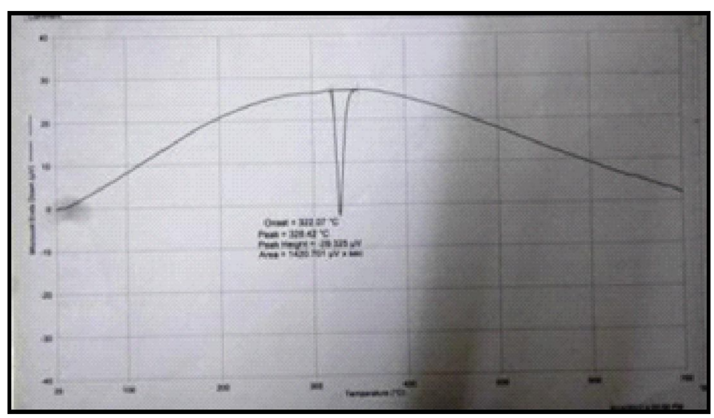
Element	**Sn %**	**Sb %**	**Bi%**	**Cu %**	**As %**	**Ag %**	**Zn %**	**Cd %**	**Ni %**
Value	0.0330	0.119	<0.005	0.0013	0.0003	0.0003	0.0006	<0.0001	<0.0001

Element	**Ca %**	**Al %**	**Au %**	**Fe %**	**Na %**	**P %**	**S %**	**Pb %**
Value	0.0003	<0.0001	<0.0006	<0.0001	0.0001	0.0068	<0.0015	99.40

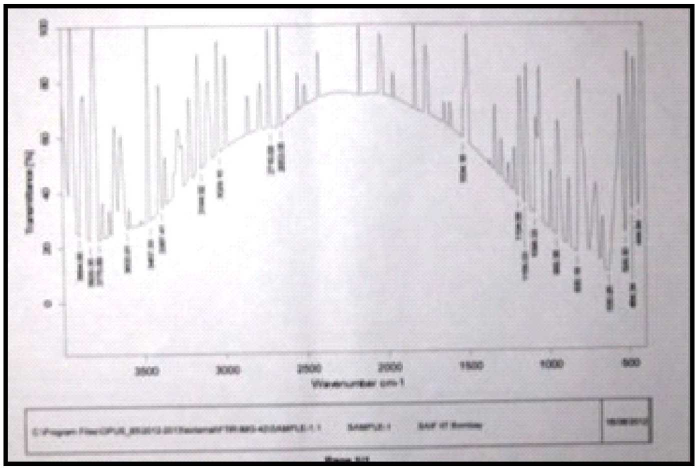
Graphs:-



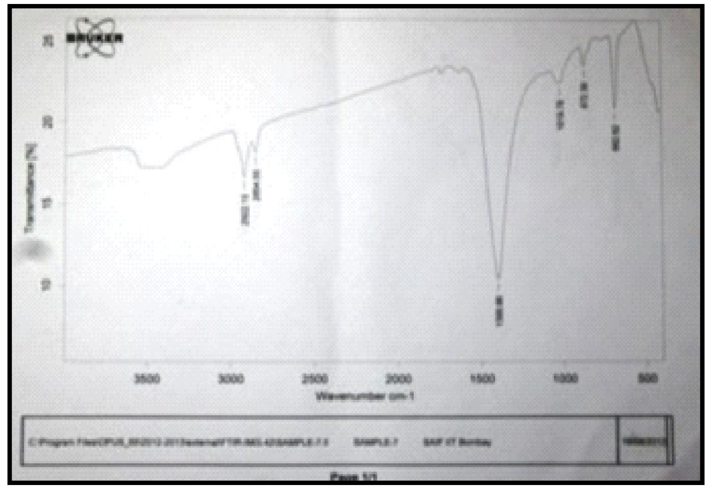
Graph 1: Melting point of *Ashuddha Naga* (TGA)



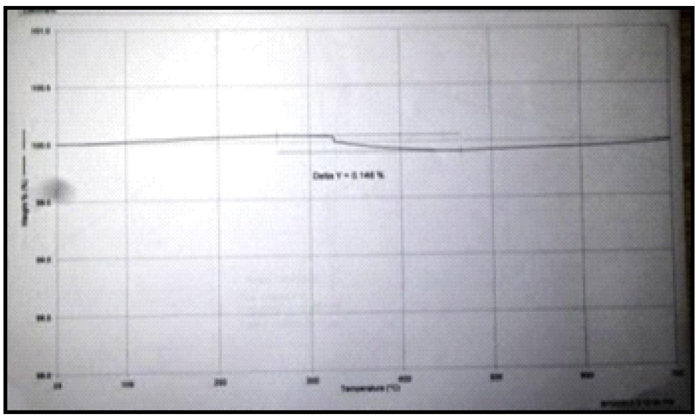
Graph 2: Melting point of *Shodhita Naga* (TGA)



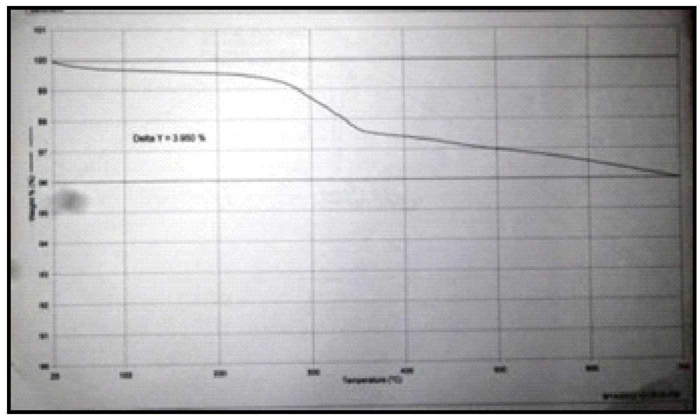
Graph 3: FTIR analysis of *Ashuddha Naga*



Draph 4: FTIR analysis of *Shodhita Naga*



Graph 5: Delta peak of *Ashuddha Naga* (TGA)



Graph 6: Delta peak of *Shodhita Naga* (TGA)

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Conflict of Interest : None