



Pharmaceutical Standardization

Standardization of *Shodhita Naga* with special reference to thermogravimetry and infra-red spectroscopy

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Abstract

Background: Standardization of Ayurvedic medicine is the need of hour to obtain desired quality of final product. *Shodhana* literally means purification, is the initial step to make drugs like metals, minerals and poisonous herbs suitable for further procedure. *Shodhana* of metals/minerals help to expose maximum surface area of drug for chemical reactions and also in impregnation of organic materials and their properties in the drug. Thermo-gravimetric analysis (TGA) facilitates in identifying the presence of organic matter and change in the melting point of metal whereas Fourier transform infra-red spectroscopy (FTIR) assists in identifying the presence of various functional groups. **Aim:** To standardize the process of *Naga Shodhana* and to study the change in chemical nature of *Shodhita Naga* in each media through TGA and FTIR. **Material and Methods:** *Samanya* and *Vishesha Shodhana* of *Naga* was carried out. Time taken for melting of *Naga*, physico-chemical changes in media used for *Shodhana* and weight changes after *Shodhana* were recorded. Samples of *Naga* were collected after *Shodhana* in each media for TGA and FTIR analysis. **Results:** Average loss occurred during *Shodhana* was 6.26%. Melting point of *Ashuddha Naga* was 327.46°C, and it was 328.42°C after *Shodhana*. Percentage purity of *Naga* (percentage of lead in *Naga*) decreased after *Shodhana* from 99.80% to 99.40%. FTIR analysis of *Shodhita Naga* in each sample showed stretching vibrations particularly between C-H and C-N bonds that are indicating the presence of various organic compounds. **Conclusion:** According to TGA and FTIR analysis, *Shodhana* process increases melting point of *Naga* and initiation of new physico-chemical properties which are indicated by detection of large number of functional groups and organo-metallic nature of *Shodhita Naga*.

Key words: Fourier transform infra-red spectroscopy, *Naga*, *Shodhana*, standardization, thermo-gravimetric analysis

Introduction

Rasashastra consists of study of Mercury along with a number of metals, minerals, gems, many plants and animals products. In *Rasashastra*, thousands of medicinal formulations are mentioned, which contain incinerated metals/minerals as essential and major ingredients. As, metals/minerals contains toxic properties, they are to be subjected to specified classical procedure that remove some of the physical and chemical

impurities. These processes also help to potentiate the therapeutic property of metal/mineral. *Shodhana* literally means “purification” or “to purify” is one such method in which metals/minerals are processed with specific liquid media and involves procedures like *Swedana* (boiling), *Mardana* (trituration) etc.^[1] In other words *Shodhana* is the process of detoxification, which involves application of various unit operative procedures like mixing, grinding, heating etc., to minimize or remove the toxic properties and to impart desired qualities in the material.

Samanya (general) and *Vishesha* (special) *Shodhana* methods have been explained in classics. *Samanya Shodhana* is conducted by sequential quenching of heated metal/mineral in liquid medias like *Tila Taila* (sesame oil), *Takra* (butter milk), *Kanji* (fermented sour gruel), *Gomutra* (cow urine) and *Kulattha Kwatha* (decoction of seeds of *Dolichos biflorus*

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Linn);^[2] while for *Vishesha Shodhana* different medias are preferred for different metals/minerals. But, the effect of *Shodhana* procedure on the chemical properties of metal is not clearly known. *Naga* (lead) was selected for present work and an attempt has been made to study the effect of each media on *Naga* through thermogravimetry and Fourier transform infra-red spectroscopy (FTIR).

Materials and Methods

Materials

Ashuddha Naga (raw lead), *Tila Taila*, *Takra*, *Gomutra*, *Kanji*, seeds of *Kulattha*, and *Churnodaka* (lime water) were used as raw materials. *Ashuddha Naga* was collected from Pharmacy, Gujarat Ayurved University, Jamnagar and authenticated as per the qualities mentioned in classical texts.^[3] *Tila Taila*, *Gomutra* and *Kulattha* seeds were procured from the local market. *Takra*, *Kanji*, *Kulattha Kwatha* and *Churnodaka* were prepared by adopting the reference of *Sushruta Samhita*^[4] *Parada Vigyaniya*,^[5] *Sharangadhara Samhita*^[6] and *Rasatarangini*^[7] respectively.

Methods

Ashuddha Naga (3 kg) was collected, divided into three equal batches and subjected for both *Samanya* and *Vishesha Shodhana*. *Samanya Shodhana* was carried out by quenching molten lead thrice in *Tila Taila*, *Takra*, *Kanji*, *Gomutra* and *Kulattha Kwatha* respectively.^[8] Each time 2 l of fresh liquid was taken. *Vishesha Shodhana* was done by quenching molted *Naga* in *Churnodaka* for 7 times.^[9] For thermo-gravimetric analysis (TGA) and FTIR, 30 g of sample was separated after completing *Shodhana* in each media. Analysis of all liquid medias was done immediately after the process.

Procedure

For *Samanya Shodhana* of *Naga* 2 l of *Tila Taila* was taken in *Pithara Yantra* (a specially prepared iron vessel with a lid having a central hole of 2 cm in diameter). *Ashuddha Naga* was heated in an iron ladle and the molten metal was quenched in *Tila Taila*. After 5 min, *Naga* was collected. This process of quenching in *Tila Taila* for two more times using fresh *Taila*. Similar quenchings were continued in further liquids viz., *Takra*, *Kanji*, *Gomutra* and *Kulattha Kwatha*. *Vishesha Shodhana* of *Naga* (VSN) was done by 7 times quenching in *Churnodaka*. For each batch and for each quenching 2 l fresh *Churnodaka* was utilized. Caution was taken to prevent physical injury while quenching due to bumping of molten *Naga*.

Required equipments with specification

- Iron ladle – length: 89.5 cm, diameter of body: 15 cm, depth: 5 cm, capacity: 800 ml
- *Pithara Yantra* – body height: 30 cm, diameter: 17 cm; Lid - shape: Conical, diameter of the hole: 2 cm, capacity: 5800 ml
- Burner: 20 cm diameter
- Other - electric weighing machine; stainless steel vessels, measuring pot and spoon.

Observations and Results

Flame was caught in melted *Naga* during *Samanya Shodhana* from 2nd quenching in *Tila Taila*. Pungent smell, hissing sounds and a rush of black fumes were observed after quenching and iron ladle turned to yellowish. Appearance of flame was continued up to first quenching in *Takra*, possibly due to the presence of *Tila Taila*. No significant change in taste and odor in liquid media was observed after quenching. Some part was converted into yellowish powder 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*. Shining of *Naga* was significantly decreased, and blackish ashes were observed floating over melted *Naga* after *Shodhana* in *Kulattha Kwatha*. Average time taken for melting of *Naga* in *Tila Taila*, *Takra*, *Kanji*, *Gomutra*, and *Kulattha Kwatha* were 5.5, 6.17, 6.73, 7.09, and 851 min respectively [Tables 1-2]. Total 18 l each liquid media was utilized for *Samanya Shodhana* for three batches of *Naga*. Slight changes were observed in the color, odor, pH, specific gravity (SG) and total solid content of all media. During VSN, hissing sound was observed during quenching. Slight shining was appeared after *Shodhana* in *Churnodaka*. Total 42 l of *Churnodaka* was utilized for complete *Shodhana* of *Naga* in three batches. Average time taken for melting of *Naga* in *Churnodaka* was 8.91 min. Slight changes in color, odor, pH, SG and total solid content of *Churnodaka* was observed [Table 3]. Average percent decrease in weight after *Samanya* and VSN were 8.77 and 6.84 respectively [Tables 4-6].

Percent purity of *Naga* was decreased from 99.80 to 99.40 [Table 7] TGA study showed a slight increase in melting point of *Naga* and presence of some organic matter. FTIR spectra of all samples were taken in the region of 670–3400 cm⁻¹. General overview of all the samples indicate the presence of a large number of functional groups. Different peaks of stretching vibrations between various bonds specially C-H and C-N was observed in the samples of *Naga*.

Discussion

Shodhana concept was in existence since the time of *Charaka Samhita* as while enumerating the fundamentals necessary of *Gunantaradhana*.^[10] The concept has further developed after the development of *Rasashastra* in the field of Ayurvedic medicine. In *Rasashastra*, generally metals/minerals and certain poisonous herbal drugs are processed through *Shodhana* to reduce their toxic nature. Repeated heating followed by quenching in various liquid medias is the basic method for *Shodhana* of metals. Repetition of heating and cooling disrupt the equilibrium between molecules and thus increases brittleness, reduces hardness and particle size of metal.

The media *Tila Taila*, *Takra*, *Kanji*, *Gomutra*, *Kulattha Kwatha* and *Churnodaka* are slight acidic, acidic, acidic, slight basic, basic and strong basic in order. The order of quenching is changed by various Acharyas, so the exact reason behind the particular sequence is not explainable. For *Naga Shodhana*, it was mentioned that 1 l of liquid is sufficient for immersion of 1 kg melted *Naga*^[9] but brittleness increases with an increase

Table 1: Average time taken for quenching of Naga during Samanya Shodhana (min)

Batch	Tila Taila			Takra			Kanji		
	1 st Q	2 nd Q	3 rd Q	1 st Q	2 nd Q	3 rd Q	1 st Q	2 nd Q	3 rd 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
Average	6.75	4.9	4.85	7.73	5.57	5.216	7.6	6.28	6.33

Q: Quenching

Table 2: Average time taken for quenching of Naga during Samanya and Vishesha Shodhana (min)

Batch	Gomutra			Kulattha Kwatha			Churnodaka						
	1 st Q	2 nd Q	3 rd Q	1 st Q	2 nd Q	3 rd Q	1 st Q	2 nd Q	3 rd Q	4 th Q	5 th Q	6 th Q	7 th 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
Average	8.16	6.48	6.63	9.55	7.84	8.16	10.48	8.35	8.72	8.63	8.88	8.6	8.76

Q: Quenching

Table 3: Physico-chemical properties of media BQ and AQ of Naga

Media	Color	Odor	pH	RI	SG	TSC
<i>Tila Taila</i>						
BQ	Blackish brown	Typical	6.66	1.614	0.9188	0.006
AQ	Typical	Slight burning	6.1	1.616	0.9217	0.065
<i>Takra</i>						
BQ	Milky	Typical	5.08	-	1.0067	0.07
AQ	Slight blackish	Typical	6.2	-	1.0091	0.114
<i>Kanji</i>						
BQ	Transparent milky	<i>Amla Gandha</i>	3	-	1.009	0.102
AQ	Turbid milky	<i>Amla Gandha</i>	3	-	1.0115	0.141
<i>Gomutra</i>						
BQ	Pale yellow	Typical	7.5	-	1.0252	0.086
AQ	Slight blackish	Slight burning	7.5	-	1.0274	0.121
<i>Kulattha Kwatha</i>						
BQ	Brown	Typical	5.2	-	1.0359	0.136
AQ	Blackish brown	Slight burning	5.5	-	1.0361	0.190
<i>Churnodaka</i>						
BQ	Mild milky	Nonspecific	10.75	-	1.0019	0.095
AQ	Slight blackish	Nonspecific	10.87	-	1.0031	0.185

BQ: Before quenching, AQ: After quenching, SG: Specific gravity, RI: Refractive index, TSC: Total solid content

Table 4: Weight of Naga before and after Samanya and Vishesha Shodhana

Batch number	Tila Taila			Takra			Kanji		
	BS (g)	AS (g)	Percentage change	BS	AS (g)	Percentage change	BS	AS	Percentage change
1	1000	1000	0	1000	979	0.9 ↓	979	970	0.91 ↓
2	1000	1009	0.9 ↑	1009	930	0.93 ↓	930	910	0.21 ↓
3	1000	1069	6.9 ↑	1069	994	0.92 ↓	994	972	1.20 ↓
Average	1000	1026	2.6 ↑	1026	967.66	0.916 ↓	967.6	950.6	0.77 ↓

BS: Before Shodhana, AS: After Shodhana

in the quantity of liquid media. Kulkarni DA advised to take liquid media 8 times to that of metal.^[11] In pilot study, it is observed that double quantity of liquid media (i.e. 2 l) is

sufficient for complete immersion as well as to get enough brittleness, therefore in present work double quantity of liquid media was taken for *Naga Shodhana*. *Naga* acquired silver luster

Table 5: Weight of Naga before and after Samanya and Vishesha Shodhana

Batch number	Go-mutra			Kulattha Kwatha			Churnodak		
	BS	AS	Percentage change	BS	AS	Percentage change	BS	AS	Percentage change
1	970	946	2.47 ↓	946	940	0.52 ↓	940	935	0.53 ↓
2	910	887	2.52 ↓	887	876	1.24 ↓	876	872	0.45 ↓
3	972	963	0.92 ↓	963	921	4.06 ↓	921	988	0.72 ↑
Average	950.6	932	1.97 ↓	932	912.3	1.94 ↓	912.3	931.6	0.56 ↑

BS: Before Shodhana, AS: After Shodhana

Table 6: Weight of Naga before and after Samanya and Vishesha Shodhana

Batch number	Initial	After Samanya Shodhana		After Vishesha Shodhana	
		Percentage change (compared to initial wt)	Percentage change (compared to initial wt)	Percentage change (compared to initial wt)	Percentage change (compared to initial wt)
1	1000	940	6 ↓	935	6.5 ↓
2	1000	876	12.4 ↓	872	12.8 ↓
3	1000	921	7.9 ↓	988	1.2 ↓
Average	1000	912.3	8.77 ↓	931.6	6.84 ↓

Table 7: Purity testing of Naga

Element (%)	Value	
	BS	AS
Sn	0.131	0.0330
Sb	0.432	0.119
Bi	0.130	<0.005
Cu	0.033	0.0013
As	0.0023	0.0003
Ag	0.0036	0.0003
Zn	0.0004	0.0006
Cd	0.0007	<0.0001
Ni	<0.0001	<0.0001
Ca	0.0003	0.0003
Al	<0.0001	<0.0001
Au	<0.0002	<0.0006
Fe	<0.0001	<0.0001
Na	0.0002	0.0001
P	0.0068	0.0015
S	<0.0015	<0.0015
Pb	99.80	99.40

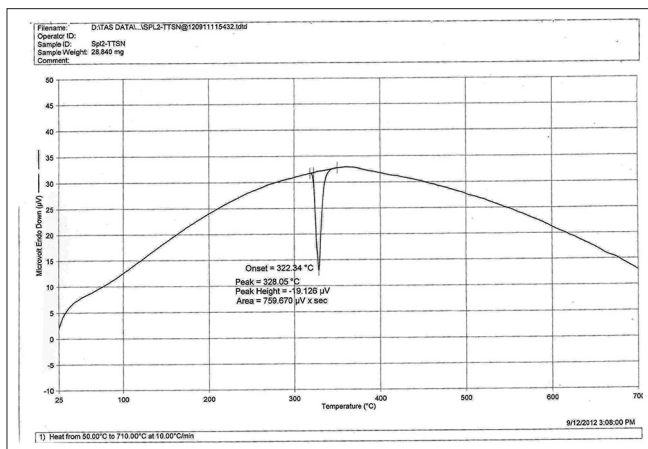
BS: Before Shodhana, AS: After Shodhana

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 and thus they may get separated. So each time new liquid media was taken. 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 medias. This may be due to conversion of some part of Naga into powder form (PbO). This powdered Naga absorbs liquids during quenching. The liquid media forms a layer around the metallic Naga. When this Naga is heated again, liquid media evaporates first, which may be the cause for longer melting time. According to Ayurvedic point of view, after repeated quenching, the heat stability of Naga may

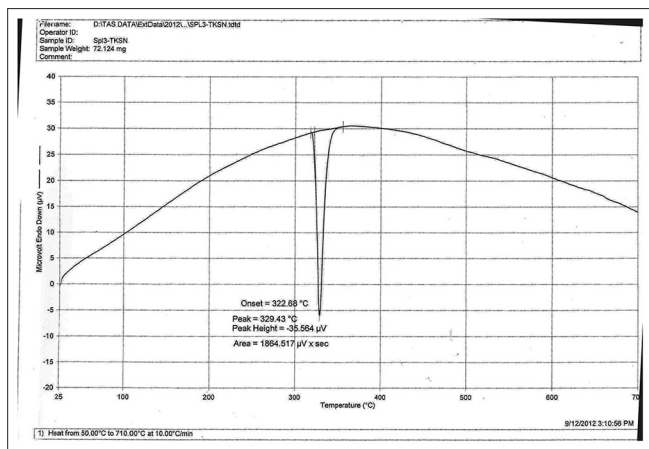
increases, causing an increase in time for melting. Some scholars opine that there is an increase in melting point of Naga,^[12] but the analytical study proves that there is no significant increase in the melting point. pH, SG and total solid content of each liquid media was slightly increased after quenching of Naga, this may be due to slight alkaline nature of Naga and dissolution of some part or impurities from melted Naga. Detail analytical study is needed to know the exact reason.

Increasing pattern of temperature at the rate of 10°C/min was adopted for TGA analysis, maximum temperature given was 710°C. Raw Naga has a melting point 327.46°C. A regular increase and decrease is observed in the melting point of Naga after Shodhana in each media. TGA showed melting point of Tila Taila Shodhita Naga (TTSN), Takra Shodhita Naga (TKSN), Samanya Shodhita Naga (SSN) and VSN as 328.05 [Graph 1], 329.43 [Graph 2], 326.74 [Graph 3] and 328.42°C [Graph 4] respectively. Melting point was decreased in Kanji Shodhita Naga (KSN) and Gomutra Shodhita Naga (GSN), which are 326.90 [Graph 5] and 325.34°C [Graph 6] respectively. The endothermic peaks obtained in KSN, GSN and SSN at 307.05, 302.97 and 295.23 are due to formation of different gases. The delta-Y calculation was used to determine the percentages of the organic component. Oxidation of organic compounds present in the Shodhita Naga samples is indicated by increased value of delta-Y as well as the decline occurred in the weight of Naga on heating. As in the observation the corresponding value of delta-Y in TTSN and TKSN is negligible, but in KSN it is slightly increased and in GSN and SSN significant change is observed [Graphs 7-12]. Repeated heating and sudden cooling in various organic media leads to impart some organic matter and thus resulted in decreasing the purity of Naga from 99.40% to 99.80%. TGA also showed the presence of nonvolatile organic compounds in the material due to repeated quenching of Naga in different media.

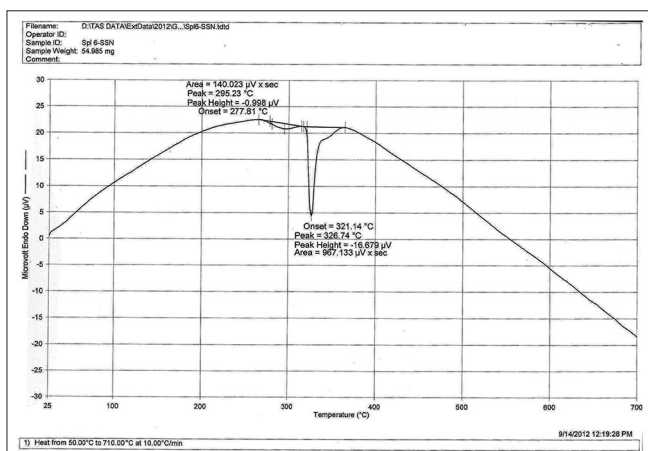
FTIR was performed to detect the presence of functional groups or organic legends in all samples of Naga collected after Shodhana in each media. General overview of FTIR spectra of all the samples indicates the presence of a large



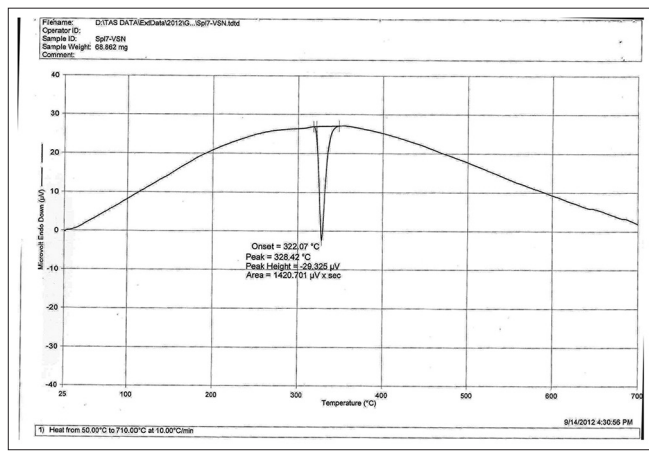
Graph 1: Melting point obtained in thermo-gravimetric analysis of Tila Taila Shodhita Naga



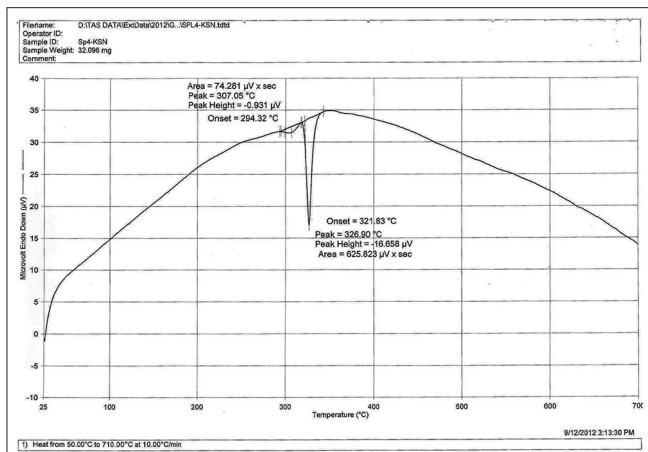
Graph 2: Melting point obtained in thermo-gravimetric analysis of Takra Shodhita Naga



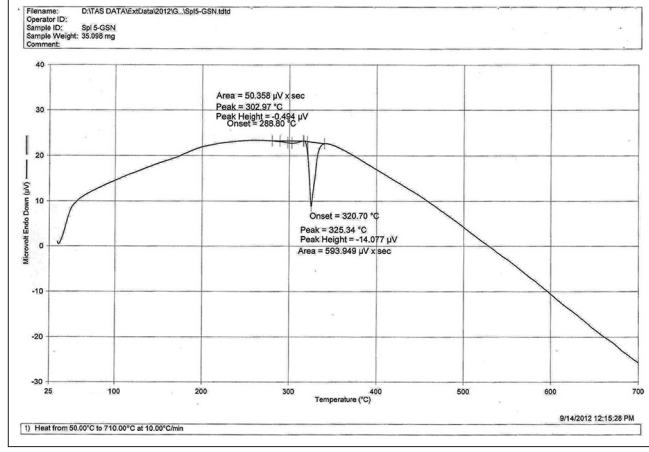
Graph 3: Melting point obtained in thermo-gravimetric analysis of Samanya Shodhita Naga



Graph 4: Melting point obtained in thermo-gravimetric analysis of Vishsha Shodhita Naga



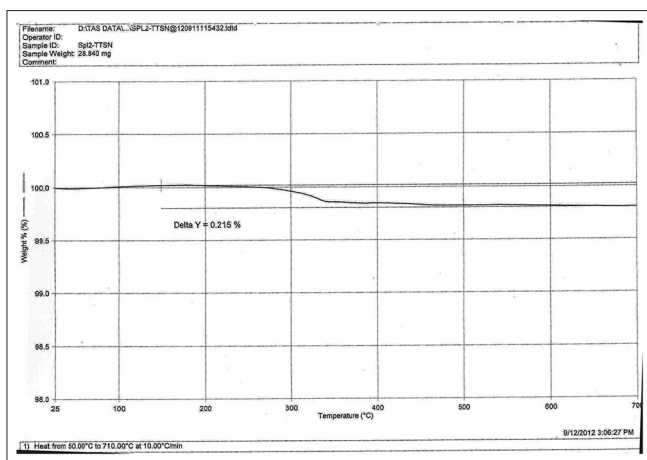
Graph 5: Melting point obtained in thermo-gravimetric analysis of Kanji Shodhita Naga



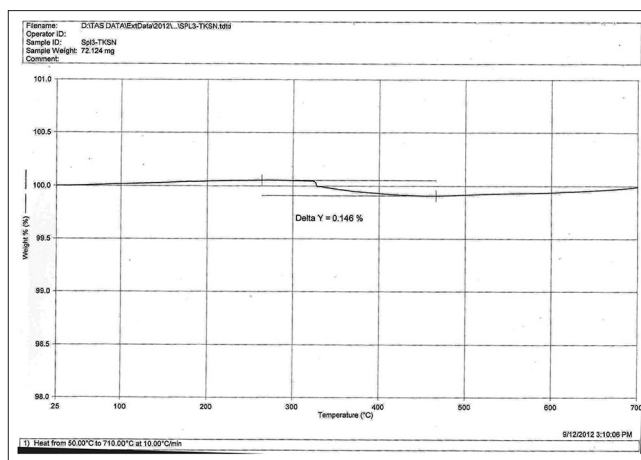
Graph 6: Melting point obtained in thermo-gravimetric analysis of Gomutra Shodhita Naga

number of functional groups. The broad peak at 3435.57 cm^{-1} observed in TTSN is ordinary due to various O-H and N-H stretching vibrations indicating bond type similar to alcohol or phenol group. The medium to strong absorption peak around

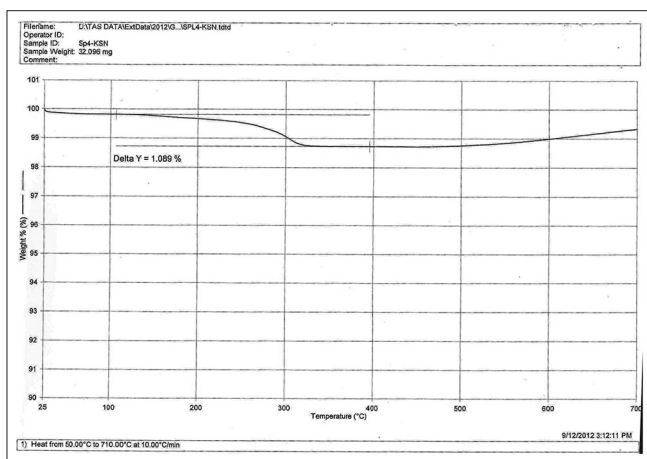
2850–2925 cm^{-1} in all samples are assigned to C-H stretching vibration in alkyl compounds that may be characterized by the presence of high content of methylene in the complex mixture of these metallic compounds. The presence of peaks around 1730–1740 cm^{-1} in TKS and SSN was assigned as carboxylic



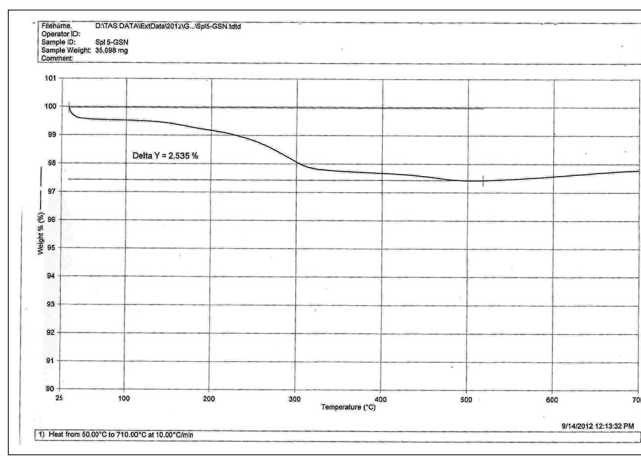
Graph 7: Delta-Y peak in thermo-gravimetric analysis of Tila Taila Shodhita Naga



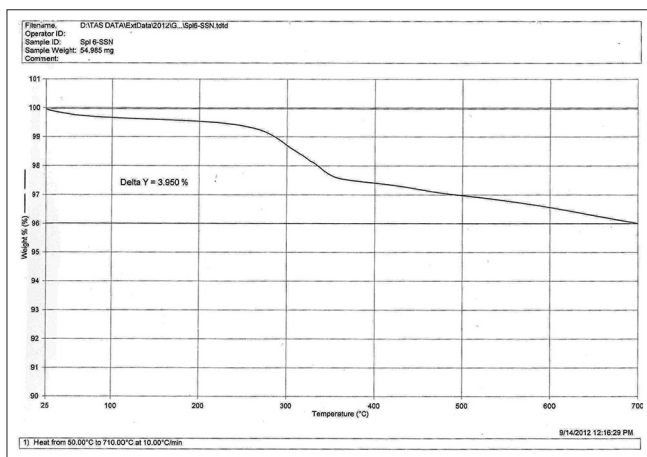
Graph 8: Delta-Y peak in thermo-gravimetric analysis of Takra Shodhita Naga



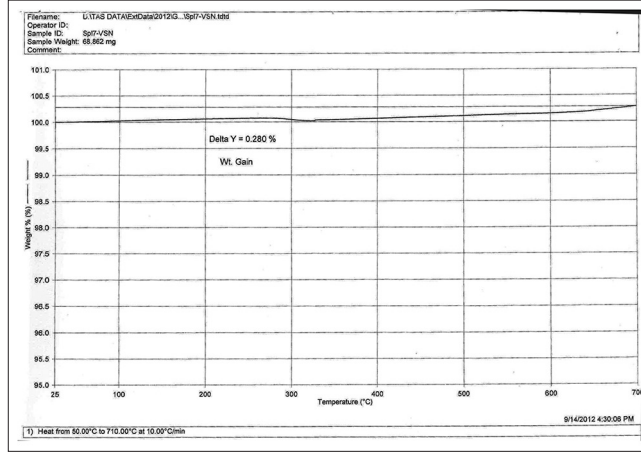
Graph 9: Delta-Y peak in thermo-gravimetric analysis of Kanji Shodhita Naga



Graph 10: Delta-Y peak in thermo-gravimetric analysis of Gomutra Shodhita Naga



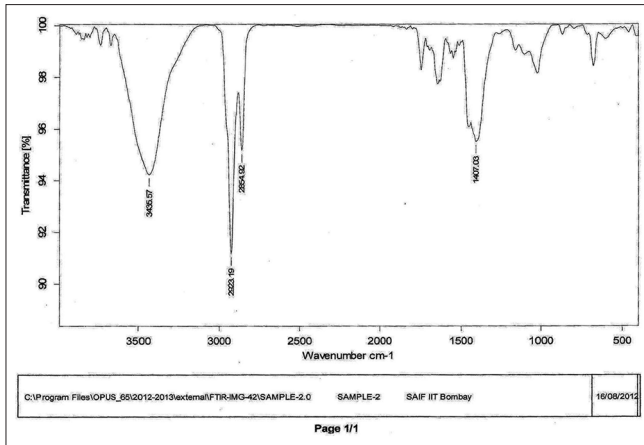
Graph 11: Delta-Y peak in thermo-gravimetric analysis of Samanya Shodhita Naga



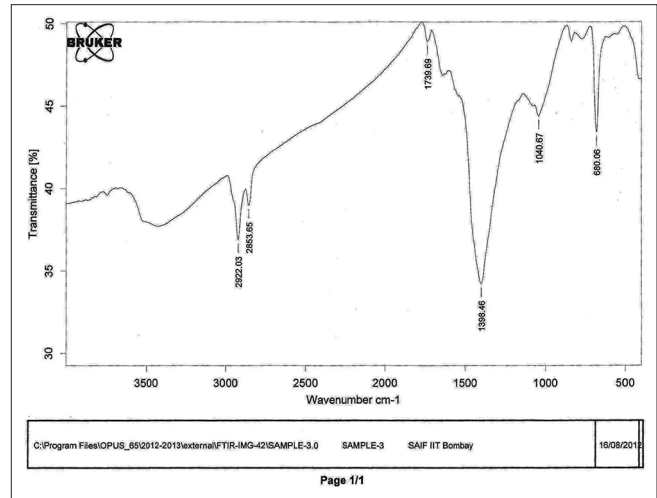
Graph 12: Delta-Y peak in thermo-gravimetric analysis of Vishesha Shodhita Naga

acid group. It was further assigned as C = O stretching vibration indicates presence of esters and lactones compounds. The carbonyl stretching vibration is characterized by absorption through the double bond region between 1950 and 1550 cm⁻¹.

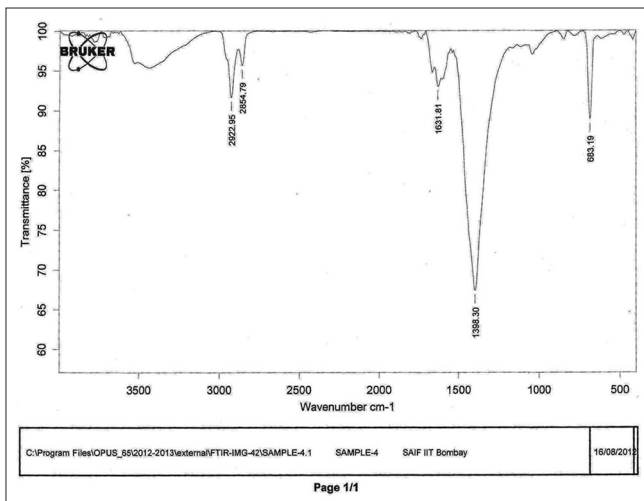
Ketones, aldehydes, acids, amides and carbonates all have absorption peaks around 1700 cm⁻¹. Esters, chlorides and acid aldehydes tend to absorb at slightly higher wavelengths; that is 1770–1725 cm⁻¹. Conjugation tends to lower the



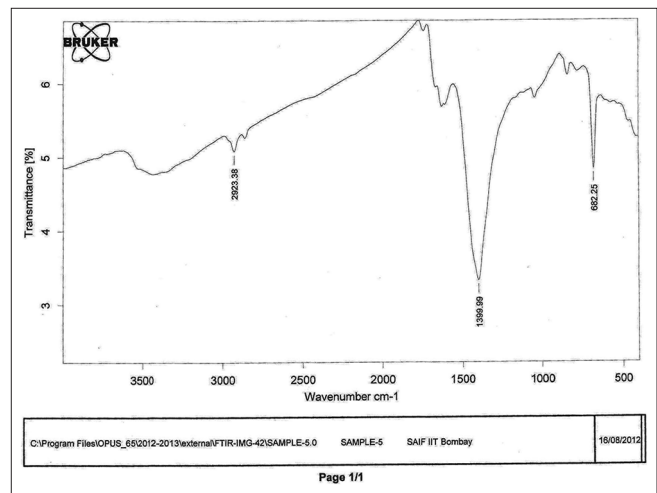
Graph 13: Fourier transform infra-red spectroscopy analysis of Tila Taila Shodhita Naga



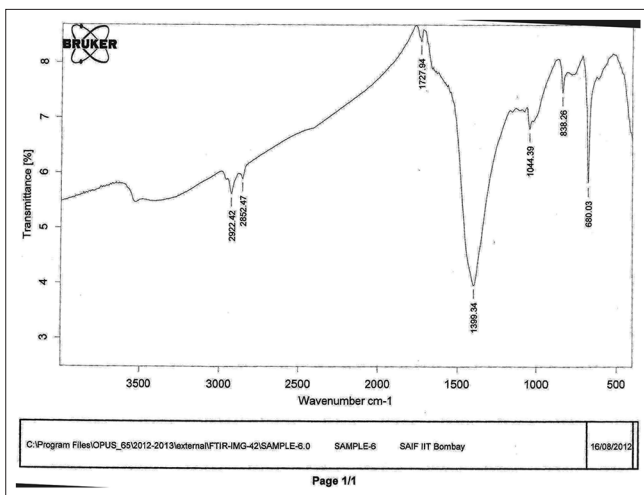
Graph 14: Fourier transform infra-red spectroscopy analysis of Takra Shodhita Naga



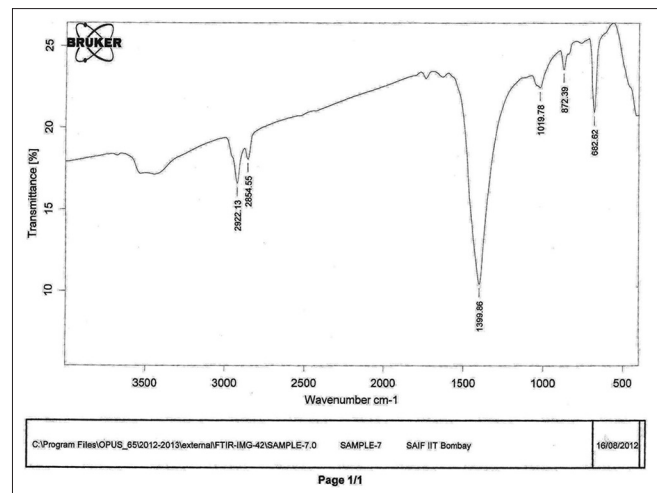
Graph 15: Fourier transform infra-red spectroscopy analysis of Kanji Shodhita Naga



Graph 16: Fourier transform infra-red spectroscopy analysis of Gomutra Shodhita Naga



Graph 17: Fourier transform infra-red spectroscopy analysis of Samanya Shodhita Naga



Graph 18: Fourier transform infra-red spectroscopy analysis of Vishsha Shodhita Naga

absorption peaks by about 20 cm⁻¹. It is frequently impossible to determine the type of carbonyl that is present solely on the basis of absorption in this region; however, examination

of additional spectral region may provide evidence needed for clear-cut identification.

The peak region between 1500 and 700 cm^{-1} is known as fingerprint region. A small difference in the structure and constitution of a molecule result in significant changes in the distribution peaks in this region of the spectrum. Most single bonds give rise to absorption bands at these frequencies. The presence of peaks at 1407.03 cm^{-1} in TTSN was assigned to aromatic bond and arises due to C-C stretching vibration. The weak peaks between 1398 and 1400 cm^{-1} observed in TKS_N, KSN, GSN, SSN and VSN are assigned to C-H stretching vibration indicative of the presence of alkyl compounds specifically methyl bond. Symmetric stretching was observed in TKS_N and SSN at 1040.67 and 1044.39 cm^{-1} are indicating presence of primary alcohol group. 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 SSN and VSN at 838.26 and 872.39 respectively are indicative of trisubstituted alkenes. Similar C-H stretching vibration peaks of vinyl compounds are observed in the region 670–700 cm^{-1} in all samples except TTSN but indicating cis-disubstituted alkenes. Thus, the FTIR study explores that *Shodhana* help in the impregnation of organic materials and their properties in the drug, making an organo-metallic forms compound. In addition to above, some minerals are also added to *Shodhita* materials that from the chemical point of view may be considered as impurities but from the therapeutic point of view may prove useful in potentiating their therapeutic effects. Observed functional groups in FTIR analysis support presence of minerals but more advanced analytical studies are needed to find out exact nature of those minerals. *Shodhana* process also helps to convert metal/mineral for further pharmaceutical process like *Jarana* and *Marana*. In presence study as per adopted reference of *Sharangadhara Samhita*, 3 times quenching of *Naga* was done for *Shodhana*, which leads to impregnation of some organic materials and conversion of *Ashuddha Naga* into organo-metallic form. From these results, it can be assumed that *Shodhita Naga* will be more organo-metallic if *Shodhana* carried out by adopting the reference in which 7 times quenching is preferred [Graphs 13-18].

Conclusion

TGA and FTIR are useful technologies to recognize the effect of Ayurvedic method of *Shodhana* of metals. About 2 l each liquid media is sufficient for proper *Shodhana* of 1 kg *Naga*.

Melting point of *Naga* insignificantly increases after *Shodhana*. About 10–15% *Naga* is converted into yellowish powder form. TGA and FTIR analysis revealed the presence of organic compounds in *Shodhita Naga* and thus elaborate the initiation of new physico-chemical properties after *Shodhana*.

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हिन्दी सारांश

थर्मोग्राह्मिमीट्री और इन्फ्रारेड स्पेक्ट्रोस्कोपी के विशेष संदर्भ से शोधित नाग धातु का मानकीकरण

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अंतिम उत्पाद मे गुणों की स्थिरता के लिए आयुर्वेदीय औषधियों का मानकीकरण महत्वपूर्ण है। धातु, खनिज, जहरीली जड़ी बूटियाँ तथा कुछ अत्यंत वीर्यशाली द्रव्यों को चिकित्सार्थ उपयुक्त बनाने मे शोधन एक महत्वपूर्ण कदम है, अतः शोधन विधियों का मानकीकरण सद्यः समय कि आवश्यकता है। थर्मोग्राह्मिमीट्री तकनीक धातुओं के विलयन बिंदु तथा उनमे उपस्थित सेंद्रिय कार्बनिक पदार्थों के अन्वेषण मे उपयुक्त है, इन्फ्रारेड स्पेक्ट्रोस्कोपी से धातुओं मे उपस्थित विभिन्न कार्यकारी समूहों की जानकारी प्राप्त होती है। अतः प्रस्तुत अध्ययन मे थर्मोग्राह्मिमीट्री और इन्फ्रारेड स्पेक्ट्रोस्कोपी के विशेष संदर्भ से शोधित नाग धातु का मानकीकरण किया गया है। नाग का सामान्य तथा विशेष शोधन क्रमशः रसतरंगिणी और शार्ङ्गधर संहिता के अनुसार किया गया। शोधनार्थ प्रयुक्त सभी द्रव्यों का भौतिक तथा रसायनिक परिक्षण किया गया। नाग शोधन में औसत हानि ६.२६% हुई। नाग धातु का गलनांक ३२७.४६ से बढ कर ३२८.४२ शतांश पाया गया तथा शुद्धता मे ०.४० प्रतिशत की कमी हुई। इन्फ्रारेडस्पेक्ट्रोस्कोपी से नाग धातु के सभी नमुनो में C-H और C-N बंध पाये गये जिससे शोधित नाग धातु मे विभिन्न सेंद्रिय कार्बनिक यौगिकों की उपस्थिति का ज्ञान होता है।