Analytical Study of Jahar Mohra Stone Samples W.S.R. to its Identification

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1. INTRODUCTION

Although Ayurveda is common in practice in Asian subcontinent predominantly in India, Sri Lanka and Nepal since Vedic period, now a day it has acquired verge of universal acceptance due to its holistic approach of "*Swasthasya Swasthya Rakshnam Aaturasya Vikaar Prashmanam Ch*" i.e. restoration of health and cure of diseased. During the golden period of Hindu dynasty i.e. Gupta reign, a unique branch of medicinal formulation emerged which practiced over the use of Mercury & other metals and minerals in the treatment of diseases and was termed as Rasa Shastra. The main emphasis of this science was to exercise mercury and mercurial preparations as medicine predominantly but as the time changed various other minerals and metals were also included in the curriculum. Rasa- Aushdhies were categorized in different groups in Rasa Shastra; one such group was 'Sikta Varga' and 'Naga pashana' was considered in 'Sikta Varga' with 'Badarashma', 'Sange- yashabha' and 'Dugdhapashana'. Jahar Mohra was described in Unani as well as in Rasa- Shastra texts. Acharya Yadav Ji Trikam Ji mentioned it for the first in his book 'Rasamritam' and 'Siddha Yoga Samgraha'. Its use as a medicine dates back to the time of 'Gallon' i.e. 1st century AD in Unani system of medicine. Basically it is a Serpentine mineral group stone. Some of the Serpentine varieties are also popular as semi precious gem stone. Jahar Mohra is supple bright stone which radiates light of green, yellow and white colour. It emanates clay like pleasant odour i.e. petrichor when dipped in water. It is also believed that softer and lighter stones are better in quality. It is a compound of magnesium and silicate which is generally found in China, Tibet, Laddakh, Garhwal, Nepal etc. The mineral has taken its name as Jahar Mohra due to its antitoxic properties described in Unani literature. It is also known as Ophite or Serpentine in mineral and mine industries. The stone is also described by some of the Ayurvedic intellectuals as Naga Pashana.

Jahar Mohra is full of potentials in the treatment of cardiac weakness, congestive cardiac failure, diarrhoea, liver disorders, chronic fever and general debility, rickets, hyperacidity etc. It is considered a panacea in childhood disorders. Due to its detoxifying and antitoxic properties it is considered as an emergency medicine in Unani system of medicine. Such a broad assortment formulation is yet to be scrutinized as no specific work had been done on the topic in both Ayurvedic and Unani systems till date. In the field of Ayurveda Jahar Mohra is profoundly used as Pishti formulation and is commonly known as Jahar Mohra Pishti. For the preparation of Jahar Mohra Pishti only single ingredient is required i.e. Jahar Mohra stone. The stone is purified, powdered and subjected to impregnation for Pishti preparation. But before the stone sample is subjected to Pishti formulation it is mandatory to identify the sample as authenticity of the raw material is the first step in medicine preparation.

2. NEED OF STUDY-

Although Jahar Mohra is quite cheaper and frequently available drug but the review over its literature revealed that it is also known as Serpentine and serpentine is a group of minerals having more than twenty varieties. Out of these some are famous as semi precious gem stone while some are used as house building material. Not only this, it was also found that one of its variety named Chrysotile is considered as asbestos and its use is quite poisonous to humankind. The use of Chrysotile may lead to pulmonary disorders like bronchial asthma, CPOD, lung carcinoma etc. so it is necessary to analyse the raw material before subjecting it to medicine formulation.

3. MATERIAL AND METHODS

1. Procurement of raw material-

The three samples of Jahar Mohra were purchased from three different places to evaluate the variation possible while collecting raw material for Jahar Mohra Pishti preparation. Two of these samples were collected from two different retailers from Jaipur, Rajasthan. While one was collected from Haridwar, Uttarakhand. As Jahar Mohra is considered as semi precious gem stone, one sample was purchased from a gem

stone dealer of Jaipur, so as to have a complete view over the connotation and maleficent properties of different varieties of Serpentine stone available in the market. The sample purchased from herbal drug dealer, Rajasthan was termed as 'sample 1', the sample purchased from gem stone dealer, Rajasthan was named as 'sample 2' and the sample purchased from herbal drug dealer, Haridwar was termed as 'sample 3'.

2. Tests and procedures used for identification-

Jahar Mohra or serpentine is a mineral stone with more than 20 varieties available in the market. So deciding the best quality for the purpose of medicinal formulation is the prime requirement. Serpentine is not a single mineral. It is a group of related minerals which complicates the identification process further. To ease the identification of Jahar Mohra samples, chemical composition of the compound Jahar Mohra is also studied through elemental assay along with peak analysis of the diffracted X-rays through XRD. Jahar Mohra/serpentine is also a known as a semiprecious gem stone. So the three samples of Jahar Mohra were tested on gemmological parameters as well. Initial particle size and elemental percentage was also analysed through SEM-EDX method. All these tests were performed by field experts so that maximum accuracy can be attained. The gem stone identification of three samples of Jahar Mohra was conducted at Indian institute of gemmology, New Delhi. The SEM EDX and XRD analysis of the samples was performed at Indian Institute of Technology, Roorkee, Haridwar.

Gemmological identification-

Various parameters of gem stone identification were used to analyse the authenticity of all three samples of Jahar Mohra. The points under observation were cut, colour, mounted, measurement, weight, refractive index, optical characteristics, microscopic evaluation and specific gravity.

Colour- the colour of the gem is determined by selective absorption of some of the wavelengths of light. With regard to their source of colour, gems fall into two categories: idiochromatic and allochromatic. Idiochromatic gems derive their colour from their basic formula while allochromatic gems derive their colour from the impurities present in the stone. It was calculated with the help of spectroscope which splits light into its component colours after it passes through the material to be tested. Light entered the pavilion of gem stone at an angle of 45^0 while the spectroscope was placed at the opposite side at the same angle. The light bounced from the opposite side

The certain type of light absorbed by the stone was noted down.

Refractive index and optic character evaluation-

The refractive index of gem stone is identified by refractometer. To evaluate the refractive index of Jahar Mohra, the stone sample was cleaned and a drop of contact liquid was put on the glass prism. Half light half dark surface of specimen was selected for analysis. Polaroid filter was placed over the eye piece and the reaction of the lightest spot was noticed.

Microscopic evaluation-

The sample was placed and observed under 10x microscope including fully corrected triplet loupe and binocular stereo zoom and the observations were recorded.

Specific gravity evaluation-

The sample was measured with hydrostatic balance method. The specimen were weighed in air and then weighed when fully merged in water and the respective gravitational values were compared. The result thus obtained was calculated as specific gravity of Jahar Mohra samples.

SEM EDX analysis-

The scanning electron microscope (SEM) uses a focused beam of high-energy electrons to generate a variety of signals at the surface of solid specimens. The signals that derive from electron-sample interactions reveal information about the sample including external morphology (texture), chemical composition, and crystalline structure and orientation of materials making up the sample. Areas ranging from approximately 1 cm to 5 microns in width can be imaged in a scanning mode using conventional SEM techniques (magnification ranging from 20X to approximately 30,000X, spatial resolution of 50 to 100 nm). The SEM is also capable of performing analysis of selected point locations on the sample; this approach is especially useful in qualitatively or semi-quantitatively determining chemical compositions, crystalline structure, and crystal orientations.

Procedure:

Accelerated electrons in SEM carry significant amounts of kinetic energy, and this energy is dissipated as a variety of signals produced by electron-sample interactions when the incident electrons are decelerated in the solid sample. These signals include secondary electrons (that produce SEM images), backscattered electron, diffracted backscattered electrons that are used to determine crystal structures and orientations of minerals.

Energy dispersive X-ray spectroscopy (EDS, EDX or EDXRF) is an analytical technique used for the elemental analysis and quantitative compositional information.

A high energy beam of charged particles such as electrons or a beam of X-rays was focused into the sample being studied that stimulates the emission of characteristic X-rays from a specimen. At rest, an atom within the sample contains ground state (or unexcited) electrons in discrete energy levels or electron shells bound to the nucleus. The incident beam may excite an electron in an inner shell, ejecting it from the shell while creating an electron hole where the electron was. An

electron from an outer, higher-energy shell then fills the hole, and the difference in energy between the higher-energy shell and the lower energy shell may be released in the form of an X-ray. The number and energy of the X-rays emitted from a specimen can be measured by an energy dispersive spectrometer. As the energy of the X-rays is characteristic of the difference in energy between the two shells, and of the atomic structure of the element from which they were emitted, this allows the elemental composition of the specimen to be measured.

X- RAY DIFFERACTION (XRD)

X-ray powder diffraction (XRD) method is a rapid analytical technique primarily used for phase identification of a crystalline material and can provide information on unit cell dimensions. The analyzed material is finely ground, homogenized, and average bulk composition is determined.

The interaction of the incident rays with the sample produces constructive interference (and a diffracted ray) when conditions satisfy Bragg's Law.

Bragg's Law - $n\lambda=2d\sin\theta$

In this Bragg's law,

λ - Wavelength of the x-ray

θ - Scattering angle

n - Integer representing the order of the diffraction peak

Procedure:

In XRD technique a powdered sample of the Jahar Mohra was placed in a holder, then the sample was illuminated with X-rays of a fixed wave-length (Copper k wavelength 1.54056 x 10-10 m) the scan was taken between 2 theta of 5° and 2 θ of 120° with a count time of 4 seconds for each step. The X-Ray detector (goniometer) moved around the sample and measures the intensity of the reflected radiation, peaks and the position of these peaks [diffraction angle 2q]. The highest peak is defined as the 100% peak and the intensity of all the other peaks was measured as a percentage of the 100% peak. This data was then analyzed for the reflection angle to calculate the inter-atomic spacing (D value in Angstrom units - 10-8 cm). The intensity (I) was measured to discriminate (using I ratios). The various D spacings and the results were compared to **J.C.P.D.S.** to identify possible matches.

J.C.P.D.S. [Joint Committee on Powder Diffraction Standards]

This organization produced standard diffraction patterns for many of the minerals and inorganic structures suitable for analysis by X-Ray Diffraction Spectroscopy, and published these data as standards. This data is represented in a collection of single-phase X-ray powder diffraction patterns for the three most intense D values in the form of tables of interplanar spacings (D), relative intensities (I/Io), mineral name and chemical formulae. By matching these patterns in data base (Powder Diffraction Files or PDF), minerals can be identified based on XRD pattern (values of d spacing, intensity of peaks), like finger prints.

After analyzing the three samples of Jahar Mohra on above said parameters the results were compared and observation tables were made.

Results and observation-

The results obtained through the above stated analysis of three samples of Jahar Mohra were compared and noted in the form of tables as shown below...

Identification parameters of samples of Jahar Mohra and their comparative analysis through Indian Institute of Gemmology-

SR. NO.	TEST	SAMPLE 1	SAMPLE 2	SAMPLE3
1	Cut	Rough specimen	Rough specimen	Rough specimen
2	Colour	Green	Green	Green
3	Mounted	Loose stone	Loose stone	Loose stone
4	Measurement	22.54x61.75x2 2.96 mm	58.54x42.58x1 7.93 mm	78.77 x43.05x24.74 mm
5	Weight	51 g	39 g	143 g
6	R.I.	1.57	1.57	1.57
7	Optical characteristics	Aggregate	Aggregate	Aggregate
8	Microscope	Translucent, moss like inclusions	Translucent, moss like inclusions	Translucent, moss like inclusions
9	Fluorescence	N.A.	N.A.	N.A.
10	Specific gravity	Floats in 2.62	Floats in 2.62	Floats in 2.62
All the above parameters proved the stone to be natural green Serpentine.				

SEM EDX results of Jahar Mohra samples-

Sample no.	magnesium		silicon		iron		aluminium		calcium	
	wt %	At %	wt %	At %	Wt %	At %	Wt %	At %	Wt %	At %
1	**17.8**	**13.7**	**17.7**	**11.8**	**6.27**	**2.1**	**-**	**-**	**-**	**-**
2	**24.5**	**18.8**	**14.8**	**9.9**	**2.4**	**0.8**	**1.49**	**1.03**	**-**	**-**
3	**11.9**	**10.1**	**19.3**	**14.2**	**8.21**	**3.03**	**10.2**	**7.8**	**4.0**	**2.0**

XRD results of Jahar Mohra samples-

Sample number	Reference code	Compound name	Chemical formula	Crystal structure
1	00-007-0417 00-029-1493 00-002-0360	Antigorite-8.0\ITM\RG Talc-2\ITM\RG Lizardite-1\ITT\RG	$Mg_{3-x}[Si_2O_5](OH)_{4-2x}$ $Mg_3Si_4O_{10}(OH)_2$ 3 $MgO.2SiO_2.2H_2O$	Monoclinic Monoclinic Monoclinic
2	01-073-2376	Clinochlrysotile-2A	$Mg_6Si_4O_{10}(OH)_8$	Monoclinic
3	00-007-0417 00-029-1493 00-002-0360	Antigorite-8.0\ITM\RG Talc-2\ITM\RG Lizardite-1\ITT\RG 1\ITT\RG	$Mg_{3-x}[Si_2O_5](OH)_{4-2x}$ $Mg_3Si_4O_{10}(OH)_2$ $3MgO_2SiO_2.2H_2O$ $O_2.2H_2O$	Monoclinic Monoclinic Monoclinic

4. DISCUSSION-

The above results show that although all the three samples purchased from market with the name of Jahar Mohra were genuine samples of natural green serpentine but every sample was different in composition from other. SEM EDX analysis showed that the samples varied profoundly in elemental composition with sample one having iron and magnesium only, sample 2 having aluminium and sample 3 having aluminium and calcium additionally with iron and magnesium. The study showed that all these samples were silicates in nature lying under the category of Serpentine group of minerals. The chemical formula and serpentine subtype of the samples was decided by XRD. The results showed that maximum peaks of sample 1 belonged to the Antigorite variety of Serpentine while major peaks of sample 2 lied in the range of Chrysotile type of Serpentine and maximum peaks of sample 3 coincided with Antigorite and Lizardite variety of serpentine stone.

Studies over the literature revealed that Chrysotile is an asbestos variety of Serpentine which is poisonous on inhalation and sample 2 which was a raw gem stone sample mainly consisted of Chrysotile variety of Serpentine. So the use of such variety as medicine should be scrutinized and work should be done over formulation of Jahar Mohra Pishti with all these varieties and results should be observed whether purification and other procedures opted during Pishti formulation really alter the chemical composition and if yes then what effects that may produce on body.

5. CONCLUSION-

The present study can be concluded in a single statement that although all the samples belonged to Serpentine group of minerals still sample identification is a mandatory step before starting the pharmaceutical procedure of Jahar Mohra Pishti. Also more work is required over the changes and therapeutic effects of Jahar Mohra after Pishti formulation.

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