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Review Article

Significance of Protocols for Analysis of Bhasma

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Abstract:
BhasmaKalpana is a unique method of Ayurveda where metals and minerals which are bio unavailable in its natural form are made assimilative form without any untoward effect. It is emphasized that Bhasmas should be genuine in terms of purity, quality and strength to make it suitable for therapeutic administration, because if Bhasma is not properly prepared it may give rise to side effects. Hence there is a need to establish the standard techniques for establishing its genuineness and purity. For this purpose, literatures of Rasashastra have explained various physical and chemical parameters for assessment of their genuineness and purity. Now the days, many analytical and instrumental techniques are developed for qualitative and quantitative standardization of metals which can be applied for Bhasma also. The current article highlights various protocols for analysis of Bhasma, and the significance of each procedure in their standardization.

Keywords: Rasashastra, Protocol, Bhasma, Standardization

Introduction

Ayurveda developed a unique process known as BhasmaKalpanathrough metals and minerals are converted in such a form so that they can be used as drugs. During this process first the impurities and toxic substances are removed by Shoshana. Then they are treated with specific herbs and subjected to the anaerobic heating of different strength/quantity and made to harmless powder form, which can be used therapeutically. These processes are known as Shodhana, Jarana and Marana etc. should be undertaken very carefully because any negligence may results in faulty Bhasma. Ayurveda from the very beginning was very careful in this regard so certain parameters were laid down by which genuineness of the Bashama can be determined.

Standardization is the measure to assess the quality, purity and strength of any formulation, which should be undertaken for every batch of product in a uniform way. It is necessary in present era, as the bulk manufacture, global marketing increased to copup daily needs. To ensure uniform standardization procedure, set of protocol is implemented by Central Council of Research in Ayurveda and Siddha (CCRAS) in collaboration with Pharmaceutical Laboratory of Indian Medicine (PLIM). Any product that does not meet the standards can be considered as a spurious preparation.

Ayurvedic Parameters: The Ayurveda parameters are meant to check the quality, genuinely and purity of the Bhasma. It includes physical tests like Varitara, Unnama, Rekhapurnata, Dantagrekachakachaabhava, Nirdhumatva, and chemical tests like Amlapareeksha, Niruttha and Apunarbhava.

Physical Parameters: The following physical parameters help in checking the fineness, particle size, density etc of the Bhasma.

Varitara:Small amount of Bhasmais spilled over the stagnant water. Genuine Bhasma is supposed to float on water[1].It correlates with the particle size of the Bhasma and its density. The Bhasma particle if is lighter in density, it floats on water. The specific gravity of the Bhasma particle will be lesser, which intern helps in explaining increased rate of absorption of Bhasma. Varitara indirectly also explains non solubility of Bhasma in water in general. This test cannot be substantiated for SudhaVargeeyaBhasmasas they are soluble in water.

Uttama: In the floating Bhasma in stagnant water, a grain is kept. The suspension of grain over the Bhasma indicates the genuinity[2]. It indicates further lightness of the Bhasma particles.

Rekha-Purnata: The Bhasmais hold in between index finger and thumb. If the Bhasmais fine enough, it gets held in between furrows of the fingers[3].

It explains particle size, fineness and softness of the Bhasma. It is expected that the Bhasma should be smaller in particle size enough to get trapped in between the furrows of the index finger and thumb. It also indicates the consistency of Bhasma. If Bhasma is hard/ irregular sized/ rough then it will not adhere to the fingers even though particle size is smaller.

Dantagre-kachakacha-Abhava: The Bhasmawhemcrushed with teeth should not produce any crushing sound[4]. Production of sound when bitten between teeth suggests incomplete oxidation of metal/mineral present in the Bhasma. This test is especially applicable for mineral containing silica content in it like Abhraka.

Nirdhumatva: The Bhasma when put on fire should not produce any fume. It is the special test for arsenic and sulfur containing compounds[5].

Nischandratva: Bhasma should not possess any shininess/lustre. This test is mentioned especially for AbhrakaBhasma[6]. It is a special test for lustrous elements like Abhraka (mica). By giving optimum amount of Puta, Chandrika producing silica (SiO_2) is converted to amorphous form[19].

Chemical Parameters: These tests are aimed at qualitatively testing for absence of free metals present in the Bhasma.

AmlaPareeksha: It is special chemical test for Cu containing Bhasma like TamraBhasma, SvarnamakshikaBhasma etc. Cu is soluble in water or liquid with pH less than 5.5 forming poisonous salts, cuprates[20]. As dadhi have pH nearly 3.5, and any feeble changes can be appreciated if curd (dadhi) is used.

The Bhasma is put in sour curd and it is observed for a period of an hour for any change in color of curd. Spurious Bhasma produces greenish tinge when reacted with amla[7].

Niruttha: It is a chemical test to find out metallic traces if any present in Bhasma. Silver is white in color and can react with the free metal present in the Bhasma, there by changing the quantity and characteristics of Rajata being added with Bhasma.

Equal quantity of silver (Rajata) is put in the Bhasma and then heated till the Rajatais completely liquefies. The Bhasma is assessed for weight changes if any to check if any reaction has occurred between Bhasma and Rajata. Genuine Bhasmadoes not react with silver[8]. As market silver sample may be impure, it should be refined with concentrated nitric acid prior to putting in Bhasma[9].

Apunarbhava: The Mitra-Panchaka-Dravyas (Guda, Gunja, Tankana, Madhu and Kshaudra) are triturated with Bhasma in a ratio of 5:1, and Putais given for 2 hours. The genuine Bhasma should not get reconverted to metal/mineral.[10]

Apunarbhavapareeksha is also similar kind of chemical test conducted on Bhasma. Mitrapanchaka used for apunarbhavapareeksha comes under dravakagana (except guda) help to acquire the melting process rapidly which in turn help to separate out the metallic traces if any present in Bhasma. If free metals present, on reaction they gather together forming a single mass.

Morphological/ Organoleptic Evaluation

It includes the tests which are done with the aid of sensory organs. i.e,

Shabda – should not produce any metallic sound when grinded with teeth

Sparsa – no coarse particle found on touch

Rupa – peculiar varna as explained for each Bhasma.

Rasa - should be nirasa (tasteless)

Gandha – should not possess any peculiar gandha.

Table 1
Certain Bhasmawith their Characteristic color[11]

Bhasma	Color (Varna)
Svarna	Champaka
Rajata, Tamra	Krishavarna
Kamsya	Dhusaravarna
Naga	Paravatavarna
Vanga	Subhravarna
Tikshnaloha	Jambuphalavarna
Abhraka	Ishtikavarna

Modern Parameters: Apart from the parameters to assess purity of Bhasmamentioned in authoritative books of rasashastra, there are a set of analytical procedures explained under protocol for analysis of Bhasma.

Physical Evaluation

1. Solubility:Usually Bhasmaare sparingly soluble in water except SudhaVargiyaBhasma.
2. Ash value: The percentage of inorganic contents in the sample is known with ash value. This test is done to determine total ash, acid insoluble ash and water soluble ash in the Bhasma sample. In AbhrakaBhasma, acid insoluble ash decreases with increase in the number of Puta. The elements were found to be having Al, Fe, Mg, Ca contents[12].
3. Loss on drying at 105^0c (LOD):This test helps to assess if water molecules are trapped in the Bhasma or not. As number of Puta increases LOD decreases.
4. pH: It represents the negative logarithm of concentration of hydrogen atoms present in the sample. pH value is calculated for SudhaVargeeyaBhasma only as they are soluble in the water. The Bhasma are supposed to be neutral.
5. Carbon Disulphide Extract Test:It is done for the Bhasma to assess if free sulphur is present or not.

Manual Analytical Methods

1. Spotting Method: It is the qualitative analytical method for assessing the presence of particular metal/mineral in the product. The sample is added with particular reagent and assessed for changes in texture, color etc.
2. Gravimetric Analysis: It is the manual method of titration to assess the presence of metals and minerals like Cu, Ag etc. Gravimetric analysis involves the separation of the constituentsto be establishedin the form of insoluble compound of the known solution. The insoluble compound is washed to free it from impurities,dried and weighed either as such or ignited to leave a residue of some other compound, which is again weighed. Now from its weight and known composition, the amount of the constituent in the given sample is calculated.
3. NamburiPhase Spot Test (NPST): It is a spot test based on a chemical reaction for assessing the quality of a prepared Bhasmadeveloped and standardized by Dr.NamburiHanumanthaRao in 1970, which has been accepted by CCRAS, New Delhi. When a drop of clear solution of a substance under examination (Bhasmaor Sindhura) is put on specially prepared chemical reacting papers, a spot appears which manifests a series of color and pattern changes. NPST involves observations of the spot and its color, at three successive phases spread over three different time intervals. Thus it has a advantage of measuring sensitivity of reactions at different time intervals. In other words, it constitutes a method to study or detect, every second or even fraction of a second, continual chemical reactions taking place gradually between two chemical substances on static media[13].

Quantitative Analytical Methods:

Nowadays various computerized instruments are being used in the modern chemical laboratories, which may help in standardization of Bhasma. This instrumental analysis can be broadly classified as qualitative, quantitative and structural analysis. Furthermore it can be classified according to the technology involved in them as spectroscopic, x-ray techniques, microscopic techniques, thermal energy (TGA), etc.

1. ICP AES (Inductive Coupled Plasma Atomic Emission Spectrometry)[14]

It is the spectroscopic technique which is destructive in nature. In this technique, interaction of light with the sample produces resultant subsequent energy transfer leading in emission of energy.

It is the technique for determination of metals, non-metals even at trace levels with more accuracy and precision due to high temperature and homogeneity of the source.

2. XRF (X-Ray Fluorescence Spectrometry)[15]

It works by energy dispersion x-ray fluorescence. Samples are hit by high energy photons produced by x-ray source. When sample is radiated by sufficient energy photon, electron in the inner shell of sample atom gets ejected from shell and instantaneously fills electron vacancy as the electron from higher orbital fall to lower by the release of energy. This is how fluorescence is produced.

It is non-destructive method to find metals and non-metals at even trace elements.

Demerits: It is limited to secondary fluorescence, not for those elements with atomic number lower than carbon.

X- Ray Diffractrometry (XRD)[16]

It is a x-ray technique which is non-destructive in nature. In this technique, the primary x-rays are made to fall on the sample substances. Because of its wavy nature like light rays, it gets diffracted to a certain angle. This angle of diffraction differs from the incident beam, give information regarding crystal nature of substance.

It is a good tool for the study of nature of crystalline substance.

Scanning electron Microscope-Energy Dispersive Spectrometer (SEM-EDAX)[17]

It is the microscopic technique that produce largely magnified image by using electron instead of light to form an image.

SEM does pictorial representation, topography, compositional analysis, size. Thus it gives quantitative information on the samples assessed including elements present in the sample.

Fourier Transform Infrared Spectroscopy (FTIR)[18]

It involves the absorption of electromagnetic radiations in IR spectrum which results in changes in the vibrational energy of molecules.

It helps to identify organic compounds which have polar chemical bonds (such as OH, NH, CH, etc.) with good charge separation (strong dipoles). It also helps in identification of natural products, polymers etc. along with their particular functional group in it.

Table 2
Summary of Application of analytical instruments

Technique	Application
Atomic Absorption Spectroscopy (AAS), Atomic Emission spectroscopy (AES)	To analyze alkali and alkaline earth metals in dilute solution, natural liquids and extracts at trace level.
Fourier Transform Infrared Spectroscopy(FT IR)	To analyze molecular (organic) and ionic species capable of absorbing at UV or visible wavelengths in dilute solutions
X- Ray Diffractometer	To study the crystalline properties of solid substances
Scanning electron microscope – Energy dispersive spectrometer	To study the topography, electronic structure and composition of metals, ceramics, polymers, composites an biological materials EDAX - quantitative analysis of elements present in the sample

Above mentioned modern instruments may be utilized for analysis of Bhasmafor their quantitative and qualitative identification, including understanding particle size, topography, elements present in it and their quantity etc. But these all requirements cannot be attained by a single instrument. Furthermore, instrumental analytical techniques are way too costlier needing high expertise and efficient hands. Interpretation of the results can only be attained with the help of standard value only.

Conclusion

Standardization of a formulation is necessary to maintain uniform quality, purity and strength of any formulation.The protocols mentioned by CCRAS, PLIM should be passed by the formulation before its being dispatched after production and to obtain optimum and uniform therapeutic benefits. BhasmaYogas being mineral preparation mandatorily should be assessed as they can cause many untoward effects if not properly prepared. Instrumental analysis gives much information on Bhasmaanalysed if interpreted correctly; tedious procedure, need for technical expertise and high cost make it inaccessible for daily batch wise standardization. Ayurvedic parameters and NPST tests successfully assess the quality and genuinity of Bhasma respectively.

NPST test is simple but lengthy procedure which is very much beneficial in identification and genuinely of sample. Standard plates which provided for the reference along with NPST test manual make it easy for researcher to interpret the results by comparison.

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