Research Article

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X-RAY DIFFRACTION AND X-RAY FLORESCENCE ANALYSIS OF VANGA BHASMA: AN AYURVEDIC METALLIC PREPARATION

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ABSTRACT

Vanga bhasma is an Ayurvedic formulation used for various diseases like prameha, medoroga, kshaya, Pradara, pandu etc. This bhasma was subjected for analytical study by using modern techniques like X-RD, X-RF with a view to find out the chemical constituents and structural characterization of the drug**.** XRD study exhibited that the major phase composition in Vanga bhasma is tin oxide (SnO_2) in tetragonal structure**.** XRF analysis revealed that the bhasma contained 19 elements mainly Sn, O, Ca, K, Si, Fe, Mg, Al, Pb, Cd, S, Cl, P, Na, Ti, Cu, Cr, Sr, Ni.

Keywords: Vanga bhasma, X-ray diffraction, X-ray Fluorescence.

INTRODUCTION

Ayurvedic herbo-mineral formulations are unique in terms of their minimal dose, quick action, palatability and wider therapeutic applicability. The metals and minerals are not used as such. They are subjected to certain pharmaceutical processes which include shodhana (purification), marana (incineration) etc. to convert the raw drug in to suitable compound form. Ayurvedic texts have described methods for quality control of finished products through different parameters like Nischandratva, Varitara, Nirutha, Apunarbhava etc., to achieve acceptable standard bhasma. With technological development the patients or the physicians seeks assurance for the quality, safety and efficacy of any medicine. Therefore, quality control for herbal preparations and bhasmas is essential as many of them contain chemical entity. Current issue of quality control method of identification of compounds made up of various metals/minerals requires chemical characterization and elemental analysis through XRD, XRF study etc. In this study the Vanga bhasma a metallic compound which is used for treating various diseases like prameha (urinary disorders), medoroga (Dyslipidemia), kshaya (Tuberculosis), Pradara (DUB), pandu (Anaemia)[1] etc was studied through XRD and XRF to find out its chemical constituents and structure.

MATERIAL AND METHODS

The drugs Vanga **(**Tin**)**, Apamarga **(***Achyranthus aspera* L**.)**, Kumari **(***Aloe barbadensis* MILL**.)**, Churnodaka **(**lime water**)** and other materials were procured from local market, Vijayawada and Vanga Bhasma was prepared in the P**.**G**.** Department of Rasa Shastra, Dr**.** N**.**R S**.** Govt**.** Ayurvedic College, Vijayawada**.** The XRD and XRF study was conducted at Sastra University, Thanjavur**.**

Preparation of vanga bhasma

Preparation of Vanga bhasma includes three stages viz
(i) Shodhana **(**purification**)**
(ii) Jarana **(**conversion of metal in to powder form**)**
(iii) Marana **(**incineration**)**

Shodhana[2]

Samanya shodhana (General purification)

The raw drug vanga was subjected to dhalana[3] **i.e.** melting and pouring in liquid**.** This procedure was repeated seven times by using fresh treating liquids each time**.** The treating liquids used were Tila taila **(**Sesame oil**)**, Takra **(**Butter milk**)**, Gomutra **(**Cow's Urine**)**, kanji **(**Sour gruel**)** and kulutha kwatha **(**Decoction of horse gram**).**

Vishesha Shodhana (Specific purification)

The solid material obtained after normal purification was subjected to similar dhalana in churnodaka **(**lime water**)** [4]**.** This procedure was repeated for seven times by using fresh churnodaka each time**.**

Jarana[5]

Sodhita Vanga was taken in an iron pan and heated till it melts, then it was rubbed by adding little amount of Apamarga **(***Achyranthus aspera* L**.)** powder**.** This process was continued till the total vanga converts to fine powder form**.** When all the metal converted in to powder form, the powder was collected in the center of the pan and covered with an earthen lid and maximum heat was given till the bottom of the vessel became red hot and then heating was stopped and left for self -cooling**.**

Marana

The Jarita Vanga was *mixed* in distilled water properly and allowed the mixture for sedimentation**.** After 3 h when the entire

Vanga particle was sediment at the bottom, the upper part was decanted carefully. Procedure was repeated until pH of the water became neutral i.e. around 7. This material was subjected to bhavana with kumari (*Aloe barbadensis* Mill.) swarasa and then made in to round pellets. These were dried under sunlight and taken in an earthen bowl, covered with another earthen bowl with interface between them sealed with a clay smeared cloth. Then it was subjected to heating through Gaja puta(Furnace)[6].

X-ray diffraction (XRD) Study [7]

X-ray diffraction technique is the most useful technique in the characterization of crystalline materials such as metals, intermetallic, ceramics, minerals, polymers etc. this can be used for qualitative and quantitative phase identification analysis as well as for the determination of crystallinity, grain size, lattice parameters and also identifying the different crystal structures of the same compound. The basic principle of the phase analysis using powder XRD technique lies the presence of diffraction peaks corresponding to various inter planar (d_{hkl}) spacing which are characteristics of a given material. The relative intensities of various peaks occurring at different d-spacing are also different for different phases.

Analysis Procedure

The sample preparation for the analysis was done using standard XRD procedure. The powder was then spread onto a double-side tape with a spatula, and then placed on a cavity with plastic holder. Care was taken to fill the powder uniformly into the mount. It was exposed to x-ray beam of intensity 35KV and 20MA. All the peaks were recorded on the chart, and the corresponding 2-theta values were calculated.

Instrument Specification: Philips X-ray generator PW3020 attached with graphic monochromator

X-ray flourescence

XRF is an elemental analysis technique with unique capabilities like accurate determination of major elemental survey of the sample composition without standards. XRF is used in analysis of rocks and metals with an accuracy of approximately 0.1% of the major elements. A technique known as fundamental parameters can estimate the elemental composition of unknown without standards. The analysis requires minimal sample preparation. Detection limits for XRF are generally in the 10-100 ppm range for heavy elements and elements lighter than Na are difficult or impossible to detect.

RESULTS AND DISCUSSION

The bhasma was grey coloured fine powder, odorless with chalk like taste. The prepared bhasma has got all the bhasma lakshnas viz nischandrika-there was no metallic luster, rekha purita- when taken between the index finger and thumb spread it was so fine as to get easily into the finger lines, varitaram- when a small quantity of the bhasma sprinkled on water, it floated on the surface and apunarbhava- the bhasma did not revert to the original state when mixed with panchamrita drugs and subjected for heating. The XRD and XRF study revealed that the elements in the Vagabhasma in oxide mode and no free metallic particles found in the bhasma. Total 19 elements found in the bhasma, among them Sn, O is the major component and remaining are in traces.

XRD Study

Vanga Bhasma

1. The graph of the XRD results show peaks of SnO_2.
2. The crystal structure of SnO_2 in this sample is 'Tetragonal'

X-RF Study

Vanga Bhasma

Oxide mode Result

The Oxide mode elements present in this sample, they are – SnO_2- 72.74%, CaO -9.31%, SiO_2-4.8%, K_2O -3.19%, Fe_2O_3 -3.02%, MgO -1.77%, SO_3-0.86%, Al_2O_3-1.51%, P_2O_5-0.75%, PbO- 0.66%, CdO-0.49%, Cl-0.34%, Na_2O-0.22%, TiO_2-0.16%, CuO-0.06%, Cr_2O_3-0.06%, SrO-0.03%, NiO -0.02%

Elemental mode Result

The elements present in this sample, they are- Sn-57.30%, O-24.73%, Ca-6.65%, K-2.65%, Si-2.24%, Fe-2.11%, Mg-1.07%, Al-0.80%, Pb-0.62%, Cd-0.43%, S-0.35%, Cl-0.34%, P-0.33%, Na-0.16%, Ti-0.09%, Cu-0.04%, Cr-0.04%, Sr-0.02%, Ni-0.02%.

Table 1: Oxide mode

Formula	Concentration (%)
SnO_2	72.74
CaO	9.31
SiO_2	4.8
K_2O	3.19
Fe_2O_3	3.02
MgO	1.77
Al_2O_3	1.51
SO_3	0.86
P_2O_5	0.75
PbO	0.66
CdO	0.49
Cl	0.34
Na_2O	0.22
TiO_2	0.16
Cr_2O_3	0.06
CuO	0.06
SrO	0.03
NiO	0.02

Table: 2 Element concentration of Vanga bhasma

Formula	Concentration (%)
Sn	57.30
O	24.73
Ca	6.65
K	2.65
Si	2.24
Fe	2.11
Mg	1.07
Al	0.80
Pb	0.62
Cd	0.43
S	0.35
Cl	0.34
P	0.33
Na	0.16
Ti	0.09
Cu	0.04
Cr	0.04
Sr	0.02
Ni	0.02

SAMPLE- VANGA BHASMA

Angle 2-Theta °	d value Angstrom	Intensity Count%	Intensity %
10.180	8.68233	6.42	0.2
22.761	3.90380	250	8.9
26.460	3.36580	186	6.6
26.821	3.32137	2814	100.0
27.201	3.27576	210	7.5
32.302	2.76916	400	14.2
34.104	2.62685	2676	95.1
34.805	2.57552	101	3.6
38.175	2.35557	722	25.7
39.210	2.29575	176	6.2
46.204	1.96322	183	6.5
51.977	1.75791	2509	89.2
54.954	1.66952	603	21.4
58.015	1.58849	375	13.3

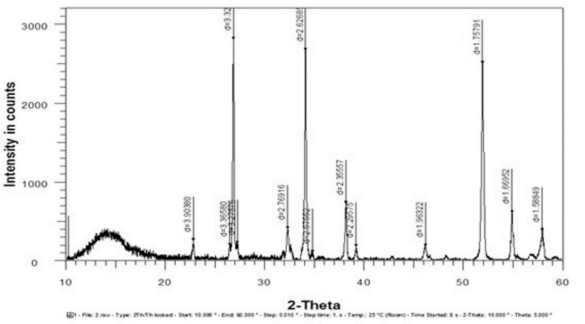

Figure 1: XRD graph of vanga bhasma

CONCLUSION

The X-RD Report of Vanga bhasma sample shown peaks of SnO_2 and all peaks were found at almost same 2 theta degrees with Tetragonal crystal structure. XRF study of Vanga bhasma has shown 19 elements mainly Sn, Oxygen as major elements and remaining elements like Calcium, Potassium, Iron, Mg, Aluminium, Lead, Cadmium, Sulphur, Cl, P, Sodium, Titanium, Copper, Cr, Strontium, Ni are in trace amounts. These values may be considered as standard values for maintaining the quality of Vanga bhasma.

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