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ORIGINAL RESEARCH ARTICLE

XRD and XRF Screening of Yasad Bhasma

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ABSTRACT

Bhasma are complex compound forms of metals or minerals obtained by repeated incineration with herbal juices. Yasad bhasma an effective medicine for treatment of prameha, … A number of modern technology are used to know material characterization of Yasad and its bhasma. Among them XRD and XRF analytical technique by which compound of materials can be detected. In XRD analysis, Yasad sample was crystalline in nature and highest peak was correspond to elemental Zinc and in its bhasma crystalline structure was destroyed and highest peak correspond to Zinc Oxide. XRF analysis, yasad sample have 98.20% zinc metal along with other trace elements like Pb-0.63%, Sn-0.11%, Fe-0.56%, Ca-0.07%, Al-0.09%, Cr-0.06% and in Yasad bhasma 98.20% zinc oxide was present along with trace element like Fe_2O_3-2.6%, K_2O-0.8%, Al_2O_3-0.32%, PbO-0.2% etc.

Key words: Yasad, Bhsama, XRD, XRF.

INTRODUCTION

Achayra Charak, mentioned the type of drugs on the basis of their source [1], various formulations and pharmacology of drugs with considerable precision. The later treaties describe the medicinal properties of various metals like Parad, Swarna etc. in form of Bhasma [2]. These are unique metal base preparation made by sophisticated pharmaceutical processes incorporating herbs, converted them in to suitable form. They are used in the Indian subcontinent since seventh century and widely recommended for the treatment of verities of chronic ailments. In 14th centaury *Rasaka Stava* (the metallic extract of zinc carbonate) was also independently known by the name of *Yasad* . *Yasad* comes under the category of puti lohas, its bhasma is mainly indicated in *Prameha* [3]. Besides this it has been also used for various disorders including Prameha (Diabetes), Pandu (Anemia), Vatayadhies (neuromuscular disorders) and Netra vikaas (eye disorders)[4]. Currently some study was done on bhasma containing heavy metal salts enlighten mainly from toxicological point of view [5, 6].

Information about the metal content of Ayurvedic preparations is becoming important, not only for standardization and consumer protection, but also because it is a vital factor in advancing drug research, enhancing the effectiveness of these drugs and improving their preparation. In metal-based preparations, the metal may not be in its raw state, but together with different herbs, is subjected to a series of elaborate processing steps culminating in calcination. These result in the production of a Bhasma – a fine powder that is used alone or in combination with other herbs. The same metal may be processed with different combinations of herbs to be used for different indications. A selection of Bhasma of key interest and importance is the final elemental form of the various elements. This will lead to an understanding of their solubility in the human digestive system, and their subsequent transfer and build up in the body organs where they will be most efficacious in treatment.[7] By considering above these point this study was planned for the

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Chemical characterization of raw as well as finally prepared Yasad Bhasma.

MATERIAL AND METHODS

Procurement and Authentication

Yasad was procured form Ayurvedic Pharmacy, Institute of Medical Sciences Banaras Hindu University and authenticated by experts of Rasa Shastra Department, faculty of Ayurveda, Institute of Medical Sciences Banaras Hindu University. Apamarg was collected form garden of Dravya Guna Department and indentified by experts.

Pharmaceutical study

Yasad was subjected to Dhalana (Process where molten metal is poured into specific liquids), Jaran (roasting purified yasad with Apamarg panchang), Maran (triturating roasted with kumari Swarasa and heating in furnace) process. Shodhan was done by adopting dhalan process using churnodaka for seven times [8] and vishesh shodhan was done by using nirgundi decoction mixed with haridra powder for seven times. Jaran was done by heating and rubbing shodhita yasad along with apamarg panchang in open atmosphere [9]. Jarita yasad was triturated with kumari swaras and incinerated using electric muffle furnace at 600^0C maintained for an hour. This process was repeated for six times to obtain yasad bhasma and analyzed as per Ayurvedic methodology as well as contemporary technology like using X-Ray Diffraction (XRD), X-ray Fluorescence (XRF)

X-Ray Diffraction (XRD)

Powder XRD method is perhaps the best known sensitive method as a phase characterization tool. It can uniquely differentiate between crystalline phases of different materials and can be used for identifying the different crystal structures of same chemical compound also. The powdered sample was spread onto a double side tape with a spatula, which was then placed on an aluminum sample holder. All the peaks were recorded on the chart and the corresponding 2 theta values were calculated which are presented in table 1[10].

X-ray Fluorescence (XRF)

The XRF method depends on fundamental principles involving interactions between electron beams and X-rays with samples. The analysis of major and trace elements in materials by XRF is made possible by the behaviour of atoms when they interact with radiation. When materials are excited with high-energy, short wavelength radiation (e.g. X-rays), they can become ionized. If the energy of the radiation is sufficient to dislodge a tightly-held inner shell electron, the atom becomes unstable and an outer shell electron replaces the missing inner electron. When this happens, energy is released because the inner shell electron is more strongly bound compared with an outer one. The emitted radiation is of lower energy than the primary incident X-rays and is termed fluorescent radiation, often called fluorescence in the vernacular. Energy differences between electron shells are known and fixed, so the emitted radiation always has characteristic energy, and the resulting fluorescent X-rays can be used to detect the abundances of elements that are present in the sample [11].

RESULTS

Properly prepared yasad bhasmas showed rekhapurnatva, varitaratva, sukshmatva, nischandratva and nirdhumatva. In XRD analysis, strongest peak correspond to Zinc in Yasad sample while strongest peak was correspond to Zinc oxide in yasad bhasma (**Table 1**). In XRF analysis yasad sample have 98.20% zinc metal along with other trace elements like Pb-0.63%, Sn-0.11%, Fe-0.56%, Ca-0.07%, Al-0.09%, Cr-0.06% and in Yasad bhasma 98.20% zinc oxide was present along with trace element like Fe_2O_3-2.6%, K_2O-0.8%, Al_2O_3-0.32%, PbO-0.2% etc (**Table 2**).

Table 1: Showing 2θ value of Three Strongest Peaks of Samanya Shodhita Yashad with their respective metals

S. No	Experimental Materials	2θ Value of Three strongest Peaks
1	Raw Yashad	54.348, 70.077, 77.081
2	Samanya Shodhita Yashad	54.340, 70.060, 76.977
3	Yashad Bhasma	56.607, 68.029, 69.081

Table 2: X-Ray Fluorescence Spectroscopy findings (Elements) of different samples

Sample Name	Elements as Oxides (wt%)								
	SnO_2	PbO	ZnO	SiO_2	Fe_2O_3	Al_2O_3	K_2O	CaO	Cr_2O_3
Raw Yashad	0.11	0.63	98.20	0.13	0.56	0.09	---	0.07	0.06
Shodhita Yashad	0.84	1.85	93.98	1.53	0.13	0.52	0.06	1.18	0.08
Jarita Yashad	0.3	0.3	96.8	0.2	0.2	---	1.8	0.7	
Yashad Bhasma	---	0.2	93.5	1.04	2.6	0.32	0.8	1.2	0.02

DISCUSSION

Rasoushadhis are used in Alpa matra (minute doses), easily palatable and fast acting. Bhasmas are one among such Rasoushadhis which are complex compound forms of metals or minerals obtained by repeated incineration with liquid

extracts. Yashada bhasma, zinc based Ayurvedic metallic preparation is indicated specially in Prameha (diabetes) and associated complications. Zinc purified by the general method was heated to melt and poured into Churnodaka (lime water) for seven times with fresh liquid each time. Molten Zinc when came in contact with liquid media produced loud blasting sound. The melting duration was extended on every dhalana procedure due to presence of carbonaceous material. This type of repeated liquefying and pouring in liquid media resulted in the formation of large amount of slag which floated on the surface of molten Zinc. Shodhita Yashada was melted in an iron pan at the temperature range of 600-700°C and Apamarga panchanga churna was added little by little and rubbed with an iron ladle with pressure. The process was continued till it turned to powder form completely. This is known as Jarita Yashada. When Apamarga is added to molten Yashada, immediately it burns and becomes carbon. While rubbing molten Yashada along with Apamarga, initially the whole material was changed into black powder form, later its color turned to grey. The reactive components of Achyranthes aspera helped in further disintegration of Zinc particles into Zinc compounds in open atmosphere. Potassium being main constituent of Achyranthes aspera will give rise to potassium oxide (alkali) at high temperature [12] Formation of Zinc compounds depends upon the concentration of potassium oxide which reacts with Zinc during Jarana process.

X-ray diffraction study of the yasad sample showed a sharp peak indicating its crystalline nature; whereas the yasad bhasma did not give sharp peaks indicating the loss of crystalline nature, thus the sharp crystalline structure of the yasad sample reflects light rays whereas loss of crystalline nature in the yasad bhasma prevents it from doing so. The XRD study of Yashad sample reveal that strongest peaks corresponded to Zinc metals (**Figure 1**), other than this many low intensity peaks were observed which may be due to presence of trace element. After the process of samanya shodhan strongest peaks of samples corresponded to untransformed Zinc metal and few weak peaks corresponds to iron (Fe), Aluminium (Al) and Chromium (Cr) peak of very low intensity was observed. This indicate that after shodhan process metallic statutes of zinc do not changed but some other element was added during shodhana the process. Jarita Yashad showed strongest high intensity peaks correspond to Zinc oxide weak low intensity correspond to zinc and very low intensity peak correspond to potassium zinc oxide (**Figure 2**) while yasad bhasma reveals that strongest high intensity peaks is identified as ZnO (Zinc Oxide) (**Figure 3**). During Jarana process (intermediate stage between shodhan and maran), shodhit yasad was rubbed with with Apamarga panchanga that may leads formation of Zinc Oxide, Potassium Zinc Oxide while some unreduced metallic Zinc was also observed . The unreduced metallic Zinc which was observed during jarana procedure disappeared in yasad bhasma, it might be possible that during marana procedure (triturating by Ghrit kumari Pulp at 500^0C in EMF) unreduced metallic zinc converted in to zinc oxide.

XRF showed that during process of yasad bhasma formation zinc element converted in to zinc oxide, Jarita yasad showed higher percentage of zinc oxide than yasad bhasma this indicate that maximum oxidation of yasad was taken place in to jarana procces. Yasad bhasma have higher percentage of Iron oxide than jarita yasda this showed that oxidation of iron was taken place in marana process. From above it is clear that oxidation of zinc take place at lower temperature i.e. during jaran process of yasad and oxidation of iron take place at higher temperature i.e. during maran process of yasad. Beside this percentage of lead, tin, silica and potassium oxide was decreased in yasad bhasma than jarita yasad this might be due to chemical reaction taken place during bhavan and maran process.

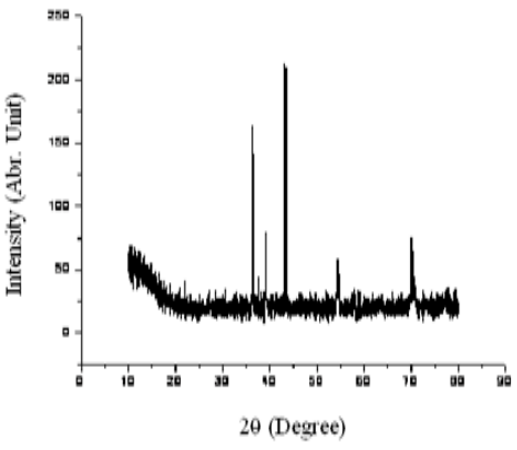

Figure1: XRD Analysis of Yashad Sample

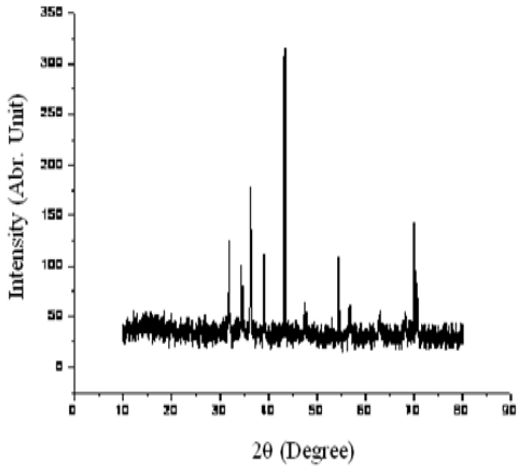

Figure 2: XRD Analysis of Jarita Yashad

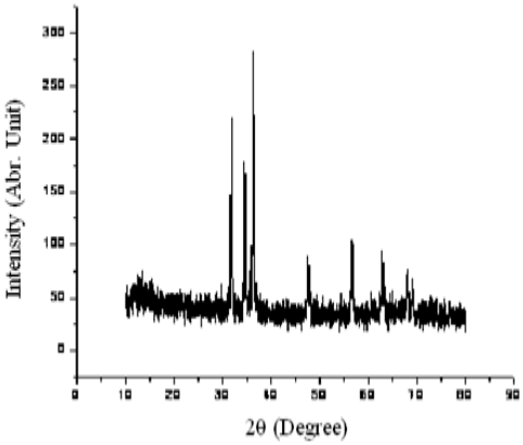

Figure 3: XRD Analysis of Yashad Bhasma

CONCLUSION

After the formation of yasad bhasma crystalline structure of raw yasad was destroyed. Zinc which was present in higher percentage in raw sample gets converted in to zinc oxide in yasad bhasma.

TERMINOLOGY

Rekhapurnatva: 'Rekha' means line pattern of ridges on tips of fingers, 'Purnatva' means filling. When the bhasma is rubbed in between the tips of the thumb and index fingers, it entered into the furrows of the thumb and index finger and the ridges on the fingertips can be clearly seen. This indicates that the bhasma prepared is fine.

Varitaratva: 'Vari' means water, 'Taratva' means ability to float. When fine powdered bhasmas were carefully sprinkled over water it floats on it. It is obvious that for this test to be positive the bhasma must be so fine that after it is sprinkled over water, the combined force created due to its weight and gravitation is less than the surface tension of water.

Sukshmatva: During trituration process repeated grinding and heating help in dividing the particles of substance into very fine state. This fine state of bhasma is very important for absorption and assimilation in body.

Nischandratva: There is no shining and luster observed in prepared bhasma even when these are rubbed with wet fingers and observed in bright sunlight through magnifying glass.

Nirdhumatva: It means 'smokelessness'. If a small quantity of prepared bhasma is put over fire, it should not produce any smoke. It indicates that it should not contain any organic matter in free state.

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