



RESEARCH ARTICLE

STUDIES OF TRADITIONAL AYURVEDIC BHASMAS CONTAINING Ca, Cu, Sn, As, Ag, Zn, S and Pb USING XRF, XRD AND FTIR

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ARTICLE INFO

Article History:

Received 14th May, 2017

Received in revised form

05th June, 2017

Accepted 23rd July, 2017

Published online 31st August, 2017

Key words:

XRD, XRF, FTIR, Ayurveda and
Ayurvedic Medicines (*Bhasma*).

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Citation: Bhavna Joshi, 2017. "Studies of traditional ayurvedic bhasmas containing Ca, Cu, Sn, As, Ag, Zn, S AND Pb using XRF, XRD and FTIR", *International Journal of Current Research*, 9, (08), 56867-56874.

ABSTRACT

In present work report our FTIR, XRF and XRD studies of various Traditional *Bhasma* consisting of Ca, Cu, Sn, As, Ag, Zn, S and Pb. The aim is to characterize these medicines using above techniques. We have also shown that for same element if method of preparation is different, FTIR pattern also show variation. These suggest that property of '*Bhasma*' is influenced by host matrix in which it is present.

INTRODUCTION

In this study those *bhasma* were used which are commonly prescribed by Ayurveda doctors (Vaidya). All these *bhasmas* were purchased from market. In present investigation *bhasmas* containing Ca, Cu, Sn, As, Ag, Zn, S and Pb were studied. Though various elements used in preparation of these *bhasmas* are toxic but their toxic effect is minimized by mixing these *bhasmas* with cardamom, cinnamon, ghee and honey and taken orally in small doses. In clinical practice as reported in old scriptures, *bhasma* is not reported to have any serious untoward effects (Prakash, 1997). Honey is considered as highly nutritious with elements such as Li, Na, K, Rb, Mg, Fe, Mn, Cu and Zn (Latorre *et al.*, 2000). It is further important to note that use of metals in medicine is often associated with toxicity (Chan, 2003). But studies on *bhasma* have shown these to be non-toxic and exhibiting free radical scavenging activity due to their antioxidant property (Patel, 1986; Svoboda, 1998). The *bhasmas* are associated with organic macro-molecules, show increased superoxide dismutase and catalase activity, which reduce free radical concentration. The basic aim of this study is to see if elemental composition of these *bhasma* in commercially available drugs. Apart from this to see if element present in particular *bhasma* coexist with impurities or it is present in single atomic state. All the results are interpreted qualitatively because our aim to see presence or absence of corresponding element / elements in these *bhasmas*.

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MATERIALS AND METHODS

For XRD Panalytical system was used. For FTIR either Varian 600 using KBrPellets or Laser based, Irtaffinity-1 Shimadzu, using KBr as standard both systems were used. Table 1 gives the description of the *bhasmas* (drugs) selected for the present study.

Selection of *Bhasmas*

All the drugs were purchased from market, we do not have authentic record of their preparation process.

Name of *Bhasmas* are

Moti bhasma, *Shankh bhasma*, *Harital Godanti bhasma* and *Prawalbhasma* (all four are Ca rich *bhasmas*), *Tamra Bhasma* (Cu rich *bhasma*), *Vangbhasma* (Sn rich *bhasma*), *Yashad Bhasma* (Zn containing drug), *Tankan bhasma* (Prepared by Fitkari, Aluminium), *Malla Sindoor* (As containing Drug), *Nag Bhasma* (Pb based *bhasma*), *Raupya Bhasma* (Silver (Ag) Containing Drug), *Gandhak shodhit* (sulfur (S) containing drug).

RESULTS AND DISCUSSION

Ca (calcium) based *bhasmas*

Calcium, a structural element, plays an important role in correcting bone metabolic disorder such as osteoporosis, a

skeletal disease characterized by low bone mass, micro structural deterioration of bone tissue leading to enhance bone fragility (Reddy *et al.*, 2003; Kumar *et al.*, 2006). Antacid activity of calcium preparations and enhance effectiveness of antibiotics have been studied (Baxi and Vasavada, 1965). Analytical studies of Ca based bhasmas derived from pearls/conch/coral have been of interest because of their extensive use as supplement (Dixit and Shivahare, 1988; Lalla *et al.*, 2002; Garg *et al.*, 1993; Pandit *et al.*, 1999). For excellent review we refer Motlag and Nath (Motlag and Nath, 1958; Pandit *et al.*, 2000). Apart from this Ca (calcium) in the body help growth of bones, enhance immunity. In old age Ca deficiency is a common problem and these Ca rich bhasma are used to supplement Ca in human body. It is used in all general health tonics also. We have studied four Ca rich bhasma, Moti bhasma, Shankh bhasma, Harital Godanti bhasma and Prawal bhasma. Though all the four drugs mentioned above contain Ca but they markedly different in the initial source of Ca and also they differ in the method of processing hence we expect variation in FTIR pattern of these drugs. XRD pattern of Moti bhasma (Fig. 1) show that characteristic peaks are present due to CaO. FTIR spectrum of Moti bhasma, Harital Godanti bhasma, Shankh bhasma, Prawal bhasma are displayed in Fig 2, 3, 4 and 5. These patterns clearly show the presence of same number of bands but frequency at which these bands appear markedly shifted. One can see from Figs that there is appreciable shift from sample to sample. Since the position of bands depends on Ca-O bonding. This difference can be attributed to the difference in source of Ca, thermal cycle and also on the herbs used in preparation of these drugs (that is on carbonaceous material present in the sample). Therefore we conclude that the source of Ca and preparation method of these drugs make them different from each other in spite they contain common element Ca. It seems Ca-O bonding may play a crucial role in the utility of these drugs in different disorders.

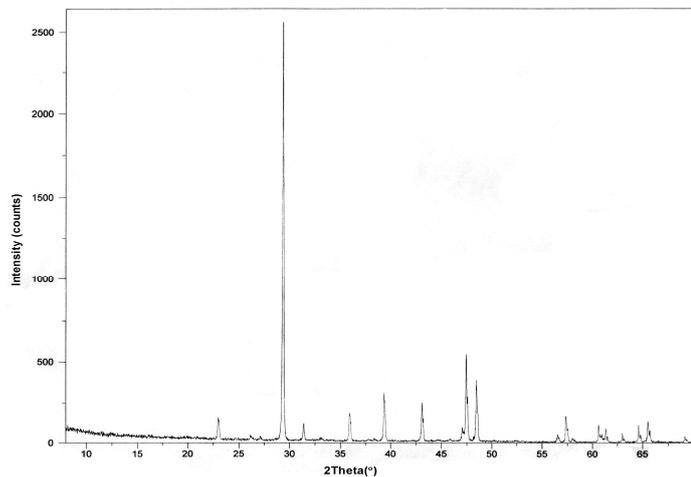


Fig. 1. XRD pattern of Moti Bhasma

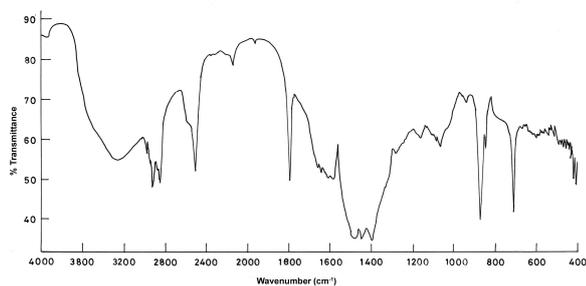


Fig. 2. FTIR Spectrum of Moti Bhasma

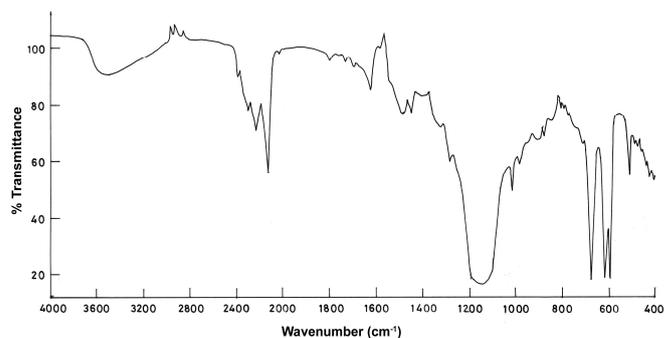


Fig. 3. FTIR Spectrum of Harital Godanti Bhasma

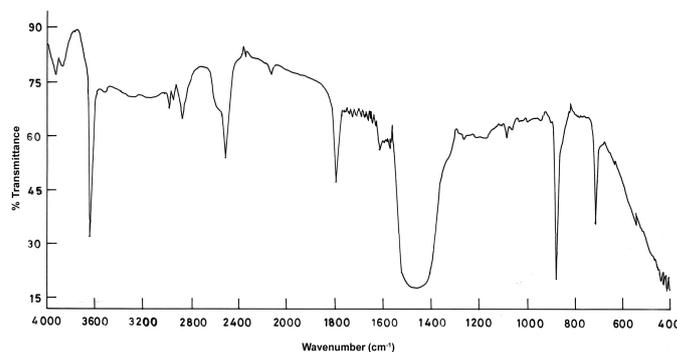


Fig. 4. FTIR Spectrum of Shankh Bhasma

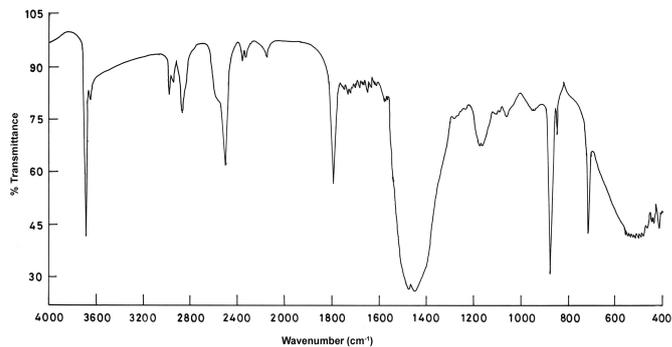


Fig. 5. FTIR Spectrum of Prawal Bhasma

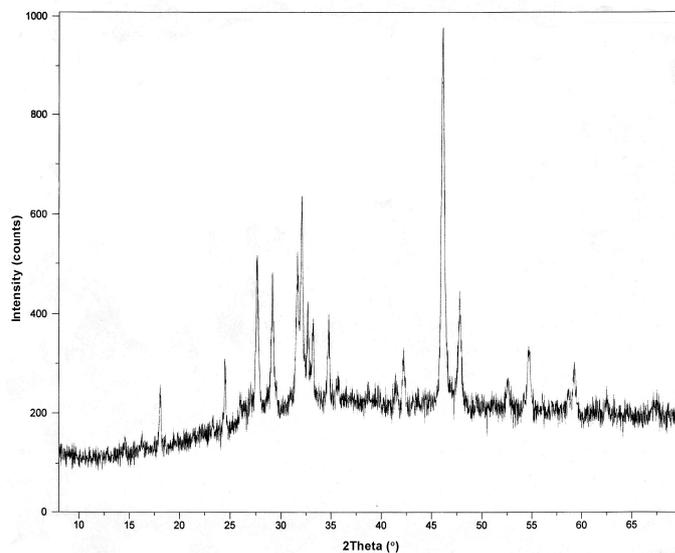


Fig. 6. XRD pattern of Tamra Bhasma

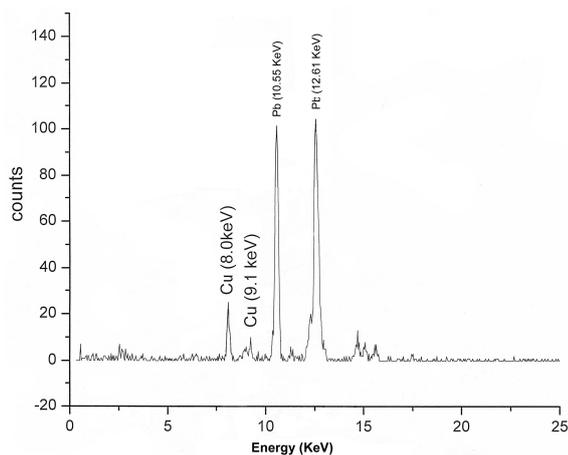


Fig. 7. XRF pattern of Tamra Bhasma

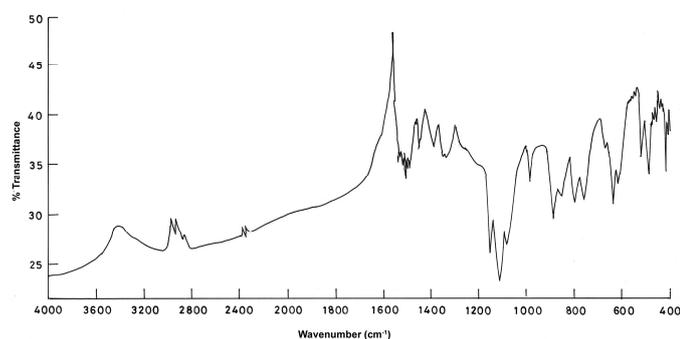


Fig. 8. FTIR Spectrum of Tamra Bhasma

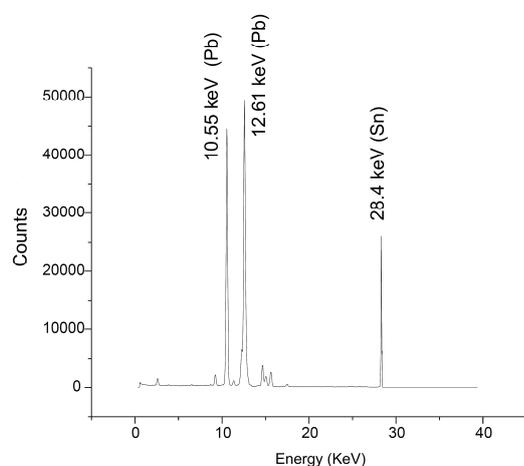


Fig. 9. XRF Spectrum of Vang Bhasma

Tamra Bhasma (Cu rich bhasma)

This bhasma contain copper (Cu). It is a versatile drug and specially recommended for all sorts of complaints related to liver and spleen tumors, dropsy etc. It is synthesized by a variety of methods developed by Ayurved pharmacists. Pure copper in the form of powder, small pieces, or very thin sheets is the starting material for all methods. This copper is subjected to a number of processes which include repeated calcinations in combination with specific plant juices (herbs (*bhavana*)). The end product of each method is assumed to be tamrabhasma (Wadekar *et al.*, 2005). XRD Pattern, XRF pattern and FTIR pattern of Tamra bhasma is given in Figs. 6, 7 and 8 respectively. The presence of Cu is appreciable but one can see from XRF pattern the presence of Pb as impurity.

This should be taken with very cautiously because Pb is highly toxic element and not preferred for human beings. Since we have not estimated its presence quantitatively but its presence itself in commercially available drugs is alarming.

Vang Bhasma

Vang bhasma prepared by incineration of Sn in an iron pot till red hot and mixed with Aparmaga (*Achyranthes aspera*) and Ghritkumari (*Aloe barbadensis*) (Nadeem *et al.*, 1999; Nadeem *et al.*, 2000). It is recommended in diabetes, semen disorder, impotency, skin disease, syphilis and gonorrhoea (Mahatyagi, 2004) and also prescribed for asthma, cough and blood disorder (Patel, 1986). XRF spectrum of Vang bhasma given in Fig.9. The XRF pattern of this drug sample clearly exhibit presence of Sn but appreciable amount of Pb is also present indicating impurities present in this drug (Fig 9). FTIR pattern is also shown in Fig 10 which is quite complex.

Yashad Bhasma (Zn containing drug)

Zinc plays a vital role as a constituent of many enzymes in the human body. More than hundred zinc metalloenzymes are needed in almost all stages of nucleic acid and protein synthesis (O'Dell and Sunde, 1997). Total dietary Zn intake is 10-15 mg/d, which comes through diet Zinc salts help in eye disease, diabetes, and skin disease, fever, as memory enhancer, chronic pyrexia, cough, boils, and urinary tract infections (Mahatyagi, 2004). Khosa and Dixit (1971) have shown Yashad bhasma to increase virility and intelligence. Role of Zinc (Yashad bhasma) in arrest of Myopia (Puri *et al.*, 1983). XRD, FTIR and XRF patterns of Yashad bhasma are given in Fig.11,12 and 13 respectively. XRF pattern clearly exhibit presence of Zn.

Tankan bhasma

Tankan bhasma is used in throat disorder. XRD, XRF and FTIR pattern are given in Fig.14, 15 and 16 respectively. This is prepared from Fit Kari (Alum). XRF pattern show presence of sulfur. The poor absorption of XRF spectrum indicates presence of low Z elements.

Malla Sindoor (As containing Drug)

Though As is considered as the king of poisons, it is now known to be a possible essential element in Unani medicine with analgesic activity and proconvulsant effects (Siddiqui *et al.*, 1999; Siddiqui and Vohora, 2000). In one of the study it was proved that As preparations have shown to no acute toxicity but vide therapeutic index (Kumar *et al.*, 2006). XRF pattern (Fig. 17) show appreciable presence of AS. The XRF and FTIR spectrum is complex and given in Fig.17 and 18 respectively.

Nag Bhasma (Pb based bhasma)

Nag bhasma (which includes lead (Pb is highly toxic element)) and different herbs is one of metallic preparation used in various diseases like diarrhea, spleen enlargement and diabetes (Kulkarni-Dudhgaonkar, 1970). Though some research work (Singh *et al.*, 1989; Mishra and Vohora, 2001) has been carried out on the different curative application of Nag bhasma but none of them give the detail on the elemental composition of the drug Nag bhasma which is an essential requirement discuss its non-toxicity and therapeutic value.

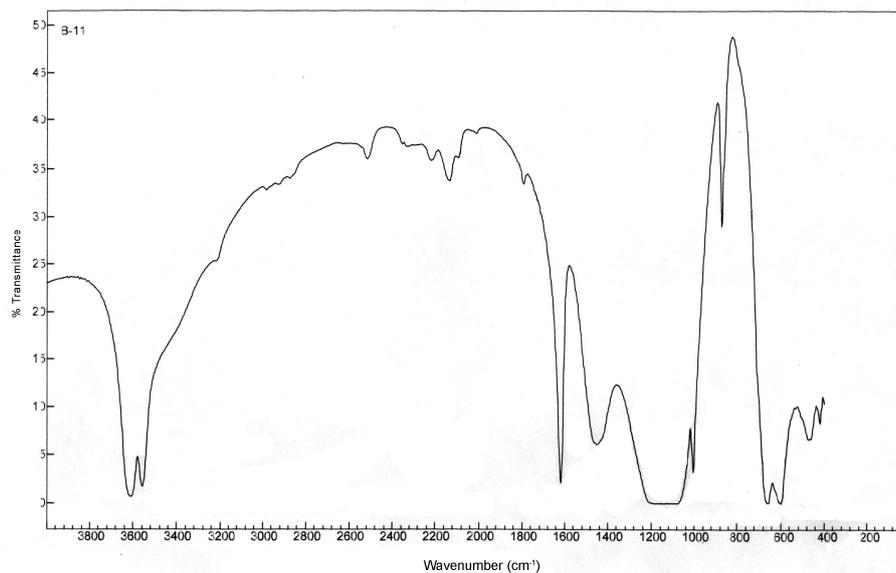


Fig. 10. FTIR Spectrum of Vang Bhasma

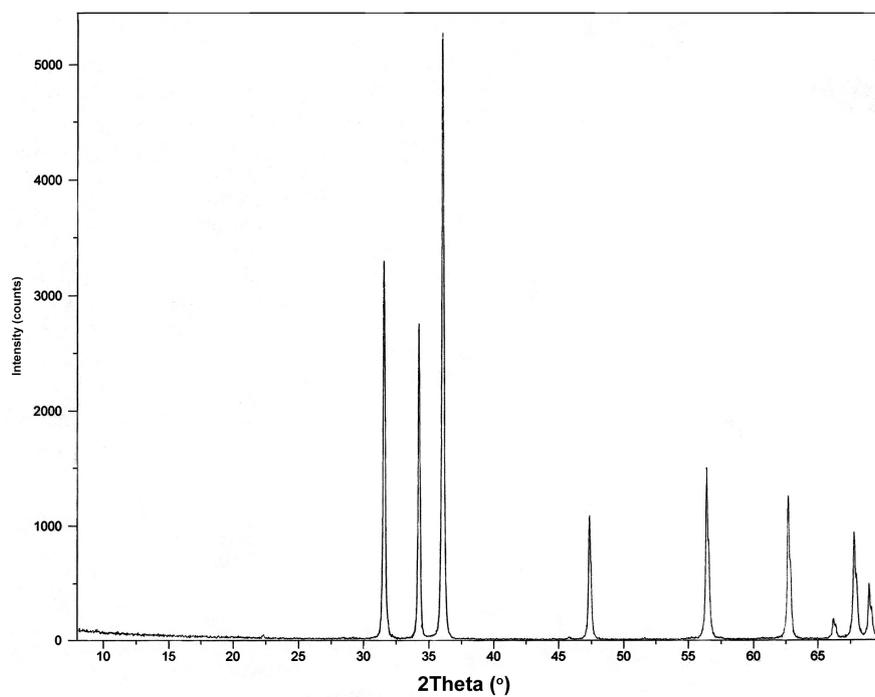


Fig. 11. XRD Pattern of Yashad Bhasma

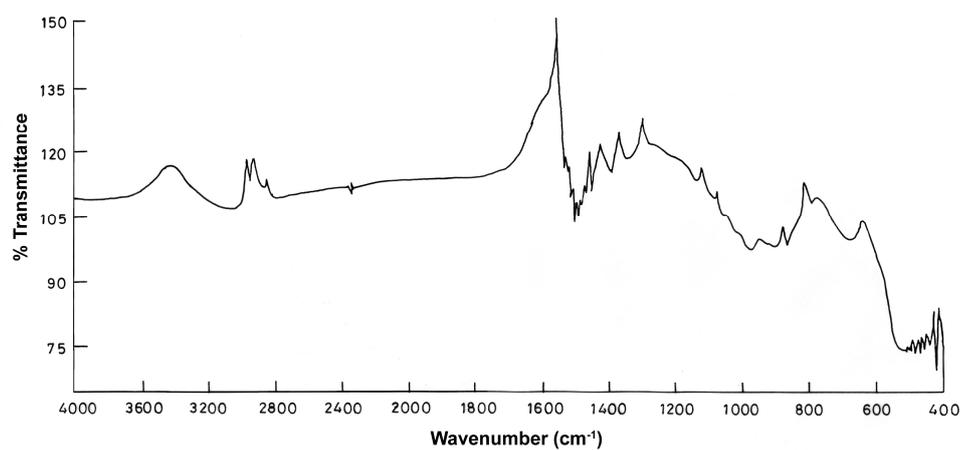


Fig. 12. FTIR Spectrum of Yashad Bhasma

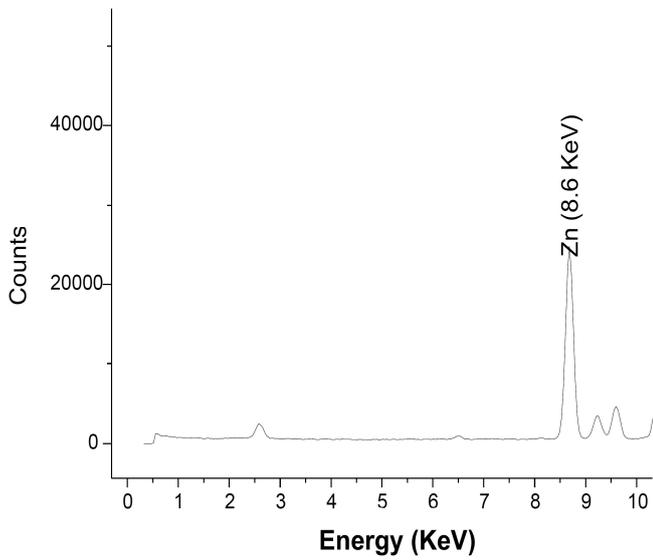


Fig. 13. XRF Spectrum of Yashad Bhasma

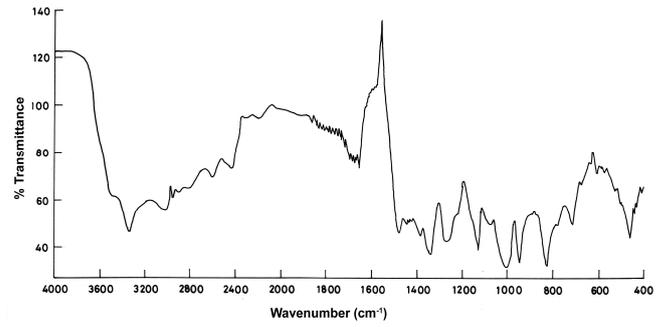


Fig. 16. FTIR Spectrum of Tankan Bhasma

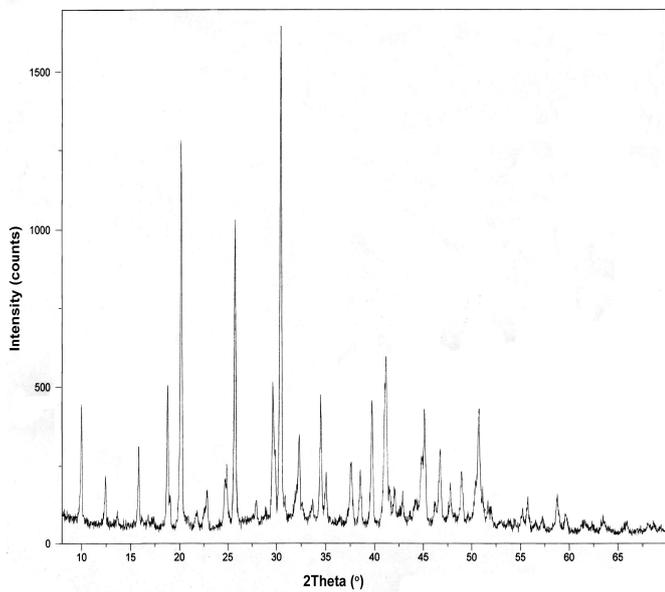


Fig. 14. XRD Pattern of Tankan Bhasma

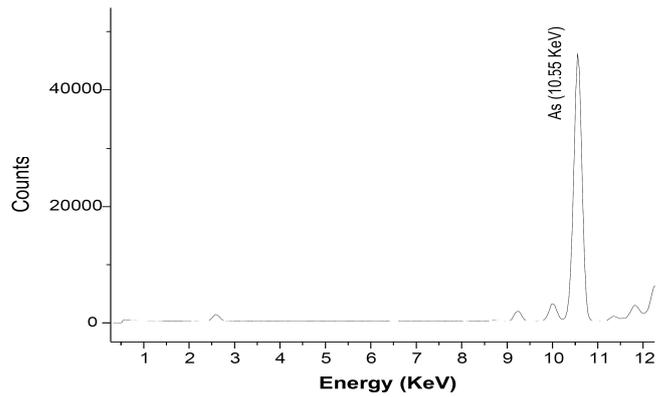


Fig. 17. XRF Spectrum of Malla Sindoor

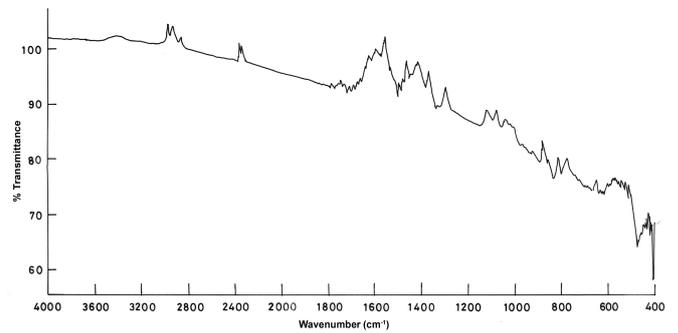


Fig. 18. FTIR Spectrum of Malla Sindoor

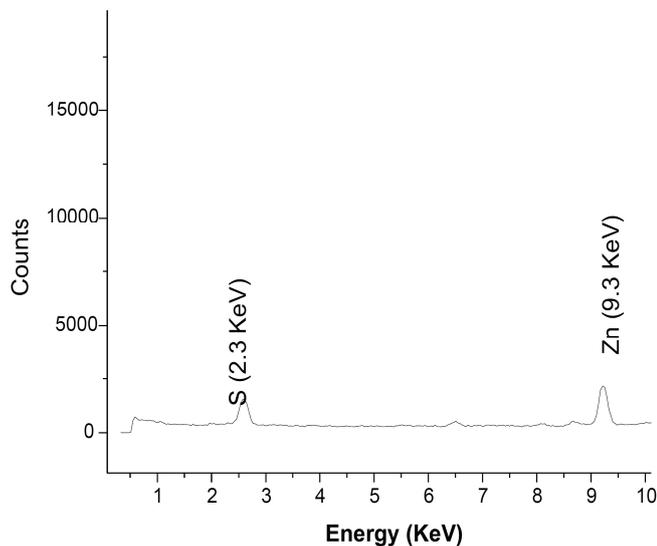


Fig. 15. XRF Spectrum of Tankan Bhasma

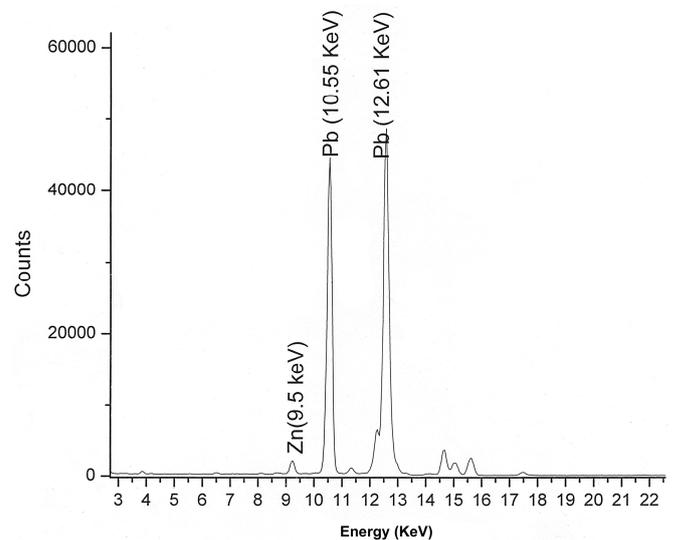


Fig. 19. XRF Spectrum of Nag Bhasma

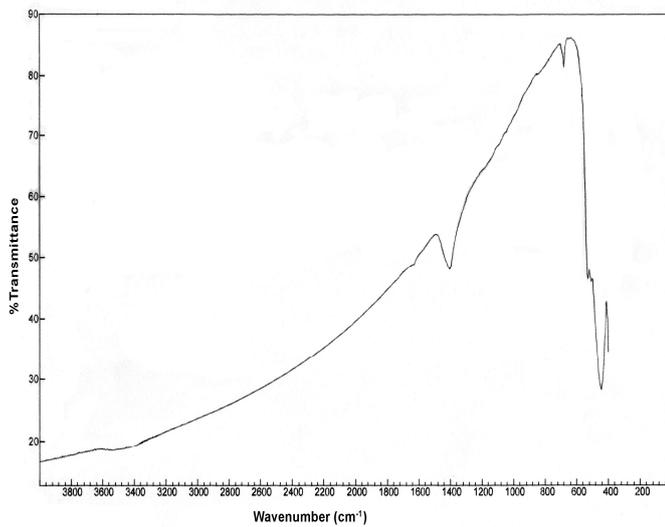


Fig. 20. FTIR Spectrum of Nag Bhasma

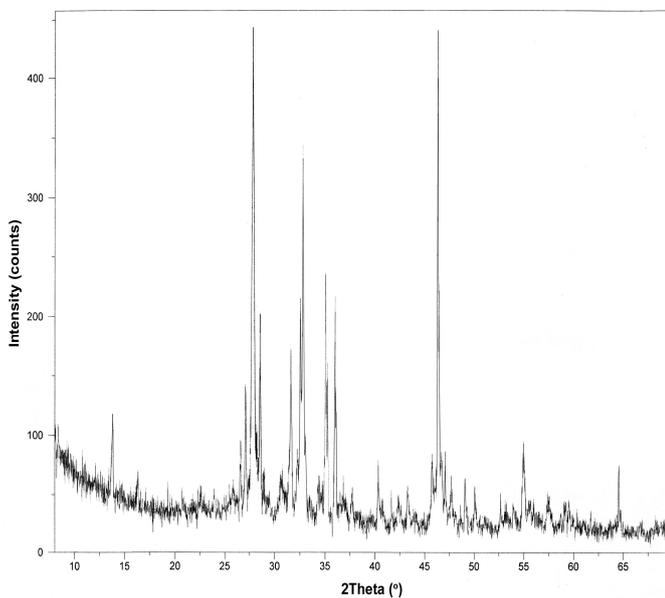


Fig. 21. XRD Pattern of Raupya Bhasma

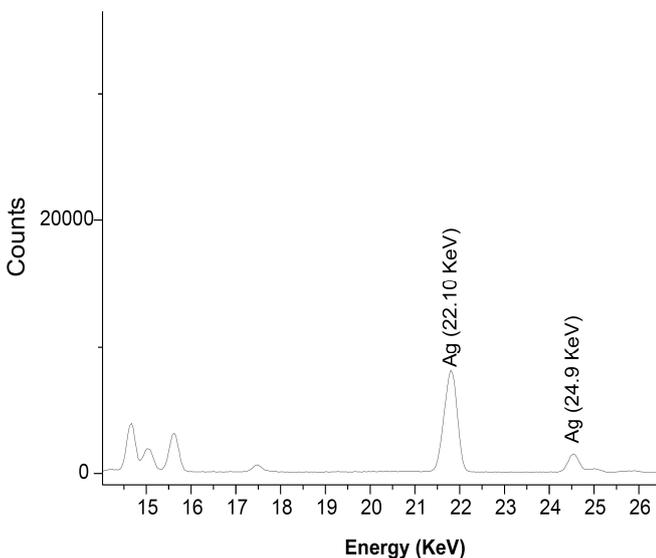


Fig. 22. XRF Spectrum of Raupya Bhasma

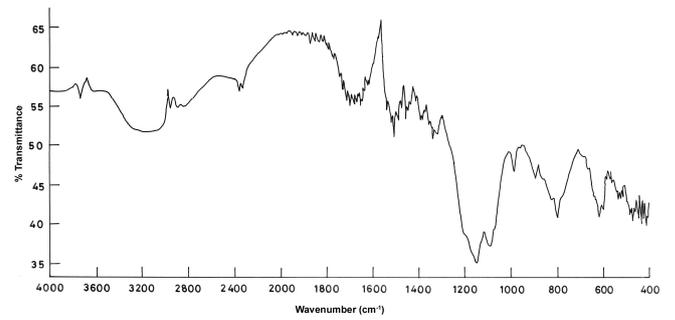


Fig. 23. FTIR Spectrum of Raupya Bhasma

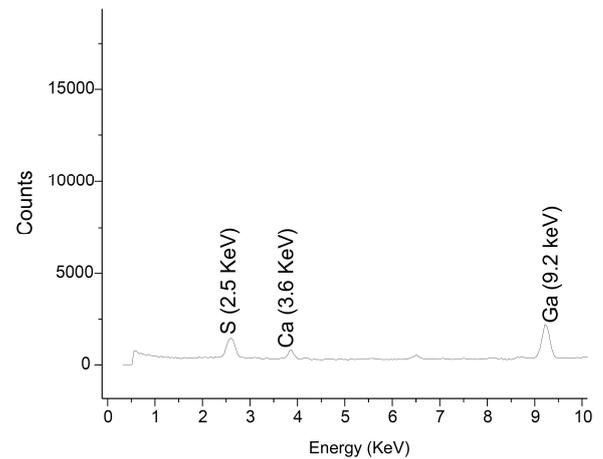


Fig.24. XRF Spectrum of Gandhak Shodhit Bhasma

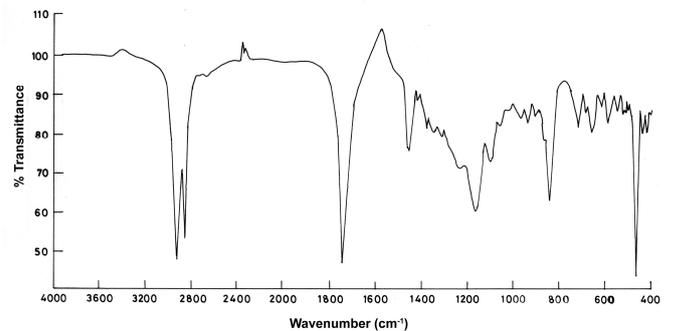


Fig. 25. FTIR Spectrum of Gandhak Shodhit

In Fig.19 we display the XRF spectrum of Nag bhasma. XRF pattern show clearly exhibit presence of Pb but it also contain Zn. FTIR spectrum of the sample is shown in Fig. 20 Spectrum of sample show large no of well defined peaks in range of 400-2000 cm^{-1} region along with peaks in higher frequency region. It should be noted that plant materials used in the preparation contains several organic molecules such as turmeric powder which contains curcumin and curcumin. Vaasa contains alkaloids vasicine, adhatodinine and several other types of molecules in traces. Neem contain azadirachtin and derivatives basically terpins and limonoids and nirgundi leaf contain flavonoids, alkaloids and terpinoids (Tiwari and Tripathi, 2007; Biswas *et al.*, 2002; Shishodiya *et al.*, 2005). All of these molecules give well defined FTIR peaks due to them or their transform (due to heat treatment) in the fingerprint region (400-2000 cm^{-1}). These peaks are also present in the bhasma (Fig. 20). Thus from the FTIR spectra it is concluded that the finally prepared bhasma is associated with the organic

macromolecules from herbs used in the preparation. These organic molecules certainly play an important role to increase the efficiency of bhasma. Attempt to find out their activity will certainly improve the understanding of bhasma.

Table 1. Give the description of Bhasmas

S.No.	Name of Bhasma	Company
1.	Moti Bhasma	Baidyanath
2.	Shankh Bhasma	Baidyanath
3.	Harital Godanti Bhasma	Baidyanath
4.	Prawal Bhasma	Baidyanath
5.	Tamra Bhasma	Baidyanath
6.	Vang Bhasma	PAB Pharmaceuticals
7.	Yashad Bhasma	Baidyanath
8.	Tankan Bhasma	Baidyanath
9.	Malla Sindoor	Baidyanath
10.	Nag Bhasma	Shree Mohata
11.	Raupya Bhasma	PAB Pharmaceuticals
12.	Ghandhak Shodhit	Dabur

Raupya Bhasma (Silver Containing Drug)

Gold and silver utensils have long been used in India for storing water by the upper class society. It's tiny particles/thin foils are used for covering the eatables including sweets. Nadeem *et al.* (Wadekar *et al.*, 2005; Nadeem *et al.*, 1999) investigated silver preparation for analgesic activity, neuropsychobehavioral effects and attributed its therapeutic ability in CNS diseases including epilepsy. Raupya (Rajat) bhasma, based on Ag, acts on the brain and nervous system through nutritive mechanism. One aim of to study this costly drug to see if Ag is actually present in commercial available Raupya bhasma or not. XRD, XRF and FTIR spectra are given in Figs.21, 22 and 23 respectively. XRF pattern clearly exhibit presence of Ag in the sample. XRD pattern also show Ag as oxide. FTIR is also characteristically different than other metal bhasma. FTIR pattern show characteristic bands due to carbonaceous matter present in sample. These bands appear at 400-600 cm^{-1} , 800-1200 cm^{-1} , 2400-3000 cm^{-1} and broad band show near frequency range 3200 cm^{-1} .

Ghandhak shodhit (sulfur containing drug)

XRF pattern show presence of S, Zn and Ga. XRF pattern given in Fig.24 and FTIR spectra are shown in Fig.25.

- One should note that metallic herbal preparations offer advantages over plant drugs by virtue of their stability over a period, lower dosage, easy storability and sustained availability. The one of the aim of this study was that *bhasmas* should be thoroughly investigated with regard to its elemental contents, speciation and organic constituents including clinical studies so as to develop understanding about their therapeutic effects.
- Though our studies are preliminary in nature but it should be looked in context that information about the metal/element content of Ayurvedic preparation is very 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 calcinations. These result in the production of a *bhasma* a fine powder that is used alone or in combination with

other herbs. Since for the first time we reported our preliminary studies on these drugs but we believe more extensive studies will follow in future.

Acknowledgement

I acknowledge Prof. R .P. Tripathi (now Retired Professor) Department of Physics, Faculty of Science, Jai Narain Vyas University, Jodhpur, INDIA for encouragement.

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