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Short Communication

Identifications studies of *Lauha Bhasma* by X-ray diffraction and X-ray fluorescence

S. C. Bhargava, K. R. C. Reddy[1], G. V. S. Sastry[2]

Junior Resident, [1]Associate Professor, Department of Rasa Shastra, Faculty of Ayurveda, Institute of Medical Sciences, [2]Professor and Head, Department of Mettallurgical Engineering, Institute of Technology, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Abstract

Procedures for preparation of *Lauha Bhasma* are described in ancient texts of Ayurveda. These procedures also begin with different source material for iron such as *Teekshna Lauha* and *Kanta Lauha* etc. In the present study, we have selected different source materials viz. magnetite iron ore for *Kanta Lauha* and pure (Armco grade) iron turnings for *Teekshna Lauha*. The standard procedures of preparation of *Lauha Bhasma* are carried out in identical conditions for these two raw materials. The final product from the *Puta* are characterized by using X-ray diffraction and X-ray fluorescence spectroscopy to understanding the crystallographic form or forms of iron oxides and their composition at the end of each *Puta*. The iron content at the end of repeated *Putas* (18 for *Kanta Lauha* and 20 for *Teekshna Lauha*) have shown a decrease in case of *Teekshna Lauha* since the starting material is pure iron while it showed only marginal decreases in the case of *Kanta Lauha* because the Fe_3O_4 of magnetite is undergoing oxidation to Fe_2O_3. The trace elements remain within the *Bhasma* in the form of various oxides of Si, Al, Ca, etc.

Key words: *Lauha Bhasma*, X-ray diffraction, X-ray fluorescence

Introduction

As the research methodology of ancient and modern parameters are different but objective behind analytical remain same, a combined analytical study is adopted for screening the drug. Iron is important in the formation of haemoglobin, myoglobin and other substances such as cytochromes, cytochrome oxidase, peroxidase and catalyse. It is essential to understand the means by which iron is utilized in the body. In Ayurveda iron in the form *Lauha Bhasma* is advised in the treatment of diseases like *Pandu* (Anemia) etc. Hence in present study characterization of *Lauha Bhasma* is conducted. In the medical field, it becomes mandatory to study complete analytical profile of the drug for its better understanding of drug without which a drug cannot claim a position in market. There are various kinds of parameters adopted in this regard.

Two samples of *Kanta Lauha* and one sample of *Teekshna Lauha* are used in the preparation of *Lauha Bhasma*. The pharmaceutical study is conducted in three batches which are mentioned below.

Batch "A"	:	*Teekshna Lauha* (Iron turning)
Batch "B"	:	*Kanta Lauha* (Magnetite iron ore)
Batch "C"	:	*Kanta Lauha* (Magnetite iron ore)

Procurement of raw material

- *Teekshna Lauha* (Iron Turnings) were collected from Dept. Of Metallurgy, IT, BHU, Varanasi.
- *Kanta Lauha* (Magnetite iron ore) were collected from NML Jamshedpur (Jharkhand).
- *Tila taila* was collected from *Ayurvedic Pharmacy*, BHU, Varanasi.
- *Gomutra* was collected from Dairy farm, Institute of Agriculture sciences, BHU, Varanasi.
- *Triphala* and *Kulattha* collected from Gola Dinanath, Varanasi.

Aims and Objectives

To analyze *Lauha Bhasma* by X-ray diffraction (XRD) method. and X-ray fluroscence (XRF) methods.

Materials and Methods

Lauha Bhasma was prepared by following classical guidelines

Address for correspondence: Dr. K. R. C. Reddy,
Associate Professor, Department of Rasa Shastra, Faculty of Ayurveda, IMS,BHU, Varanasi, Uttar Pradesh, India.
E-mail: drkrcreddybhu@yahoo.co.in

i.e., *Samanya Shodhana*, *Vishesha Shodhana*, *Bhanupaka*, *Sthalipaka* and *Putapaka*. In the above steps *Samanya Shodhana* was done on the basis of *Rasa Ratna Samucchya*,[1] and rest of all steps were done on the basis of *Rasendra Sara Sangraha*.[2]

Observations and results of X-ray diffraction

Data were recorded from 2θ = 10°-80° at a scanning rate of 4°/mm of 6 kw energy. XRD pattern as shown in the above figure, that the iron oxide is manly present in the form of αFe_2O_3 and Fe_3O_4 (Magnetite). The raw material as it was iron turning processed to get the *Bhasma*(Sample-A7) is αFe_2O_3 and the other two *Bhasma* sample B7 and C7 are also αFe_2O_3; however, starting material (raw material) was Fe_3O_4 (Magnetite) B1 and C1, respectively. During the process of *Bhasmaikarana* at high temperature heating (600°) iron oxide formed in its most stable state i.e., αFe_2O_3. Therefore all the *Bhasma* showed αFe_2O_3 phase independent the starting raw material. The magnetite phase Fe_3O_4 is a mixture of two states of iron i.e., iron FeO and Fe_2O_3. The FeO state easily converted to its most stable higher state Fe (III) and form Fe_2O_3 either γ or α phase. At higher temperature αFe_2O_3 is most stable; therefore, it forms in this state only. The imported data is presented in Table 1 and Figure 1.

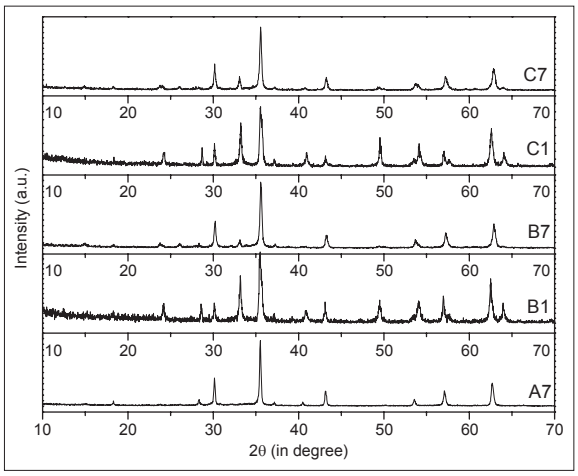

Figure 1: X- Ray diffractograms
A7-*Teekshna Lauha Bhasma*, B1 – *Kanta Lauha* raw material, B7 – *Kanta Lauha Bhasma*, C1 – *Kanta Lauha raw* material, C7 – *Kanta Lauha Bhasma*.

Observations and results of X-ray fluroscences

Sample of all the three batches viz.,*Teekshna Lauha* (Iron turning) A, *Kanta Lauha* (Magnetite iron ore) B and *Kanta Lauha* (Magnetite iron ore) C were subjected to XRF spectroscopy. The imported data is presented in Table 2.

Other elements

Sample 1: Raw material
Sample 2: After sthalipaka
Sample 5: After 10th Puta,
Sample 7: After 18th Puta for magnetic and 20thPuta for iron turning
Batch A : Teekshna Lauha (Iron turning)
Batch B : Kanta Lauha (Magnetite iron ore)
Batch C : Kanta Lauha (Magnetic iron one)

Firstly, the iron contents (in the form of an oxide) is increasing in the sample of *Kanta Lauha* (B and C) with increasing No. of *Putas* while in case of iron turnings (*Teekshna Lauha* A), the iron contents estimated by XRF is lower than the starting (Raw) material as in this case the iron along with its alloying elements is being oxidized. The minor elements such as Si, Al, Ca and Mn have shown an increase in their weight fraction at the end of the processing in the case of iron turnings while they either remained constant or showed marginal increase in the case of *Kanta Lauha* samples. However, increase in Si contents in the case of these samples is significantly high.

Other elements are also present in the samples found during XRF analysis. It is interesting to observe that few of them are from the groups of

P, Cl, Ni, Ar, S, K, Tb, Sm, W, Dy, Cu, Zn, Gd, Co, Rb, Sr, Ti, Er, Ga, Y, Na.

Conclusions

The iron contents (Fe_2O_3) at the end of repeated *Putas* has shown a decrease in the case of *Teekshna Lauha* since the starting material is pure iron while it showed only marginal decrease in case of *Kanta Lauha* because the Fe_3O_4 of magnetite is undergoing oxidation to Fe_2O_3. The other elements remain within *Bhasma* in the form of various oxides of Si, Al, Ca, etc., the source of these elements is either by mortar, raw material itself or the triphala kwatha[3] added during trituration.

Table 1: X-ray diffraction data of the samples

Sample no. A 7		Sample no. B 1		Sample no. B 7		Sample no. C 1		Sample no. C 7	
2θ	d space	2θ	d space	2θ	d space	2θ	d space	2θ	d space
-	-	24.2	3.695	-	-	24.2	3.695	-	-
28.2	3.16	28.22	3.16	-	-	28.6	3.12	-	-
30	2.9698	30	2.9698	30	2.9698	30	2.9698	30	2.9698
-	-	33.1	2.6500	33.1	2.6500	33.1	2.6500	33.1	2.6500
35.6	2.5327	35.6	2.5327	35.6	2.5327	35.6	2.5327	35.6	2.5327
43	2.100	43.06	2.091	43.06	2.091	43.06	2.091	43.06	2.091
53.5	1.71	-	-	-	-	-	-	-	-
-	-	54.09	1.6981	54.09	1.6981	54.09	1.6981	54.09	1.6981
57.29	1.6165	57.08	1.612	57.08	1.612	57.29	1.6165	57.29	1.6165
62.6	1.482	62.6	1.482	62.6	1.482	62.6	1.482	62.6	1.482
-	-	64.13	1.452	-	-	64.13	1.452	-	-

Table 2: XRF analysis

Element		Sample – 1		Sample – 2		Sample – 5		Sample – 7	
		Wt. %	Std. error	Wt. %	Std. error	Wt. %	Std. error	Wt. %	Std. error
Fe	Batch – A	98.10	0.07	58.18	0.78	80.92	0.20	70.26	0.23
	Batch – B	94.62	0.11	76.69	0.38	89.30	0.15	88.03	0.16
	Batch – C	57.05	0.40	93.56	0.12	67.75	0.23	90.18	0.15
Si	Batch – A	0.405	0.020	3.74	0.11	1.44	0.06	0.968	0.048
	Batch – B	1.81	0.07	7.91	0.17	3.88	0.10	3.51	0.09
	Batch – C	1.75	0.07	1.89	0.07	16.37	0.18	4.34	0.10
Al	Batch – A	0.137	0.009	1.26	0.07	0.487	0.024	0.311	0.016
	Batch – B	1.29	0.06	2.56	0.12	1.84	0.07	1.52	0.00
	Batch – C	0.344	0.023	0.751	0.037	6.3	0.12	1.90	0.07
Ca	Batch – A	0.074	0.0037	0.30	0.02	1.32	0.06	1.50	0.06
	Batch – B	0.052	0.0026	0.8	0.01	0.718	0.036	1.15	0.05
	Batch – C	0.164	0.010	0.204	0.01	0.177	0.011	0.138	0.007
Mn	Batch – A	0.745	0.037	1.36	0.06	1.77	0.07	1.63	0.06
	Batch – B	1.21	0.05	0.538	0.02	0.4526	0.021	0.534	0.027
	Batch – C	0.350	0.017	0.495	0.02	4.31	0.02	0.129	0.006
Ag.	Batch – A	-	-	-	-	-	-	-	-
	Batch – B	-	-	-	-	-	-	-	-
	Batch – C	1.89	0.33	-	-	-	-	-	-
Others elements	Batch – A	0.539	-	35.16	-	14.063	-	74.66	-
	Batch – B	1.018	-	11.502	-	3.8	-	5.256	-
	Batch – C	40.153	-	3.1	-	5.093	-	3.313	-

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हिन्दी सारांश

लौह भस्म का एक्स–रे डिफरैक्सन एवं एक्स रे फ्लोरेसेन्स द्वारा पहचानात्मक अध्ययन

एस. सी. भार्गव, के. आर. सी. रेड्डी, जी. वी. एस. शास्त्री

आयुर्वेद के प्राचीन ग्रन्थों में लौह भस्म निर्माण की विधियों का वर्णन किया गया है । इन निर्माण विधियों से विभिन्न प्रकार के लौह,तीक्ष्ण लौह एवं कान्त लौह से भस्म निर्माण के लिए बताया गया है। प्रस्तुत अध्ययन में प्रारंम्भिक द्रव्य के रूप में, मैग्नेटाइट खनिज को कान्त लौह के लिए तथा शुद्ध (आर्मकों ग्रेड) लौह टर्निंग को तीक्ष्ण लौह के लिए लिया गया । एक ही निर्माण विधि से दोनों लौह से लौह भस्म का निर्माण किया गया । अन्तिम उत्पाद एवं प्रत्येक पुट के पश्चात का एक्स रे डिफरैक्सन एवं एक्स रे फ्लोरेसेन्स एवं लौह भस्म के घटक द्रव्यों, इनकी विन्यासीय रचना का अध्ययन किया गया । अन्तिम उत्पाद के प्रारम्भिक द्रव्य की तुलना में लौह की मात्रा (Fe_2O_3) तीक्ष्ण लौह में कम हो गयी जबकि कान्त लौह में प्रारम्भिक शुद्ध द्रव्य की अपेक्षा मामूली परिवर्तन मिला, क्योंकि मैग्नेटाइट का Fe_3O_4–अक्सीकरण के पश्चात Fe_2O_3 में परिवर्तित हो गया । विभिन्न द्रव्यों के आक्साइड के रूप में एल्युमिनियम, सिलका, कैल्सियम अशुद्धियाँ पायी गयीं । ये अशुद्धियाँ या तो प्रारम्भिक द्रव्य से या फिर भावना द्रव्य के रूप में त्रिफला क्वाथ से आयी हैं ।