Short Communication

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

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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 *Fe₂O₄* of magnetite is undergoing oxidation to *Fe₂O₃*. 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 | Source of Iron |
|-------|----------------|
| A     | *Teekshna Lauha* (Iron turning) |
| B     | *Kanta Lauha* (Magnetite iron ore) |
| 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 fluorescence (XRF) methods.

Materials and Methods

*Lauha Bhasma* was prepared by following classical guidelines

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i.e., Samanya Shodhana, Vishesha Shodhana, Bhamapaka, Sthalipaka and Putapaka. In the above steps Samanya Shodhana was done on the basis of Rasa Ratna Samuccya,[4] and rest of all steps were done on the basis of Rasendra Sara Sangraha.[5]

Observations and results of X-ray diffraction
Data were recorded from 2θ = 10°-80° at a scanning rate of 4°/min of 6 kw energy. XRD pattern as shown in the above figure, that the iron oxide is mainly present in the form of α-Fe₂O₃ and Fe₃O₄ (Magnetite). The raw material as it was iron turnings processed to get the Bhasma (Sample A7) is α-Fe₂O₃ and the other two Bhasma sample B7 and C7 are also α-Fe₂O₃; however, starting material (raw material) was Fe₃O₄ (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., α-Fe₂O₃. Therefore all the Bhasma showed α-Fe₂O₃ phase independent the starting raw material. The magnetite phase Fe₃O₄ is a mixture of two states of iron i.e., iron FeO and Fe₂O₃. The FeO state easily converted to its most stable higher state Fe (III) and form Fe₂O₃ either γ or α phase. At higher temperature α-Fe₂O₃ 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](image)

**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 | - | - | - | - | - | - |

Observations and results of X-ray fluoroescence
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 20th Puta 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 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 (Fe₂O₃) 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 Fe₂O₃ of magnetite is undergoing oxidation to Fe₃O₄. 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 added during trituration.
Table 2: XRF analysis

| Element | Sample – 1 | | | Sample – 2 | | | Sample – 5 | | | Sample – 7 | |
|---------|------------|---|---|------------|---|---|------------|---|---|------------|---|
| 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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