Research Article

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COMPARATIVE STUDY ON PHYSICOCHEMICAL PARAMETERS OF KASISA BHASMA PREPARED BY TWO DIFFERENT METHODS

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ABSTRACT

Kasisa is an Iron-containing compound mentioned in Ayurveda. Different methods for the preparation of Kasisa Bhasma are described in ancient Ayurveda textbooks. However, the lack of standardisation in the incineration process poses a significant challenge to ensuring the preparation's quality. In the present study, the method mentioned in Rasamrutha was adopted. The classical method of bhasma preparation comes with certain challenges. An Electric Muffle Furnace offers a more controlled and consistent alternative, addressing some of the difficulties associated with the classical approach. Hence, two different heating methods were adopted here to prepare bhasma (the classical method and an Electric Muffle Furnace). The final product obtained from these two methods was characterised by X-ray diffraction to determine the composition. The study findings indicate a notable shift in the product to oxide form, with a higher percentage observed in the classical method of bhasma preparation.

Keywords: Kasisa bhasma, X-ray diffraction, haematite

INTRODUCTION

Bhasmas are unique Ayurvedic herbo-mineral preparations obtained from metals, minerals or animal products by treating them with herbs through bhasmikarana (incineration) [1]. The quality of the bhasma depends on the nature of raw materials and herbs used in the preparation, the bhavana process (trituration) and the heating cycle employed. The metals/minerals are heated to a high temperature during this process in a limited or controlled air supply.

Kasisa Bhasma is one of the widely used organometallic preparations in Ayurveda. It is therapeutically used both externally and internally for the treatment of diseases like anaemia, leucoderma, prolapse of the rectum and uterus and splenic disorders[2]. It also possesses hematinic and antioxidant properties[3]. In the classical method, the process of bhasmikarana involves repeated puta (quantum of heat) until desired siddha lakshanas (characteristics) of the bhasma are achieved. However in the present scenario, these traditional parameters may not be sufficient to ensure these preparations' quality, efficacy, and safety. Hence, incorporating advanced techniques can provide more accurate control over the manufacturing process, allowing for better quality assurance.

In the classical method, incineration is carried out in specialised pits using cow dung cakes as the fuel. Here, the amount of fuel required for incineration is mentioned in the size of the pit, and the number of cow dung cakes, but the definite amount of metal or mineral to be taken for each batch is not specified[2]. In the case of Kasisa bhasma preparation, dasaprastha vanopala (8 kg) is only mentioned as the amount of fuel. This can lead to difficulty in standardising the bhasma preparation[3]. In addition, there are certain valid challenges, such as more time consumption, workforce, fuel resources and temperature control difficulties.

Using an Electric Muffle Furnace for incineration in the synthesis of bhasma can help address some of the challenges of the classical method. It can reduce the time required to prepare bhasma and allow more precise control of the temperature and duration of the heating process; it can also be programmed to maintain the temperature at a specific level for a particular duration.

Considering all these factors, the present study focuses on evaluating the incineration process of Kasisa bhasma through the classical method and using an Electric Muffle Furnace (EMF). After incineration, detailed characterisation of the obtained bhasma is crucial to evaluate its authenticity and quality. Classical literature outlines a set of criteria for this, but these criteria have certain limitations. Integrating proper instrumentation facilities allows more precise characterisation and sheds light on these compounds' hidden properties and composition. So, in this study, we also conducted a comprehensive analysis comparing the quality control checks of bhasmas prepared by two different methods using the parameters described in Ayurvedic classics and employing the XRD technique.

Aim and objectives: To prepare Kasisa Bhasma by classical method and by using an Electric Muffle Furnace and to evaluate the physicochemical parameters of both.

MATERIALS AND METHODS

The general preparation of Kasisa Bhasma involves two major stages: shodhana (purification) and marana (incineration). The reference from Rasamrutha was followed here to prepare Kasisa

Bhasma [5].

Collection of raw material: Kasisa was purchased from the local market of Thiruvananthapuram, Kerala, India. Its authenticity was checked through the XRD technique.

Shodhana of Kasisa
Materials required: Kasisa 240 g and Bhringaraja Swarasa (expressed juice of *Eclipta alba* Linn.) - 100 ml.

Principle: Bhavana (Trituration)

Equipment required: Khalwa yantra (mortar and pestle) and spatula.

Procedure: 240 g of raw Kasisa was taken in a khalwa yantra and powdered well. Then, 48 ml of freshly prepared Bhringaraja swarasa was added to it so that the powder was immersed entirely, and the swarasa could be seen just over the surface. The mixture was then grounded well. The grinding was continued till the Kasisa became dry. It took about 6 hours to complete the first bhavana. Then, the entire process was repeated two more times. Approximately 30 ml and 22 ml of bhringaraja swarasa were used for the second and third bhavana, respectively.

Marana of Kasisa
Materials required: Shodhitha Kasisa 248 g and Nimbhu swarasa (expressed juice of lemon).

Equipment required: Khalwa yantra, earthen sharava (crucible), clay and cloth, Electric Muffle Furnace (EMF), spatula and tray.

Procedure: 248 g of Shodhitha Kasisa was taken in a khalwa yantra, and 30 ml of fresh Nimbhu swarasa was added. Then, the mixture was ground well until it reached a consistency that could be shaped into chakrikas (pallets) of uniform thickness. Each chakrikas weighed about 2.5 g with a diameter of 2.5 cm. A total of 98 chakrikas were made in this way. These chakrikas were then dried well till the moisture contents were evaporated entirely.

After that, the obtained chakrikas were divided into two equal batches, **Batch A** and **Batch B**, each containing 49 chakrikas. Batch A was subjected to the marana process (incineration) by the classical method using cow dung cakes as fuel. Batch B was subjected to the marana process using an Electric Muffle Furnace.

Batch A
The 49 chakrikas were arranged uniformly in an earthen sharava. Then this sharava was covered with another sharava of the same size. The edges between these two sharavas were sealed with the help of a cloth smeared with a paste of clay and water. The same sealing process was repeated six more times, allowing adequate time for drying in between.

A cubical pit with dimensions 45 cm in length, 45 cm in breadth and 41 cm in depth was initially filled with 5.5 kg of cow dung cakes (approximately 2/3rd quantity). On average, each cow dung cake weighed about 60 g, measuring 5 inches in diameter and 4 mm in thickness. The sealed sharava was then placed over it. Red hot charcoal pieces (15 pieces) were placed at the four corners of the pit in between the cow dung cakes to initiate the burning of the cow dung cakes. This technique helps to ensure that the cow dung cakes burn consistently, thus providing a steady source of heat during the entire process. The remaining part of the pit was filled with 2.5 kg of cow dung cakes (approximately 1/3rd quantity). An industrial pyrometer was regularly introduced between the cow dung cakes to monitor the temperature. The maximum temperature attained was 620 ^{0}C. After attaining the swanga sheeta (self-cooling), the sharava samputa was removed, and the physical impurities on its surface were removed. The sealing was carefully removed using a knife, and the content was transferred into a clean khalwa yantra. The same procedure was repeated until bhasma pareeksha lakshanas were obtained.

The following photographs show various stages of the synthesis of Kasisa Bhasma (Figures 1 and 2).

Figure 1: Chakrikas arranged in sharava

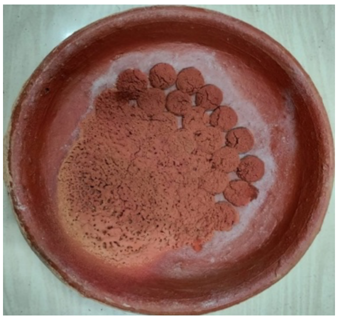

Figure 2: Product obtained after 2nd puta

Batch B
In Batch B, the remaining 49 chakrikas were arranged uniformly in an earthen sharava and another sharava was used to close it. The edges were then sealed according to the procedure adopted for Batch A. Then, after proper drying, the sealed sharava was placed in the Electric Muffle Furnace, and the temperature was allowed to rise gradually to 700 ^{0}C for 2 hours and maintained at 700 ^{0}C for half an hour. After that, the EMF was switched off and allowed to self-cool to room temperature. On the 3rd day, the sharava was removed, and the sealing was carefully removed using a knife. Then, the content was transferred into a clean khalwa yantra and powdered well. After the first puta itself, the obtained Kasisa Bhasma attained bhasma pareeksha lakshanas.

OBSERVATION AND RESULTS

Kasisa Shodhana

Table 1: Observations during Kasisa Shodhana

Bhavana	Weight of Kasisa before Bhavana	Bringaraja swarasa used	Weight of Kasisa after bhavana
1st	240 g	48 ml	243 g
2nd	243 g	30 ml	246 g
3rd	246 g	22 ml	248 g

Preparation of Chakrikas

Table 2: Observations during the preparation of Chakrikas

Weight of Kasisa	248 g
Amount of Nimbhu swarasa	30 ml
Number of Chakrikas	98
Weight of chakrikas after drying	238 g

Quantities of puta

Table 3: Observations concerning quantities of puta

		Number of Chakrikas	Weight of Chakrika before puta (g)	Weight of the product (g)
Batch A	1st Puta	49 (2.5 g each)	110 g	43 g
	2nd Puta	21 (2 g each)	39 g	27 g
Batch B	1st Puta	49 (2.5 g each)	108 g	29 g

Temperature pattern during puta
The maximum temperature observed:
Batch A: 1st puta: maximum temperature attained was 620 ^{0}C.
2nd puta: maximum temperature attained was 740 ^{0}C.
Batch B: 700 ^{0}C and maintained for half an hour. The time taken to achieve peak temperature was two and a half hours.

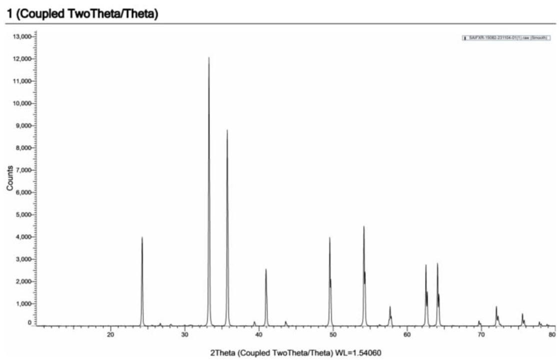

Figure 3: XRD results of the product of Batch A

Organoleptic characters of Kasisa Bhasma

Table 5: Organoleptic characters of Kasisa Bhasma

Character	Batch A	Batch B
Colour	Dark red	Brownish red
Lustre	Lustreless	Lustreless
Odour	Odourless	Odourless
Taste	Tasteless	Tasteless
Touch	Smooth	Smooth

Testing of Kasisa Bhasma by Ayurvedic parameters (Bhasma pareeksha)

Niramlatva (completely sourless) and gairika varna (red colour) are the main characteristic tests for assessing the quality of Kasisa Bhasma. In Batch A, after two putas and in Batch B, after the first puta itself, these parameters were obtained. In addition to this, products of both batches satisfactorily passed nishchandratva (lustreless), varitaratva (floating of product on water), and rekhapurnatva (particle size enters in the furrows of the finger)[6].

XRD Analysis

The powdered XRD patterns of prepared Kasisa Bhasma by two methods are displayed in Figures 3 and 4, respectively. The data was recorded.

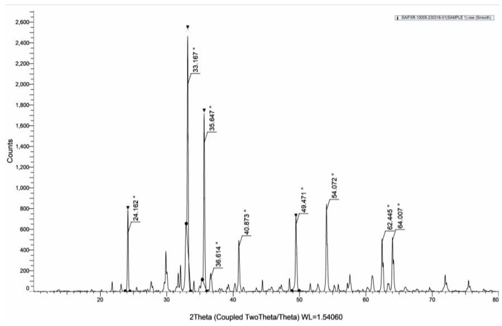

Figure 4: XRD results of the product of Batch B

DISCUSSION

Characterisation of Kasisa Bhasma by XRD

The raw material used was FeSO4.7H2O (Sulphate form of iron)[7]. During bhasmeekarana, a high temperature was given for its conversion to bhasma state, satisfying classical parameters like niramlatwa and Gairika varana. These parameters were achieved with two putas in Batch A and with one puta in Batch B. X-ray diffraction studies were conducted on the two samples for deeper evaluation, providing insights into their structure and phase composition[8].

The peak values matched precisely with standard data (ICSD & PDF). All the peaks were indexed. Around 18 characteristic peaks were identified in Figure 3, and nine characteristic peaks were identified in Figure 4. Comparable diffraction patterns were observed in 8 peaks (24.16, 33, 35, 40, 49, 54, 62, 64) corresponding to the peaks of α- Fe_2O_3 (Haematite) at 2θ values. The α-Fe_2O_3 form is indeed a stable form of iron, and its stability contributes to its formation after incineration. The powder data was analysed using Rietveld technology to quantify its phases. The XRD patterns of the two batches match, but on quantitative analysis, the haematite form of iron was identified as 100% and 86.4% in Batch A and Batch B, respectively. In Batch B, trace elements were also identified in the form of oxides of Ca (7.9%), Ti (1.9%), and Si (3.73%). This phase change of raw Kasisa to its oxide form during the bhasmikarana process is crucial to its therapeutic value. In comparing two batches through the XRD technique, observing a higher percentage of hematite in Batch A suggests that the classical method of bhasma preparation holds more value regarding the specific phase composition achieved.

Ensuring repeatability is challenging in the classical method due to difficulties in standardising temperature patterns. In contrast, the Electric Muffle Furnace allows better temperature control. Certainly, conducting further studies by exploring variations in temperature patterns or increasing the number of putas is a logical approach. This can help assess how these adjustments influence the percentage of hematite in the Electric Muffle Furnace method. Such investigations contribute to refining the bhasma preparation process, enhancing our understanding of the relationship between temperature control and the desired phase composition, and ultimately optimising therapeutic outcomes.

CONCLUSION

An iron-based mineral drug, Kasisa, was converted to its bhasma form through the classical method and using an Electric Muffle Furnace and its quality checks were analysed through Classical parameters and XRD techniques. In the present study, the percentage of the oxide form of iron was higher in Batch A. In Batch B, additional Ca, Ti and Si oxides were also identified. The source of these additional elements may be attributed to the processing techniques or the vessel used. Considering standardisation parameters, the Electric Muffle Furnace has added benefits. So, optimising this method by considering adjustment parameters such as temperature and heating duration for achieving the desired phase change is crucial. Hence, undertaking further studies in this aspect are needed.

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