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AN APPROACH TOWARDS STANDARDIZATION OF SWARNA MAKSHIK BHASMA (AN AYURVEDIC PREPARATION)

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ABSTRACT
Swarna Makshik (Chalco-pyrite), a mineral having various therapeutic uses in Pandu (Anemia), Kushtha (Skin disorders) and Kamala (Jaundice) has been used since long in Ayurveda. The present study was conducted to standardize raw and processed swarna makshik using techniques which can be used by pharmacies. Powdered swarna makshik was heated in an iron pan by adding lemon juice for 3 days till liberation of sulphur fumes stopped completely. Bhasma of this purified swarna makshik was obtained by triturating it with purified sulphur and lemon juice. It was then subjected to heat in 13 putas, and for firing in each puta, 3.5 kg cow dung cakes were used. To assure the quality of bhasma, rasa shastra quality control tests like nischandratva, varitara, amla pariksha, etc., were used. After the bhasma complied with these tests, the bhasma was analyzed using X-ray Diffraction (XRD) and Thermo Gravimetric analysis (TGA) revealed that SM bhasma contains Fe_2O_3, FeS_2, CuS and SiO_2. It may be concluded that raw SM is a complex compound which gets converted into a mixture of simple compounds after the particular process of marana.
Key Words: Swarna makshik bhasma, X-ray diffraction, Thermo Gravimetric analysis

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INTRODUCTION

Swarna makshik is used as single ingredient or in combination with other ingredients as in multi – ingredient formulations. However, there is variation in collection of raw materials and the pharmaceutical procedure followed, which generates the same bhasma with different characters. As a result, reproducibility is often not achieved. Ayurvedic texts have described methods for quality control of finished products through different parameters like nischasndratva, varitara, niruttha, apunarbhava, etc., to achieve a specific acceptable standard bhasma[1]. This study was performed to standardize bhasma using sensitive tools and techniques. These analytical methods for bhasma could be used as standards to for ensuring quality and reproducibility of standards of the medicines.

MATERIALS & METHODS

Processing of Swarna Makshik

This was carried out in two steps, namely Shodhana (purification) and marana (calcinations) of swarna makshik[2]. The Swarna makshik was procured from 'Hindustan Copper Mine, Khetri, Jaipur, India and lemon juice (sufficient quantity) was obtained from the market.

Instruments

Iron mortar and pestle, Charcoal furnace, iron pan, iron ladle, pyrometer, etc.

Shodhana

At first swarna makshik was powdered with help of iron mortar & pestle. A clean and dry iron pan was then heated on a charcoal furnace onto which was poured the powdered swarna makshik and subjected to intense heat with frequent addition of lemon juice till the liberation of sulphur fumes stopped and it turned red. The process was completed in 3 days and the final product called purified swarna makshik obtained[3]. [Figure 1& 2]

Marana

For the Marana of swarna makshik, purified sulphur and lemon juice (q. s.) were procured. Equal amounts of purified swarna makshik and purified sulphur were triturated with lemon juice till a homogenous paste was formed. After triturating, small pellets of uniform size and thickness were prepared and dried in sunlight. Pellets were kept inside a sharava (shallow earthen disc) and another sharava was inverted over it. The joint between

the two discs was sealed with a ribbon of cotton cloth uniformly smeared with fuller's earth seven times and dried in sunlight.

The properly sealed and dried samputa was subjected to puta system of heating with 3.5 kg cow dung cakes. The process was repeated using purified sulphur in equal proportion to swarna makshik for the first cycle and then in half the proportion for subsequent 12 cycles. Bhasma of the desired quality was obtained in 13 putas. The bhasma obtained from the above process was subjected to analysis[4]. [Figure 3, 4 & 5]

Analysis Using Parameters Described In Ayurveda Texts

The final product (swarna makshik bhasma) was analyzed on quality control measures described in Ayurvedic texts as follows and found appropriate[5].

Nischandratva

The bhasma was taken in a Petri dish and observed for any luster in daylight through magnifying glass. No luster was observed in the bhasma.

Rekhapurnatvam

A pinch of bhasma was taken in between the thumb and index finger and rubbed. It was observed that the bhasma entered into the lines of the finger, and was not easily washed out from the cleavage of the lines. [Figure 6]

Varitaratavam

A small amount of the prepared bhasma was sprinkled over the still water in a beaker. It was found that the bhasma particles floated over the surface of the water. [Figure 7]

Nisvadutvam

The prepared bhasma was found to be tasteless when a small amount was kept on the tongue.

Amla pariksha

A pinch of prepared bhasma was mixed with a little amount of dadhi (curd) in a clean and dry Petri dish and observed for any color change. No color change of dadhi was observed. The same procedure was followed with lemon juice taken in a test tube, and the same result was observed. [Figure 8]

Avami

Ingestion of 5-10 mg of the bhasma did not produce any nausea / vomiting.

Uttam

When a grain was placed on the varitara film of Bhasma, it was float like swan on water; such Bhasma is termed as Uttam. [Figure 9]

Niruttha

Bhasma is heated at high temperature in a koshthi along with measured quantity of silver. At the end of the process, the quantity of silver should not increase. [Figure 10]

Apunarbhava

Bhasma when mixed with mitrapanchaka and heated at high temperature should not undergo any change in its physical properties. The bhasma should not regain its original state. [Figure 11, 12]

Analysis Using Modern Parameters

The bhasma) was analyzed using the following techniques:

1. X-ray diffraction (qualitative)
2. Thermo Gravimetric analysis (TGA)

X-Ray Diffraction Study

Instrument: Philips Holland XRD system PW 1710 using cu – Tube anode

X-ray diffraction studies were performed at National Chemical Laboratory, Pune, India. The powdered sample was spread onto a double-side tape with a spatula, which was then placed on an aluminum sample holder; it was covered & sealed with glass plate. It was then exposed to x-ray beam of intensity 35KV and 20MA. All the peaks were recorded on the chart, and the corresponding 2θ (theta) values were calculated[6]. Results are summarized in Figure 13 and Table 1.

The strongest peak identified in bhasma was Ferrous oxide of Iron (Fe_2O_3) & other phases were identified as FeS_2, Copper sulphide (CuS) and SiO_2.

Thermo Gravimetric Analysis

Instrument: Thermal analyzer, Type-TA 4000, Model – TG 50, Make – Mettler, Switzerland.

Thermogravimetry study was performed at National Chemical Laboratory, Pune, India. The instrument for thermogravimetry is a precision balance programmed for a linear rise of temperature. Swarna Makshik Bhasma sample was placed in sample holder and heating was preceded. The temperature was gradually increased from 35°C to 815°C the rate of temperature increases was maintained at 10°C minute. Weight changes during this period were recorded. A plot of weight change versus temperature of time represents results from the programmed operation of thermo balance. This plot is referred to as the 'Thermogravimetric curve' - TG curve. TG curve gives information that how much weight lost, by heating a sample to a given temperature. The result was presented in the form of graph of weight loss plotted against temperature. Change in weight per unit change in temperature was derived and it's another graph against the temperature i.e. derivative of mass (dm) change with respect to time i.e. dm / dt was recorded as a function of temperature or time. Another curve i.e. DTA (Differential Thermal Analysis) was obtained it is often considered an adjunct to TG is, in fact more versatile and yields data of a considerably more fundamental nature. This technique is simple as it involves the technique of

recording the difference in temperature between a substance and a reference material against either time or temperature as the two specimens are subjected to identical temperature regimes in an environment heated or cooled at the controlled rate. Thus the differential thermogram consists of a record temperature (differential temp; Δ T) plotted as a function of time t, sample temperature (T_s), reference temperature (T_r) or furnace temperature (T_f). DTA allows the detection of every physical and chemical change whether or not it is accompanied by a hange in weight[7].

The resultant curves were obtained as -

1. Thermo Gravimetry (TG) curve.
2. Derivative Thermo Gravimetry (DTG) curve.
3. Differential Thermal Analysis (DTA) curve.

The results obtained are shown in Figure 14

DISCUSSION

It is remarkable that there are very precise pharmaceutical measures and procedures described in the rasa shastra literature which transfers toxic metals/ minerals into a suitable dosage form. The bhasmas prepared are well tolerated both for short-term and long-term use; moreover, it is claimed that their prolonged administration is required to achieve the rejuvenation effect[8]. According to the need of time, characterization of bhasma using scientific techniques is necessary to determine the effect of the process and to judge its safety and efficacy. Swarna Makshik bhasma was prepared and studied with this objective. X-ray diffraction study of the raw material showed a sharp peak, indicating its crystalline nature; whereas the final product did not give sharp peaks, indicating the loss of crystalline nature. This is suggested by the test described in Ayurveda namely, as loss of luster (nischandrika) in the final product. Thus the sharp crystalline structure of the raw material reflects light rays whereas loss of crystalline nature in the final product prevents it from doing so. Hence the "loss of luster" (nischandrika) described in Ayurveda as a quality to be looked for in the final product.

The study revealed peaks of Fe_2O_3, Iron sulphide (FeS_2), CuS and silicon oxide (SiO_2) in the final product. The formation of some different compounds in the final product may be due to oxidation and reduction reaction of Cu, Fe with sulfur in the presence of oxygen. It is likely that the lack of change of colour in an acidic medium (amla (curd) pariksha) in the final product is due to the absence of free metallic groups as free copper reacts with lemon juice to give a blue color. Sulfides and oxides of iron and copper present in swarna makshik bhasma do not show any unwanted effects and the bhasma has been used over a long period of time in clinical practice and no toxic effect has been recorded so far. Presence of SiO_2 may be due to the use of earthen casseroles, which may have a reaction with oxygen[9].

From TG curve of Swarna Makshik Bhasma it is observed that, there is superficially negligible loss about 0.85% by weight. DTA shows an endothermic peak which is exactly superimposes the DTG curve at ~ 600°C. The endothermic peak observed in DTA may be due to some internal physical / phase change. From DTG it is evident that the appreciable change is observed at ~ 600°C which is reinforced by the DTA curve. On above observation we can say that above technique can be used as a confirmative or supportive test for any Bhasma or Mritaloha. In rasa shastra texts, various Bhasma pariksha were described by Rasacharyas. Niruttha Pariksha is one of them. In which the sample of Bhasma is strongly heated along with silver up to 900°C. In this context, TGA can be alternative and supportive to Niruttha pariksha. TGA has advantages over Niruttha pariksha, as it require less sample (up to few mg), specific controlled mode of heating can be maintained, automated mechanism increases perfection in results. TGA can be established as the quality control test of Bhasma in relation to Niruttha pariksha.

CONCLUSION

Thus, Swarna makshik which contains iron (Fe), Copper (Cu) and sulphur, the manufacturing process plays a definite role to convert the $CuFeS_2$ in the raw material mixture of Fe_2O_3, FeS_2, CuS and SiO_2, in the Final product. These could be important chemical markers for SM bhasma prepared using this particular method. As a result of different stages of processing techniques like shodhana (which involves roasting, with addition of herbal juices and continuous stirring) and marana [which involves bhavana (wet trituration) and puta system of heating], the particle size reduces significantly, which may facilitate absorption and assimilation of the drug into the body system. The particle size in the final bhasma was 1-2

criterion for the final product conforming to all the traditional parameters under bhasma pariksha (examination of properly prepared bhasma).

This can be one of the important factors for standardization of bhasmas. Thus, modern techniques can assist in proper characterization of Ayurvedic dosage forms and standardization of Ayurvedic medicines.

Definitions of terms used

Tests of Bhasma

Varitara-

The bhasma that floats on water is termed as varitara.

Apunarbhava-

Bhasma when mixed with mitrapanchaka and heated at

high temperature should not undergo any change in its physical properties. The bhasma should not regain its original state.

Niruttha-

Bhasma is heated at high temperature in a koshthi along with measured quantity of silver. At the end of the process, the quantity of silver should not increase.

Niswadu-

Bhasma should be tasteless. If bhasma has any taste, it is considered as semi-finished and should be subjected to puta again.

Nischandra-

The sparkling particles (chandrika) in a bhasma indicate a semi-finished product.

Avami-

The bhasma should not produce nausea on administration.

Puta-

In continuation with the etymological meaning, puta is the measure of the amount of heat required to convert or transform any metal or mineral. This amount is substance specific and measured in terms of number or weight of fuel.

Sharava-

Earthen Petri dish having specific measurements.

Bhavana-

Trituration of the drug with liquid medium, e.g., hingula with juice of fresh *Zinzibar officinalis*.

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Table 1 – X-Ray Diffraction of Swarna Makshik Bhasma

Angle (^{0}2θ)	d-value	Peak width (^{0}2θ)	Peak intensity	Relative intensity (%)
27.567	3.2331	0.16	237	23.7
31.937	2.8000	0.10	999	100
35.827	2.5044	0.21	365	36.5
39.381	2.2861	0.01	163	16.3
45.792	1.9799	0.02	415	41.5
48.744	1.8666	0.01	7	0.7
54.286	1.6884	0.008	304	30.4
56.914	1.6165	0.02	108	10.8
59.466	1.5531	0.04	123	12.3
61.952	1.4966	0.31	74	7.4
66.763	1.4000	0.015	1	0.1
69.103	1.3582	0.01	12	1.2
71.407	1.3199	0.01	4	0.4
73.680	1.2847	0.01	39	3.9
75.927	1.2522	0.01	51	5.1
78.152	1.2220	0.01	16	1.6

Figure 1 - Heating of Swarna Makshik With Lemon juice

Figure 2 – Red hot condition of Swarna Makshik after heating for 3 hrs. with lemon juice

Figure 3 – Pellets of uniform size & thickness of purified Swarna Makshik

Figure 4 - Sharava Samputa Placed in Pit Surrounded by Cow Dung Cake (incineration process)

Figure 5 – Final product of Swarna Makshik Bhasma

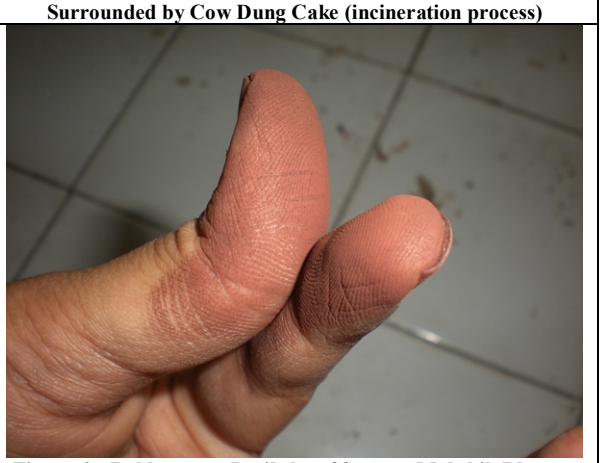

Figure 6 – Rekhapurna Pariksha of Swarna Makshik Bhasma

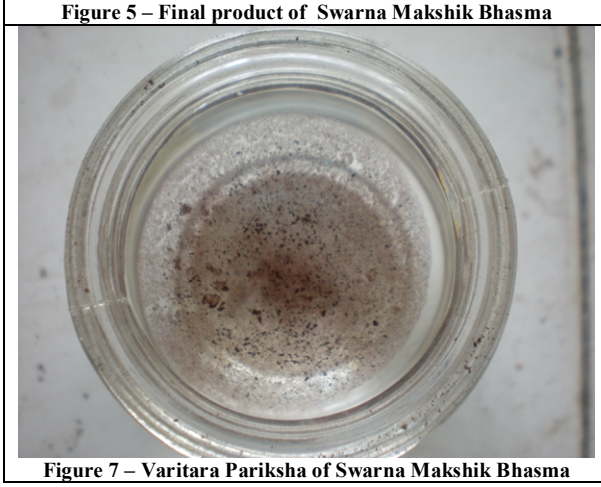

Figure 7 – Varitara Pariksha of Swarna Makshik Bhasma

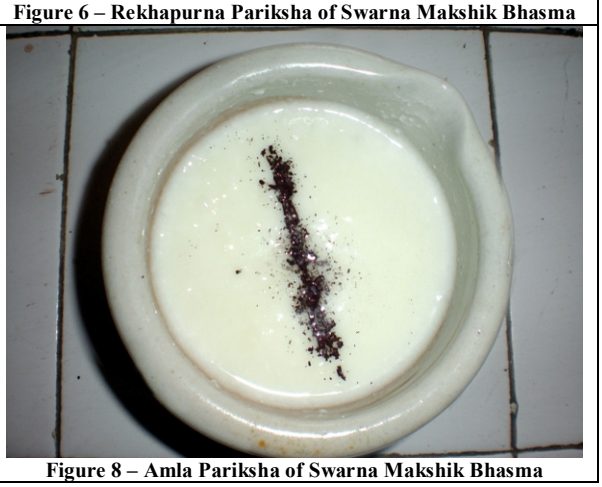

Figure 8 – Amla Pariksha of Swarna Makshik Bhasma

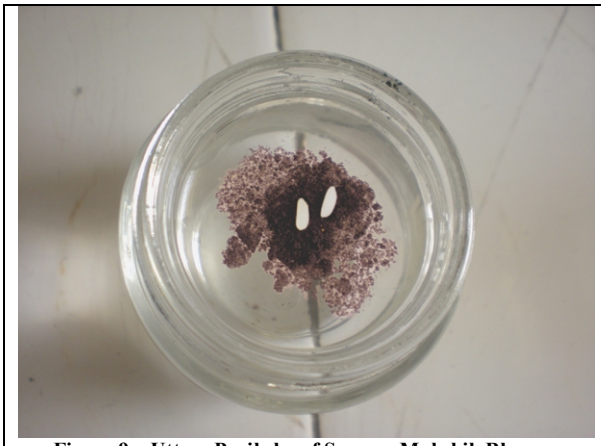

Figure 9 – Uttam Pariksha of Swarna Makshik Bhasma

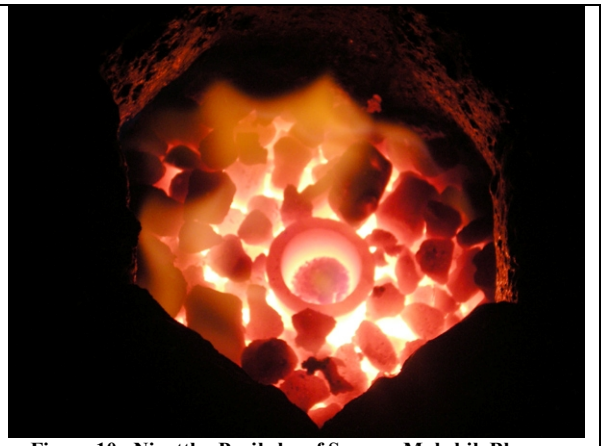

Figure 10– Niruttha Pariksha of Swarna Makshik Bhasma

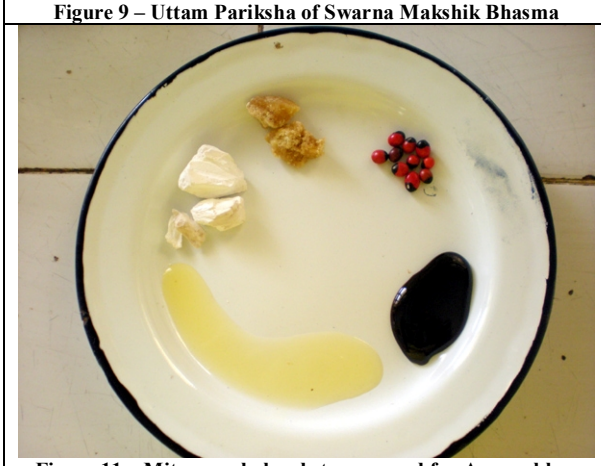

Figure 11 – Mitrapanchak substances used for Apunarbhav Pariksha

Figure 12 – Apunarbhav Pariksha of Swarna Makshik Bhasma

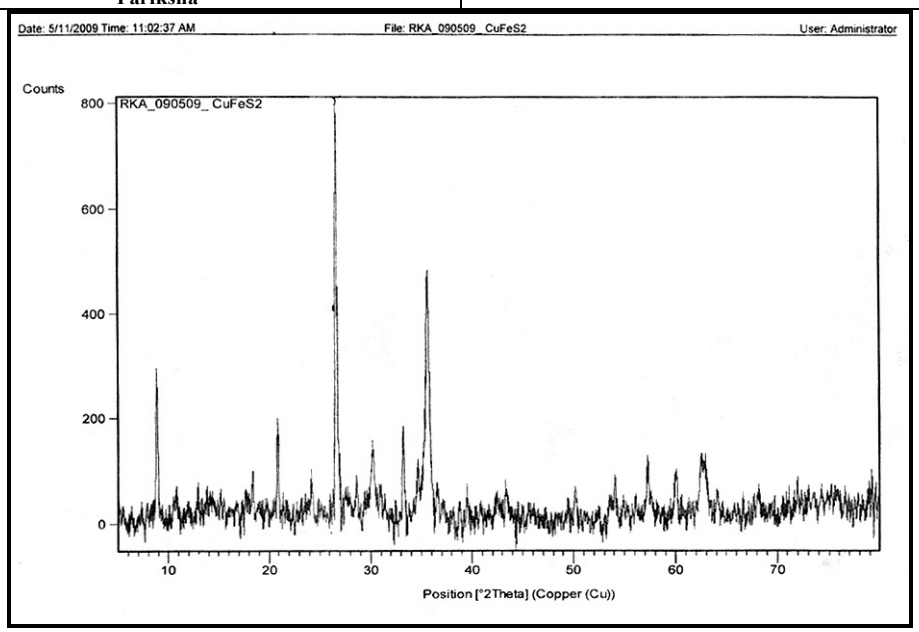

Figure 13 – X-ray diffraction of swarna makshik bhasma

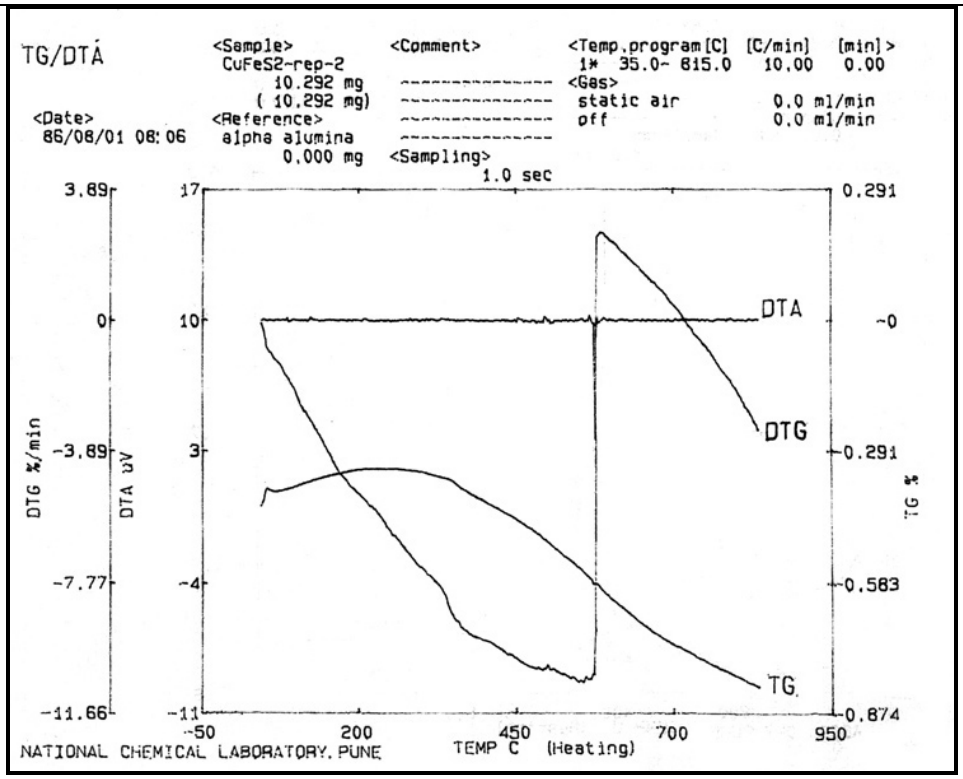

Figure 14 - Thermogravimetric Analysis of Swarna Makshik Bhasma

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