

Characterization of indigenous Traditional medicine - *Muktashukti Bhasma*

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The *Bhasma* of calcium (*muktashukti bhasma*) mentioned in the Ayurvedic text *Rasaratnasamuchchaya*, *Ayurvediya rasashastra*, *Ayurved sarsangraha*. *Muktashukti Bhasma* prepared and has been analyzed by various analytical techniques to scrutinize their chemical compositions. The raw materials, intermediates obtained during the synthesis and the final products have been characterized by various instrumental techniques including powder X-ray diffraction, Infrared spectroscopy, scanning electron microscopy. spectroscopic techniques are proved to be useful in obtaining chemical profile of lab prepared *Muktashukti Bhasma*. These techniques are useful in studying qualitative and quantitative differences in inorganic as well as organic chemical constituents.

Keywords: Ayurvedic drug, Spectroscopy, *Muktashukti Bhasma*

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Ayurveda is an ancient traditional system of medicine of India evolved and practiced over thousands of years. *Bhasma* is the well known potent preparation of this system termed as *rasaushadhi*. *Bhasma* literally means 'ash'. *Bhasmas* are inorganic preparations produced by an alchemic process, which converts a metal or mineral into its compounds like carbonates, oxides, etc. *Bhasmas* of iron, calcium, copper, tin, silver, gold, lead, and zinc are commonly used. The advantages of these preparations over plant preparation are their stability, lower dose and potency¹. The lack of understanding of traditional methods resulted in a difficulty to reproduce authentic preparations. Review of literature revealed that very few reports are available where attempts have been made to understand the physico-chemical properties of *bhasma*. The literature reveals the need of scientific methods for assessing and maintaining the quality of this ayurvedic preparation^{2,3}. *Muktashukti bhasma* (MSB) is a calcium-containing *bhasma*. This biomedicine is synthesized through special calcination of the mother of pearl. MSB is used as an antacid, anti-pyretic, and as a source of calcium. It is also used in tuberculosis, cough, asthma, dysmenorrhea, arthritis, rheumatism, conjunctivitis^{4,7}. Recent studies have shown that adding heated oyster shells to the diet

of elderly patient increased the bone mineral density of the lumbar spine. MSB is one third to one half as potent an anti-inflammatory as the amino salicylic acid⁸. Considering all these facts, it was found worthwhile to carry out a systematic and scientific study of MSB with respect to physico-chemical properties of various parameters was primary aspects of project and then pharmacological study of acute oral toxicity.

Methodology

Preparation of *Muktashukti Bhasma* as per the method prescribed in "Ancient Ayurvedic Rasashastra Literature"

Muktashukti (mother of pearl) procured from local market of Nagpur (Maharashtra), India. *Muktashukti bhasma* was prepared under the guidance of traditional practitioner of Government Ayurveda Mahavidyalaya, Nagpur, as per method described in Ayurvedic texts^{9,10}. The process of synthesis of *bhasma* is divided broadly into two stages. *Shodhana* (Purification), *Marana* (Calcination), and *Bhavana* (Trituration).

Instrumental analysis of *Muktashukti Bhasma*

Powder X-Ray Diffraction analysis

Fig. 1 shows the powder X-ray diffraction patterns of the raw materials, intermediates and the final product.

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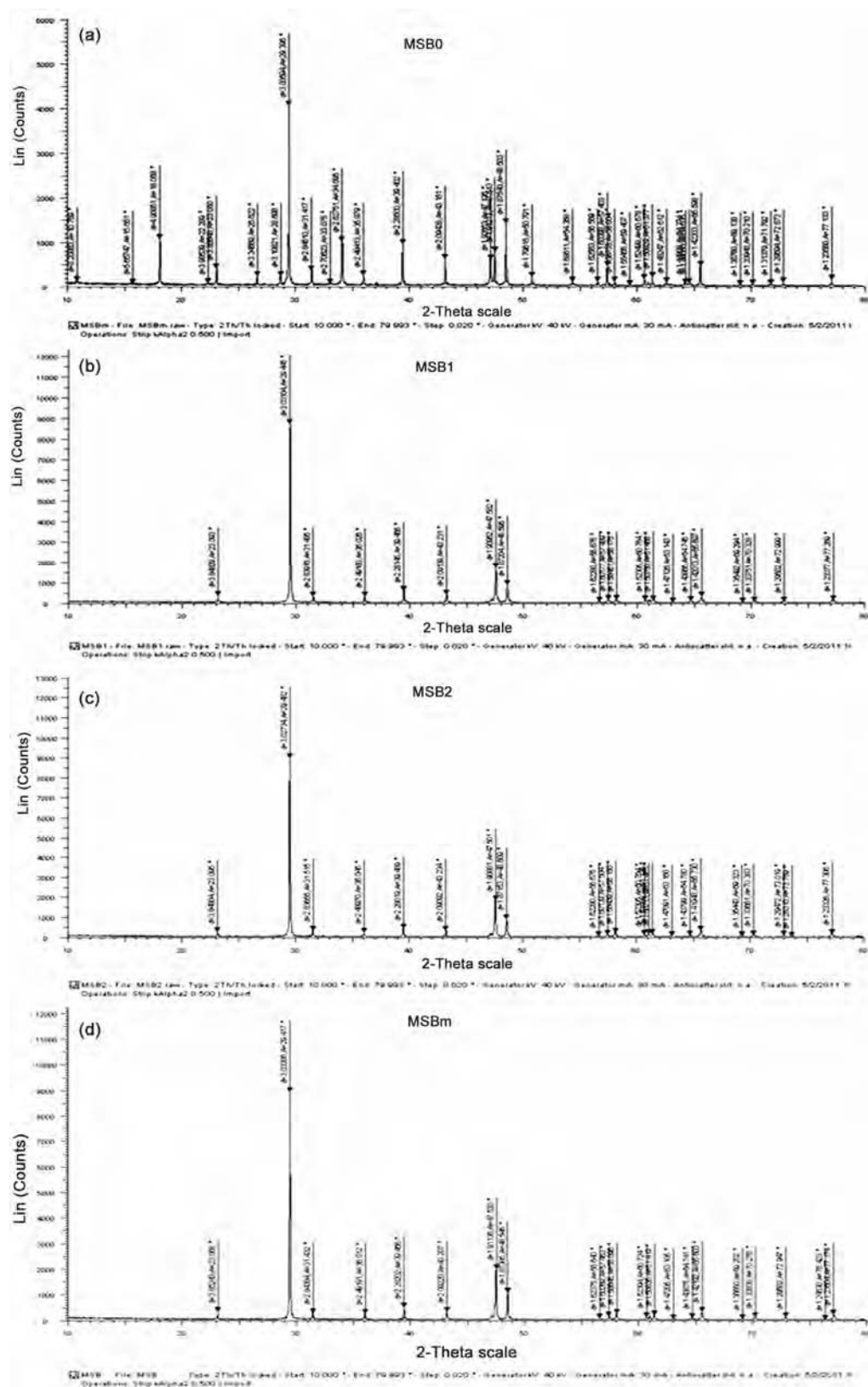


Fig. 1—a) Powder XRD patterns of the raw material b) Powder XRD patterns of the intermediates c) Powder XRD patterns of final product d) Powder XRD patterns of Marketed sample

The pattern of MSB 0 shows that the raw material *Muktashukti* is in the aragonite form of calcium carbonate. The diffraction pattern of MSB1 shows the presence of two phases, calcite form of calcium carbonate and calcium hydroxide. Thus during the first heat treatment, the crystalline form of calcium carbonate changes from aragonite to calcite. The peaks for the calcite phase are strong and sharp. The calcium hydroxide peaks are broader and reflect smaller crystallite size. Hydroxide phase is the major one. The diffraction pattern of MSB2 shows presence of three phases, calcite, calcium hydroxide and calcium oxide. Calcite is the predominant phase. The peaks for the calcite phase are sharp, while that for the hydroxide phase are broader. Calcium oxide phase is in low concentration. The final product, *Muktashukti bhasma* (MSB 3) was obtained by treating this sample with *Aloe barbadensis* Mill. syn. *A. vera* Tourn. ex L. juice and igniting it in a similar manner. The XRD pattern of the *bhasma* shows presence of only one phase, calcite form of calcium carbonate. This indicates complete conversion of the hydroxide and oxide phases into calcium carbonate. However, the peaks are even sharper than those of the MSB 2. sample and reflect high crystallinity of the final product^{11,12}.

Infrared analysis

Fig. 2 shows FTIR spectra of the raw material, intermediates and the final product & marketed sample. The IR Spectra of the raw material *Muktashukti* shows bands at 2335 (w), 2513 (w), 1795 (m), 1427.3 (s), 877 (m) and 711 (m) resembling the reported spectrum of the aragonite form of calcium carbonate. The IR spectrum of MSB 1 shows a strong band at 3630 cm⁻¹ due to the hydrate molecules. Powder XRD pattern of this sample confirms presence of calcium hydroxide as the major phase. There are no absorption bands corresponding to the organic material suggesting complete combustion of the organic phase during calcinations of the MSB sample. The bands at 1797, 1416, 878 and 712 cm⁻¹ show the presence of calcite form of calcium carbonate. The IR spectrum of MSB2 is similar to that of MSB3. However, the intensity of the peak corresponding to calcium hydroxide is less than that observed in the MSB 1 sample. The calcite peaks are prominent. The IR spectrum of MSB 3 shows presence of peaks corresponding to only calcium carbonate in the calcite form^{11,12}.

Scanning Electron Microscopy

Scanning electron microscopy images of *Muktashukti bhasma* after different cycles of calcinations are shown in Fig. 3.

In Fig. 3 the particle in the raw material and in the sample of intermediary process were not uniformly arranged while in the final product the particle uniformly arranged. The particle size ranges are lesser in the final product. In this process it was found that spongy and relatively compact microcrystalline aggregates of calcite were observed after the first calcinations cycle, which were covered by small dusty crystalline. Second calcinations cycle resulted into a spongy nature of the crystallites with increased agglomeration as indicated by the increased particle size. A distinct change in the morphology was also observed with last calcinations cycle as several well defined shaped particle were seen in the SEM of *Muktashukti bhasma*. This simply means that repeated calcinations cycles are necessary to stabilize the particle to a minimum particle size¹³.

Result and discussion

Instrumental analysis of *Muktashukti Bhasma* by using Powder x-ray diffraction analysis, Infrared analysis and scanning electron microscopy.

In powder x-ray diffraction analysis of the comparative results of lab-prepared and marketed preparation are shown in Tables 1 & 2. Table 1 shows the result of phase analysis obtained from with the help of powder XRD data and Table 2 shows the result of diffraction pattern of sample obtained by powder XRD data.

In infrared analysis the IR spectra of raw material (*Muktashukti*) show bands at 2335 (w), 2513 (w), 1795 (m), 1427.3 (s), 877 (m) and 711 (m) resembling the reported spectrum of the aragonite form of calcium carbonate. The IR spectrum of MSB1 shows a strong band at 3630 cm⁻¹ due to the hydrate molecules. Powder XRD pattern of these sample confirms presence of calcium hydroxide as the major phase. There are no absorption bands corresponding to the organic material suggesting complete combustion of the organic phase during calcination of the MSB sample. The bands at 1797, 1416, 878 and 712 cm⁻¹ show the presence of calcite form of calcium carbonate. The IR spectrum of MSB 2 was similar to that of MSB 3. However, the intensity of the peak corresponding to calcium hydroxide was less than that observed in the MSB 1 sample.

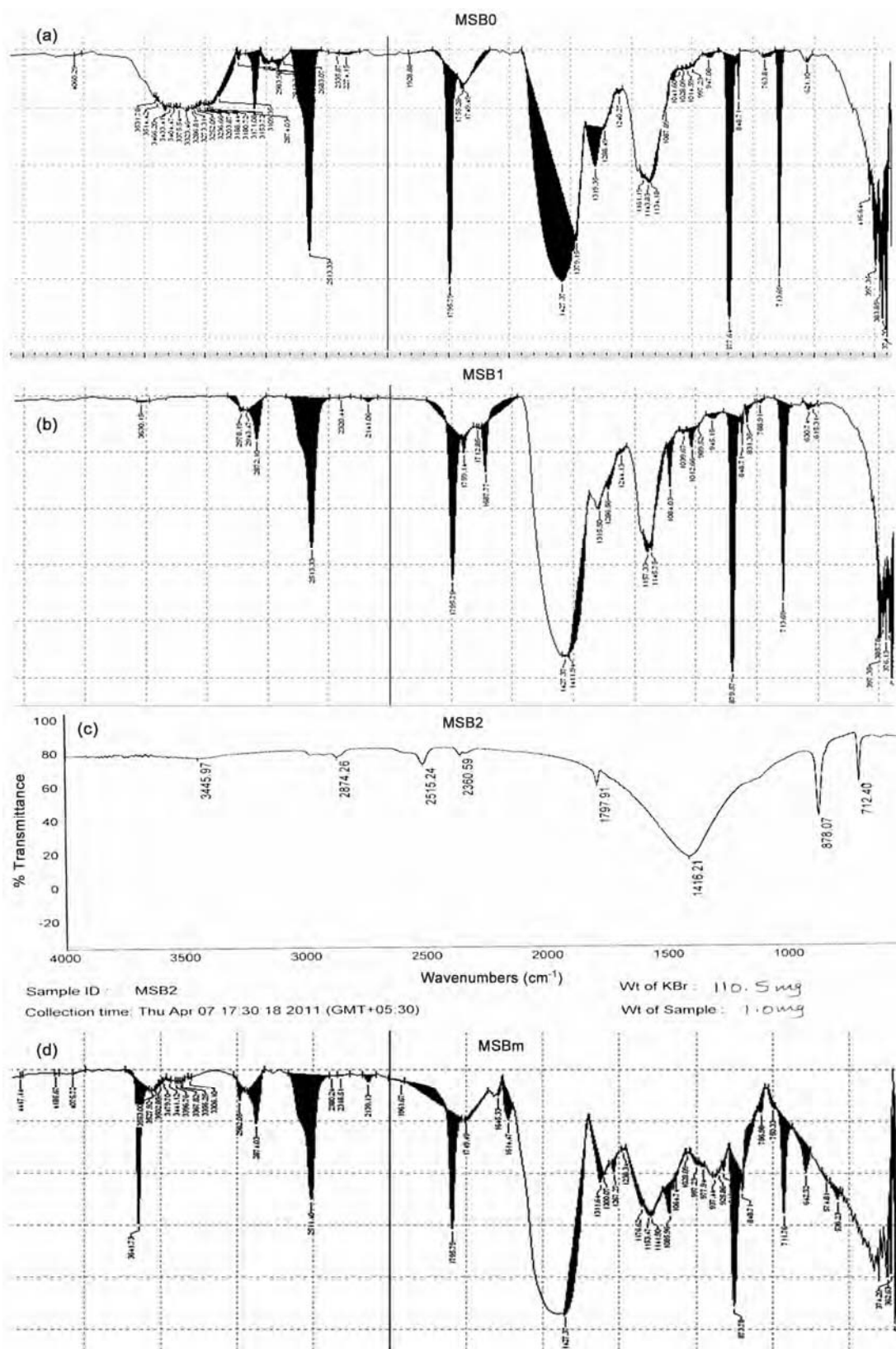


Fig. 2—a) FTIR spectra of the raw material b) FTIR spectra of the intermediates c) FTIR spectra of the final product d) FTIR spectra of the Marketed sample

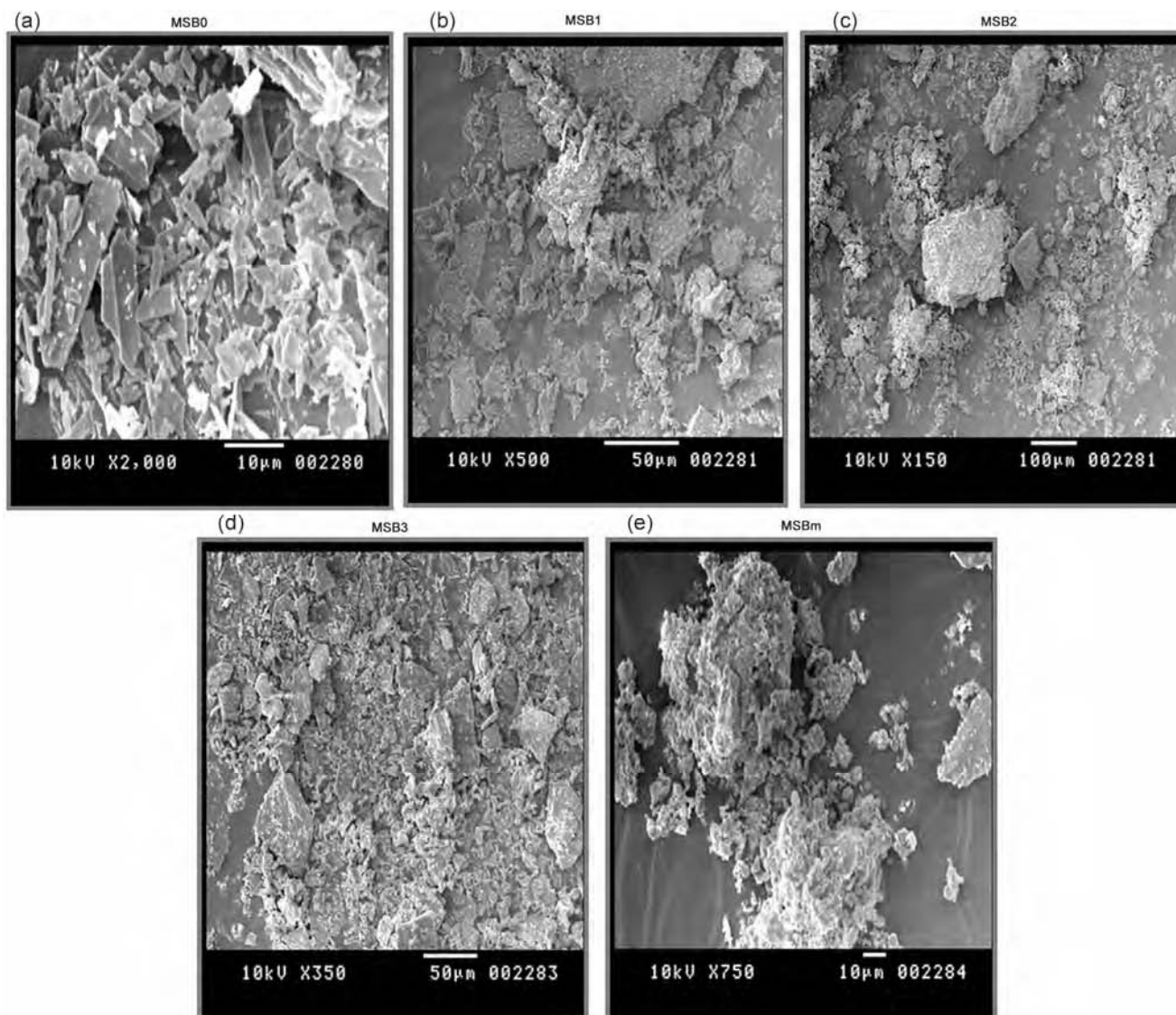


Fig. 3—a) SEM of raw material of *Muktashurti* b) SEM of 1st Calcination cycle c) SEM of 2nd Calcination cycle d) SEM of 3rd Calcination cycle e) SEM of marketed preparation

The calcite peaks were prominent. The IR spectrum of MSB 3 shows presence of peaks corresponding to only calcium carbonate in the calcite form.

Scanning electron microscopy images of *Muktashurti bhasma* after different cycles of calcinations were shown in Fig. 3. In the figure 3 the particle in the raw material and in the sample of intermediary process were not uniformly arranged while in the final product the particles seen uniformly arranged. The particle size even found lesser in the final product. In this process it was found that spongy and relatively compact microcrystalline aggregates of calcite were observed after the first calcinations cycle, which were covered

by small dusty crystalline. Second calcinations cycle resulted into a spongy nature of the crystallites with increased agglomeration as indicated by the increased particle size. A distinct change in the morphology was also observed with last calcinations cycle as several well defined shaped particle were seen in the SEM of *Muktashurti bhasma*. This simply means that repeated calcinations cycles are very necessary to stabilize the particle to a minimum particle size. In case of marketed sample it showed that there was spongy and relatively compact microcrystalline aggregates with increased agglomeration as indicated by the increased particle size.

Table 1—Result of the phase analysis obtained from with the help of powder XRD data

Sr. No	Sample	Phase present
1	MSB0	CaCO ₃ (Aragonite)
2	MSB1	CaCO ₃ (Calcite) + Ca(OH) ₂
3	MSB2	CaCO ₃ (Calcite) + Ca(OH) ₂ + CaO
4	MSB3	CaCO ₃ (Calcite)
5	MSBm	CaCO ₃ (Calcite)

Table 2—Result of the diffraction pattern of sample obtained by powder XRD data

Sample	d-value	2 θ -value
Muktashukti Bhasma (MSB3) (Final product)	3.03 Å	29.45
	2.28 Å	39.47
	1.92 Å	47.11
	1.87 Å	48.58
	1.42 Å	66.69
Marketed sample of MSB (MSB m)	3.03 Å	29.41
	2.28 Å	39.45
	1.91 Å	47.53
	1.87 Å	48.54
	1.42 Å	66.60

Conclusion

Significant results and conclusion

Powder X-Ray Diffraction Analysis indicates complete conversion of the hydroxide and oxide phases into calcium carbonate. However, the peaks are even sharper than those of the final product sample and reflect high crystallinity of the final product.

The IR spectrum of MSB2 is similar to that of MSB3. However, the intensity of the peak corresponding to calcium hydroxide is less than that observed in the MSB 1 sample. The calcite peaks are prominent. The IR spectrum of MSB 3 shows presence of peaks corresponding to only calcium carbonate in the calcite form.

SEM analysis simply means that repeated calcinations cycles are very necessary to stabilize the particle to a minimum particle size. In case of marketed sample it showed that there was spongy and relatively compact microcrystalline aggregates with increased agglomeration as indicated by the increased particle size.

Small Particle size with high crystallinity of final product of MSB increases easy absorption, distribution, metabolism and excretion (Pharmacokinetics) as well as its therapeutic potential (Pharmacodynamics).

Significance of the study to the society/researchers

Now a days various marketed preparations of *bhasma* are found to be adulterated or with insufficient amount of active chemical constituents which is inactive to initiate any therapeutic effects in human beings, as the dose required is very low. The quality of raw materials utilized in preparation of *bhasma* also affects the final product. Analytical study on *bhasma* is very important to evaluate all physicochemical parameters to validate the therapeutic potential of raw material as well as final product. This detailed investigation of lab prepared *muktashukti bhasma* suggests and prompts the rational utility of lab prepared *muktashukti bhasma* over marketed preparation.

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