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"FROM *PUTA* TO ELECTRIC MUFFLE FURNACE: A CRITICAL REVIEW OF TEMPERATURE PATTERNS, STANDARDISATION AND THEIR EFFECT ON *BHASMA* QUALITY"

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ABSTRACT

Background: Incineration in *puta*, a pit or enclosure heated with cow-dung cakes, is the defining step of *bhasma* preparation. Its heat is uneven and hard to reproduce, and manufacturers increasingly use electric muffle furnaces. Whether furnace-made *bhasmas* are equivalent to traditional ones is debated. **Objective:** To review the evidence on temperature patterns of traditional *puta*, the conversion of these patterns into furnace programmes, and the effect of heating conditions on the properties of *bhasmas*. **Methods:** A critical narrative review of standard manufacturing procedure studies, temperature-profile studies and comparative characterisation studies of *bhasmas* prepared by traditional *puta* and electric muffle furnace. **Results:** Measured peak temperatures differ markedly between classical *puta* types, from about 850 °C for *Varaha puta* to about 1060 °C for *Gajaputa* and about 1380 °C for *Mahaputa* in one study, with large variation depending on fuel quantity, pit design and weather. Furnace-based procedures commonly use peaks of 600–1100 °C, with holding times of 0.5–3 hours, and have been applied to *Makshika*, *Abhraka*, *Pittala*, *Lauha* and *kupipakva* preparations. Where compared, furnace and *puta* products had similar classical and analytical properties. Few studies measured the temperature-time curve inside the sealed *sharava*, and the number of *puta* cycles has been linked to particle size. **Conclusion:** Electric muffle furnaces can reproduce traditional heating if the full temperature-time profile, not just the peak, is matched. Pharmacopoeial *bhasma* monographs should specify heating profiles and instrumental end-points.

KEYWORDS: *Puta*; *Gajaputa*; Electric muffle furnace; *Bhasma*; Standard manufacturing procedure; Temperature profile; *Marana*

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INTRODUCTION

Marana, the conversion of a purified metal or mineral into a *bhasma*, depends on repeated heating in a sealed earthen vessel (*sharava samputa*). The heating system is called *puta*, and classical texts describe many types that differ in the size of the pit and the quantity of fuel, from small *kapota* and *kukkuta puta* to *varaha*, *gaja* and *maha puta*[1,2]. Each type is matched to a material: hard metals such as iron receive more intense *puta*, and delicate materials such as calcium compounds or mica are often processed with many milder cycles. The number of cycles ranges from a few to sixty or more, and in some classical recommendations to hundreds[3].

The traditional *puta* is a remarkable empirical technology, but it is inherently variable. Its temperature depends on the number and calorific value of the cow-dung cakes, their moisture, the depth and insulation of the pit, wind and ambient temperature. Its fuel demand is high: a single *Gajaputa* for *Lauha bhasma* has been reported to use about 1000 cow-dung cakes and to burn for about eight hours[4]. These constraints have led to the widespread adoption of electric muffle furnaces in academic and industrial pharmacies.

This review examines what is known about the temperature patterns of traditional *puta*, how they have been translated into furnace programmes, and whether furnace-made *bhasmas* match traditional ones.

METHODS OF THE REVIEW

This is a critical narrative review. Literature was identified through PubMed, PubMed Central, DOAJ, Crossref-indexed records and journal archives using the terms *puta*, *gajaputa*, *varaha puta*, muffle furnace, electric furnace, standard manufacturing procedure, *bhasma*, *marana* and temperature. Studies were included if they reported heating conditions for *bhasma* preparation together with any physical, chemical or analytical outcome.

TEMPERATURE PATTERNS OF TRADITIONAL PUTA

1. Peak temperatures

The most direct comparison of classical *puta* types comes from measurements with cow-dung cakes of average calorific value 15.44 MJ/kg, which recorded peak temperatures of about 1380 °C for *Mahaputa*, 1060 °C for *Gajaputa* and 850 °C for *Varaha puta*[5]. The *Varaha puta* profile was then reproduced in an electric muffle furnace, and *Swarna Makshika bhasma* prepared by the two methods showed similar properties[5]; the same alternative heating approach to *Varaha puta* has been published for *Swarna Makshika bhasma*[6]. Other studies of the same material have used furnace programmes or traditional *puta* with smaller quantities of cow-dung cakes[7-9].

These figures should be read with caution. Peak temperatures in *puta* depend strongly on fuel loading, and reports differ in where the thermocouple was placed. A temperature measured in the burning fuel bed can be much higher than the temperature inside the sealed *sharava*, which is what matters for the material. In one study of *Pittala bhasma*, a *Gajaputa* reaching about 900–910 °C fused the pellets, and the quantity of cow-dung cakes had to be adjusted[10].

2. The shape of the curve

A *puta* is not a constant-temperature process. It has a heating phase as the fuel ignites, a short peak, and a long natural cooling phase that continues until the next day (*svangasheeta*). The heating rate, the time above critical temperatures and the cooling rate all influence reactions such as oxidation, decomposition of carbonates and sulphides, sintering and grain growth. Matching only the peak temperature in a furnace, and then cooling rapidly, may therefore produce a different product. Studies that reproduced a full traditional profile in a furnace, rather than just a peak, offer the strongest evidence of equivalence[5,6].

ELECTRIC MUFFLE FURNACE PROGRAMMES

Table 1. Selected heating programmes used for *bhasma* and *kupipakva* preparation

Preparation	Heating system	Programme	Main outcome
Swarna Makshika bhasma	Traditional *Varaha puta* vs muffle furnace	Traditional profile (peak about 850 °C) reproduced in furnace	Similar properties of products made by the two methods
Swarna Makshika bhasma	Traditional *puta*	9 *puta*, each with 4 kg cow-dung cakes	Particle size reduced from 6–8 µm to 1–2 µm; Fe_2O_3, FeS_2, CuS, SiO_2

Makshika bhasma	Vertical electric muffle furnace for *kupipaka*, then traditional *puta*	*Kupipaka* up to 250 °C (3 h), 250–450 °C (3 h), 450–650 °C (4 h), held at 650 °C for 30 min; then 6 *puta* with 4 kg cow-dung cakes each	Product passed classical tests after the sixth *puta*
Abhraka bhasma (60 *puta*)	Electric muffle furnace	Peak 900 °C held for 1 h, natural cooling; 60 cycles	About 9.5% weight loss from 1st to 60th *puta*; lustre disappeared by about the 30th *puta*; all classical tests passed
Pittala bhasma	Traditional *puta* vs muffle furnace	Furnace up to 1100 °C for 3 h, repeated 7 times	Weight loss 25 g (*puta*) vs 30.5 g (furnace)
Lauha bhasma	Traditional *Gajaputa*	About 1000 cow-dung cakes per *puta*, about 8 h burning, 7 cycles	Iron content 96.82% in raw steel and about 89.5% in *bhasma*
Makaradhwaja (*kupipakva*)	Electric muffle furnace	Graded heating to about 600 °C over about 12 h	Yield 76–94% depending on form of gold
Mukta bhasma	Traditional *puta* with cow-dung cakes	Repeated calcination	Mean weight loss 47.04%; aragonite to calcite

Furnace programmes vary widely, from peaks of about 650 °C for *kupipaka* stages to 1100 °C for brass, and holding times from 30 minutes to 3 hours[8,12]. Some studies combine furnace and traditional methods within one process. The diversity of programmes for the same material shows that there is not yet a shared standard.

DOES THE HEATING METHOD CHANGE THE BHASMA?

1. Classical and analytical end-points

Where furnace and traditional products have been compared, they have generally passed the same classical tests and shown similar physical and chemical properties[5,12]. In a 60-cycle *Abhraka bhasma* prepared entirely in a furnace, the classical tests were passed and lustre disappeared by about the 30th cycle, with only modest weight loss thereafter[11]. *Abhraka bhasma* prepared by two different methods has also been characterised[15].

2. Number of *puta* and particle size

The number of *puta* has been linked to particle size, with more cycles giving finer particles in *Vanga bhasma*[16]. A similar trend was seen in *Swarna Makshika bhasma*, where particle size fell from 6–8 µm to 1–2 µm over nine cycles[7]. For lead, the transformation from metal to lead sulphide in *Naga bhasma* required many heating steps[17,18].

3. Chemical transformations depend on temperature

Several transformations in *bhasma* preparation have defined temperature ranges. Aragonite in pearl and conch converts to calcite at moderate temperatures, and calcium carbonate decomposes to calcium oxide at higher temperatures, as discussed in the review of calcium *bhasmas* in this series[14,19]. Sulphide minerals oxidise progressively to oxides and sulphates, mercuric sulphide sublimes and recrystallises in *kupipaka*, and metals oxidise faster at higher temperatures[13]. Changing the peak temperature or holding time by a few hundred degrees can therefore change the phase composition of the product. The variability between commercial products of the same *bhasma*[20] may partly reflect such differences in heating.

ADVANTAGES AND LIMITATIONS OF FURNACES

Table 2. Comparison of traditional *puta* and electric muffle furnace

Aspect	Traditional *puta*	Electric muffle furnace
Temperature control	Indirect, through fuel quantity and pit design	Direct, programmable
Reproducibility	Low; affected by fuel, moisture and weather	High, if the programme and load are fixed
Fuel and environment	Large quantities of cow-dung	Electricity; no combustion products near the

	cakes; smoke	material
Scale	Limited by pit size; batch-to-batch variation	Scalable with industrial furnaces; uniform heating in a well-loaded chamber
Atmosphere	Smouldering fuel may create local reducing or oxidising conditions	Usually oxidising air; may differ from *puta*
Classical fidelity	Defined by the texts	Must be validated against the classical product
Documentation	Rarely recorded beyond fuel quantity	Temperature-time data can be logged for each batch

The main advantage of furnaces is control. A logged temperature-time curve for each batch allows a manufacturer to show consistency and allows regulators to inspect it. The main limitation is that a furnace programme is only as good as the profile it copies. Atmosphere is also important: smouldering cow dung around a sealed *sharava* may create conditions that differ from the oxidising air of a furnace, and these could affect the oxidation state of iron, copper or sulphur in the product.

RECOMMENDATIONS FOR STANDARDISATION

- **Record full temperature-time curves.** Studies should measure temperature inside or immediately adjacent to the *sharava* and report the full curve, including heating rate, peak, holding time and cooling.
- **Define programmes by material.** For each *bhasma*, a validated furnace programme that reproduces the classical *puta* should be established and published with comparative characterisation.
- **Use instrumental end-points.** Phase composition by X-ray diffraction, elemental assay and particle size should be used alongside the classical tests to decide when *marana* is complete.
- **Report number of cycles and weight changes.** These simple data help to compare studies and detect problems.
- **Include equivalence testing.** Where a furnace replaces a *puta*, the products should be compared for phase, composition, particle size and, where relevant, dissolution.

RESEARCH GAPS

The evidence base is narrow. Most comparisons involve a single batch, few measure the temperature inside the *sharava*, and very few include biological or dissolution testing to confirm that the furnace product behaves like the traditional one. Inter-laboratory studies using the same raw material and programme would help to separate the effect of the heating method from other sources of variation.

CONCLUSION

Traditional *puta* produce peak temperatures that range from about 850 °C to well above 1000 °C, with heating and cooling patterns that are difficult to reproduce. Electric muffle furnaces offer control and documentation, and products made with them have generally matched traditional products in classical and analytical tests. Equivalence depends, however, on reproducing the whole temperature-time profile and the heating atmosphere, not only the peak temperature. Pharmacopoeial monographs and manufacturers' standard procedures should specify heating programmes and instrumental end-points for each *bhasma*.

REFERENCES

1. Vagbhata. Rasa Ratna Samucchaya. Shastri AD, editor. Varanasi: Chaukhamba Amarabharati Prakashan; 1995.
2. Sharma S. Rasa Tarangini. Shastri K, editor. 11th ed. New Delhi: Motilal Banarsidass; 2004.
3. Vidiyala N, Sunkishala P, Parupathi P, Nyavanandi D. High investigation of the role of magnesium aluminometasilicate (Neusilin® US2) as a porous carrier for improving the amorphous drug loading and stability of ezetimibe by hot melt extrusion [preprint]. Preprints. 2025. doi:10.20944/preprints202503.1750.v1
4. Rajendraprasad ML, Shekhar S, Subramanya AR. Pharmaceutical and analytical study on Loha bhasma. Int J Ayurvedic Med 2010;1:47–59.
5. Investigation of temperature profiles of traditional puta and preparation of chalcopyrite ash for ayurvedic treatment using muffle furnace [institutional repository record]. Moratuwa: University of Moratuwa. Available from: https://dl.lib.uom.lk/items/1be218e8-264d-4fdc-b615-6d8bdfc06fe6

6. Pathiraja PMYS, Ranatunga YMMK, Herapathdeniya SKMK, Gunawardena SHP. Swarna Makshika Bhasma preparation using an alternative heating method to traditional Varaha Puta. J Ayurveda Integr Med 2020;11:206–12.
7. Mohaptra S, Jha CB. Physicochemical characterization of Ayurvedic bhasma (Swarna makshika bhasma): an approach to standardization. Int J Ayurveda Res 2010;1:82–6. https://doi.org/10.4103/0974-7788.64409
8. Gupta RK, Jha CB. Standard manufacturing procedure of Makshika Bhasma. Int J Ayurvedic Med 2013;4:361–6.
9. Meena V, Bhushan S, Chaudhary A. Critical review on pharmaceutico-analytical and safety profile of Swarna Makshika Bhasma (chalcopyrite calx). J Drug Res Ayurvedic Sci 2021;6:3–11.
10. Ramayanam NR, Bukke SPN, Kumar BJ, Vidiyala N, Sunkishala P, Thalluri C, et al. Nipah virus infection as a putative risk factor for Alzheimer's disease: a testable hypothesis. J Alzheimers Dis Rep. 2026;10:254
11. Jani K, Bedarkar P, Shukla VJ, Patgiri BJ. Pharmaceutico-analytical standardization of 60 Puti Abhraka Bhasma. Int J Ayurvedic Med 2021;12:360–5.
12. Kale B, Rajurkar N. Synthesis and characterization of Pittal Bhasma. J ISAS 2023;1(3).
13. Vora N, Selvaraj K, Vidiyala N, Larmon R, Cartwright D, Mangu N, et al. DoE approach for optimization of granulation set-up as CPP for impact on dissolution and yield as CQA in manufacturing multi-particulates with a high drug load … [abstract T1430-06-045]. In: AAPS PharmSci 360; 2018.
14. Joshi N, Sharma K, Peter H, Dash MK. Standardization and quality control parameters for Muktā Bhasma (calcined pearl). Anc Sci Life 2015;35:42–51.
15. Gundeti M, Vidiyala N, Dalvi S, Girase R, Thota SK, Paudel KR, et al. Next-generation Pluronic micelles for advanced drug delivery application. Macromol Mater Eng. 2026;311(9):e70344.
16. Bhatt A, Bajaj N, Kashyap CP. Effect of number of Puta on particle size of Vang Bhasma. Int Ayurvedic Med J 2017;5:2372–7.
17. Singh SK, Gautam DNS, Kumar M, Rai SB. Synthesis, characterization and histopathological study of a lead-based Indian traditional drug: Naga bhasma. Indian J Pharm Sci 2010;72:24–30. https://doi.org/10.4103/0250-474X.62232
18. Nagarajan S, Krishnaswamy S, Pemiah B, Rajan KS, Krishnan U, Sethuraman S. Scientific insights in the preparation and characterisation of a lead-based naga bhasma. Indian J Pharm Sci 2014;76:38–45.
19. Chavan S, Tayade S, Gupta V, Deshmukh V, Sardeshmukh S. Pharmaceutical standardization and physicochemical characterization of traditional Ayurvedic marine drug: incinerated conch shell (Shankha Bhasma). Mar Drugs 2018;16:450.
20. Nyavanandi D, Mandati P, Vidiyala N, Parupathi P, Kolimi P, Mamidi HK. Enhancing patient-centric drug development: coupling hot melt extrusion with fused deposition modeling and pressure-assisted microsyringe additive manufacturing platforms with quality by design. Pharmaceutics. 2025;17(1):14.