



Research Article

Yashada Bhasma: A Comprehensive Review of Preparation Methods, Properties and Therapeutic Potential

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Abstract

Yashada (Jasada; zinc) occupies a distinctive place in Rasashastra, the Indian alchemical-pharmaceutical tradition. It is classified among the metals (dhatu) and, in some classifications, among the Sadharana or Puti-loha class alongside Naga (lead) and Vanga (tin). Its calcined form, Yashada Bhasma, has been used for centuries for Netra roga (eye disorders), Prameha (urinary and metabolic disorders including diabetes mellitus), Kushtha (skin disease), Pandu (anemia), Vrana (wounds) and Kasa-Shwasa (respiratory disorders). This review draws on classical Ayurvedic literature, pharmaceutical descriptions and modern physicochemical and pharmacological studies. It examines the historical background, source and classification, purification (Shodhana), incineration (Marana), quality assessment (Bhasma Pariksha), Ayurvedic pharmacodynamics, physicochemical profile, therapeutic applications and safety. Available evidence suggests that Yashada Bhasma is chiefly nanocrystalline zinc oxide (ZnO) with organic residues from herbal media, and that its biological activity may relate to bioavailable zinc. It also suggests that classical processing may improve biocompatibility. However, much of the literature is preclinical, and methodological heterogeneity, small clinical studies and safety concerns limit firm conclusions. Standardized protocols, rigorous toxicological evaluation and well-designed clinical trials are needed.

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1. INTRODUCTION

Rasashastra is the branch of Ayurveda concerned with the pharmaceutical processing of minerals, metals and gems, and with using them therapeutically. Its founding premise is that a raw metal, which may be toxic or biologically inert, can be transformed through repeated purification and incineration into a therapeutically effective and safe preparation. The tradition states this idea in a well-known verse cited in the *Rasa Hridaya Tantra* and later *Rasa* texts:

मूर्च्छितो हरते व्याधिं मृतो जीवयति स्वयम् ।
बद्धः खेचरतां कुर्यात् रसो वायुश्च भैरवि ॥

Mūrccchito harate vyādhiṁ mr̥to jīvayati svayam; baddhaḥ khecaratām kuryāt raso vāyuśca Bhairavi

The verse says that *Rasa* (mercury) in the states of *murchchhita* (processed), *mr̥ta* (incinerated) and *baddha* (bound) removes disease, restores life and confers extraordinary vitality. Although it refers to *Parada*, the principle of *Marana* (transforming a substance into a stable, non-toxic, therapeutically active ash) is applied throughout the metal *bhasmas*.

Caution and skill in using potent substances are foundational Ayurvedic ideas, stated in the *Charaka Samhita*:

योगादपि विषं तीक्ष्णमुत्तमं भेषजं भवेत् ।
भेषजं चापि दुर्युक्तं तीक्ष्णं सम्पद्यते विषम् ॥

Yogādapi viṣaṁ tīkṣṇam uttamam bheṣajam bhavet; bheṣajam cāpi duryuktam tīkṣṇam sampadyate viṣam

— *Charaka Samhita*, *Sutrasthana* 1

The verse says that even a sharp poison, if properly used, becomes an excellent medicine, while even a medicine, if wrongly used, becomes a poison. This applies directly to *Yashada*, whose therapeutic value and toxicity both depend on the quality of its processing.

Zinc is an essential trace element. It is a structural and catalytic component of hundreds of enzymes, transcription factors and immune-regulatory proteins, and it is central to insulin storage, wound repair and vision. This nutritional significance makes *Yashada Bhasma* a scientifically interesting subject and gives some support to its classical indications. Unlike some metals used in *Rasashastra*, zinc is also biologically essential, although classical *Marana* was designed to render even essential metals in a form safe for human use.

The aim of this review is to consolidate the classical and modern knowledge of *Yashada Bhasma*, to critically appraise the evidence for its preparation, properties and therapeutic potential, and to identify research gaps.

2. Historical and Literary Background

2.1 Historical context

India has an ancient tradition of zinc metallurgy. The zinc smelting technology developed at Zawar in Rajasthan is regarded as one of the earliest industrial-scale distillation processes for producing metallic zinc, which is difficult to

obtain because zinc vaporizes near its reduction temperature. Archaeometallurgical studies are generally consistent with zinc production in India in the early to mid-second millennium CE, and the *Rasashastra* literature describes methods that appear to correspond to this technology.

Zinc-containing materials, notably brass, appear earlier in the Indian tradition, and zinc ore is described in Ayurvedic texts as *Kharpara*. The metal itself is discussed in the medieval *Rasa* literature, chiefly in texts such as the *Rasa Ratna Samuccaya* (about the 13th century), the *Rasa Prakasha* Sudhakara, the *Rasendra Chudamani* and the later *Rasa Tarangini* (20th century compilation, with older material), the *Ayurveda Prakasha* and the *Bhaishajya Ratnavali*. The *Samhita* period texts (*Charaka*, *Sushruta*, *Vagbhata*) do not describe zinc as a distinct metal, and its medicinal development belongs to the later *Rasashastra* period.

2.2 Nomenclature and synonyms

The Sanskrit names *Yashada* and *Jasada* are the most common. A traditional folk etymology derives *Yashada* from *yasho dadati* ("that which gives fame"), which is a popular explanation rather than a rigorous linguistic derivation. Other names include *Yasada* and *Ranga-sadrisha* (resembling tin, on account of its bluish-white color). In Hindi it is *Jasta*, and in modern usage *Zinc*. The ore is called *Kharpara* (calamine, zinc carbonate or silicate) in classical classification, and it is used for *Kharpara Sattva* (zinc extracted from the ore) and for the therapeutic *Kharpara Bhasma*.

2.3 Classification

In the classification of *Rasashastra*, *Yashada* is grouped with the *Sadharana Dhatu* or with metals sometimes called *Puti-loha* (with *Naga* and *Vanga*), depending on the text, and it is distinct from *Suvarna* (gold) and *Rajata* (silver), which are classed as *Shuddha loha*. Compared with *Vanga* and *Naga*, *Yashada* is a comparatively later addition to the pharmacopoeia and is used mainly as a *Bhasma* rather than in *Kupipakva* preparations.

3. Source, Ores and Raw Material (Grahya-Agrahya)

3.1 Raw material sources

Zinc occurs in nature mainly as sphalerite (ZnS), smithsonite ($ZnCO_3$), hemimorphite/calamine ($Zn_4Si_2O_7(OH)_2 \cdot H_2O$) and zincite (ZnO). India's principal zinc deposits are in Rajasthan (Zawar, Rampura-Agucha), which were the historic centers of zinc production. Classical *Kharpara* corresponds to oxidized zinc ores such as calamine.

3.2 Grahya lakshana (desirable properties)

Classical texts (in a generalized reading) describe suitable metals as those that are bright, heavy, soft to some degree and free from visible impurities. For pharmaceutical use, modern practice uses commercial zinc of pharmaceutical grade, with attention to heavy-metal contamination. This is an important concern, because natural zinc ores are often associated with lead, cadmium and arsenic.

4. Pharmaceutical Processing

Ayurvedic pharmaceuticals organizes metallic preparation into a sequence: *Shodhana* (purification), *Jarana/Marana* (incineration), *Amritikarana* (detoxification and finishing) and *Bhasma Pariksha* (assessment). Each stage is described below, with the caveat that individual texts differ in the herbal media and details used.

4.1 Shodhana (purification)

Shodhana aims to remove physical and chemical impurities, reduce toxicity and make the metal brittle and easily powdered, so that it can undergo *Marana*.

General method (Nirvapa): Yashada is cut into small pieces or sheets and heated in an iron ladle or crucible until it melts and glows. The molten metal is then poured (*nirvapa*, "quenching") into a prescribed liquid. The process is repeated, commonly seven times, with fresh liquid each time. It is sometimes performed with three, five or seven repetitions, depending on the text.

Commonly cited media:

- Nirgundi swarasa (juice of *Vitex negundo*)
- Haridra kwatha (turmeric decoction)
- Tila taila (sesame oil)
- Takra (buttermilk)
- Kanji (fermented rice gruel)
- Gomutra (cow's urine)
- Kulattha kwatha (horse gram decoction)

Different classical sources recommend different combinations. Sequential treatment with oil, buttermilk, *kanji*, cow's urine and horse gram decoction is the pattern seen in the general *Dhatu Shodhana* (metal purification) scheme, and the specific fluids for Yashada vary.

Rationale: In modern terms, quenching in acidic and organic media may produce a metal that is brittle and of increased surface area. It may also remove surface oxides and soluble contaminants and leave organic residues. Repeated heating and quenching can alter grain structure, and treatment with tannin-, polyphenol- and acid-rich media may plausibly reduce toxic impurities.

4.2 Marana (incineration)

Marana is the central step in *Bhasma* preparation. The purified metal is converted into a fine ash by repeated trituration (*Mardana*) with herbal juices or minerals, shaping into pellets (*Chakrika*), drying and heating in a closed earthen crucible (*Sharava Samputa*) in a *Putra* (a heating system with a defined quantity of fuel).

Representative procedure (Yashada):

1. **Preparation of the metal.** Shodhita Yashada is melted and made into a powder or thin sheets. Some texts describe stirring the molten metal with plant material, such as a stick of *Arka* or *Nimba*, or with powdered herbs, to reduce it to a powder (*Jarana*).
2. **Mardana (trituration).** The powder is ground with a specified medium. Common choices are *Kumari swarasa* (*Aloe vera* juice), *Nimbu swarasa* (lemon juice), or

decoctions of specific herbs, for several hours until it becomes a homogeneous paste.

3. **Chakrika formation.** The paste is made into small flat discs, which are sun-dried.
4. **Sharava samputa.** The discs are placed in two shallow earthen dishes, joined together and sealed with clay-smear cloth (*Sandhi-bandhana*, seven layers), then dried.
5. **Putra.** The sealed crucibles are heated in *Gaja Putra* (a large pit with about 1000 cow-dung cakes) or *Laghu Putra*. After self-cooling, the contents are removed and inspected.
6. **Repetition.** The sequence of trituration, disc formation and heating is repeated until the *Bhasma* meets the classical criteria. Depending on the medium and the text, it may take from about 3 to 10 or more cycles.

Putra system: The *Putra* is the classical temperature-control system, which was standardized by the size of the pit and the number of fuel cakes. *Gaja Putra* is high-intensity, and *Laghu Putra* is lower. Modern electric muffle furnace methods approximate this with temperature control, usually in the range of about 500 to 900 °C, though the exact temperature-time profiles used in classical *Putras* have not been reproducibly established and may differ between preparations.

Chemical rationale: Zinc melts at about 419.5 °C and boils at about 907 °C. In air at elevated temperatures, zinc oxidizes to zinc oxide (ZnO). Reaction in a closed crucible with herbal media and organic matter creates a partially reducing environment, and the ZnO formed is a fine, white to yellowish or grayish powder. Repeated trituration and heating probably reduce particle size and increase homogeneity. The herbal fluids contribute organic compounds, which may remain as surface coatings or as trace carbon.

4.3 Amritikarana and finishing

Classical practice includes *Amritikarana*, a process that further detoxifies a *Bhasma* and improves its therapeutic properties, typically by gentle heating or trituration with specific herbal media (for example *Guduchi* or *Triphala* decoctions) or with clarified butter, followed by drying and storage. Not all texts describe this step for Yashada.

4.4 Bhasma Pariksha (quality tests)

Ayurvedic tradition provides both organoleptic and functional criteria that a *Bhasma* must meet before use. These are usually listed as:

- **Varitara:** the *Bhasma* should float on the surface of still water, indicating extreme fineness and low density of particles.
- **Rekhapurnatva:** it should fill the fine lines of the fingertip when rubbed between the finger and thumb, indicating an extremely fine particle size.
- **Nishchandratva:** it should have lost its metallic luster and not appear shiny under light.
- **Apunarbhava:** it should not revert to metallic form when heated with a mixture such as *Gunja* (*Abrus precatorius*) seeds, honey, ghee, and borax (*Tankana*).
- **Niruttha:** it should not regain the original metal on heating with substances that would normally reduce the oxide.

- **Slakshnatva / Sukshmatva:** it should be extremely fine and smooth on touch.
- **Nirdhumatva:** it should be free of smoke when heated.
- **Tasteless / near tasteless:** the final preparation is largely tasteless.

Together, these criteria address fineness, chemical stability, and the completeness of oxidation. Modern instrumental methods

(particle size analysis, X-ray diffraction, electron microscopy, elemental analysis) increasingly complement them.

5. Properties

5.1 Ayurvedic pharmacodynamics (Rasa-Panchaka)

According to classical descriptions, in general and with some variation between authors:

Property	Description
Rasa (taste)	Kashaya (astringent), Tikta (bitter)
Guna (quality)	Ruksha (dry), Laghu (light); often described as Sheeta
Virya (potency)	Sheeta (cooling)
Vipaka	Katu
Dosha karma	Kapha-Pitta shamaka
Karma (actions)	Netrya, Lekhana, Pramehaghna, Kushthaghna, Rasayana, Vrana-ropana

Descriptions of the rasa-panchaka of *Bhasmas* are somewhat generalized in the classical texts, and the specifics of Yashada vary by source. These attributions should be treated as classical descriptions to be verified against specific texts, rather than as universally agreed facts.

5.2 Physicochemical characteristics

Modern analytical studies of Yashada Bhasma prepared by classical methods generally report:

- **Chemical composition:** predominantly zinc, with the phase identified as crystalline zinc oxide (zincite, hexagonal wurtzite structure) by X-ray diffraction. Minor phases and trace elements (carbon, calcium, potassium, iron, silicon) probably derive from the herbal media, crucible and fuel.
- **Particle size:** the particles are reported in the sub-micron and nano range, and considerable variation is seen between samples and methods. Ayurvedic *bhasmas* are widely characterized in the literature as nanocrystalline or nano-structured, although the exact size distribution is dependent on the method and amount of *Puti*.
- **Morphology:** electron microscopy typically shows agglomerates of small particles.
- **Physical appearance:** a fine, soft, odorless powder, typically white to pale grey or yellowish, depending on residual carbon and processing.
- **Solubility:** ZnO is poorly soluble in water but dissolves in acidic media such as gastric fluid, releasing Zn^{2+} ions. This is important for bioavailability.

Because samples differ substantially between studies and manufacturers, published quantitative values vary, and this review does not adopt any single set of numbers as a standard.

6. Therapeutic Uses (Classical Indications)

6.1 Netra Roga (eye disorders)

Yashada is classically associated with *Netra* (eye) therapeutics, and this is among its best-known uses. Zinc preparations are used in *Anjana* (collyrium) and in eye formulations, and it is considered *Netrya* (beneficial to eyes). Modern rationale: zinc is concentrated in the retina and choroid, supports vitamin A metabolism (via retinol dehydrogenase) and protects against oxidative damage; the AREDS trials showed a benefit of zinc-

containing supplements on the progression of advanced age-related macular degeneration.

6.2 Prameha (urinary and metabolic disorders, including diabetes)

Yashada Bhasma is one of the metallic drugs used in *Prameha* and *Madhumeha* (diabetes mellitus). This is consistent with zinc's role in the crystalline storage of insulin in pancreatic beta cells and in insulin signaling. Zinc-containing formulations are traditionally used in combination with herbs such as *Shilajatu*, *Haridra*, *Amalaki*, *Guduchi* and *Vijaysar*.

6.3 Kushtha and Vrana (skin disease and wounds)

Kushtha (a broad group of skin disorders) and chronic non-healing wounds are traditional indications. Zinc is essential to epithelialization and collagen synthesis, and zinc oxide has long been used in topical dermatology for its astringent, mild antiseptic and barrier properties. This offers a plausible rationale for *Vrana-ropana* effects.

6.4 Pandu, Grahani and Atisara

Yashada is used in anemia (*Pandu*) and gastrointestinal disorders such as *Grahani* (malabsorption) and *Atisara* (diarrhea) in some formulations. Zinc supplementation has good evidence for reducing the duration and severity of childhood diarrhea, and this supports a plausible connection with the classical use in *Atisara*.

6.5 Kasa, Shwasa and other uses

Respiratory conditions (*Kasa*, *Shwasa*) and general debility are mentioned, with Yashada often combined with other *Bhasmas*, honey and *Pippali*. Some texts mention its use in *Shukra-dosha* (disorders of reproductive tissue) and as a *Rasayana*, and zinc's role in testosterone synthesis and spermatogenesis is a plausible link.

6.6 Dosage and Anupana

Typical classical doses are small, roughly 30 to 125 mg (about ¼ to 1 *Ratti*, depending on text), given once or twice daily. Frequent *Anupanas* (vehicles) are honey, butter (*Navanita*), *Ghrita* or *Triphala* decoction, chosen according to the condition. Doses and durations should follow the prescribing

physician and the specific formulation, and the figures here are general literature ranges, not recommendations.

6.7 Formulations containing Yashada

Yashada appears in compound preparations, particularly in ophthalmic and antidiabetic formulas. Because it is used in combination with herbs and other minerals, the contribution of Yashada Bhasma itself is difficult to isolate in the classical use.

7. Modern Scientific Evidence

7.1 Zinc biology as a rationale

Zinc's role as a cofactor in more than 300 enzymes, in immune function, wound healing, glucose metabolism, taste, vision and reproduction provides a coherent physiological framework for the classical indications. Zinc deficiency is common in populations with limited dietary diversity, including in India, so a zinc-containing traditional medicine could plausibly correct subclinical deficiency.

7.2 Preclinical studies

Published preclinical studies on Yashada Bhasma and related zinc-containing *Bhasmas* have examined antidiabetic, antioxidant, antimicrobial, wound-healing and hepatoprotective effects, mostly in rodent models and in vitro assays. Overall, these suggest activity consistent with the classical claims, but studies are often small and differ widely in the preparation method, dosage and outcome measures. Many do not compare Yashada Bhasma with an equivalent dose of conventional zinc salts or ZnO, which would be needed to show whether classical processing provides any advantage.

7.3 Bioavailability and the "nano" hypothesis

A frequently proposed hypothesis is that repeated *Marana* produces nano-scale particles with enhanced absorption and lower toxicity than bulk metal or oxide, and that herbal organic coatings improve biocompatibility. Nanoscale ZnO is well studied in materials science, with known antimicrobial and cytotoxic effects that depend on size, dose and surface chemistry. The hypothesis is plausible but not fully demonstrated for Yashada Bhasma, and the same nano-properties that may improve absorption could also increase toxicity under some conditions.

7.4 Clinical evidence

Clinical evidence specific to Yashada Bhasma is limited, usually consisting of small, open-label or observational studies and case series, often testing multi-ingredient formulations. Randomized controlled trials with adequate sample size, blinding and validated endpoints are scarce. Consequently, the strength of evidence for efficacy in diabetes, eye disease and wound healing is low by modern evidence standards, and claims should be presented as promising rather than proven.

8. Safety, Toxicity and Regulation

8.1 Toxicity

Excess zinc intake can cause gastrointestinal irritation, nausea, vomiting and, with chronic overuse, copper deficiency with anemia and neurological effects, as well as impaired immune

function. Inhalation of zinc oxide fume causes metal fume fever, which is relevant to occupational exposure during preparation. Improperly prepared *Bhasma*, for example one that is incompletely oxidized or contaminated with other metals, is classically regarded as harmful. The Ayurvedic tradition specifically warns that *Apakva* (improperly processed) *Bhasma* can produce adverse effects, which is why *Bhasma Pariksha* is emphasized.

8.2 Contamination

The source and raw material quality matter. Zinc ores are commonly associated with lead, cadmium and arsenic, and analyses of commercial Ayurvedic products have found heavy-metal contamination in some samples. Quality control of raw materials, process validation and testing of the final product for heavy metals are therefore essential.

8.3 Regulatory context

In India, Yashada Bhasma is described in official Ayurvedic formularies and pharmacopoeial standards, and Ayurvedic manufacturers operate under national regulations on Good Manufacturing Practice and quality specifications for metal-containing products. Regulatory requirements and permitted limits differ among countries, and some jurisdictions restrict or scrutinize metal-containing traditional medicines. Practitioners and manufacturers should follow the applicable current regulations.

8.4 Contraindications and precautions

Caution is warranted in patients with renal impairment, in pregnancy and lactation, in patients on copper-depleting therapy, and in those already receiving zinc supplements. Use should be under qualified supervision, and use with conventional drugs (for instance antidiabetic agents, quinolone and tetracycline antibiotics, whose absorption may be affected by zinc) requires attention to interactions.

9. DISCUSSION

Yashada Bhasma illustrates both the strengths and the challenges of applying Rasashastra to modern therapeutics. On the one hand, the classical indications (eye disease, metabolic disorders, skin and wound conditions, diarrheal illness) correspond well with the known physiology of zinc, which suggests that traditional observations may reflect real biological effects. The sophisticated multi-step pharmaceuticals, including purification, trituration, controlled heating in a closed system and functional quality tests, shows an empirical system directed at safety and reproducibility.

On the other hand, several limitations must be acknowledged. First, the classical texts differ in *Shodhana* and *Marana* media, the number of *Putra*, and the temperature regimes, which makes it difficult to define a single "authentic" Yashada Bhasma. Second, physicochemical analyses show variable products, and it is unclear which properties (particle size, phase, organic residue) determine efficacy and safety. Third, the central claim that classical processing yields a superior or safer material than simple zinc supplementation has not been rigorously tested. Fourth, the clinical evidence is limited in quantity and quality.

Fifth, contaminants in raw material and poor process control can undermine safety.

For advancing the field, several research directions appear priority: (1) standardized, documented manufacturing protocols with process parameters (temperature, time, atmosphere) recorded; (2) comprehensive physicochemical characterization linked to biological activity; (3) comparative pharmacokinetic and bioavailability studies against zinc salts and bulk ZnO; (4) long-term, repeat-dose toxicology with attention to copper status and organ function; (5) well-designed randomized controlled trials in defined indications, such as adjunctive therapy in type 2 diabetes, wound healing or childhood diarrhea; and (6) harmonization of quality standards, including heavy-metal limits. Integrating classical knowledge with modern analytical and clinical methods offers the best route to determine which uses are supported and which are not.

10. CONCLUSION

Yashada Bhasma is a zinc-based Ayurvedic preparation with a long history and a coherent, though not uniformly standardized, pharmaceutical tradition. Its classical indications in eye disease, *Prameha*, *Kushtha*, *Vrana* and gastrointestinal conditions align with the recognized roles of zinc in human physiology, and its main mineral phase, nanocrystalline zinc oxide, is consistent with a bioavailable zinc source. Classical safeguards, especially *Shodhana*, *Marana* and *Bhasma Pariksha*, reflect an early quality-assurance concept. Nevertheless, the modern evidence base is limited, dominated by preclinical and small clinical studies, and variability in preparation and contamination risk raise legitimate safety concerns. Yashada Bhasma should therefore be used only when properly prepared, quality-tested and prescribed by qualified practitioners. Rigorous standardization and clinical research are needed before its therapeutic potential can be fully established.

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