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Review Article

EXPLORING THE BENEFITS OF *YASHADA BHASMA* (ZINC OXIDE) IN SUNSCREEN FORMULATIONS: BRIDGING CLASSICAL WISDOM WITH SCIENTIFIC VALIDATION

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ABSTRACT

The utilization of minerals in cosmetic formulations has been a longstanding tradition, with *Yashada Bhasma* (zinc oxide) emerging as a prominent ingredient in modern sunscreen formulations due to its remarkable properties. This article provides a comprehensive examination of *Yashada Bhasma* historical significance, chemical composition, and therapeutic attributes as described in classical literature. The scientific analysis validates its efficacy as a physical barrier against UVA and UVB radiation, highlighting its photostability and compatibility with sensitive skin. Structural and chemical characterization techniques illuminate its nano-scale transformation during the purification process, enhancing its effectiveness. Comparative analyses with other sunscreen ingredients emphasize its superiority in terms of UV protection spectrum, skin compatibility, and regulatory approval. A market survey reveals the widespread incorporation of *Yashada Bhasma* into various Ayurvedic and herbal cosmetic products, reflecting its acceptance and popularity among consumers. Overall, this article bridges the gap between Classical wisdom and scientific validation, showcasing *Yashada Bhasma* as a versatile and effective component in sunscreen formulations, poised to meet the evolving needs of skincare and sun protection in contemporary times.

INTRODUCTION

Minerals have been a cornerstone of the cosmetic industry for an extensive period. Many prominent cosmetic products incorporate minerals such as *Abhraka* (mica), *Suvarna* (gold), *Mouktika* (pearl), *Yashada* (zinc), and more. However, in recent times, there has been a notable uptick in the utilization of *Yashada Bhasma* (zinc oxide) due to its remarkable antimicrobial properties and its ability to provide UV protection.[2] *Yashada Bhasma* (zinc oxide) is a key ingredient in many sunscreen formulations for several compelling reasons. Firstly, it offers broad-spectrum protection against both UVA and UVB radiation by acting as a physical barrier. This means that it reflects and scatters harmful UV rays away from the skin, providing comprehensive protection against sun damage.

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Additionally, it is highly photostable, meaning it does not degrade upon exposure to sunlight. This ensures that the sunscreen maintains its effectiveness over time, providing long-lasting protection against UV radiation. Furthermore, zinc oxide is renowned for its gentle nature on the skin, making it suitable for sensitive skin types. It is non-comedogenic and non-irritating, making it ideal for individuals with conditions like acne or rosacea. Importantly, zinc oxide is also considered reef-safe, unlike some chemical sunscreen filters. This means that it does not harm coral reefs or marine ecosystems when washed off into the ocean, aligning with environmentally conscious sunscreen practices. Overall, zinc oxide stands out as a versatile and effective ingredient in sunscreen formulations, offering broad-spectrum protection, photostability, skin compatibility, and environmental safety. [3-7]

The classical literature describes the activities of *Yashada Bhasma* as *Krimighna* (antimicrobial), *Kanthikara* (improves complexion), *Rasayana* (rejuvenator), and *Grahi* (improves moisture holding

capacity of skin). It is utilized in cosmetics for skin care, wound cure, and sun protection action. [8]

This article extensively scrutinized a diverse array of resources to compile comprehensive insights into the multifaceted benefits of *Yashada Bhasma* (zinc oxide) as a UV protector. Furthermore, it conducted a market survey of numerous companies that integrate *Yashada Bhasma* as a key ingredient in their cosmetic product ranges.

MATERIALS AND METHODS

Historical background

Yashada Dhatu was first mentioned in *Madanpal Nighantu*[9] in 15th century. The *Rasa Grantha* Ayurveda Prakasha, was first to include it as *Dhatu*. Also in 10th century *Rasarnava*[10], it is mentioned as '*Kharparsatva*'. It is classified under *'Puti loha'*, means one who emits an obnoxious smell while melting.

Table 1: Introduction to *Yashada*[11]

Classification	*Dhatuvarga*
Chemical composition	Zn
Atomic number	30
Synonyms	*Jashad, Jasad, Ritihetu, Kharparaj, yasad, Yashad, Jasta, Tamra-ranjak, Netra Rogari, Rangsankash, Ritikruta*
Rasa	*Kashaya, Tikta*
Virya	*Sheet*
Vipaka	*Katu*
Gunadharma	*Kaph-pitta samutthit roga, Pandunashan, Pramehaghna, Chakshushya, Shwashar, Kasahar, Shramavasadahar*

Yashada Bhasma

Yashada Bhasma undergoes a meticulous three-step process comprising *Shodhan* (purification), Jarana (incineration), and Marana (calcination). The infusion of plant extracts and herbs during the calcination stage not only enriches its medicinal properties but also diminishes its size to the nano-scale.

X-ray Diffraction (XRD) analysis of *Yashada Bhasma* showcases a crystalline hexagonal phase of zinc oxide (ZnO), while the raw metal exhibits the presence of zinc metal crystallites. Dynamic Light Scattering (DLS) reveals a notable decrease in particle dimensions of *Yashada Bhasma* (339.8 nm) in contrast to the raw metal (2063nm). This reduction in size is further corroborated by Scanning Electron Microscopy (SEM), which delineates the particle size of *Yashada Bhasma* (324nm) and raw metal (1-2µ). The zeta potential value underscores the stability of *Yashada Bhasma*. Energy Dispersive X-ray Analysis (EDAX) discloses variations in the concentration of zinc and oxygen between the two samples. [13]

Table 2: *Rasa Panchaka* (Pharmacological Action) of *Yashada Bhasma* [12]

Rasa	***Guna***	***Veerya***	***Vipaka***	***Dosha Karma***	***Rogaghnata***
Kashay, Tikta	*Sheeta*	*Sheeta*	*Katu*	*Kaphapittanashak*	*Prameha, Pandu, Kas, Shwas, Netrarog, Ratri swedahar, Vran, Vranasrav*

Sunscreens and their Classification

Sunscreens play a pivotal role in shielding the skin from the adverse effects of both short-term and long-term exposure to ultraviolet (UV) radiation. In the contemporary landscape of procedure-centric dermatology, sunscreens have evolved into an essential component of every patient's post-procedure skincare regimen.[14]

The biologically significant components of ultraviolet (UV) radiation encompass UVA and UVB radiation. Below delineates the primary targets of UV radiation in the skin along with their respective effects: [15]

UVB (290-320 nm)

- Principally responsible for severe damage
- Directly affects cellular DNA and proteins
- Results in acute damage such as sunburn
- Contributes to long-term damage including cancer

UVA (320-400 nm)

- Not directly absorbed by biological targets
- Penetrates deeper into the skin compared to UVB
- Influences connective tissue by generating reactive oxygen species; induces significant immuno suppression.
- Responsible for tanning, photoaging, photocar cinogenesis, exogenous photosensitization, and

various idiopathic photodermatoses (including polymorphous light eruption).

Classification of Sunscreen

Chemical sunscreens, also referred to as organic sunscreens, operate based on their chemical composition, typically featuring an aromatic compound conjugated with a carbonyl group. This configuration enables them to absorb high-energy UV rays, prompting the molecule to enter an excited state. Upon returning to the ground state, the molecule emits energy at longer wavelengths. The specific range of wavelengths absorbed by a sunscreen may vary.

Chemical sunscreens encompass both UVA and UVB blockers. UVB filters effectively absorb the entire spectrum of UVB radiation (290 to 320nm). UVA filters, however, do not cover the entire UVA spectrum. UVA radiation is further classified into UVA I (340 to 400nm) and UVA II (320 to 340nm). Broad-spectrum sunscreens are formulated to absorb UV radiation from both the UVA and UVB segments. [16]

Physical sunscreens: The mechanism underlying the action of physical sunscreens relies on the reflection and scattering of UV light, akin to the protective function of clothing. The effectiveness of these sunscreens is contingent upon their reflective properties, which encompass factors such as the reflective index, particle size, film thickness, and base dispersion. A higher reflective index correlates with superior UV filtering capabilities. Reducing particle size to a micronized form (10 to 50nm) enhances cosmetic appeal but also alters protective properties, potentially leading to increased absorption of shorter wavelengths and heightened risk of systemic absorption. [16] Physical sunscreens consist of zinc oxide and titanium dioxide. [17]

Zinc Oxide (*Yashada Bhasma)* in Sunscreen

Zinc oxide is commonly incorporated into sunscreens in the form of a very fine powder, typically produced by allowing zinc oxide vapor to react with oxygen. This process yields ZnO granules that are a few micrometers in size, imparting a dense, white appearance to the lotion or spray. While this aids in ensuring comprehensive coverage, it often results in a noticeable white residue, which can be quite thick.

However, this issue can be mitigated by reducing the size of the ZnO particles even further. When particles measure between one and 100 nanometers in any dimension, they are classified as nanoparticles. Nano-sized particles exhibit distinct properties compared to larger counterparts, and ZnO is no exception. Nanoparticles of ZnO display reduced scattering of reflected light compared to microparticles, resulting in the disappearance of the white coloration. Consequently, sun lotions containing nanoparticle ZnO still offer effective UV protection but appear transparent when applied to the skin, a preference for many users. [1]

Microfine zinc oxide offers robust protection against a broad spectrum of UVA radiation, encompassing UVA 1 (340 to 400nm). Notably, it exhibits exceptional photostability and does not engage in reactions with other UV filters. In comparison to titanium dioxide, microfine zinc oxide demonstrates heightened efficacy in shielding against UVA radiation. However, it may display relatively less efficiency in safeguarding against UVB radiation. [17,18]

Secondary photoprotection involves a range of compounds including antioxidants, osmolytes, and DNA-repair enzymes, which collectively work to mitigate skin damage by interrupting the photochemical cascade triggered by UV sunlight exposure. Antioxidants operate by mitigating the reactive oxygen species (ROS) generated from UVA radiation. Naturally occurring antioxidants in the body, such as superoxide dismutase and catalase, typically neutralize these ROS. However, during periods of excessive ROS production, these enzymes may become overwhelmed, leading to an antioxidant deficiency and subsequent damage to proteins and DNA. Topical antioxidants function intracellularly to replenish the diminished antioxidant levels, thereby offsetting the deficiency. Moreover, they can maintain their efficacy for several days post-application, ensuring sustained protection against oxidative stress.[18,19]

Yashada Bhasma (zinc oxide), underwent screening to evaluate its potential as a free radical scavenger. Parameters including lipid peroxidation (LPO), superoxide dismutase (SOD), catalase (CAT), and reduced glutathione (GSH) were examined. The study involved administering the drug in suspension form at three different concentrations: 1%, 2%, and 5%, over varying durations of 1 day, 2 days, and 4 days for each suspension. Results indicated that a concentration of 2% *Yashada Bhasma* was adequate for inhibiting lipid peroxidation (LPO), with superior outcomes observed over 4 days compared to the standard drug (Vitamin C). Furthermore, assessments of SOD, GSH, and CAT activity demonstrated enhanced efficacy with a 5% suspension of *Yashada Bhasma*. [20]

Comparison between Zinc Oxide and Titanium Oxide[16,17,21,22]

Both zinc oxide and titanium dioxide are commonly used in sunscreens as physical sun blockers, protecting against both UVA and UVB radiation.

Table 3: Characteristics features of Titanium oxide and *Yashada Bhasma*

S. no.	Characteristics	Titanium Oxide	*Yashada Bhasma* (Zinc Oxide)
1.	Chemical Composition	Titanium+ Oxygen	Zinc + Oxygen
2.	UV Spectrum Coverage	UVA+ UVB	UVA+UVB
3.	Particle Size	228.6 nm	>= 100 nm
4.	Skin Compatibility	All except Sensitive Skin	All including Sensitive Skin
5.	Effectiveness	Blocking UV Radiation	Broad Spectrum of UV Rays
6.	Regulatory Approval (FDA)	+ve	+ve

Both *Yashada Bhasma* and Titanium oxide are effective and commonly used in sunscreens but *Yashada Bhasma* proves to be better than the latter.

Market Survey

The notion of beauty and the practice of cosmetics have traversed the epochs of human civilization. With an ever-growing societal demand, the field of cosmetology is advancing at a rapid pace. Ayurveda, an ancient system of indigenous medicine, holds a distinct position, for it is not merely a medical science but an intricate philosophy of holistic living for humanity. In the realm of cosmetology, Ayurveda is witnessing a surge in demand owing to its distinctive perspective on beauty and its efficacious, enduring therapies. Its principles resonate deeply with individuals seeking natural, sustainable approaches to enhancing their aesthetic appeal. Ayurveda's emphasis on harmony between mind, body, and spirit aligns seamlessly with modern aspirations for holistic well-being and enduring beauty. [23]

As per a report by Maximise Market Research Private Ltd., the global Ayurveda market reached an estimated value of US$ 4.5 billion in 2019. Projections indicate a significant growth trajectory, with expectations to soar to US$ 14.9 billion by 2026, boasting a Compound Annual Growth Rate (CAGR) of 16.14%. [24]

A comprehensive evaluation of various Ayurvedic and Herbal Cosmetic Products was conducted by examining the websites of the respective companies to identify those containing *Yashada Bhasma* (zinc oxide) as an ingredient. Below is a list of the companies and their products that include Zinc oxide:

Table 4: List of Companies and their product name that have *Yashada Bhasma*

S.No.	Name of the Company	Product Name	Presence of *Yashada Bhasma* (Zinc oxide)
1.	Biotique	Sun Shield *Aloe Vera*	+
2.	Himalaya Herbals	Protective Sunscreen Lotion	+
3.	VLCC	Mineral Sunscreen SPF 50	+
4.	Forest Essentials	• Soundarya Radiance Cream • Eladi Day Cream SPF 30 • Light Day Lotion Lavender and Neroli with SPF 25 • Hydrating Facial Moisturiser for Men Sandalwood and Orange peel with SPF 25 • Ultra Rich Body Milk Soundarya with 24K Gold and SPF 25 • Sun Fluid Tender Coconut Water with Turmeric and Basil Leaf SPF 50 PA+++	+ + + + + +
5.	Kama Ayurveda	Natural Sun Protection	+
6.	Aroma Magic	• Sunscreen Body Lotion SPF 70+ • Aloe vera Sunscreen Gel • Sunblock Lotion • Cucumber Suncreen Lotion • Sunlite Spray	+ + + + +
7.	Jovees Herbal	• Sun Derma Care Lotion SPF 50 PA+++ Broad Spectrum	+

		• Sunscreen Fairness SPF 25 Lotion for Oily and Sensitive Skin • Sun guard Lotion SPF 60 • Sun Block Sunscreen SPF 45 • Sun Cover SPF 30 • Sun Zinc Shield SPF 30 • Sun Screen Face Serum SPF 65 PA+++ • Broad Spectrum Sunscreen Powder SPF 50	+ + + + + + +
8.	82e	• Turmeric Shield SPF 40 SPF	+
9.	Mamaearth	• Daily Glow Sunscreen with Vitamin C and Turmeric for Sun Protection And Glow • Ultra Light Indian Sunscreen with Carrot seed, Turmeric & SPF 50	+ +
10.	Sadhev	• Sadhev Sunscreen SPF 30	+
11.	The Ayurvedic Co. (TAC)	• Eladi Sunscreen SPF 50 • Kumkumadi Sunscreen SPF 50	+ +
12.	Just Herbs	• Tinted Serum Sunscreen with SPF 50+ PA+++ • Moisturising Sunscreen Gel with SPF 35+ with Jojoba and Wheatgerm • Sun'nil Jojoba Grapeseed Moisturising Sun Protection Lotion	+ + +

[Note: '+' represent presence of *Yashada Bhasma* (Zinc oxide)]

DISCUSSION

The article provides a comprehensive exploration of the utilization of *Yashada Bhasma* (zinc oxide) in sunscreen formulations within the cosmetic industry, drawing from both classical literature and modern scientific research. The historical roots of *Yashada Bhasma* are traced back to ancient texts, highlighting its classification, chemical composition, and therapeutic properties. Its purification process, involving *Shodhan, Jarana*, and *Marana*, is described, underscoring its transformation into a potent medicinal substance.

The classical literature elucidates *Yashada Bhasma's* multiple properties, including antimicrobial, complexion-improving, rejuvenating, and moisturizing effects. These properties align with its contemporary application in cosmetics for skincare and sun protection. Modern scientific analysis corroborates these benefits, emphasizing its efficacy as a physical barrier against both UVA and UVB radiation, along with its photo stability and compatibility with sensitive skin types.

Utilizing techniques such as X-ray Diffraction (XRD), Dynamic Light Scattering (DLS), Scanning Electron Microscopy (SEM), and Energy Dispersive X-ray Analysis (EDAX), scientific studies delve into the structural and chemical characteristics of *Yashada Bhasma* as crystalline hexagonal phase of zinc oxide (ZnO). These analyses emphasize its transformation into nano-scale particles (100nm) during the calcination process, enhancing its efficacy and stability.

A comparative analysis between *Yashada Bhasma* (zinc oxide) and titanium dioxide elucidates their respective properties, efficacy, and regulatory approval. *Yashada Bhasma* emerges as a superior option due to its broader spectrum of UV protection, skin compatibility, and regulatory approval.

The market survey reflects the widespread incorporation of *Yashada Bhasma* into various Ayurvedic and herbal cosmetic products. Companies across the spectrum, from Biotique and Himalaya Herbals to Forest Essentials and Kama Ayurveda, feature sunscreen products containing Zinc oxide, indicating its popularity and acceptance among consumers.

CONCLUSION

The article underlines the rich historical legacy and scientific validation of *Yashada Bhasma* as a key ingredient in sunscreen formulations. Its multiple benefits, ranging from UV protection to skin care, resonate with both ancient Ayurvedic principles and modern cosmetic practices, positioning it as a versatile and effective component in the ever-evolving landscape of skincare and sun protection.

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