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Synthesis And Characterisation of Shankha Bhasma (Calcinated Conch Shell) Processed with Kumari and Nimbu Swaras [Aloe Vera and Citrus Juices]

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ABSTRACT:
Shankha Bhasma, an important calcium-based Ayurvedic formulation, was prepared using four different combinations of shodhan (detoxification) and maaran (incineration) media, including Nimbu Swarasa, Kumari Swarasa, and Nimbukamla.(1) The raw Shankha(Conch shell) was subjected to purification and repeated incineration (puta) cycles, followed by characterization using organoleptic and physicochemical parameters, Ayurvedic Bhasma Pariksha, Particle Size Analysis, X-Ray Fluorescence (XRF), Fourier Transform Infrared Spectroscopy (FTIR), and Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Nimbukamla, prepared chemically using chalk powder and sulphuric acid, exhibited a highly acidic nature (pH 0.3) and played a significant role in reducing the number of Putas(2) (heating cycles) required for achieving quality Shankha Bhasma. Analytical results revealed that all samples were soft to touch, tasteless, odorless, and possessed characteristic carbonate and carboxylic functional groups(3). Calcium content remained consistently high across all samples, while magnesium and potassium concentrations varied depending on the herbal media used. Particle size analysis confirmed a high proportion of single particles with fine micron-range sizes. This study emphasizes the influence of shodhan media on the properties of Shankha Bhasma and highlights Nimbukamla as an effective shodhan medium for producing high-quality bhasma.(4)

Introduction

Shankha Bhasma is a classical Ayurvedic herbo-mineral formulation, primarily composed of incinerated conch shell, traditionally used for its digestive, antacid, and bone-strengthening properties.(5) Classical texts emphasize the importance of proper selection of Shankha, purification through shodhan, and repeated incineration cycles (puta) for achieving a pharmaceutically and therapeutically acceptable bhasma. Various herbal liquids are traditionally employed for shodhan, including kanji (sour gruel), nimbu (Citrus limon juice), Jayanti swarasa (Sesbania sesban juice), cholaiswarasa (Amaranthus juice), and Nimbukamla (citric acid prepared chemically).(6)

While previous studies have reported the use of lemon juice, curd, and kanji for Shankha purification, Nimbukamla has not been widely explored. According to Rasatarangini(6) text of ayurved, Nimbukamla, prepared by a defined chemical process, possesses a highly acidic nature, which facilitates removal of impurities from Shankha and supports efficient incineration process. The present study aimed to synthesize and characterize Shankha Bhasma using four different combinations of liquid herbal media, including Nimbukamla, Nimbu swaras and Kumari Swaras and extended to evaluate the impact of these herbal media treatments on the physicochemical, organoleptic, and structural properties of Shankha bhasma using classical Ayurvedic tests and modern analytical techniques.

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Materials and Methods

Selection and Preparation of Raw Materia: Three different market samples of Shankha were compared based on classical Ayurvedic selection parameters, and the most suitable sample recommended by experts was selected for further processing.(7)(8)(6)

Preparation of Nimbukamla: Nimbukamla was prepared as per ayurved pharmaceutical guidelines by reacting chalk powder with sulphuric acid in different ratios. The final product exhibited a highly acidic nature with pH 0.3, suitable for facilitating the incineration process and releasing calcium and carbonate ions from Shankha.(6)

Shodhan and Maaran (Purification and incineration process)of Shankha : The selected Shankha underwent shodhana process in which boiling of raw Shankha was done in two different herbal liquids, nimbu swarasa (lemon juice) and nimbukamla (prepared citric acid solution) for a period of three hours, following classical guidelines .(9)(10)(11)

The purified Shankha samples were then subjected to the maarana (incineration) process using cow dung cakes as fuel. Four different Shankha Bhasma samples were prepared using combinations of Nimbu Swarasa, Kumari Swarasa, and Nimbukamla wherein levigation in herbal juices and heating of levigated, dried material was done in traditional furnace as per ayurvedic pharmaceutical guidelines stated in classical texts. Four final products are formulated as follows

Four samples of *Shankha Bhasma* were prepared using different combinations of herbal media for *shodhan* and *maaran*. ShB1 was prepared using *nimbu swarasa* for both *shodhan* and *maaran*, while ShB2 was prepared using*nimbu swarasa* for *shodhan* and *kumari swarasa* for *maaran*. ShB3 was processed with *nimbukamla* as the *shodhan dravya* and *nimbu swarasa* for *maaran*, and ShB4 was prepared using*nimbukamla* for *shodhan* and *kumari swarasa* for *maaran*.

For ShB1 and ShB2, a total of five cycles of incineration were administered. Initially purified Shankha was subjected to traditional furnace using 60 cowdung cakes. Obtained powdered material was then levigated with Nimbu swaras and Kumari swaras respectively,dried and further processed in furnace to attain quality Bhasma product

For the preparation of Shankha bhasma 1 (ShB1) and Shankha bhasma 2 (ShB2), 5 putas were required for each sample having 146 no. of cow dung cakes, weighing 42 kg and temperature ranges between 900 – 1000o C. For the preparation of Shankha Bhasma 3 (ShB3) and Shankha bhasma (ShB4), 3 putas were required for each sample having 105 no. of cow dung cakes, weighing 28 kg in total and temperature ranging between 900 – 1000o C.

During the process of preparation intermediate products were tested using ayurvedic Bhasma pariksha. After achieving those parameters, the final four products were tested with organoleptic and Bhasma testing parameters. Those were further analysed using particle size analysis, XRF, FTIR and ICPOES techniques. Results were collected and compared.

Results and Discussion

Organoleptic and Physicochemical Characteristics

All four samples were soft to touch (mrudu), tasteless (nihswadu), and odorless (nirgandha). Color differences were observed depending on the shodhan media: Nimbu Swarasa-treated samples (ShB1 and ShB2) appeared greenish white, while Nimbukamla-treated samples (ShB3 and ShB4) were bright white.(2)

Physicochemical analysis revealed similar pH across samples (ShB1: 11.88; ShB2: 12.23; ShB3: 12.12; ShB4: 12.40). Moisture content ranged from 0.3–0.42%, loss on drying from 0.27–0.41%, total ash from 92.15–97.88%, acid-soluble ash from 0.95–1.3%, and water-insoluble ash from 1.5–2.1%. These results indicate uniformity in basic physicochemical properties across the four formulations.(12)

Bhasma Pariksha

All samples passed classical Ayurvedic tests:(13) floated on stable water (varitaratwa), lodged in finger furrows (rekhapurnatwa), did not show shininess under sunlight (nishchandratva), showed no burning sensation when kept onthe tongue (jihvagranadahyati), and no sound was observed when pressed in between teeth (dantagrekachakachabhav).

Particle Size Analysis

ShB1 showed a total particle count of 14,517 with moderate fineness (d50 = 1.50 µm) and low

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agglomeration. ShB2 had the highest particle count (17,030) with finer particles (d50 = 1.32 µm). ShB3 exhibited fewer particles (10,870) but finer single particle size (d50 = 1.74 µm) and less agglomeration, while ShB4 had the lowest particle count (6,080) with higher agglomeration (551) and intermediate particle size (d50 = 1.42 µm).

Overall, Nimbukamla-treated samples (ShB3 and ShB4) demonstrated smaller single particle and agglomerate sizes, while Nimbu Swarasa-treated samples had higher total particle counts, suggesting that use of Nimbukamla facilitates particle breakdown and getting fineness in final Bhasma product

XRF Analysis

XRF revealed calcium as the major element, highest in ShB1 (48.81%) and lowest in ShB2 (42.55%). Light elements (C, H, O) were highest in ShB2 (56.51%) and lowest in ShB1 (49.81%). Trace elements including silicon were detected in Nimbu Swarasa-treated samples. Nimbukamla-treated samples (ShB3 and ShB4) exhibited lower levels of heavy metals such as arsenic, mercury, and lead, indicating detoxification of raw shankha through Nimbukamla was done appropriately.

FTIR Analysis

All four samples displayed characteristic carbonate peaks around 870–872 cm^{-1} and 1396–1406 cm^{-1}. While ShB1 showed an additional peak at 1144 cm^{-1}. Peaks corresponding to organic functional groups (1792–2099 cm^{-1} and 1550–1700 cm^{-1}) were detected in ShB2, ShB3, and ShB4, reflecting phytochemical residues from the herbal media. Nimbukamla treated samples showed a cleaner spectrum with reduced organic remnants, confirming its effectiveness in purification.

ICP-OES Analysis

Calcium content remained consistently high across all samples (ShB1: 42,156.63 mg/L; ShB2 : 42080.44 mg/Kg, ShB3 : 42026.28 mg/Kg, ShB4: 41,525.98 mg/L). Magnesium and potassium were higher in Nimbu Swarasa-treated samples (ShB1 and ShB2) and lower in Nimbukamla-treated samples (ShB3 and ShB4), indicating that the choice of shodhan medium influences minor elemental retention.

In previously research works on Shankha bahsma the findings align well and consistently identify calcium carbonate as the principal constituent and magnesium and potassium as minor constituents subject to variation depending on processing methodology.Thus, the present results support the classical rationale that while the major identity of Shankha Bhasma is preserved through its calcium-rich profile, the choice of shodhana and maaraṇa media fine-tunes the levels of accessory elements such as magnesium and potassium, which may influence the physicochemical behavior and eventual digestion-phase performance of the bhasma.

An attempt was done in present study which was not explored till date thus the analytical values obtained in the present study would be utilized as established values for the specific method of preparation of four samples. Research can work with this data generated through the study and plan further works for testing preclinically and clinically

Conclusion

A standard operating procedure (SOP) was developed for the preparation of *Nimbukamla*, following the reference described in *Rasatarangini*. Similarly, a detailed SOP was formulated for the preparation of four samples of *Shankha Bhasma* using different herbal media for both *shodhan* (purification) and *maaran* (incineration) processes. All the prepared samples were subjected to advanced instrumental analyses, which revealed distinct variations in their physicochemical properties. Among the four, **ShB1**, the sample prepared using *nimbu swarasa* as both *shodhan dravya* and *maarandravya*, exhibited the highest percentage of calcium content. In contrast, **ShB3**, the sample prepared using *nimbukamla* as *shodhan dravya* and *nimbu swarasa* as *maarandravya*, demonstrated the smallest particle size, indicating enhanced fineness. Furthermore, FTIR analysis confirmed the presence of carbonate functional groups in all *Shankha Bhasma* samples, validating the expected chemical composition of the formulation.

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