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A Preliminary Study Of The Development Of An Innovative Prasadana Anjana [Ophthalmic Collyrium] Containing Triphala Ghrita, Soot & Mukta Pishti

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Abstract
Vision is regarded as the most vital sense, and Ayurveda emphasises ocular health under Netra Vyadhi. Prasadana Anjana, recommended for daily use, is described to enhance vision and prevent disorders. This study was aimed to develop and analyse an innovative Prasadana Anjana containing Mukta Pishti (pishti of pearls) and Triphala Ghṛita as a safe Ayurvedic ophthalmic formulation. Mukta (pearls) were purified with Jayanti (Sesbania sesban) Swarasa and converted to Pishti through 21 bhavana cycles with rose water, followed by analysis by PSA, XRD, FTIR, and Raman spectroscopy. Triphala Ghṛita was prepared as per classical guidelines and tested by HPTLC. Carbon soot was prepared using purified cow's ghṛita and analyzed by FTIR and Raman spectroscopy. The final formulation was prepared with Mukta Pishti, Triphala Ghṛita, Bhimseni Camphor, beeswax, coconut oil, and carbon soot using the double-boiling method and stored aseptically. Mukta Pishti attained nanoscale fineness (80–300 nm). XRD confirmed retention of the aragonite phase; FTIR and Raman validated carbonate and protein structures. HPTLC confirmed gallic acid in Triphala Ghṛita. The final formulation was smooth, homogeneous, stable for three months, and free from harmful additives. The innovative Prasadana Anjana proved safe, stable, and therapeutically relevant, offering a validated Ayurvedic alternative to commercial kajals often contaminated with lead and parabens.
Keywords: *Triphala Ghrita, Mukta Pishti, Anjana, Ayurveda, Analytical validation, ophthalmic formulation, Collyrium*

1. INTRODUCTION

Vision is considered the most vital sense, and ocular health plays a central role in overall well-being and quality of life. In Ayurveda, eye diseases are classified under *Netra Vyadhi*, with preventive and therapeutic approaches are prescribed to preserve and restore vision, as described in detail. Among them, *Anjana* (medicated collyrium) is emphasized for both daily use and disease-specific applications. *Prasadana Anjana*, described in *Sushruta Samhita*, is a mild and soothing collyrium recommended for regular use to maintain clarity of vision and prevent ocular disorders (1). The present study is focused on the development of a novel *Triphala Ghrita* based *Prasadan Anjana* containing *Mukta Pishti*. The innovation is rooted in the need to provide a safe and effective Ayurvedic alternative to commercially available kajal preparations, many of which are reported to contain harmful constituents such as parabens, lead, sulfates, and artificial colorants. (2) Monitoring of these cosmetic kohl or kajal under limited hazard quotients (HQ) is not commonly available (3). These toxic ingredients may pose significant ocular and systemic health risks, thereby necessitating the exploration of safer, natural formulations.

Classical texts describe *Mukta* (pearl) as *pitta-shamaka* and *drushti-prasadana*, attributing to it both preventive and curative roles in ocular disorders (*Netra Roga*) (4). While, *Triphala ghrita* is recognized as *chakshushya* and *Rasayana*, indicating its therapeutic utility in promoting vision and maintaining ocular health (5). Integrating these ingredients in a novel *Prasādana Anjana* offers both traditional support and modern safety. The present study was therefore undertaken to develop and analyze an innovative formulation using *Mukta Pishti* and *Triphala Ghrita*, validated through classical and modern analytical methods.(1).

1.1 Mukta (Pearls) *Sushruta Samhita* mentions *Mukta* in *Anjana Kalpana* for its cooling and soothing effects(6) ,while *Ashtanga Hridaya* also highlights its role in ocular formulations(7). *Rasa Ratna Samuccaya* describes *Mukta* as *laghu* (light) and *hima* (cool), with acceptable qualities (*grahya lakshana*) that improve

vision, relieve burning, and neutralize toxins.(8) (9) As an ingredient of *Prasadana Anjana*, *Mukta* is validated by classical references for daily use in maintaining clarity of vision and preventing eye disorders, thus forming a strong foundation for its application in innovative formulation.(6)(9)

Modern studies confirm that pearls, mainly composed of aragonite calcium carbonate with organic matrix, provide bioavailable calcium and regenerative potential.(10)Keshi pearls, composed entirely of nacre and free from bead nuclei, are chemically purer and richer in calcium carbonate, making them highly suitable for therapeutic preparations such as *Mukta Piṣṭi* and ophthalmic formulations. (11)(12). Their purity and pharmacological relevance provide a strong basis for their use in innovative *Prasadana Anjana*, bridging classical Ayurvedic wisdom with modern validation.

***1.2 Triphala ghrita* in *Netra Vyadhi* (A Classic Ocular Remedy):** *Triphala Ghrita* is a classical Ayurvedic formulation prepared by processing the decoction (*kwatha*) and paste (*kalka*) of *Triphala*, a combination of *Haritaki (Terminalia chebula), Bibhitaka (Terminalia bellirica),* and *Amalaki (Emblica officinalis)* with cow's ghee (*go-ghrita*). It is extensively described in Ayurvedic literature as a rasayana (rejuvenative) and chakshushya (vision-promoting), highlighting its preventive and therapeutic role in ocular health.(13) (14). The ghee base enhances bioavailability, facilitates tissue penetration, and provides sustained nourishment to ocular structures. Classical texts, including *Suśruta Uttartantra*, recommend Triphala Ghrita for internal and external use in ocular disorders, especially those of *pittaja* origin, applied as *anjana*, *tarpana*, or *lepa*, and administered internally in decoction, paste, or powder forms. (5)(15).Modern studies attribute its efficacy to polyphenols, flavonoids, and tannins, which offer antioxidant and anti-inflammatory effects, protecting against cataractogenesis and ocular degeneration. The lipid medium of ghee further improves absorption, ocular lubrication, and tissue nourishment. Ayurvedically, Triphala Ghrita acts as both *ama-pachak* (detoxifying) and *rasayana* (rejuvenative), confirming its preventive and therapeutic potential in *Netra Vyadhi* (16).

1.3 *Anjana* (Herbo-Mineral Collyrium)

The Suśruta Saṁhitā emphasizes the preventive role of Anjana (collyrium) in ocular health. As part of dinacharya (daily regimen), the regular application of Prasādana Anjana is recommended to preserve clarity of vision, strengthen the eyes, and protect against Netra Vyadhi (ocular disorders).(9) Unlike therapeutic types such as *Lekhana* (scraping) or *Ropaṇa* (healing), *Prasādana Anjana* is mild, soothing, and nourishing, promoting ocular clarity while preventing dryness and fatigue. Possessing *madhura rasa*, *snigdha guna*, and *prasadana* action, it is well-suited for preventive and promotive eye care. The present study applies this classical principle in formulating a novel *Prasādana Anjana* using *Mukta Piṣṭi* and *Triphala Ghrita* (1).

1.4 Introduction to Instrumental Analysis:

In this study, the raw ingredients (*Mukta, Jayanti, Triphala, Ghrita,* and carbon soot) and the final *Prasādana Anjana* were analyzed using modern techniques, including Particle Size Analysis (PSA), X-Ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), Raman Spectroscopy, and High-Performance Thin Layer Chromatography (HPTLC), alongside classical Ayurvedic tests. These evaluations confirmed the identity, purity, and standardization of the samples, providing scientific validation and ensuring the safety and therapeutic suitability of the formulation.

1.5 Need for Safe and Validated Ayurvedic Ophthalmic Formulation

Eye preparations have been central to Ayurvedic therapeutics, with *Anjana Kalpana* prescribed for both prevention and treatment of *Netra Vyadhi*. *Prasadana Anjana* is recommended for daily use to maintain vision, prevent ocular disorders, and promote eye comfort. In contrast, modern commercial ocular cosmetics, such as kajal and eyeliners, often contain harmful substances like lead, parabens, sulfates, and artificial colourants, which may cause irritation, dryness, allergies, and long-term health risks. This underscores the need for a safe, standardised, and scientifically validated Ayurvedic ophthalmic formulation. Classical texts describe *Mukta* (pearls) as *dṛuṣhṭi-prasadana* and *pitta-shamaka*, while *Triphala Ghrita* is recognised for its *chakshushya* and *rasayana* properties. Combining these into a *Prasadana Anjana* preserves traditional wisdom while ensuring safety and efficacy through modern analytical validation, offering a reliable alternative to commercial kajal for preventive and therapeutic herbal eye care.

Commercial kajal preparations often contain toxic substances that may cause ocular irritation, dryness, or long-term health risks, emphasising the need for a safe and validated Ayurvedic alternative. *Mukta Pishṭi*, retaining its organic protein (conchiollin) and *sheeta* (cooling) property, soothes and protects ocular tissues. *Triphala Ghṛta* acts as a detoxifier, antioxidant, and *rasayana*, nourishing and rejuvenating the

eyes, while *Bhimseni Karpur* (camphor) provides additional cooling, anti-inflammatory, and antiseptic effects. By integrating these ingredients into a novel *Prasadana Anjana*, this study aims to develop a safe, effective, and scientifically validated ocular preparation that combines preventive and therapeutic benefits, bridging classical Ayurvedic principles with modern pharmaceutical standards and analytical validation.

2. RAW MATERIALS AND AUTHENTICATION

2.1 Collection and identification of raw materials.

Figure. 01 Ingredients of the Formulations

Collection and Authentication of Mukta sample (keshi pearls).

Figure no.02 Sample of keshi pearls: Uneven Shape Potent Nacre, Highly Glistening, Absecnce of Nucleus

Mukta (pearls) samples were procured from authenticated gem traders supplying directly to Ayurvedic pharmacies. The samples were verified using classical grahya–agrahya tests described in Ayurvedic Granthas and further evaluated with modern parameters to ensure purity and suitability for pharmaceutical processing (Figures 1(a) and 2). The assessment included narrative inference, morphological, and organoleptic characteristics based on classical criteria and modern parameters such as color, luster, surface texture, shape, size, and origin. Keshi pearls were authenticated as genuine Mukta, with natural seawater origin, absence of nucleus, and high nacre content, confirming their purity and therapeutic suitability. These pearls were therefore selected for further pharmaceutical formulation and analytical study. *Sesbania sesban* (*Jayanti*) was procured and authenticated at the Quality Control (QC)

Laboratory, BVDU, based on macroscopic and microscopic characteristics, referencing classical Ayurvedic texts and modern pharmacognostic standards (Figure 1b). Fresh *Rosa centifolia* flowers were collected and authenticated according to Ayurvedic references and API standards in the QC Laboratory, BVDU. *Triphala* powder and coarse *bharad* were sourced and verified in the QC Laboratory as per Ayurvedic Pharmacopoeia of India (API) standards (Figure 1d). Organic beeswax was obtained from a verified local vendor, free from additives, and authenticated in the QC Laboratory (Figure 1f). Cold-pressed coconut oil was procured from Two Brothers Organic Farms, prepared via traditional wooden *ghani* without chemicals or heat, preserving its natural phytoconstituents (Figure 1h).

3. METHODOLOGY

Study Design: The study was carried out in two phases:

A. Pharmaceutical Study: Selection, purification, and preparation of raw materials, followed by the formulation of Prasadan Anjana.

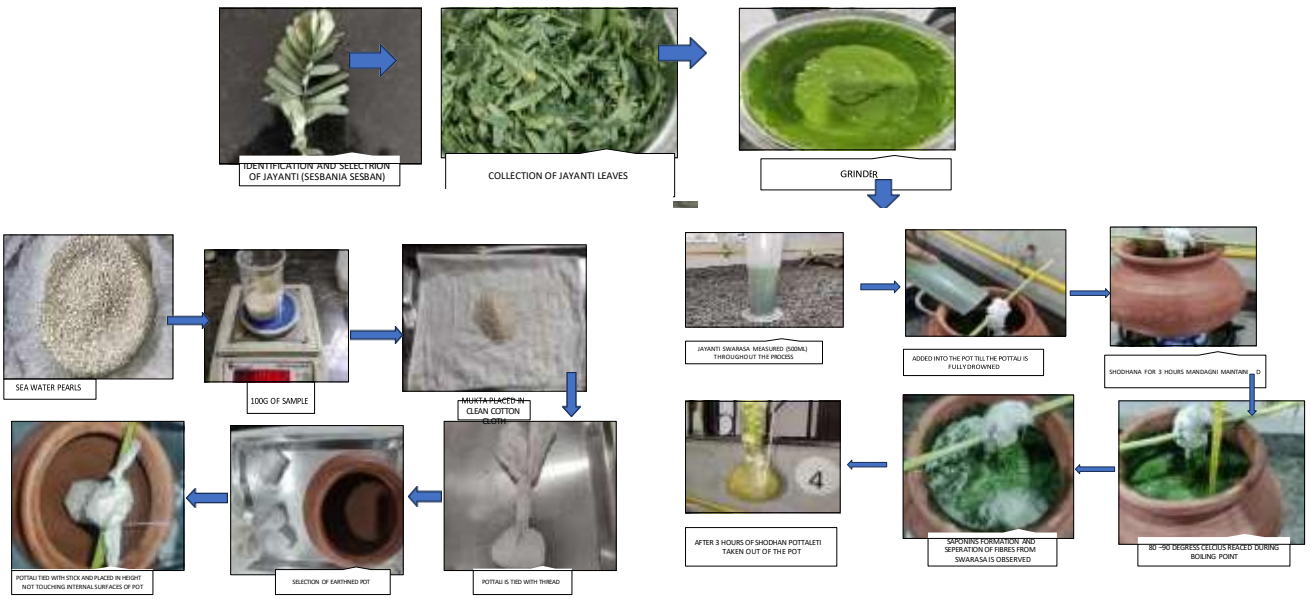
B. Analytical Study: Classical and modern analytical evaluation of the prepared formulation.

A . Pharmaceutical Study

3.1 Manufacturing of Jayanti Swarasa: Sample: Fresh leaves of *Jayanti* (*Sesbania sesban* Linn.) **Raw Material:** 10 kg of leaves **Procedure:** Fresh *Jayanti* leaves were thoroughly washed with running water, rinsed with distilled water, and shade-dried briefly to remove surface moisture. The leaves were then ground in a mechanical grinder to form a homogeneous pulp. The pulp was filtered through a clean muslin cloth to extract the *Swarasa* (fresh juice) (17). The freshly obtained *Swarasa* was collected in a sterile container and used immediately for the *Shodhana* (purification) of *Mukta* (pearls), as per classical references, since freshly expressed juice is considered most potent. Figure 3

Figure 3. Preparation of Jayanti Swarasa:

***3.2 Shodhan Of Mukta* by Jayanti Swarasa:** As recommended in *Rasatarangini*, the *Shodhana* (purification) of *Mukta* (Keshi pearls) was performed using the *Dola Yantra* method. 4(a)The pearls were suspended in *Jayanti Swarasa* and gently heated for three hours to remove impurities without causing significant weight



loss (18). The formulation used were*Mukta* (keshi pearls) in a quantity of 100 g, and *Jayanti* (*Sesbania sesban* Linn.) leaves, from which 4 kg of fresh leaf juice was extracted for use in the preparation.figure 4(b)

4(a) **4(b)**

Figure 4. Shodhana of Mukta with Jayanti Swarasa:

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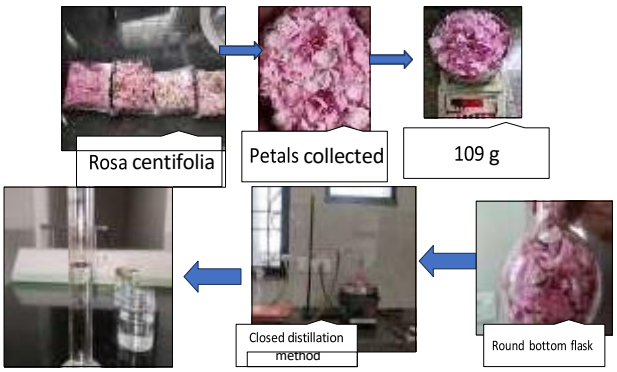
https://www.theaspd.com/ijes.php

3.3 Rose Water Preparation (Closed Distillation Method) Fresh rose petals (100 g) were distilled with purified water (500 mL) in a 1:5 ratio using a closed distillation system. The mixture was gently heated at 70–75 °C (*mandagni*) for about four hours, yielding ~100 mL of rose water. The process was considered complete when the petals turned pale and the aroma weakened. The distillate was filtered through muslin cloth and stored in sterilized amber bottles under cool, dry conditions. Figure 5

Figure no. 05 preparation of rose water by closed distillation method

3.3 manufacturing of carbon soot from cow's ghee: A clean mud lamp (diya) with a cotton wick was filled with purified cow's ghṛita and lit to produce a steady flame. A polished stainless steel plate was



inverted above the flame at an appropriate distance for six hours, with molten ghṛita added periodically to maintain combustion. Fine black soot deposited on the plate was gently scraped off with a sterile spatula and collected in sterilized amber glass containers for use in the *Prasādana Anjana* formulation.

Figure no 06: carbon soot prepared from mud diya and cow's ghee:

3.5 Manufacturing of Triphala Ghṛita: Triphala Ghṛita was prepared as per the classical method described in Aṣhtanga Hṛuday in timir chikitsa (19)**.** Triphala churna (384 g) was taken and a kwatha was prepared by boiling with 3072 ml of water and reducing it to 768 ml. To this kvātha, Triphala kalka (48 g), cow's ghṛita (384 g), and cow's milk (768 ml) were added. The mixture was subjected to heating over mandagni (mild flame) with constant stirring until attainment of ghṛita siddhi lakṣaṇas (completion signs such as uniform aroma, non-sticky consistency, and absence of froth/moisture). The hot liquid was then filtered and stored in clean, sterilized amber-colored containers to protect from light and maintain

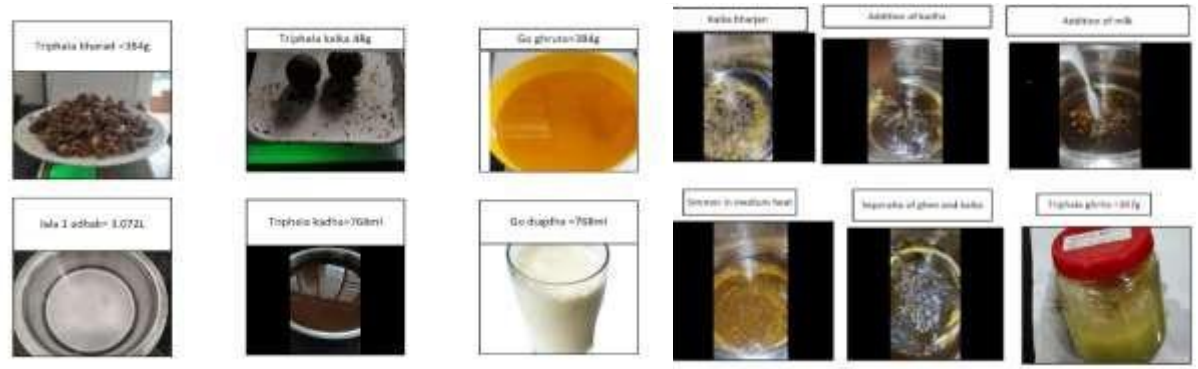


Figure no. 07 preparation of triphala ghrita:

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https://www.theaspd.com/ijes.php

3.5 Manufacturing of Mukta Pishti

Purified *Mukta* (100 g) was powdered in a marble mortar and pestle to obtain a smooth, uniform base. The powder was triturated with freshly prepared rose water for about six hours daily, continued for 21 *bhavana* cycles. Trituration was carried out under moonlight exposure to enhance *sheeta guṇa* (cooling property) and facilitate particle size reduction. After 21 cycles, a smooth, white, fine-textured *Mukta Pishti* was obtained, suitable for incorporation into *Prasadana Anjana*.

Table no. 14 trituration of purtified mukta by rose water for 21 days:

Day	Date	rose water extract (ml)	Duration
1	27/08/24	Dry trituration	5 hr
2	22/9/24	25ml	4hr
3	28/9/24	25ml	5 hr
4	29/9/24	25ml	6 hr
5	22/10/24	75ml	5hr
6	10/11/24	25ml	6hr
7	25/11/24	25ml	6hr
8	16/01 25	20ml	6hr
9	28/01 25	10ml	5 hr
10	28/01/25	15ml	5 hr
11	30/01/25	15ml	5hr
12	31/01/25	15ml	5 hr
13	07/02/25	10ml	5hr
14	14/02/25	15ml	6hr
15	15/02/25	10ml	6hr
16	16/02/25	10ml	6hr
17	17/02/25	10ml	5hr
18	18/02/25	10ml	5hr
19	23/02/25	**10ml**	4hr
20	25/02/25	10ml	6hr
21	4/03/25	10ml	6hr
TOTAL		**1910ml**	**112hours**

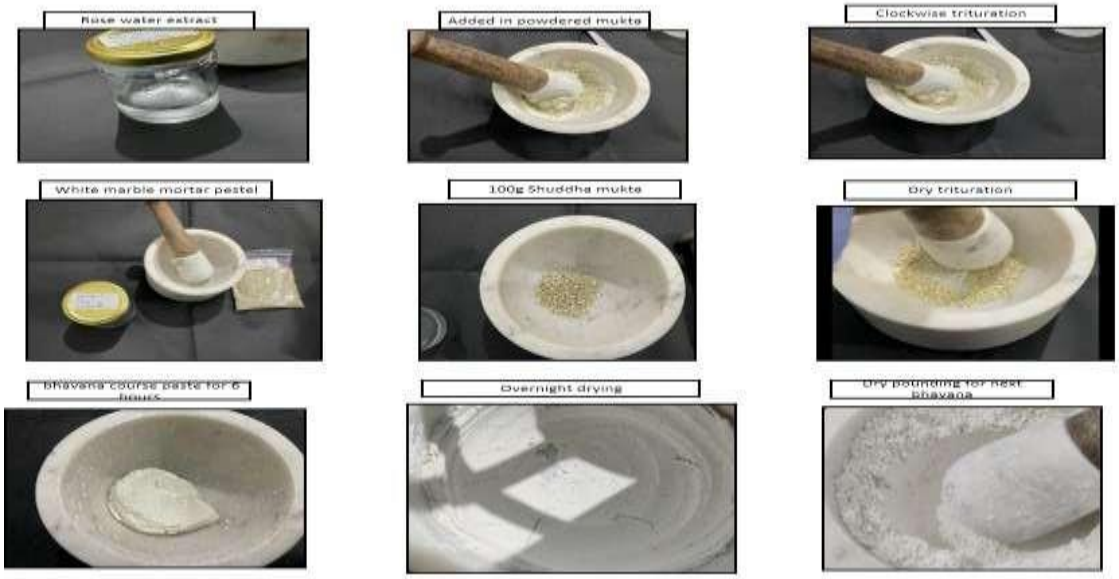

Figure no. 08: Purified Mukta triturated 21 times with rose water (Bhavana) under moonlight for 6 hours

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https://www.theaspd.com/ijes.php

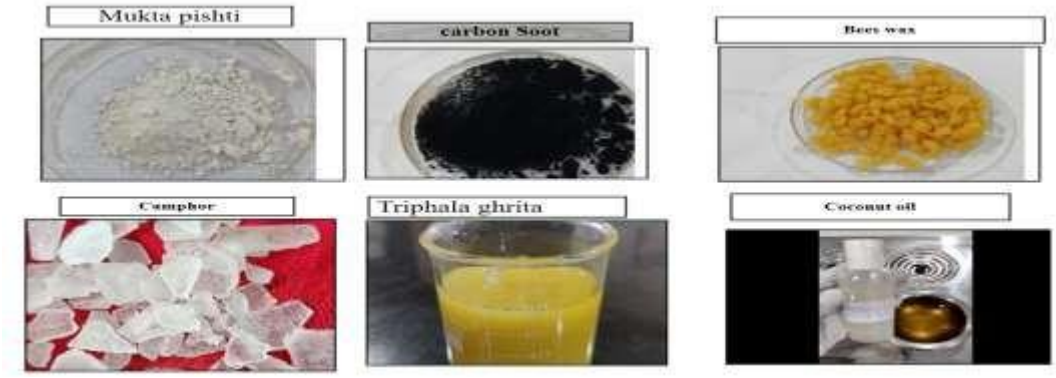


Figure 09 Ingredients: of innovative prasadana Anjana:

3.6 Methodology for Preparation of Prasadana Anjana The *Prasādana Anjana* formulation comprised *Mukta Piṣṭi* (1 g), *Triphala Ghṛta* (10 g), carbon soot from natural cotton wick (0.4 g), *Bhimseni Karpur* (camphor, QS), beeswax (0.5 g), and cold-pressed coconut oil (2 g). All ingredients were accurately weighed. *Triphala Ghṛta* and beeswax were melted using the double-boiling method, followed by addition of coconut oil to form the lipid base. *Mukta Piṣṭi* was then levigated into this base for uniform dispersion, and pre-processed carbon soot was gradually incorporated with continuous trituration to ensure fineness and homogeneity. A small amount of *Bhimseni Karpur* was added for preservative, antimicrobial, and cooling effects. The mixture was homogenized into a smooth, black, semi-solid paste and stored in sterilized containers. The final *Prasādana Anjana* was black, smooth, and of uniform consistency.The final packaged product was labeled and stored under controlled room temperature conditions.

Figure no. 10 Final SOP of pasadana Anjana :

3.7 Methodology for Aseptic Filling of Prasadana Anjana

A horizontal Laminar Air Flow (LAF) unit (Pheroh Company) was used to ensure aseptic conditions during product filling. The blower was switched on for 30 minutes to stabilize airflow, and the UV light was run for 30 minutes to sterilize the work area. Following sterilization, the LAF unit provided a clean aseptic environment, with the operator wearing sterile gloves, mask, and protective clothing. The prepared *Prasādana Anjana* was then transferred into sterile containers inside the unit under aseptic precautions, ensuring freedom from external contamination. The containers were sealed immediately after filling and stored appropriately.

Figure no. 11 Homogeneous, stable mixture filled in sterile containers under Laminar Air Flow.

Figure 12: Final packedging of Prasadana Anjana:

Instrumental analysis:

Methodology for XRD Analysis of Mukta Pishti: XRD was performed to study the crystalline structure and phase identity of *Mukta Pishti*, providing information on crystallinity, particle size, and polymorphic forms. The powdered sample was evenly spread on a glass holder, ensuring a smooth surface, moisture removal, and homogeneity. Analysis was carried out using a diffractometer with Cu-Kα radiation (λ = 1.5406 Å), operated at 40 kV and 30 mA. Diffraction patterns were recorded in the 2θ range of 10°–80°, with a step size of 0.02° and scan speed of 1°/min. A graphite monochromator was used to reduce background noise and improve peak resolution.

Methodology for FTIR Analysis of Mukta Pishti: FTIR was carried out to identify functional groups in *Mukta Pishti*. The sample (2–3 mg) was finely powdered, dried, and mixed with ~200 mg of spectroscopic grade KBr. The mixture was compressed into a transparent pellet using a hydraulic press under vacuum and immediately placed in the instrument holder. Spectra were recorded in the mid-infrared range (4000–400 cm^{-1}) with 4 cm^{-1} resolution, averaging 32 scans for optimal signal-to-noise ratio. A pure KBr pellet was used for background correction.

Methodology for Raman Spectroscopy of Mukta Pishti: Raman spectroscopy was performed to characterize the molecular structure of *Mukta Pishti*. A small quantity of finely powdered, dried sample was placed directly on a clean glass slide, ensuring uniform regions to minimize fluorescence interference. Spectra were recorded using a Raman spectrometer with a 532 nm or 785 nm laser excitation source. The spectral range of 100–2000 cm^{-1} was scanned to capture carbonate ion vibrations and other functional

groups. Laser power was optimized to prevent thermal degradation, and multiple scans were averaged to improve the signal-to-noise ratio.

Particle Size Analysis- Raw Mukta, shodhita (Purified) Mukta, and Mukta Pishti by DLS: Particle size reduction of *Mukta* at different stages Raw, *Śodhita* (purified), and *Pishti*—was analyzed using Dynamic Light Scattering (DLS). About 10 mg of each powdered sample was dispersed in 10 mL deionized water, ultrasonicated for 10 minutes, and filtered through a 0.45 µm syringe filter before loading into disposable cuvettes. For *Mukta Pishti*, prepared with rose water, homogenization was carried out prior to analysis. Measurements were performed in triplicate using a Malvern Zetasizer Nano ZS at 25 ± 1 °C with a 633 nm He–Ne laser at a scattering angle of 173° (backscatter mode). The instrument provided Z-average particle size, polydispersity index (PDI), and distribution profiles.

Methodology for FTIR Analysis of Carbon Soot Prepared from Ghee: FTIR was performed to identify functional groups in the carbon soot obtained from burning cow's ghee in a clay lamp (*diya*). The soot was carefully collected, finely powdered, and mixed with spectroscopic grade KBr (~2–3 mg sample with 200 mg KBr). The mixture was compressed into a transparent pellet under vacuum, or alternatively analyzed as a thin film on a KBr crystal window. Spectra were recorded in the mid-infrared region (4000–400 cm^{-1}) with 4 cm^{-1} resolution, averaging 32 scans. A pure KBr background spectrum was used for correction.

Quantification of Gallic Acid from Triphala Ghrita using HPTLC One gram of Triphala Ghṛita was dissolved in methanol, vortexed, sonicated for 10 min, diluted to 10 mL (100,000 ppm), and filtered through a 0.22 µm syringe filter. Gallic acid (100 ppm) served as the reference standard. Samples and standard were applied on precoated silica gel 60 F254 plates (Merck) using a CAMAG Linomat V applicator. Plates were developed in a twin-trough chamber with an optimized mobile phase and scanned densitometrically at 272 nm using CAMAG Scanner 4.

3 OBSERVATION AND RESULTS:

A. Pharmaceutical Observations: Raw material authentication by physicochemical parameters

***Mukta* (pearls)** The physico-chemical evaluation of raw Mukta (Keshi pearls) showed that 100 g of sample was obtained, and its pH was recorded as 9.

Jayanti (sesbania sesban)

Table no.2 Quality control analysis of Jaynati (sesbania sesban)

Name of the Parameter	Standard Values	Obtained Values
Moisture content	Not more than 11%	4.52%
Total Ash	Not less than 2%	5.29%
Water soluble extractive	Not less than 25%	8.23%
Alcohol soluble extractive	Not less than 7%	6.22%
pH	N/A	5.31

Triphala churna

Table no.3 Quality control analysis of triphala churna

Name of the Parameter	Obtained Values %
Moisture content	3.92%
Total Ash	3.3%
Water soluble extractive	24.18%
Alcohol soluble extractive	16.82%

pH	4.5

Raw material authentication by organoleptic parameters

Mukta (keshi pearls) exhibited dull and less resonant sound (shabda) and were slightly uneven and irregular to touch, though cool (sparsa). Their appearance (rupa) was whitish with moderate luster, irregular or baroque in shape, and notably lacked a nucleus. In terms of taste (rasa), they were predominantly kaṣhay (astringent) with occasional mild saltiness, while odour (gandha) was absent, indicating a niragandha nature.

Keshi pearls the sample was white to off-white in color and irregular in shape. Its surface appeared smooth and lustrous, with the absence of a nucleus. The texture was hard, cool, and smooth to touch. It was odorless and tasteless, and when struck, it produced a clear metallic "click" sound.

Rose (rosa centifolia) the rose petals produced a soft rustling sound (shabda) when handled, owing to their delicate and thin nature. On touch (sparsha), they were soft, velvety, and smooth. Their appearance (rupa) varied from bright pink to deep red depending on the variety. The taste (rasa) was mild, slightly kashay (astringent), and cooling to the palate, while the odour (gandha) was pleasant with the characteristic fragrance of rose.

Authentication of intermediate formulations by organoleptic parameters and physicochemical parameters

Jayanti swarasa the sample did not exhibit any distinct sound (shabda). On touch (sparsha), it was soft, velvety, fibrous, and frothy. Its appearance (rupa) was velvety green, while the taste (rasa) was distinctly bitter. The odour (gandha) was mild in nature.

Shuddha mukta the physico-chemical evaluation of śuddha mukta showed a yield of 99.99 g with a recorded ph of 8.

Mukta pishti the physico-chemical evaluation of mukta pishti showed a yield of 96.7 g with a recorded ph of 7.

Rose water (distillate)rose water was found to be soluble in both alcohol and water but insoluble in fats and oils, with a recorded pH of 6.

Organoleptic Characters of **Rose water extract:** Rose water did not exhibit any sound (shabda) and was liquid to the touch (Sparsha). Its appearance (Rupa) was that of a clear, water-like liquid, with a slightly floral and sweet taste (Rasa). The characteristic rose fragrance (Gandha) was derived from the petals.

***Triphala ghrita*.** The sample did not exhibit any sound (Shabda) and was oily to touch (Sparsha). Its appearance (Rupa) was yellow and oily, with a mild bitter-sour taste (Rasa) and a pleasant odour (Gandha).

Table.no.4 Quality control analysis of triphala ghrita :

Name of the Parameter	Standard Values	Obtained Values
Specific gravity	NA	0.913
Acid value	Not more than 3	1.8 mg KOH
Refractive Index	1.452 to 1.455	1.46
Weight per ml	0.910 to 0.935 g	0.912 g
Saponification value	200 to 225	229 mg KOH/g
Iodine Value	35 to 45	38.52
pH	NA	5.7

Observations after Mukta Shodhan: After Śodhana, the pearls exhibited noticeable physical changes: loss of intense lustre, mild surface shine, prominent exposure of nacreous layers, and absence of a central nucleus—a characteristic of Keshi pearls. These observations confirmed the sample's identity and demonstrated Śodhana's effect in enhancing suitability for pharmaceutical processing.

Ayurvedic Specific Tests of Mukta Pishti Mukta Pishti was evaluated using classical Ayurvedic tests. The Sukṣhma test confirmed adequate particle size reduction, "*Danta Kach Kach Bhava"* showed no grittiness,

and the "Jivhadhaeyta" test indicated no burning or discomfort on the tongue, demonstrating its safety and suitability for therapeutic use.

Observation during Jayanti swarasa preparation:

Mechanical crushing of 6 kg fresh Jayantī leaves yielded ~3 L of Swarasa, with stable frothing indicating a significant presence of saponins. Due to the leaves' low moisture content, a small amount of water was added to ensure complete juice extraction.figure13

Figure 13. Observation during shodhan of Jayanti swarasa

***Observation during* TLC of Jayanti churna under 366nm 254nm and visible light:** Thin-layer chromatography (TLC) of Jayantī chūrṇa was observed under UV light at 366 nm and 254 nm, as well as under visible light (Figure 14), revealing distinct spots corresponding to its phytoconstituents**.**

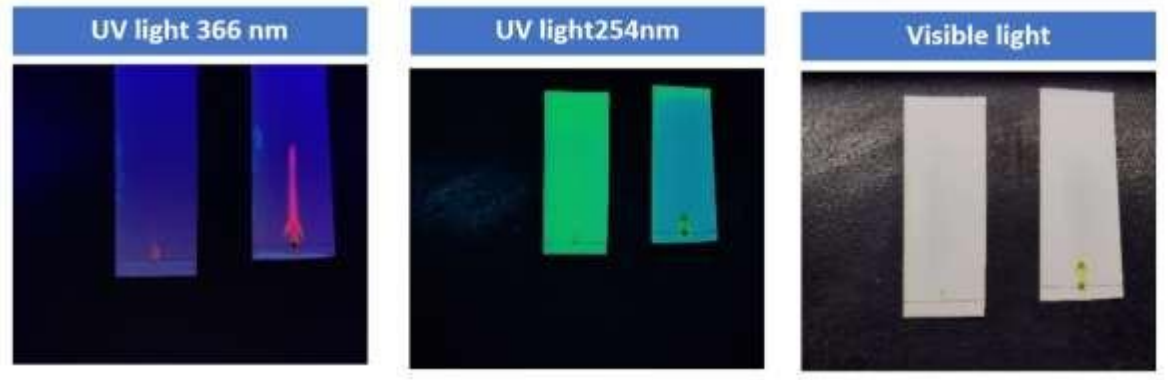


Figure 14: Observation during Tlc of Jayanti churna:

Observation after triphala ghrita preparation: The initial mixture of ghṛita, Triphala kwath, and kalka was heterogeneous with frothing. On kalka acquired a granular texture, separating cleanly. Siddhi Lakṣaṇa was confirmed by forming a varti from the mixture and igniting it; steady burning without crackling (nirghoṣa) indicated complete moisture removal and proper assimilation of kalka with ghṛita, confirming ghṛita siddhi and readiness for further processing.Figure 15

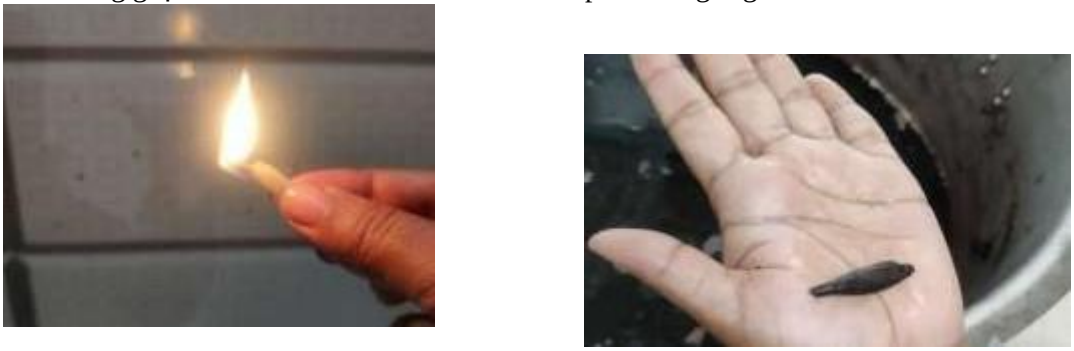
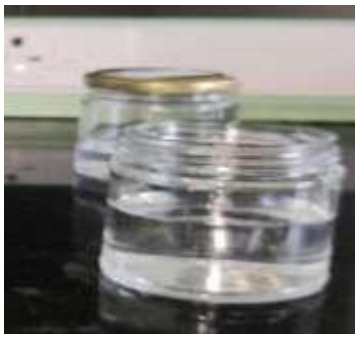


Figure 15 Observation after triphala ghrita preparation:

Observation of rose water post distillation:Fresh pinkish-red rose petals with characteristic fragrance were distilled with water. The clear, colourless distillate exhibited a pleasant rose aroma and pH 6.0, indicating slight acidity from natural organic acids. No turbidity or discoloration was observed, confirming proper distillation. figure 1

***Figure 16: Observation of rose water post distillation* and ph.**

Observation on Beeswax: Beeswax was evaluated using standard organoleptic and analytical tests. It



showed a yellowish color, smooth texture, and mild honey-like odor, with a melting point of 62–65 °C. Its solubility profile (insoluble in water, sparingly soluble in alcohol, soluble in chloroform/ether) confirmed the sample's authenticity and purity.

Observation on Carbon Soot (from Cow's Ghee): Carbon soot prepared by traditional method using cow's ghee was obtained as a fine, smooth, jet-black powder with a characteristic smoky smell. The texture was soft and uniform, suitable for incorporation into Anjana formulation. The deposition was consistent and easily scraped off the vessel surface. The process yielded a light, fluffy carbon soot suitable for further incorporation in Anjana preparation. Figure 17

***Figure 17. Observation during* soot preparation:**

Observation on Final Formulation (Anjana): The prepared *Prasādana Anjana* was homogeneous, semisolid, and showed smooth spreadability on ocular application. It was sterile, with no contamination detected, stable for 4–5 hours, and caused no irritation, confirming ocular safety. The shelf life was estimated at one year. Organoleptic evaluation showed no sound (*Shabda*) on handling, blackish color (*Krushnabh*), camphor-tinged taste (*Rasa*), pleasant camphor aroma (*Gandha*), and smooth texture

(*Sparsha*). The formulation was well-blended, free from aggregates, soft in texture, and uniformly jet-black, consistent with classical descriptions of *Anjana*. Figure 19 depicts the final preparation.

Figure 18. Observations of Final Formulation of anajana:

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https://www.theaspd.com/ijes.php

RESULTS

Particle Size Analysis (PSA):

Optical microscopy of *Mukta Pishti* showed predominantly fine particles between 700–2000 nm, with minor agglomerates around 3200 nm.

Dynamic Light Scattering (DLS) provided complementary results. The first report indicated a main peak near 660 nm with a high Z-average (2121.6 nm) and unusually high PDI, suggesting aggregation. The second report showed a shift towards larger hydrated particles, with a peak around 1650 nm and Z-average of 3317.3 nm, along with a more acceptable PDI.

Overall, microscopy confirmed submicron to micron-sized particles, while DLS highlighted the tendency of *Mukta Pishti* to form hydrated aggregates in dispersion, validating the refinement achieved during processing.

- **Ray Diffraction (XRD):**

The XRD pattern of *Mukta Pishti* showed distinct peaks in the range of 26–30° (2θ) with d-spacings of 3.0–3.4 Å, corresponding to aragonite and calcite phases. Additional peaks were observed at 35–37° (2θ) with d-spacings of 2.3–2.5 Å, and at 45–47° (2θ) with d-spacings of 1.9–2.0 Å, both characteristic of calcite. These findings confirm the predominance of aragonite along with traces of calcite, consistent with the natural crystalline structure of pearls.

Table.no 5 Comparison to Standard Calcium Carbonate (Pearl / Aragonite / Calcite XRD):

2θ (Degrees)	d-spacing (Å)	Possible Phase
~26-30	3.0-3.4	Aragonite / Calcite
~35-37	2.3-2.5	Calcite
~45-47	1.9-2.0	Calcite

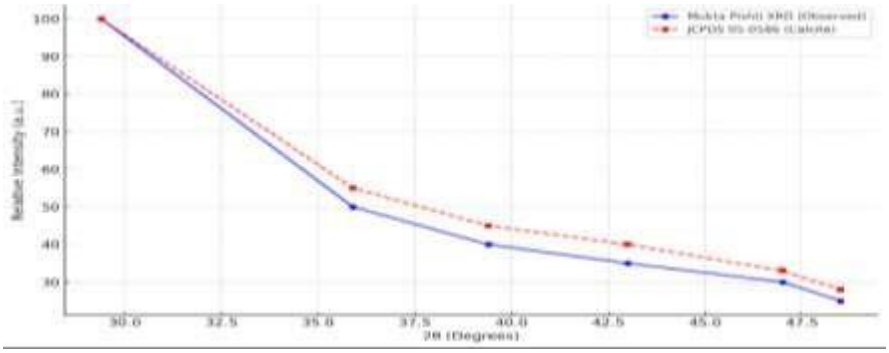

Figure 19. Comparison of XRD Pattern: Mukta pishti vs JCPDS 05-0586 Calcite

Blue Line: Mukta Pishti sample (observed data)Red Line: Standard JCPDS data for pure CalciteBoth patterns show excellent alignment of peak positions (2θ), confirming calcite phase.Minor differences in intensity are normal due to sample preparation, particle size, and instrument variations**.**

Fourier Transform Infrared Spectroscopy (Ftir): Mukta Pishti: The FTIR spectrum of *Mukta Pishti* showed characteristic carbonate peaks, confirming the presence of the $CO_3 2^-$ group. Prominent bands were observed at 711.7 cm^{-1} (out-of-plane bending), 858.3 cm^{-1} (in-plane bending), 1082.0 cm^{-1} (asymmetric stretching), and 1440.8 cm^{-1} (strong carbonate bending). A minor peak at 1782.2 cm^{-1} suggested a possible carbonyl (C=O) stretch, indicating trace organic or impurity presence. These findings validate the carbonate-rich composition of pearls and preservation of their mineral structure after Pishti processing.minor organic compounds from the Bhavana (rose water) used during preparation.

Raman Spectroscopy: Mukta Pishti: The Raman spectrum of *Mukta Pishti* showed features broadly consistent with calcium carbonate ($CaCO_3$). A weak rise in the 0–500 cm^{-1} region likely reflected particle background rather than lattice modes. Slight signals in the 700–800 cm^{-1} range corresponded to $CO_3 2^-$ bending vibrations (ν4), though weaker than the standard. A clearer match was seen at 1080–1100 cm^{-1}, representing the symmetric stretch (ν1) of carbonate. A shoulder between 1450–1500 cm^{-1} indicated overtone vibrations (ν1+ν4). Additionally, a broad band between 2800–3200 cm^{-1} suggested the presence of organic residues such as conchiolin, consistent with the natural matrix of pearls. These results confirm the preservation of carbonate structure along with traces of organic components in the processed Pishti.

FTIR of carbon soot ghee The FTIR spectrum provided shows several peaks at characteristic wavenumbers. These peaks correspond to specific functional groups (bonds) present in the carbon soot derived from ghee. The FTIR spectrum of carbon soot from burning cow's ghee showed key peaks at **1274.9 cm^{-1} (C–O stretch)** and **1616.3 cm^{-1} (aromatic C=C, graphitic structure)**. Signals between **1973–2160 cm^{-1}** indicated overtone/combination bands and alkyne C≡C stretches, while a minor peak at **2513.2 cm^{-1}** suggested C–H vibrations. A broad band at **3500–4000 cm^{-1}** reflected O–H stretching from hydroxyl or moisture. These peaks confirm carbonaceous structures with minor organic and oxygenated groups.

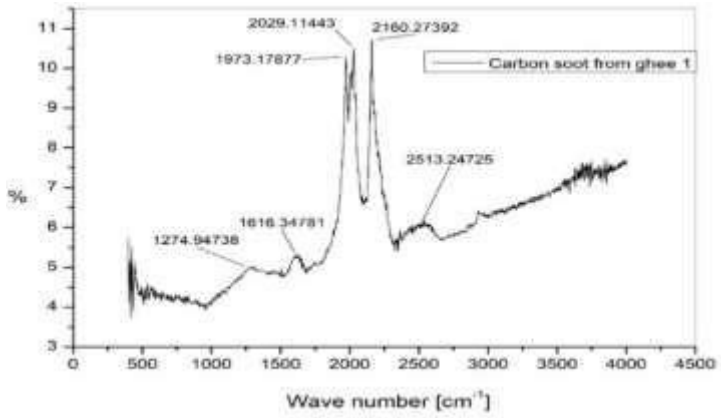

Figure 20. FTIR of carbon soot ghee

Raman spectroscopy of carbon soot: For **carbon soot**, Raman spectra revealed distinct **D-band (~1350 cm^{-1})** and **G-band (~1580 cm^{-1})**, characteristic of graphitic and disordered carbon structures. This confirmed the presence of stable carbonaceous material, ensuring its suitability as a safe base for ophthalmic application in the Anjana formulation.

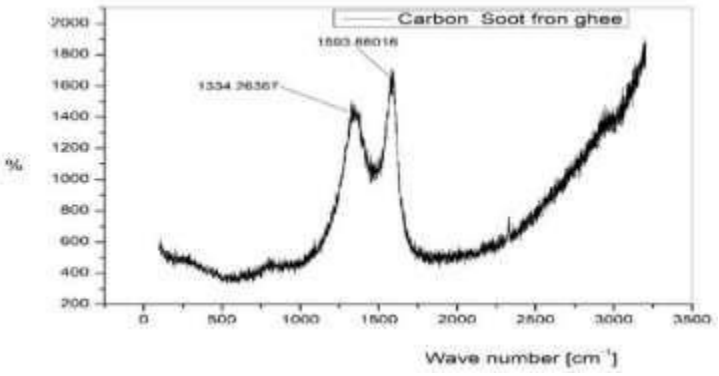

Figure 21. Raman spectroscopy of carbon soot

Quantification of Gallic Acid from Triphala Ghṛita using HPTLC

A Densitograms of the standard and the sample were recorded. Overlay of the densitograms demonstrated clear matching peaks, and linearity studies confirmed the suitability of the method for quantitative estimation.HPTLC analysis of *Triphala Ghṛita* was performed using gallic acid as a reference marker. The standard gallic acid showed clear bands at an Rf of ~0.50 (±0.065), with strong linear calibration (R2 = 0.9992). The test sample of *Triphala Ghṛita* displayed a corresponding band at Rf 0.512, confirming the presence of gallic acid. Quantification revealed 118.8 µg of gallic acid per gram of *Triphala Ghṛita*, equivalent to an average concentration of 11.88 µg/mL in the methanolic extract. Multiple peaks were observed in the chromatogram, with gallic acid contributing ~55% of the total peak area, while additional peaks represented other polyphenolic components of *Triphala*. These findings validate the phytochemical integrity of *Triphala Ghṛita*, demonstrating that classical preparation retains antioxidant markers like gallic acid, which correlate with its *chakshushya* (vision-promoting) and *rasayana* (rejuvenative) properties.

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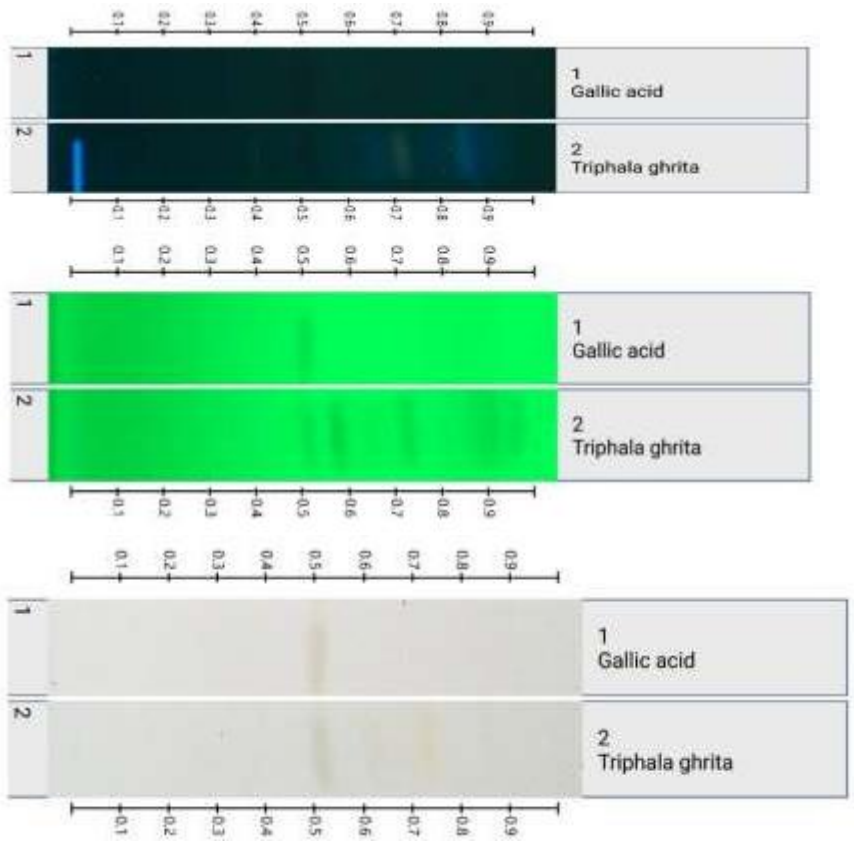

Figure 22. Quantification of Gallic Acid from Triphala Ghṛita using HPTLC

DISCUSSION

The innovative Prasadana Anjana showed close alignment between Ayurvedic principles and modern validation. Mukta Piṣṭi, processed with rose water bhāvanā, attained nanoscale fineness. Scientific evidence supports that nano-calcium carbonate enhances bioavailability and ocular absorption, justifying the classical emphasis on repeated bhāvanā.This study demonstrates strong correlation between classical Ayurvedic principles and modern validation. *Bhavana* cycles reduced pearl particles to nanoscale, enhancing bioavailability. *Triphala Ghṛta* provided antioxidant and rejuvenative activity consistent with *chakshushya* and *rasayana* claims.Beeswax and coconut oil provided structural stability, while Bhimseni Camphor contributed antiseptic and cooling effects. Purified carbon soot served as a safe and effective pigment and therapeutic agent, unlike commercial kajals contaminated with heavy metals. Free from lead, sulfates, and synthetic colors, this Anjana represents a safe and reliable alternative to conventional kajals.Triphala Ghṛita was confirmed to contain gallic acid and other antioxidants, correlating its classical rasāyana properties with modern antioxidant and anti-inflammatory actions. The lipid base enhances ocular penetration, supporting its use in Timira and eye fatigue. HPTLC analysis showed a distinct band at Rf 0.30–0.34 under UV light (254 nm, 366 nm) and white light, matching the gallic acid standard. On derivatization with ferric chloride, bluish-black bands further validated the presence of gallic acid in the sample.

XRD analysis of *Mukta Piṣṭi* showed intense peaks at 2θ ≈ 26.2°, 27.2°, 33.1°, 45.9°, and 50.1°, confirming the crystalline aragonite and calcite polymorphs of $CaCO_3$. The Scherrer equation estimated an average crystallite size of ~65–80 nm, and the absence of extraneous peaks indicated high phase purity. Peaks at ~29.4° (104), ~35.9°, ~39°, and ~43° matched standard calcite reflections, consistent with the natural composition of pearls. FTIR spectra revealed characteristic carbonate peaks at 711, 858, 1082, and 1440 cm^{-1}, confirming $CaCO_3$ presence, while a minor peak at 1782 cm^{-1} suggested trace organic components, likely from the Bhāvanā with rose water. Together, these analyses validate the composition and purity of *Mukta Piṣṭi* used in the formulation.

Particle Size Distribution: *Mukta Piṣṭi* exhibited a fine particle distribution suitable for therapeutic use. Fifty percent of single particles were below ~1.5 µm, and 90% were below ~2.5 µm, indicating most particles are in the nano to fine-micron range. Agglomerates had a d50 of ~3.3 µm, with 90% below

~5.95 µm. Overall, single particles ranged mostly from 700 nm to 2.5 µm, with occasional clusters up to ~6 µm, remaining within acceptable micronic limits.

Raman analysis of *Mukta Piṣṭi* showed characteristic calcium carbonate peaks, including a broad band near 1085 cm^{-1}. C–H vibrations at 2900–3100 cm^{-1} indicated organic content typical of natural pearls. The absence of sharp peaks suggests an amorphous or nanocrystalline structure, possibly influenced by the organic matrix from Bhāvanā.

Commercial kajal products often contain harmful substances like lead and parabens, raising safety concerns. In contrast, the prepared *Prasādana Anjana* is free from such toxins, as confirmed by pharmaceutical and instrumental evaluations. This formulation bridges consumer safety with Ayurvedic ophthalmology, validating classical wisdom through modern methods and providing a safe, effective, and innovative ocular preparation.

CONCLUSION

The innovative *Prasādana Anjana*, prepared with Mukta Piṣṭi and Triphala Ghṛita, demonstrated strong alignment between classical Ayurvedic principles and modern scientific validation. Pharmacologically, Mukta Piṣṭi contributed cooling and vision-promoting effects (drushti-prasādana, pitta-śāmaka), while Triphala Ghṛita provided antioxidant, rejuvenative, and chakṣhuṣya benefits. Supporting ingredients—beeswax, coconut oil, Bhimseni Camphor, and carbon soot enhanced stability, spreadability, and antimicrobial activity, resulting in a safe, homogeneous, and lead-free formulation. Classical processes of sodhana and bhāvanā were validated by particle size reduction and preservation of the aragonite crystalline phase.

Analytical evaluations confirmed smooth texture, uniform color, three-month stability, and nanoscale refinement of Mukta Piṣṭi, correlating with improved bioavailability. Instrumental studies further substantiated the formulation: DLS showed particle sizes in the nano to fine-micron range; XRD confirmed crystalline aragonite; FTIR and Raman revealed carbonate bands with minor organic components; carbon soot FTIR indicated safe oxygenated groups; and HPTLC verified gallic acid (11.88 µg/mL) in Triphala Ghṛita.

Overall, the formulation is stable, cooling, homogeneous, and consistent with classical *Prasādana Anjana* lakṣaṇas. These findings establish it as a safe, analytically validated, and instrumentally standardized Ayurvedic alternative to toxic commercial kajals, offering preventive, promotive, and therapeutic ocular benefits.

Future Scope: While the present study establishes the safety, stability, and analytical validation of the innovative *Prasādana Anjana*, further research is warranted to strengthen its clinical relevance. Extended stability testing under accelerated conditions can help determine long-term shelf life and storage requirements. Preclinical studies on ocular safety and irritation potential should precede well-designed clinical trials to evaluate efficacy in conditions such as eye strain, burning sensation, and early *timira* (incipient cataract). Comparative studies with commercial kajals may further highlight its safety advantages and consumer acceptability. In addition, advanced analytical approaches such as zeta potential analysis, SEM, and in-vitro antioxidant assays can provide deeper insights into its physicochemical and therapeutic profile. Such studies will bridge classical Ayurvedic wisdom with modern scientific evidence, ultimately paving the way for safe, evidence-based Ayurvedic ophthalmic care.

REFERENCES:

1. Shastri Ambikadutta. Sushrut Samhita Uttartantra Chapter 17 Verse 96-99 . Vol. 2. Chaukhambha Sanskrit Sansthan; 2018. 112 p.
2. Kicińska A, Kowalczyk M. Health risks from heavy metals in cosmetic products available in the online consumer market. Sci Rep [Internet]. 2025 Dec 1 [cited 2025 Aug 21];15(1). Available from: https://pubmed.ncbi.nlm.nih.gov/39747381
3. Baroi A, Siddique MAB, Akbor MA, Chowdhury FN, Jamil MAR, Uddin MK, et al. Exposure and health risks of metals in imported and local brands' lipsticks and eye pencils from Bangladesh. Environmental Science and Pollution Research [Internet]. 2023 Apr 1 [cited 2025 Aug 21];30(16):46222–33. Available from: https://pubmed.ncbi.nlm.nih.gov/36715797
4. Shastri Ambikadutta. Sushrut Sutrasthan Chaspter 21 Verse 10, Vol. 2. Varanasi: Chaukhambha Sanskrit Sansthan; 2018. 115 p.
5. Shastri Ambikadutta. Sushrut Samhita Uttartantra, Chapter 17 Verse 31. Vol. 2. Varanasi: Chaukhambha Sanskrit Sansthan; 2018. 79 p.
6. Shastri Ambikadutta, Sushrut Samhita Uttartantra Chapter 18 Verse 56 .Vol 2, 96 p .
7. Tripathi Bramhananda. Ashtang Hrudaya Uttartantra Chapter11 Verse 36. Chaukhambha Sanskrit Pratishthan, 2018. 956 p.
8. Mishra Siddhinandan, Bhaisajya Ratnavali, Vol. 1. Varanasi: Chaukhamba Sanskrit Pratishthan; 2019. 52–53 p.

9. Shastri K. A. Sushrut samhita part 1, Chapter 24 verse 19. Vol. 2. varanasi : Chaukhamba sanskrit sansthan ; 132 p.
10. El-Refi A, Gharib I, Abdul Fatah N. Pearls: a literature review. International Design Journal [Internet]. 2022 Jul 1 [cited 2025 Aug 23];12(4):243–51. Available from: https://www.researchgate.net/publication/361703780_Pearls_a_literature_review
11. Earl Lang Keshi Pearls. https://www.pearl-lang.com/pages/keshi-pearls.
12. Hänni HA. A short review of the use of "keshi" as a term to describe pearls.
13. Skmk H, Medhavini Sooriyaarachchi M. Pharmaceutical study of triphala ghrita with special reference to akshi tarpana [Internet]. Faculty of Indegeneous Medicine, University of Colombo, Rajagiriya, Sri Lanka; 2023. Available from: https://www.researchgate.net/publication/383952919
14. Mishra Siddhinand. Bhaisajya Ratnavali Chapter 64 Verse 89-93. Varanasi: Chaukhamba Surabharati Prakashan; 2005. 992 p.
15. Mishra Siddhinand. Bhaisajya Ratnavali Chapter 64 verse 240-255. Varanasi: Chaukhambha Surbharati Prakashan; 2005. 1008–1009 p.
16. Timmapur G, Fiaz S. Efficacy of Triphala Ghrita and Goghrita Manda Tarpana in the management of Shushkakshipaka w.s.r. to dry eye syndrome: An open labelled randomized comparative clinical trial. Ayu [Internet]. 2020 [cited 2025 Jul 22];41(1):52. Available from: https://pubmed.ncbi.nlm.nih.gov/34566385
17. Vaidya Tricumji Jadavji Acharya; Ayurveda Prakash Chapter 5 Verse 150 Ayurveda Granthamala
18. Shastri Kashinath, Rasa Tarangini, Chapter 23 Verse 67. Motilal Banarsidas International; 2012.
19. Tripathi Bramhananda, Ashtang Hrudaya Uttartantra Chapter 13 Verse 10-11. Varanasi: Chaukhamba Sanskrit Pratishthan; 2018.