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IMPORTANCE OF THERAPEUTIC USE OF PEARLS [MUKTA] IN AYURVEDA AND OTHER HEALTHCARE SYSTEMS FOR OPHTHALMIC AILMENTS- PREVENTIVE, PROMOTIVE AND CURATIVE ROLE: A REVIEW

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ABSTRACT

Background: Netra vyadhi (ocular disorders) are among the most significant health concerns due to increasing pollution, digital strain, and ageing. Ayurveda describes Mukta (pearl) and its processed forms (pishti, bhasma), prepared through classical purification and incineration, are traditionally indicated for Netra rogas (eye diseases) such as Abhishyanda, Timira, and Adhimantha, as a netrya (beneficial for eyes), pitta-shamaka (pacifying excess pitta), and rasayana (rejuvenative). In contemporary times, ocular health is threatened by oxidative stress, inflammation, and degenerative disorders.Mukta(Pearls), owing to their cooling, anti-inflammatory, antioxidant, and nourishing effects, play an important preventive, promotive, and curative role in ocular health.

Objective: To review and analyse the role of Mukta in classical Ayurvedic ophthalmology with classical references and modern evidence on the therapeutic potential of pearls in ophthalmology, highlighting their preventive, promotive, and curative applications.

Methods: A Narrative literature review was conducted from Ayurvedic classical texts including Sushruta Samhita, Charaka Samhita, Rasatarangini, Ashtanga Hridaya, Rasaratna Samucchaya, Bhaishajya Ratnavali, Sharngdhara Samhita), Ayurvedic Formulary of India, and contemporary pharmacological research as well as indexed journals (PubMed, Google Scholar, DHARA). Modern pharmacological studies on pearl-derived calcium carbonate nanoparticles and ocular applications were also analyzed.

Results: Mukta, described as Pitta-shamaka with sheeta veerya, Madhura rasa, and Laghu-Snigdha guṇa, supports ocular health by balancing Alochaka Pitta. Orally, Mukta Piṣhṭi with Kamdudha Rasa aids systemic Pitta-prashamana. In Kriyakalpa, it is used in Lekhana and Prasadana Anjana for curative and nourishing effects. Modern studies demonstrate pearl powder ($CaCO_3$ nanoparticles) has antioxidant, anti-inflammatory, and properties, explaining its promotive, curative, and preventive roles in ocular disorders. Cross-cultural use in Traditional Chinese Medicine and integration in formulations like Ratnavali Pearl Anjana further highlight its therapeutic relevance.

Conclusion: Mukta demonstrates dual promotive and curative roles in Netra Vyadhi, supported by classical Ayurvedic texts and emerging modern evidence. Bridging traditional knowledge with contemporary validation highlights its potential as an integrative ophthalmic therapeutic. Its preventive, promotive, and curative actions make it a valuable option in ocular care, warranting further clinical and pharmacological exploration.

Keywords: Mukta, Pearls, Netra Vyadhi, Mukta Pishti, Ayurvedic Ophthalmology, Anjana.

INTRODUCTION

Mukta(pearl) holds a significant place in Rasashastra, particularly in ratna varga and sudha varga (calcium group drugs)(1). Pearls are solid and luminous objects created by shelled mollusks. The mollusk's secretion, layered concentrically, called Nacre consists of conchiolin protein and calcium carbonate layers are called as calcite crystal layer(2). The ideal pearl is perfectly round and smooth, but many other shapes are available. The finest quality of natural pearls has been highly valued as gemstones and objects of beauty for many centuries.(3)Mukta's medicinal usage is well-documented, with various dosage forms such as Bhasma or Pishti. Shuddha mukta (purified pearls)

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is processed and converted into bhasma and pishti.(4)

Several synonyms that highlight its origin, appearance, and association with the moon includes Mukta, Mauktika, Shuktija, Muktaphala, Chandraratna, and Chandrapriya(5).

According to Ayurved Prakash, pearls (Mukta) are classified based on their natural sources. These include those obtained from Shukti (oyster shell), Shankha (conch shell) etc is believed to impart subtle variations in the qualities and potency of the pearl, with Muktashukti (oyster-derived) pearls being the most widely recognized and therapeutically valued(6).

Pearls can be divided into many types according to different ways, such as natural and artificial pearls with different genesis (Zhao, 1992). Seawater and freshwater pearls have different ecological environments, have different colours (Feng et al., 2005) and can be classified into nucleated and non-nucleated pearls.(7)

Identification of pearls in traditional practice can be done by rubbing a pearl lightly against a tooth used to detect this natural roughness and differentiate it from imitations. The lustre is distinctly pearly, contributing to its aesthetic and therapeutic appeal. They occur naturally in a range of colours, including white, pink, silver, cream, golden, green, blue, black, and yellow(3)

Mukta exhibits a hardness ranging from 2.5 to 4 on the Mohs scale, making it relatively soft and susceptible to surface damage, specific gravity typically falls within 2.66–2.78, varying with the source and form of the nucleus, whereas cultured pearls generally range from 2.72–2.78. In terms of toughness, Mukta is considered fair, being soft in nature and easily damaged by acids or prolonged exposure to skin oils(3).

Vision is central to human survival and communication with the external world. The Sushruta Samhita, Uttara Tantra Shaaya Tantra, presents a well-developed framework for ocular health, identifying seventy-six distinct types of Netra vyadhi (eye diseases) along with their etiology, pathogenesis, clinical features, and therapeutic approaches.These include Vartmagata Roga (eyelid disorders), Sandhigata Roga (canthi), Shuklagata Roga (sclera), Krishnagata Roga (cornea), Sarvagata Roga (entire eye), and Drishti Gata Roga (visual impairment.(8) Mukta (pearl) is particularly indicated in pitta-predominant eye disorders such as Abhishyanda (inflammatory conjunctivitis).Netra Daha (burning sensation), Kacha (incipient cataract), and Timira (progressive visual impairment). Pearls are described as netrya (eye-beneficial), pitta-shamana (pacifying pitta), chakshushya (vision-improving), and rasayana (rejuvenating)(9) Their therapeutic utility spans preventive, promotive, and curative domains of Netra Chikitsa.

The governing factor of visual perception is Aalochaka pitta, a subtype of pitta dosha localized in the eyes. Any disturbance of this pitta leads to ocular manifestations such as redness, burning sensation, pain, inflammation, and diminished vision. Therefore, drugs and therapies that pacify ocular pitta, provide cooling energy, and act as netrya are therefore especially valuable in managing ocular disorders(10). Mukta, with its sheeta virya (cool potency), pitta-shamaka (pitta pacifying), and netrya (eye nourishing) properties, directly supports the balance of alochaka pitta. This makes it particularly useful in pitta-dominant ocular diseases such as abhishyanda (inflammatory eye conditions), timira (incipient visual impairment), netra daha (burning of eyes), and rakta pitta (hemorrhagic eye disorders).

The management of netra vyadhi in Ayurveda rests upon several principles, including nidana parivarjana (elimination of causative factors), shamana (palliative measures), shodhana (detoxification therapies), and specialized local procedures known as netra kriyakalpa,including anjana, tarpana, putapaka, aschyotana, and bidalāka. Furthermore, Ayurveda emphasizes the use of chakshushya dravya (vision-promoting substances) and rasayana (rejuvenatives) for both prevention and treatment, reflecting its unique focus on preventive ophthalmology.(11)Mukta holds a significant role and is incorporated in several netra kriyakalpa preparations such as Churnānjanā, Bhadrōdaya Anjana, and Vaidurya Anjana suggests that the mukta is indicated in netra vyadhi in the form of anjan karma (herbal collyrium).

Among all kriyakalpas, anjana is regarded as the most effective for both prevention and management of eye disorders. It involves applying medicated preparations—gutika (pill), raskriya (extract), or churna (powder)—to the inner eyelid margin using a fingertip or anjana shalaka. Classical texts prescribe its daily use, especially Sauvīra Anjana (antimony sulphide) and Rasānjana (extract of Berberis aristata) with honey, to expel excess kapha and maintain visual clarity. Since the eye is dominated by pitta dosha or teja mahabhuta, balancing kapha through anjana supports both ocular health and disease prevention. (10)

Anjana(collyurium) is a medicinal preparation which is applied on the lower and inner margins of the eye. Its active principles may be transferred to the interior of the eye according to their hydrophilicity and lipophilicity, mainly through the conjunctiva and cornea by paracellular and transcellular pathways (12).Its suggested in *sushrut cikitsathan*,the regular application of anajana can promote the overall eye healh of an individual. “Anakthi Thi Anjanam” is the definition of Anjana

and the word root is "Anji" because it gives moving, cleaning and clarity to the eyes. These formulations illustrate the multifaceted role of Mukta in Netra Vyadhi, integrating local therapies (Anjana) with systemic support (Rasayana), consistent across authoritative Ayurvedic sources.

According to classical text of Sushruta Samhita Anjana is classified on the basis of its action, form, and composition. i.e, Lekhana (scraping and cleansing effect) useful in kaphaja vikaras, Ropana(wound healing and improves visual acuity) especially in pittaja vikaras, and Prasadana/Snehana(soothing, nourishing, and vision-purifying action), indicated in vataja vikaras.(13)

The dosage of anajana is on the basis of qualities (guṇa), it is divided into tikṣṇa (strong, penetrating) and mṛdu (mild, soothing) varieties, where tikṣṇa anjana is administered in smaller doses and mṛdu in nearly double quantity. (13)

Despite abundant classical mentions, modern clinical studies are sparse, and preparation standards vary widely, necessitating a review of both traditional indications and modern evidence.

MATERIAL AND METHODOLOGY

The present review draws on classical Ayurvedic literature including the Brihattrayi, Laghutrayi, Rasa Shastra texts, and Nighantu, alongside modern research databases such as PubMed, AYUSH Portal, and Google Scholar. The inclusion criteria focused on studies and textual references related to the use of pearls in ocular health, analytical evaluations of Mukta Pishti or Mukta Bhasma, and clinical trials involving Netra Vyadhi. Studies not involving ophthalmic applications or pearls processed without the prescribed Shodhana and Marana procedures were excluded.

2.1 Shodhana of Mukta:

Before therapeutic application, Mukta (pearl) undergoes Shodhana (purification) to remove impurities and ensure safe internal use. Although pearls do not contain active poisonous alkaloids, traditional purification methods are recommended to enhance their therapeutic efficacy and prevent any potential adverse effects. Classical Rasa Shastra texts describe Shodhana of Mukta using media such as Jayanti Patra Swarasa (juice of Sesbania grandiflora leaves), Agasti Patra Swarasa, or Churnodaka (lime-water). The process typically involves Swedana (sudation) in a Dola Yantra for three hours, ensuring complete cleansing and preparation of the pearl for medicinal formulations.(14)

2.2 Marana of Mukta

Following Shodhana, Mukta (purified pearl) undergoes Marana (calcination) to obtain its fine, bioavailable Bhasma form. The purified pearls are finely powdered in a mortar, and cow's milk or rose water is added to facilitate trituration, producing a smooth paste. This paste is then shaped into small Chakrikas (pellets) and dried. The dried Chakrikas are placed in earthen plates (Sharava Samputa), sealed, and subjected to incineration using a Laghu Puta (mild heating process). Generally, three consecutive Puta cycles are sufficient to yield the desired Mukta Bhasma, characterized by its fineness, smooth texture, and therapeutic potency (15)

2.3 Preparation of Mukta Piṣṭi

After Shodhana, pearls can also be processed into Piṣṭi form, which is considered a cooling and more sūkṣma (subtle) preparation compared to Bhasma. The purified Mukta is finely powdered using a mortar and pestle. This powder is then triturated (bhāvanā) with rose water (Gulāb Jal) continuously for several hours, often over 7–8 days, until a smooth, lustrous, and micronized paste is obtained. This paste is dried under shade to preserve its cooling properties and stored in airtight containers. Mukta Piṣṭi is valued for its quick assimilation, potent pitta-śāmaka effect, and application in ophthalmic as well as cardiac and neuroprotective therapies(4)

3. Classical references of mukta in netra vyadhi :

Pearls (Mukta) in Ayurvedic Samhitas: In Ayurvedic literature, pearls are consistently esteemed for their therapeutic value, particularly in ocular disorders.

- **Charaka Samhita**: Sauvirādi Cūrṇāñjana (Tri-marmiya Adhyaya, Ch. Chi. 26:250) includes Mukta Bhasma as a key netrya dravya (eye-beneficial substance), recognized for its cooling, pitta-pacifying, and vision-promoting properties.
- **Sushruta Samhita (Uttara Tantra)**: Mentions Mukta Piṣṭi in Prasādana Anjana, described as netrya, pitta-hara, and chakṣushya, particularly for Abhishyanda (conjunctivitis) and Adhimantha (glaucoma-like disorders), where it alleviates burning, redness, and visual disturbances. (16) (17)Refer table-1)
- **Ashtanga Hridaya (Vagbhata)**: Prescribes Mukta in formulations like Ratnanjana and Rasanjana Yogas for pitta-predominant eye diseases. In Timira Chikitsa, it is included in Churna Anjana (AH Uttara Tantra 13/22, 13/45, Table 1) and as Prasādana Anjana to enhance ocular clarity.
- **Rasatarangini**: Describes Mukta as netrya (eye-beneficial), dīpana (digestive stimulant), and daha-śamana (relieving burning). (12).
- In the **Sarangadhara Samhita** (Uttarakhaṇḍa, Adhyaya 13:119–120), Nayanāmṛtāñjana is described as an important ocular formulation,

while the **Bhaisajya Ratnavali** (Netrarogadhikara 123–127) records Nāgārjunāñjana as another classical preparation. Both formulations are also referenced in the Ayurvedic Formulary of India (AFI), underscoring their continued recognition and therapeutic relevance in traditional ophthalmic practice.

- **Rasaratna Samuccaya**: Attributes laghu (light), hima (cooling), and madhura (sweet) properties to Mukta, with actions like improving complexion, vision, and digestion (kanti–dṛṣṭi–agni–puṣṭikaraṇa. It also notes pearls in collyria (e.g., Dantavarti, Pravālādyanjana) for corneal ulcers and xerophthalmia, and recommends pearl necklaces for conditions like Murcha (syncope) and as cooling agents in summer.

3.1. Classical references on Mukta are described in Netra Vyadhi:

Across the Bṛuhat Samhitas-Charaka, Sushruta, and Vagbhata, along with Rasa texts, pearls are repeatedly emphasized as a therapeutic gem in netra rogas, valued for their pitta-shamana, netrya, and ropana (healing) properties, while also offering systemic benefits

Table no.02 References of Mukta in Netra Chikitsa mentioned in various Samhitas:

Classical Source	Form of Mukta Used	Indications in Netra Vyadhi	Formulation Type
Sushrut samhita (18)	Mukta Pishti, Mukta Bhasma	Preventive ocular health	Prasadan anana, Varti
Charak samhita(19)	Mukta powdered	Timir vyadhi	churnanjana
Ashatang hriday(20)	Mukta	Timir chikitsa	Anjana, varti
Rasaratna samuccaya(21)	Mukta bhasma	Netra roga, pittaja vikara	Anjana
Bhaishajyaratnavali(22) (Netraroga prakarana)	Mukta Pishti, Mukta bhasma	Abhishyanda, Timira, Raktapitta	Oral + Topical
Sharngadhara Samhita	Mukta with Ghrita	Burning eyes, Pittaja netra roga	Ghrita yoga
Rasatrangini	Mukta pishti	Promotive health	Mukta rasayana
Ayurvedic Formulary of India (AFI)(23)	Mukta Bhasma / Pishti	Ophthalmic disorders	Varti, Anjana

- **Charaka Samhita:**

In Charak Chikitsasthan Tri-marmiya Adhyaya mentions Sauviradi Churnanjana includes Mukta Bhasma as a key netrya dravya (eye-beneficial substance), recognized for its cooling, pitta-pacifying, and vision-promoting properties indicated in timir vyadhi.

Table No.03 Mukta Related To Anjana Mentioned In Charak Chikitsasthan Netra Vyadhi

Sr. no.	Name	formulations	Type	Ingredients	Indication	Reference
1	Sauviradi churnanjana n or varti (19)	Anjana	churnanjanan	Black Surma (Antimony), purified Tutia (Copper Sulphate), Suvarṇamakshika Bhasma (calcined Chalcopyrite), purified Manasheela (Realgar/Orpiment), Van-Kulathi (Horse gram), Mulethi (Licorice), Lauha Bhasma (calcined Iron), Mukta (pearls), and other gems like Vaidurya, Pushpanajana (White Surma/Zinc oxide), rock salt, boar's tusk, and Nirmali seeds.	Timir vyadhi	Charak chikitsa Sthan. 26: 250

- **Sushruta Samhita**

In Sushruta Samhita Uttartantra, Shalakyatantra mentions Mukta Pishti in Prasadana Anjana, described as netrya, pitta-hara, and chakshushya, particularly for Abhishyanda (conjunctivitis) and Adhimantha (glaucoma-like disorders), where it alleviates burning, redness, and visual disturbances (17)(24). Includes pearls in formulations for Netra Kriya Kalpa, highlighting its use in Anjana for vision enhancement and reduction of ocular irritation.

Table. No .04 Mukta Related To Anjana Mentioned In Sushruta Samhita Uttartantra: Netra Vyadhi:

Sr. No	Name	Type	Ingredients	Indication	Reference

1.	Prasadan anjanan (25)	Mukta pishti	Flowers of Meshashringi (Gymnema sylvestre) Sirish (Albizia lebbeck, dhava (Anogeissus latifolia Wall.) and Mukta (pearls), vaidurya (cat's eye), Srotaja/vidruma (Sphatikacrystal), samudraphena (foam), Manashila (Arsenic compound), and marich (Piper longum).	Nirmalikaran	Sushrut Samhita uttartantra. 17/ 96-97
2	Shreshtha churnanjanan (26)	Mukta	Nilotpala (blue lily flower), tamra (copper), shatakumbha (gold), and rajata (silver),ghrita (ghee), madhu (honey), taila (oil), madya (wine), vasa (muscle fat), and majja (bone marrow, sarvagandha dravyas (fragrant substances such as ela(Elettaria cardamom), karpura (camphor,) and chandana (sandalwood), draksha (grape juice), ikshu (sugarcane juice), triphala kwatha (decoction of Triphala), drugs of the sarivadi gana and utpaladi gana, mukta (pearl), sphatika (rock crystal), vidruma (coral), danta (elephant tusk), sphaṭika (rock crystal), vaidurya (beryl), shankha (conch shell), ashmana (stone), asana (wood of Pterocarpus marsupium), shatakumbha (gold), shringa (horn of animals), or rajata (silver).	Sarva netra vyadhi	Sushrut Samhita uttartantra. 18/85-93
3	Bhadrodaya Anjana (27)	Mukta	kushṭha (Saussurea lappa), chandana (Santalum album), ela (Elettaria cardamomum), tamala-patra (Cinnamomum tamala), anjana (collyrium base), flowers of meshashringi (gymnema sylvestre), tagara (Valeriana jatamansi), bharangi (Clerodendrum serratum), padma (lotus, Nelumbo nucifera), nagakeshara (Mesua ferrea), ushira (Vetiveria zizanioides), and bhallataka (Semecarpus anacardium),saptaratna (seven precious gems), kukkutanda-kapala (hen's eggshell), vibhitaka-majja (marrow of Terminalia bellirica) pippali (Piper longum), the best variety of tuttha (copper sulphate), daruharidra (Berberis aristata), pathya (Terminalia chebula), gorochana (yellow pigment obtained from cow bile in equal quantity, finely powdered. This combination constitutes Bhadrodaya Anjana.	Bhumipah (kings)	Sushrut Samhita uttartantra. 18/94-97
4	Vaidurya Anjana (16)	Mukta	Vaidurya (cat's eye/beryl), sphatika (alum), vidruma (coral), Mukta (pearl), shankha (conch), rajata (silver) or shatakumbha (gold), mishri(sugar), and madhu(honey).	Anjana karma shukti roga	Sushrut Samhita uttartantra. 10/15
5	Lekhyanjana (28)	Mukta	loha (powder/ash of metals like iron, gold, copper, etc.), dhatu (ores such as manasheela,haritala, gairika, lavaṇa (salts like saindhava, vida), ratna (gems like Mukta, vaidurya), danta (teeth/tusk), shrunga (horns), and drugs of the avasadana gaṇa (e.g., kasis). Kukktanda-kapala(eggshell), lasuna (garlic), kaṭutraya (three pungents), karanja beeja (Pongamia seeds), and ela (cardamom).	Arjuna nashaka	sushrut samhita uttartantra. 18/94-97
6	Shankhadyanjana (29)	Mukta	Equal parts of shankh (conch shell), samudraphena (cuttlefish bone/sea foam), samudra-maṇḍuki, sphaṭika (alum/rock crystal), kuruvinda (ruby), pravala (coral), ashmantak(ficus rumphii) vaidurya-pulaka (blue beryl), mukta (pearl), and powders of ayas (iron) and tamra (copper) and srotonjana.	All 5 types of arma-sirajala-sirapidika	sushrut samhita uttartantra. 15/ 25-28

- **Ashtanga Hridaya**

In Ashtanga Hridaya Uttartantra, Netra Chikitsa prescribes Mukta in formulations like Ratnanjana and Rasanjana Yogas for pitta-predominant eye diseases. In Timira Chikitsa, it is included in Churna

Anjana and as Prasadana Anjana to enhance ocular clarity.

Table.No.05 Mukta Related To Anjana Mentioned In Netra Vyadhi Ashtanga Hridaya Uttartantra Netra Chikitsa

Sr.no.	Preparation	Type	Ingredients	Indication	Reference
1	Danta varti (30)	Mukta	Danta (teeth) obtained from danti (elephant), varaha (boar), ushtra (camel), go (cow), ashva (horse), and khara (donkey), along with shankha (conch shell), mauktika (pearl), ambhodhi-phena (sea-foam/cuttlefish bone), and marich-padika (identified as a marine shell or mineral substance), are used in preparing danta-varti.	Kshat shukra	Ashtang Hruday uttartantra 11/33-34
2	Anjana (31)	Mukta	Ratna (precious stones), danta (teeth/tusks), shrunga (horns), dhatu (minerals), tryushna (the three pungents – pippali, marich, shunthi), truṭi (a mineral drug), karanja-beeja (seeds of Pongamia pinnata), and lasuna (garlic) are combined with other vrana- saadi bheshaja (wound-healing drugs) to prepare this añjana (collyrium). It is indicated as savarna-avrna-gambhira-tvak-stha-shukra-ghna useful in conditions with wounds or without wounds, deep-seated lesions, cutaneous afflictions, and disorders of shukra (semen).	Avran-savran shukra	Ashtang Hruday uttartantra 11/36
3	Churnanjana (32)	Mukta	tamra (copper), ayas (iron), roupya (silver), and kanchana (gold) in equal parts, sealed in a crucible, heated, and quenched seven times in rasa-skandha decoctions. The processed mass is then mixed with vaidurya (beryl), mukta (pearl), and shankha (conch shell) powders, and made into churnanjana(collyrium), which cures timira (ocular opacities).	Timir vyadhi	Ashtang Hruday uttartantra 13/20-22
4	Ratnanajana (33)	Mukta	All Ratna (precious gems), roupya (silver), sphatika (rock crystal), suvarna (gold), srotonjana (collyrium mineral), tamra (copper), shankha (conch shell), kucandana (red sandalwood), and lohita-gairika (red ochre) are combined into a churnanjana (powdered collyrium), which is effective in curing sarva-drik-aamaya (all eye disorders).	Sarva netra roga	Ashtang Hruday uttartantra 13/45
5	Varti Anjana (20)	Mukta	sariva (Hemidesmus indicus), padma (lotus), ushira (Vetiveria zizanioides), mukta (pearl), shabara-candana (wild sandalwood) , powdered collyrium (churnanajana) made with patra (Cinnamomum tamala leaves) and utpala (blue lotus). Another variety includes nagapuṣpa (Mesua ferrea), karpura (camphor), yashṭi (Glycyrrhiza glabra), suvarna-gairika (red ochre/yellow ochre).	Prashasta Anjana	Ashtang Hruday uttartantra 13/64-65

- **Rasa Ratna Samuccaya:**

In Rasa Ratna Samuccaya, Trayovinsho Adhyaya Mentions the details of the properties, grahya lakshana, and therapeutic actions of Mukta.

Table.No. 06: Ratna Samucchay, Trayovinsho Adhyaha

Sr. no.	Name	Type	Ingredients	Indication	Reference

1	**Nagadi varti**	Varti	Seesaa bhasm(lead ash), shuddh parad(purified mercury) aamalaki churna(emblica officinalis),Kapur(camphor) **Mukta (pearls**),ghrita(cow's ghee), pippali(piper nigrum), saindha namak(rock salt), shuddh rasanjana(Barbaris aristata) and Madhu(honey), tambuli patra swarasa (betel leaf juice)	Pitta abhishyanda Pitta adimantha ,	Rasaratnas amucchay 23/35
2	**Ekarins hangav arti**	**Vart i**	shuddha Parada (purified mercury), Nagabhasma (incinerated lead), shuddha Rasaut (purified extract of Berberis aristata), Pravalbhasma (incinerated coral), shuddha Kasisa (green vitriol, ferrous sulphate), Lodhra-churna (Symplocos racemosa bark powder), Tamra-bhasma (incinerated copper), Saptaparna-tvaka (Alstonia scholaris bark), shunthi (dry ginger, Zingiber officinale), Marica (black pepper, Piper nigrum), Pippali (long pepper, Piper longum), Gairika (hematite, red ochre), Saindhava (rock salt), Samudraphena (sea foam), Triphala , **Mukta-bhasma** (pearl calx), Muramamshi (Selinum vaginatum), Babul-cchāla (Acacia bark, Vachellia nilotica), the five salts (pañcalavaṇa: saindhava, sauvarchala, vida, audbhida, samudra), along with Aparajita (Clitoria ternatea), Dhattura-mula (Datura metel root), and Tamarind bark (Tamarindus indica).	Adhimantha, pilla roga	Rasaratna samuccha y 23/39-41

3.2 Formulations of Mukta in Ayurvedic Formulary of India (AFI) (Netra chikitsa)

The Ayurvedic Formulary of India (AFI) serves as an authoritative reference for standardized Ayurvedic formulations, ensuring uniformity in composition and preparation. For Netra Roga, AFI enlists several Anjana Kalpanas drawn from classical texts such as Bhaiṣajya Ratnavali and Sharangadhara Saṃhita.Formulations like Nayanamrutanjana and Nagarjunanajana are included for their proven efficacy in ocular disorders, reflecting the continued relevance of classical ophthalmic preparations in contemporary practice.

Medicines used externally for the eye come under the category of Varti, Netrabindu and Anjana.Varti are made by grinding the fine powders of the drugs with the fluids specified in the formula to form a soft paste. This is then made into thin sticks of about 2 centimeters in length and dried in shade. Netrabindu is prepared by dissolving the specified drugs in water or kashay and used as eye drops. Anjana are very fine powders of drugs to be applied with netra shalaka.

Table.No. 07 Ayurvedic Formulary Of India (AFI) Mukta Used As In Various Forms:

Sr.No.	Name	type	Reference
1	Nayanamrtanjana (34)	Anjana	Sarangadharasamhita, Uttarkhanda; Adhyaya 13 119-120
2	Nagarjunanjana (35)	anjana	Bhaisajyaratnavali, Netrarogadhikara 123-127

Table no. 08: Various Formulations of Mukta in AFI:

Sr.no	**Name (formulation)**	**Type of Mukta**	**dosage**	**Indication**
1	Kamadudha Rasa (Mukta -yukta) (36)	Mukta pishti	125mg-500mg	Twacha roga,rakta pitta, amlapitta
2	Kancanabhra rasa (37)	Mukta bhasma	As per physician	Kshaya slesamapittaja kasa; prameha; vataroga.
3	Javahara mohara (38)	Mukta pishti	125mg	Hrddaurbalya

4	Pravala pancamrta rasa (39)	Mukta bhasma	250mg	Anaha; gulma; udararoga; pliha roga; kasa; Svasa; agnimandya; ajima; grahani; atisara; hrdroga.
5	Brhat vangesvara rasa (40)	Mukta bhasma	125mg-259mg	Prameha; muttrakracchra; atisara; somaroga; pandu; dhatustha jvara; halimaka; raktapitta; grahani; ajamadosa; agnimandya; aruci.
6	Brahmi vati (41)	Mukta bhasma /pisti	125mg-250mg	Vata roga; sannipata jvara; apatantraka; aksepa; santatajvara; hrddaurbalya; bhrama; manoroga.
7	Mahatarunarka (42)	Mukta bhasma	250mg	Sannipata jvara.
8	Yakuti (43)	Mukta pishti	125mg	Hrdaurbalya; sannipata javara, svedadhikya.
9	Vasanta tilaka rasa (44)	Mukta bhasma	125-250mg	Kasa: vasa; pandu; ksaya; Stila; grahani; visa; prameha; hrdroga; jvara.
10	Svasa kasa cintamani rasa(45)	Mukta bhasma	250mg	Svasa; kasa.
11	Hiranya garbha pottali rasa (46)	Mukta bhasma	250mg	Mandagni; Grahani; Visamajvara; Gudankura (Arsa); Atisara; Svasa: kasa; pinasa; sotha; pandu; yakrtpliharoga.

Table No.09 Marketed Available Medicines Containing Mukta:

Product Name	Type (Form)	Key Pearl Ingredient	Other Key Ingredients	Main Indications / Benefits
Patanjali Divya Eyegrit Gold Tablets(47)	Oral Tablets	Mukta Shukti Pishti (Pearl Shell ash)	Amla, Bhringraj (and other herbal extracts)	Strengthens eye health; relieves inflammation; improves vision; preventive eye care (Apollo Pharmacy)

3.3 Modern Studies On Pearl and Pearl-Derived Preparations

Pearls are solid and luminous objects created by shelled mollusks. The mollusk's secretion, layered concentrically, called Nacre consists of conchiolin protein and calcium carbonate layers are called as calcite crystal layer.Pearls can be divided into many types according to different ways, such as natural and artificial pearls with different genesis. Seawater and freshwater pearls have different ecological environments, have different colours and can be classified into nucleated and non-nucleated pearls.(2)

Pearls can be divided into many types according to different ways, such as natural and artificial pearls with different genesis. Seawater and freshwater pearls have different ecological environments, have different colours and can be classified into nucleated and non-nucleated pearls.(7)

3.4 Traditional Chinese Medicine (TCM) Studies from Pubmed Source:

In Chinese medicine, pearls have long been valued for improving eyesight, treating ocular “nebula,” and calming the nerves

A study on pearl powder identified trace elements (Na, Mn, Se, Al, Cu) and essential amino acids (Aspartate, Glutamate), showing higher protein and metal ion content than shell nacre. These active components, including conchiolin (a 17-amino-acid protein), support wound healing, bone repair, and skin cell regeneration. Pearl powder’s benefits also extend to ocular therapy, traditionally used for inflammatory eye disorders, trauma, and visual weakness, linking historical evidence with modern biomedical applications.(48)

A total of 190 proteins were identified in freshwater pearl powder, with matrix proteins grouped into eight biomineralization-related categories, showing properties like wound healing, osteogenic, antioxidant, neuro-regulatory, skin-lightening, anti-inflammatory, anti-apoptotic, and immunomodulatory effects. These findings highlight the diversity of pearl proteins and the molecular basis of pearl powder’s therapeutic use in traditional Chinese medicine (TCM).(49)

Nacre, obtained from pearl, is recognized in Traditional Chinese Medicine (TCM) for its therapeutic effects on ocular disorders. Its hydrolysate contains bioactive mineral elements and amino acids that contribute to its pharmacological activity. Previous studies using a chick form-deprivation myopia (FDM) model demonstrated that nacre can modulate axial elongation of the eyeball, assessed through Abbe’s comparator and A-mode ultrasonography. Experimental findings also

indicate its role in regulating oxidative stress and nitric oxide pathways by influencing superoxide dismutase (SOD), nitric oxide synthase (NOS), and nitric oxide (NO) levels in the retina–pigment epithelium–choroid complex. Collectively, these results support the traditional application of nacre in eye diseases and suggest its potential value in the prevention and management of myopia.(50)

Although none of these current studies focus exclusively on ophthalmic clinical trials, their findings on tissue regeneration, antioxidant effects, and eye-specific pharmacological traditions provide a compelling foundation for future ocular research involving Mukta

Seawater pearl powder (SPP) was studied for its effects on UV-induced photoaging in mice. Protein and trace elements were identified using LC-MS, AFS, and ICP-AES. SPP reduced melanin by inhibiting tyrosinase and scavenging excess ROS, suggesting its potential as a cost-effective treatment for photoaged skin, with an optimal concentration of 100 mg/g.(51)

This study evaluated calcium bioavailability of pearl powder in healthy adults. Nanonized pearl powder (NPP) showed superior absorption and retention compared to micronized pearl powder (MPP), with faster serum calcium rise, greater iPTH reduction, and higher calcium concentration. Thus, pearl powder is a beneficial calcium source, and nanonization enhances its bioavailability.(52)

Subjects taking pearl powder showed significant increases ($p < 0.05$) in antioxidant capacity (0.45 to 0.69 mM), thiols (0.23 to 0.29 mM), glutathione (5.89 to 9.19 mM), and enzyme activity (SOD-1248 to 1308; Gpx-30 to 32; GR-2.4 to 2.9), while reducing lipid peroxidation from 4.95 to 3.27 mM. In vitro and in vivo tests indicated pearl powder's protein extract is a potent antioxidant that extends C. elegans lifespan, suggesting its potential for treating age-related degenerative disorders.(53)

Sleep deprivation can imitate cognitive decline caused by insomnia through altered protein expression in the hippocampus; such behavioral and pathological changes can be significantly improved by pearl powder.(54)

SEM studies revealed that in raw and purified materials the particles were found scattered and unevenly arranged in the range of 718.7–214.7 nm while in final product, uniformly arranged, stable, rod-shaped, and rounded particles with more agglomerates were observed in the range of 279.2–79.93 nm. EDAX analysis revealed calcium as a major ingredient in MB (average 46.32%) which increased gradually in the stages of processing (raw 34.11%, odhita 37.5%)(56)

Pearls, long valued as the “queen of jewels,” are now primarily produced through cultured methods, with China contributing over 98% of global output, largely from freshwater sources. Japan remains the leading producer of high-value marine pearls, while Chinese production is characterized by high volume but lower market value. Despite technological advances, global pearl production has declined significantly in the past decade, reflecting industry challenges. Cultured pearl farming is a complex, long-cycle process with economic risks, emphasizing the need for sustainable management practices to ensure future growth and stability of the pearling industry.(57)

This paper reviewed natural and cultured pearl formation, with emphasis on cultured pearls that closely mimic natural ones and dominate modern jewelry manufacturing. Various pearl types and enhancement treatments were also discussed, highlighting methods to improve luster, correct flaws, and modify color. Future research should focus on tracing the evolution of pearl jewelry design to inspire innovative approaches that can strengthen competitiveness in today’s rapidly changing jewelry market.(58)

Physicochemical analysis of mukta pishti revealed particle sizes ranging from 0.1–30 μm with elemental composition including oxygen, calcium, silica, carbon, phosphorus, and sodium. FTIR confirmed the presence of aragonite crystals capable of binding gastric mucin. While Mukta pishti modulated gastric pH in a simulated digestion model without altering gastric content or acidity in vivo, it significantly reduced ulcer index and protected against epithelial damage, hemorrhage, and edema in the pylorus ligation model.(48

4. Modern Evidence on Mukta (Pearl) In Eye Care

Mukta pishti is used as therapeutic medicine against hyperacidity, irritable bowel syndrome, and gastric ulcers.Anti-ulcerogenic activity. MKP alleviated peptic ulcer induced by pylorus ligation in the male Wistar rats.(59)

polyherbal formulation ,Pearl (Mukta Shukhti Pishti), and coral calcium (Praval pishti).on memory acquisition and retention was studied using passive avoidance learning and elevated plus maze model (EPM) in rats.(55)

5. Traditional chinese medicine (tcm) studies from pub-med source:

In Chinese medicine, pearls have long been valued for improving eyesight, treating ocular “nebula,” and calming the nerves.

BetweenAD 907–960, Chinese texts documented pearls in ocular therapy. YaoXingLun noted their use for cataracts and phlegm, while HaiYaoBenCao emphasized eyesight improvement. **Pearl-yielding mollusks were linked to eye benefits**: Pteria martensii for red eyes, trauma, and weak vision; Hyriopsis cumingii for red eyes; and Cristaria

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6. Pharmacological & Analytical Perspective

The TEM photomicrograph of Mukta was done showed 20-100nm particles in the sample. This leads to increase in dissolution of drug and rapid absorption. Mukta are having good dissolution rate and smaller particle size make the drug in bio assimilable form so it is easily and readily absorb in body (60)

SEM studies revealed that in raw and purified materials the particles were found scattered and unevenly arranged in the range of 718.7–214.7 nm while in final product, uniformly arranged, stable, rod-shaped, and rounded particles with more agglomerates were observed in the range of 279.2–79.93 nm. EDAX analysis revealed calcium as a major ingredient in MB (average 46.32%) which increased gradually in the stages of processing (raw 34.11%, Śodhita 37.5%)(56)

Mukta Bhasma was found to contain 43.86% w/w calcium by AAS, while XRF analysis confirmed a calcium content of 45.07%. Physicochemical evaluation revealed loss on drying at 0.24% w/w, total ash 99.84% w/w, acid-insoluble ash 0.34% w/w, and water-soluble ash 8.31% w/w, with a specific gravity of 1.0185. TEM analysis showed particle sizes ranging from 20–100 nm. XRD confirmed the crystalline phase as calcium carbonate (calcite). XRF further detected major elements Ca (45.07%), O (41.52%), and C (12.44%), along with trace elements including Na, P, Si, Cl, S, Mn, Mg, K, Sr, Al, Fe, As, Cu, and Zr, indicating the complex elemental profile of Mukta Bhasma. (22)

6.1 Compositions

Pearls are primarily composed of **calcium carbonate ($CaCO_3$)** in the aragonite or vaterite crystalline form. The vast majority of natural and cultured pearls used in jewellery are found in bivalves and they have a nacreous surface which is entirely made out of aragoniteThey also contain trace elements such as magnesium, zinc, copper, silica, and amino acids that enhance their therapeutic efficacy.(61)It is a soft gemstone having all its properties given by nature. Its specific density is 2.65 to 2.89. Hardness is 3.5.(4)

6.2 Pharmacological Actions of Mukta

In Ayurveda, Mukta is described as having Madhura Rasa (sweet taste), Śīta Vīrya (cooling potency), and Laghu Guṇa (lightness). These attributes contribute to its capacity to pacify aggravated Pitta and Kapha doṣas, making it beneficial in conditions involving heat, inflammation, or excessive mucus. Its cooling nature supports ocular health, cardiac wellness, and mental calmness, aligning with its classical

designation as a pitta-śāmaka and netrya (eye tonic) agent.(15)

7. Role of Mukta (Pearls) in Traditional Ayurvedic Ophthalmology

Pearls (Mukta) have been extensively described in classical Ayurvedic texts for their role in maintaining and restoring ocular health. The Suśruta Saṃhitā recommends the use of pearl powder (Mukta Bhasma) in the treatment of conjunctivitis, corneal ulcers, and cataracts, as well as in Dantavarti Anjana, a medicinal collyrium designed to improve vision and reduce ocular inflammation (30). Similarly, the Caraka Saṃhitā mentions pearls in ocular therapies for vision enhancement and for pacifying aggravated Pitta, which is associated with burning sensations, redness, and eye inflammation.(19) The Rasatarangini emphasizes the use of pearls in Netra Rasayana (eye tonics) to enhance vision and prevent degenerative conditions such as night blindness and age-related weakening of eyesight. It also recommends their use in cooling eyewashes to relieve dryness (xerophthalmia) and irritation, highlighting their preventive, promotive, and curative potential in ophthalmic care. (9)

8. Nutritional and Rejuvenating Properties of Mukta

Pearl powder is rich in calcium and essential trace minerals, which contribute to strengthening ocular tissues and supporting overall eye health. The calcined form, Mukta Bhasma, is traditionally used as a Rasayana (rejuvenator) in Ayurveda, helping to prevent age-related vision deterioration and maintaining the vitality of ocular structures. Its mineral-rich composition, combined with rejuvenating properties, makes it a valuable therapeutic agent in both preventive and promotive eye care (46).

9. Treatment of Pitta-Related Eye Disorders

In Ayurveda, excess Pitta dosha is associated with various ocular disturbances such as redness, excessive watering, burning sensation, and blurred vision. Pearls (Mukta) are valued for their Sheetala (cooling) and Pitta-balancing properties, making them beneficial in managing these conditions. They are traditionally used in the treatment of glaucoma to help reduce intraocular pressure, in photophobia to alleviate sensitivity to light, and in conditions arising from eye strain, such as that caused by prolonged screen exposure. By pacifying aggravated Pitta, pearls help restore ocular homeostasis while providing soothing and rejuvenating effects.

10. Modern Ayurvedic Eye Formulations with Pearls

In contemporary Ayurvedic practice, pearls (Mukta) continue to be incorporated into a variety of ophthalmic formulations due to their cooling, rejuvenating, and Pitta-balancing properties. Mukta Piṣṭi is widely used in the management of eye infections, cataracts, and conditions associated with weak eyesight. Additionally,These formulations demonstrate the continued relevance of pearls in both preventive and curative eye care in modern Ayurvedic medicine.

DISCUSSION

The present review comprehensively highlights the importance of Mukta (pearl) as a therapeutic agent in Ayurvedic ophthalmology, emphasizing its preventive, promotive, and curative roles in Netra Vyadhi. Classical Ayurvedic literature consistently describes Mukta as a **netrya, chakshushya, pitta-shamaka,**and **rasayana dravya**, making it particularly relevant in ocular disorders dominated by Pitta doṣa. Disorders such as Abhishyanda, Timira, Adhimantha, Netra Daha, and Kacha—commonly associated with inflammation, burning sensation, redness, and visual impairment—are classical indications where Mukta is repeatedly advocated.

From an Ayurvedic pathophysiological perspective, **Alochaka Pitta** governs visual perception, and its vitiation leads to both functional and structural ocular disorders. Mukta, owing to its **Sheeta virya, Madhura rasa, and Laghu-Snigdha guna**, directly counteracts aggravated Pitta and stabilizes ocular physiology. Its incorporation in **Anjana, Varti, Ghrita yogas, and Rasayana formulations** reflects a well-integrated approach combining local Kriyākalpa with systemic support. Among Kriyakalpas, Anjana holds prime importance, and the repeated inclusion of Mukta in **Lekhana, Ropana, and Prasadana Anjana** across Sushruta Samhita, Ashtanga Hridaya, and Rasa texts indicates its versatility in addressing different stages and doṣic predominance of eye diseases.

The review also brings out the **preventive ophthalmology** aspect of Ayurveda, where Mukta is not limited to disease management but is advocated for maintaining **Netra Swasthya**. Regular use of Mukta-containing Rasayana and Anjana formulations is described to enhance ocular strength, clarity, and endurance, thereby delaying age-related degeneration and visual fatigue. This preventive role becomes especially significant in the modern context, where increased screen exposure, pollution, oxidative stress, and lifestyle-related factors contribute to early ocular morbidity.

Modern pharmacological and analytical studies provide a rational scientific basis for these classical claims. Pearl-derived preparations, particularly Mukta Pishti and Mukta Bhasma, are shown to possess nano-sized particles (20–100 nm), which enhances dissolution, bioavailability, and tissue assimilation. Calcium carbonate nanoparticles, along with trace elements and bioactive proteins

present in pearls, exhibit antioxidant, anti-inflammatory, cytoprotective, and tissue-healing properties. These effects correlate well with Ayurvedic concepts of Pitta-shamana, Ropana, and Rasayana, explaining Mukta's efficacy in inflammatory and degenerative ocular conditions.

Evidence from Traditional Chinese Medicine (TCM) further strengthens the cross-cultural therapeutic relevance of pearls. TCM literature and modern studies document the use of pearl powder and nacre in ocular inflammation, trauma, cataract-like conditions, and visual weakness. Experimental studies demonstrating regulation of oxidative stress markers, nitric oxide pathways, and retinal tissue protection offer mechanistic insights that align closely with Ayurvedic descriptions of Mukta as a cooling, stabilizing, and nourishing agent for the eyes.

Despite extensive classical references and promising experimental evidence, the review also identifies a gap in contemporary ophthalmic clinical trials specifically evaluating Mukta-based formulations. Variability in preparation methods, dosage forms, and lack of standardized clinical protocols remain limitations. However, the consistent mention of Mukta across authoritative texts, its inclusion in the Ayurvedic Formulary of India, and emerging nanopharmacological evidence collectively indicate strong therapeutic potential.

Overall, Mukta emerges as a unique integrative ophthalmic drug, offering a tri-dimensional role—preventive (rasayana and antioxidant action), promotive (netrya and chakshushya effect), and curative (anti-inflammatory and tissue-healing action). Bridging classical Ayurvedic wisdom with modern scientific validation not only supports its traditional use but also opens avenues for future clinical research and evidence-based integration of Mukta in contemporary eye care.

CONCLUSION

Classical Ayurvedic literature describes Mukta as Pitta-śāmaka owing to its Śīta vīrya, Madhura rasa, and Laghu-Snigdha guṇa, which help in balancing Alochaka Pitta responsible for visual perception. When administered orally, Mukta Piṣṭi in combination with Kamdudha Rasa exerts a synergistic effect on systemic Pitta-praśamana and contributes to ocular health. As a Netrīya (eye-nourishing) drug, Mukta is incorporated into numerous ophthalmic formulations such as Anjana, Varti, and other Netra-kalpana. Within Kriyākalpa procedures, Mukta is especially used in Anjana preparations—both as Lekhana Anjana (scraping type for eliminating morbid doṣas) and Prasādana Anjana (soothing type for nourishing and strengthening ocular tissues).

Modern studies validate these classical claims, showing that pearl powder ($CaCO_3$ nanoparticles) possesses antioxidant, anti-inflammatory, cytoprotective, and tissue-healing properties, which justify its ophthalmic applications. Thus, Mukta plays a promotive role by enhancing clarity and endurance of vision, a curative role in inflammatory, infectious, and degenerative ocular disorders, and a preventive role by delaying age-related ocular degeneration. Beyond Ayurveda, pearl powder has long been recognized in Traditional Chinese Medicine (TCM) as a classical remedy for ocular and systemic health, highlighting its cross-cultural relevance. Presently, several Ayurvedic eye-care formulations, such as Ratnavali Pearl Anjana, incorporate Mukta for its therapeutic as well as cosmetic benefits.

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