

Role of Copper in the Management of Eye Diseases in Ayurveda- A Narrative Review

Jeeja Sasi¹, Renjini R²

¹Associate professor, Department of Shalakyantra, Government Ayurveda Medical College, Thiruvananthapuram, Kerala, India.

²MS scholar, Department of Shalakyantra, Government Ayurveda Medical College, Thiruvananthapuram, Kerala, India.

Abstract

Copper (Tamra) is one among the metals used in the treatment of many diseases in Ayurveda. In the management of eye diseases different local therapeutic procedures are there and Anjana (Collyrium) is one among them. More than 80 types of Anjana preparations are there in the texts. Many of them are Herbo mineral combinations. Several metals are incorporated in the formulation of Anjana, with Tamra being one among them. Tamra is known to promote ocular well-being. Hence tamra is selected for the present study. The objective of the review is to provide in depth evaluation of tamra's medicinal applications, its pharmacological characteristics and its clinical relevance in the context of various ocular conditions.

Keywords: Anjana, copper, netra roga, tamra

INTRODUCTION

Ayurveda, the ancient and time-tested medical science of India, is still a hidden treasure of knowledge. It has eight branches, Shalakya tantra¹ is the branch dealing with the disease effecting the area above the clavicle. Diseases of eye and its management is explained in detail in this branch. Being the most precious sense organ, preventive and therapeutic care of eye has got at-most importance in Ayurveda. Seven special local therapeutic procedures² (Netra kriyakrama) are there for the eye i.e. Seka, Aschyothana, Anjana, Pindi, Vidalaka, Tharpana and Putapaka. Anjana and Tharpana is indicated for swastha (healthy individuals) also.

Anjana³ (Collyrium) is the application of medicine in eye in the form of choorna, rasakriya or gudika. Detail description about the procedure, time, dose, site, indication, contraindication, benefits and pre and post procedures is there in the literature. As a part of daily routine (dinacharya) application of Souveranjana for 6 days followed by Rasanjana for 1 day is advised for the health and wellbeing of the eyes.

In the context of treatment of various eye diseases more than eighty types/formulations of collyrium is described in texts. Majority of them are Herbo-mineral combinations. In traditional system of Ayurveda, Tamra (copper) is recognized as a therapeutically significant metal with a broad spectrum of medicinal properties. Tamra holds special importance in the context of eye disorders, where it is traditionally described as netrya, beneficial for ocular health.

Materials and methods

MATERIALS

Literature of tamra is collected from RRS, RT, published compilation text books of Rasasastra, Copper containing formulations used in eye diseases collected from Ashtanga hridaya, Susrutha samhita, updated internet data

METHODS

Literature collected from different classical textbooks and data presented as:

Property of Tamra⁴

RASA – Tikta, Kashaya

GUNA – Laghu

VEERYA – Ushna

DOSHAGHNATA – Kaphapithahara

KARMA – Lekhana, Netrya

INDICATIONS – Kushta, Jatara ruk, Ama nasana , Sthoulyam, Durnama, Kshaya, Pandu.

Preparation of Tamra Bhasma

To prepare any metal or mineral for therapeutic use, specific processes such as Śodhana (purification) and Māraṇa (calcination) are essential. Śodhana helps in removing physical and chemical impurities, thereby reducing toxicity, minimizing side effects, and enhancing the potency of the drug. In the case of Tāmra (copper), it undergoes Sāmānya Śodhana (general purification), Viśeṣa Śodhana (special purification), Māraṇa, and Amṛtīkaraṇa to obtain Tāmra Bhasma (TB). Tāmra Bhasma⁴ is considered highly potent, with properties like Sāraka (purgative), Lekhana (scraping of excessive fat), Ropaṇa (wound healing), and Bṛmhaṇa (rejuvenating). It balances Kapha and Pitta doṣas and is beneficial in conditions such as Pariṇāma Śūla (peptic ulcer), Pāṇḍu (anemia), Udaraśūla (abdominal pain), Arśa (hemorrhoids), Kuṣṭha (skin disorders), and Śvāsa (dyspnea). However, the use of raw copper or improperly prepared TB can cause serious adverse effects including Vanti (vomiting), Mūrcchā (fainting), Bhrama (hallucination), Śūla (spasmodic pain), Dāha (burning sensation), Moha (delirium), Aruci (anorexia), and even Āyu-nāśa (death). Hence, proper preparation following classical methods and quality control standards is vital to ensure the safety and therapeutic efficacy of Tāmra Bhasma.

Śodhana

The purification of copper is carried out in two stages—Sāmānya Śodhana (general purification) and Viśeṣa Śodhana (specific purification). In Sāmānya Śodhana⁴, the procedure of Nirvapa (heating and quenching) is performed by repeatedly heating the copper until it becomes red-hot and then quenching it in different media such as Tila Taila (sesame oil), Takra (buttermilk), Gomūtra (cow's urine), Kañji (fermented gruel), and Kulattha Kvātha (decoction of horse gram). Each step is usually repeated seven times, which helps remove gross impurities and makes the copper ready for further purification. In Viśeṣa Śodhana⁴, the generally purified copper is subjected to Swedana (steaming) using a Dola Yantra. Here, the copper is tied in a cloth (Pottali), suspended in Gomūtra, and exposed to continuous heating for a fixed duration, typically around three hours. This process provides deeper detoxification and ensures that the copper is properly prepared for the next stage of processing, such as Māraṇa.

Marana⁴

Purified Parada (mercury) and Gandhaka (sulphur) are triturated with the juice of Jambira (lemon) to prepare a fine paste. This paste is applied over purified copper leaves (Tamra Patra), which are then placed

in a sealed earthen container (Sharava Samputa). The container is subjected to three successive incinerations (Putra), resulting in the preparation of Tamra Bhasma.

Amṛtīkaraṇa⁵

In this process, Sūraṇa Kanda (elephant foot yam), Śuddha Gandhaka (purified Sulfur), and Nimbū Svarasa (lime juice) are used. Tāmra Bhasma is first triturated with half its quantity of Śuddha Gandhaka in a mortar, followed by Bhāvanā with Nimbū Svarasa. The mixture is then dried under sunlight and placed inside a Sūraṇa Kanda. It is covered with a thick layer of cloth smeared with mud and again dried in sunlight. After this preparation, the material is subjected to Pūta. Once cooled, the product is removed, triturated well, and finally stored in an airtight glass container.

THIS IS TO BE USED IN SEVERAL FORMULATIONS

Tāmra-containing formulations, mainly used in the form of Añjana, are as follows:

In Ashtanga Hridaya Uttarasthana⁶

Vartmagata roga

- Pushpakasisadi anjana – pakshmasata
- Dwinisadi varti – kukoonaka

Sandigata roga

- Saindavadi anjana – pooyalasa

Krishnagata roga

- Tamalapatradi – sarva sukra
- Mahaneela gutika – sudha sukra

Drishtiroga

- Choornanjanā- timira
- Bhaskara churṇa- timira
- Ratnadi - timira
- Drakshadi gudika- rakṭaja timira

Sarvakshi

- Sandhavanjanā
- Ghoshadi moothi (vyoshadi moothi)
- Saindhava triphaladi varti
- Pushpakasisadi

In Susrutha Samhita⁷

- Sleshmabhishyanda – varti anjana prepared with sindhutha, hingu etc
- Rakṭhabhishyandha – lekhyanjanā
- Suklaroga – shireeshabeejadi
- Sasopha asopha akshipaka- anjana with sarpi, saindhava, tamra, sthanya
- Pooyalasa – kasisadi anjana
- Arma- choornjanā prepared with sankha, samudra phena, manduki etc

- Drishti roga- prasadartha anjana
 - It is also mentioned in lekhana putapaka dravya
 - In the context of Anjana (kriyakalpa) - manasila devakashtadi and kamsyadi anjana
- The above formulations can be grouped into two based on the expected therapeutic effect i.e. first one for anti-inflammatory, antimicrobial or analgesic action and the second group for the improvement of vision as follows:
1. Anti-inflammatory, analgesic or antimicrobial action - For anterior segment diseases (vartma, sandhi and krishna gata roga) and diseases effecting whole eye -sarvakshi roga
 2. To improve the vision in posterior segment disease- i.e. Drishtigata roga

Table 1- Tamra containing formulations in AH, for anterior and posterior segment diseases

Sl No.	Anterior segment diseases	Posterior segment diseases
1	Pushpakasisadi anjana	Choornanjanana
2	Dwinisadi varti	Bhaskara churna
3	Saindavadi Anjana	Ratnadi
4	Tamalapatradi	Drakshadi gudika
5	Mahaneela gutika	
6	Sandhavanjana	
7	Ghoshadi moothi	
8	Saindhava triphaladi varti	

COPPER IN HUMAN HEALTH AND VISION

Extensive literature review reveals the following facts about copper.

Copper is an essential trace element required for numerous physiological functions. It is absorbed primarily in the stomach, duodenum, and jejunum, and distributed throughout the body via the liver. Copper serves as a prosthetic group in several key enzymes and plays a vital role in bone marrow activity and neurological health.

Deficiency – systemic and ocular:

Clinical manifestations of copper deficiency are mainly haematological and neurological. Haematological features include leukopenia and various forms of anaemia (microcytic, normocytic, or macrocytic), while thrombocytopenia is relatively uncommon. Bone marrow findings may mimic myelodysplastic syndrome. Neurologically, deficiency⁸ can present as myelopathy or peripheral neuropathy resembling subacute combined degeneration. Although visual symptoms are less commonly reported, several studies describe optic nerve involvement, including optic neuritis, reduced visual acuity, progressive optic neuropathy, and even acute blindness. Experimental studies in animals have also shown decreased myelination of optic nerves in copper deficiency, suggesting that ocular pathology may occur independently of gastrointestinal surgery.

Role of copper in vision:

Copper is critical for retinal antioxidant defense. The retina contains three types of superoxide dismutase (SOD) isoenzymes: Cu, Zn-SOD⁹ in the cytosol, Mn-SOD in the mitochondrial matrix, and extracellular SOD in tissues. Among these, Cu, Zn-SOD is the most abundant in the human retina. Deficiency of this enzyme may accelerate age-related retinal changes. Copper deficiency also reduces ceruloplasmin, a ferroxidase with antioxidant properties, thereby lowering the eye's defence against oxidative stress.

Copper deficiency and Age-Related Macular Degeneration (ARMD):

Bharathselvi et al. found a negative correlation between plasma copper and homocysteine or homocysteine-thiolactone in patients with ARMD⁸, suggesting that copper deficiency may contribute to its pathogenesis, partly due to inhibition of Cu-dependent enzymes such as Cu, Zn-SOD. The Age-Related Eye Disease Study (AREDS) evaluated 3,640 individuals over 55 years of age for more than six years and showed that zinc and antioxidants (with zinc) reduced the risk of progression to advanced ARMD. Although zinc was emphasized in these reports, supplementation always included copper. Thus, it remains possible that copper, rather than zinc, provided significant benefit.

Ocular absorption

The ocular absorption of copper nanoparticles¹⁰ is complex, as the eyes has significant natural barriers that can limit entry but do not fully prevent it. Studies show that copper nanoparticles can penetrate ocular tissues, primarily through cellular uptake via endocytosis, and can distribute throughout the eye.

Different studies have proved the following effects of copper

- **Antimicrobial Activity**

CuNPs (Copper Nano Particles) exhibit strong antibacterial, antifungal, and antiviral activity. Useful in treating or preventing infections like keratitis, conjunctivitis, and post-surgical infections. They disrupt microbial membranes and generate reactive oxygen species (ROS), killing pathogens.

- **Antioxidant & Anti-inflammatory Effects¹¹**

Copper is a cofactor for antioxidant enzymes (e.g., superoxide dismutase).

CuNPs can reduce oxidative stress in retinal cells, making them candidates for diseases like age-related macular degeneration (AMD) or diabetic retinopathy.

- **Wound Healing in Cornea¹²**

Copper ions stimulate angiogenesis and collagen cross-linking.

CuNPs incorporated into eye drops, hydrogels, or contact lenses can promote corneal epithelial repair after injury or surgery.

- **Drug Delivery Systems**

CuNPs can be surface-modified (e.g., with polymers, lipids, peptides) to improve biocompatibility. Used as carriers for sustained release of drugs in glaucoma, uveitis, or infections.

- **Nanocoating for Ocular Devices¹⁰**

CuNPs can be embedded in contact lenses, intraocular lenses (IOLs), or surgical implants to prevent biofilm formation and infection.

RESULT AND DISCUSSION

Tamra due to its tiktakashaya rasa, madhura vipaka and ushna virya is kaphapithapaha in nature. It is used as anjana form in pakshmasata, kukoonaka, suklaroga, puyalasa due to lekha and sophahara action.

Keeping medicines in tamra bhajana such as in mahaneela gutika to make the medicine more potent and sterile. Because copper have janthvanthakrith property- antibacterial and anti-microbial properties. Apart from anti-inflammatory, anti-bacterial action, copper shows anti-oxidant action. Because of this it is widely used as an ingredient in anjana yogas. Copper is necessary for visual cycle and photo receptor survival. It is also crucial for normal functioning of anti-oxidant enzymes. Studies shows its deficiency can leads to morphological changes in retinal structures and also causes decreased myelination. In our classical texts, it was mentioned that tamra is Netrya (good for eyes). Copper deficiency clearly contributes to hematological abnormalities, neuropathy, and optic nerve involvement, with potential implications for ARMD. Since nerve repair and remyelination are slow processes, timely diagnosis and supplementation are critical. Greater attention should be directed toward the role of copper deficiency and homocysteine metabolism in the pathogenesis of ARMD.

Copper containing anjanas mentioned in drishtiropa might have this action.

Researches into the ocular absorption of CuNPs indicates that their small size, surface charge and surface coating enables them to cross protective ocular barriers, although this process is complex and the absorption is typically low. Despite potential therapeutic benefits, such as treating retinal angiogenesis, CuNPs are highly toxic to ocular cells. All anjana yogas are combination of different drugs and their mode of preparation also differs. This may help to enhance its therapeutic action and reduce the toxic effect. The specific combinations mentioned for anterior segment disease may not cross the protective ocular barrier while those for drishti gata roga only might get absorbed through these barriers. All these facts are to be investigated scientifically.

CONCLUSION

By considering all the facts from different ayurvedic classical texts, it proves tamra can be useful in various eye diseases affecting different mandalas. It's mode of action in eye and ocular structures are supported by classic as well as modern scientific researchers.

But detail study of these anjanas is not available. So further research should be aimed at exploring the phytochemical screening and pharmacological action of these combinations, to know, what are the chemical changes happening to tamra when it combines with other ingredients of anjanas and how it affects ocular structures. It is only possible by integrative approach.

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