



## A Comprehensive Understanding of Gut-Eye Axis in Ayurveda

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### KEYWORDS

Gut, Eye, Ayurveda, Gut-eye axis, Agni, Ama

### ABSTRACT:

The association of the gut with various systems of the body especially through the gut-brain axis has been well studied. In the recent years, studies have established a possible relationship of the gut microbiome and the eye. Diseases such as Age-Related Macular Degeneration (ARMD), Diabetic Retinopathy, Uveitis, Glaucoma, Dry Eye Disease have been analyzed and the pathogenesis of these diseases are linked with the dysbiosis of the gut microbiome. In the view of this gut-eye axis, therapeutic interventions such as probiotics, prebiotics, fecal-microbiota transplantation are highlighted to address the gut microbiota in the treatment of eye disorders. Even though this concept of gut-eye axis has been recently stated, Ayurveda has always given importance to gut health. Changes in Agni (factor responsible for digestion and metabolism) and formation of Ama (metabolic toxins) are considered to be the root causes of all diseases, including Netra rogas (eye diseases). Treatment principle in Ayurveda starts with Deepana (Enhancing digestive fire) and Pachana (Enhancing digestion) in the view of eliminating the Ama and enhancing the Agni. Shodhana (Purificatory therapy) procedures such as Virechana (Therapeutic purgation), Vamana (Therapeutic emesis) and Basti (Medicated enema) have their action as gut cleansing and improving the gut health. Netra Kriyakalpas (Topical ophthalmic Ayurveda treatments) have a direct impact on the ocular surface microbiome. This review highlights the concepts of Agni and Ama and the possible understanding of Gut-Eye axis in Ayurveda.

### INTRODUCTION

Recent studies have established new associations of gut and its revelation of having not only digestive, but extra-digestive functions. The inter-relation of Gut and Eye was first put forth by Rowan, who studied the possible role of gut dysbiosis and the formation of retinal damages. <sup>[1]</sup> A healthy gut consists of several microorganisms which are responsible for a wide range of bodily functions. The gut microbiome is considered to be a dynamic ecosystem which is responsible for the regulation of immune system in the body and overall health, apart from digestion. <sup>[2,3]</sup> In the view of this, the gut-eye axis has been widely studied in the recent times and the pathogenesis of diseases such as Age-Related Macular Degeneration (ARMD), Diabetic Retinopathy, Uveitis, Glaucoma, Dry Eye Disease has been reinstated with the incorporation of the gut-eye axis. <sup>[4]</sup> In Ayurveda, *Agni* is viewed as the vital principle that upholds and maintains life. *Agni* is not a mere digestive influencer but it is the one responsible for *Ayu* (life), *Bala* (Strength), *Swasthya* (Overall health), *Upachaya* (Nourishment) and *Ojas* (Immunity). <sup>[5]</sup> Any derangement in the *Agni* can disrupt the normal metabolism and lead to diseases. <sup>[5,6]</sup> *Ama* is formed as a result of impaired *Jatharagni* (metabolic factors located in digestive tract), which is

regarded as the fundamental cause of various diseases in the body, including disorders of the eye. <sup>[7,8]</sup> This review aims to explore the concepts of *Agni* and *Ama* in the purview of Gut-Eye Axis and the possible understanding of Gut-Eye axis in *Ayurveda*.

**METHODS** – An elaborate data search was done in the classical Ayurveda textbooks, modern literature, public databases such as PubMed and Google Scholar. Recent Journals and studies conducted in relation to the topic were reviewed.

### RESULTS AND DISCUSSION

#### The Human Gut-Microbiome

Microbiota refers to the diverse community of microorganisms including bacteria, fungi, archaea, viruses, and protozoa, that reside within the gut. These have co-evolved with the host and exist in a symbiotic relationship. <sup>[9]</sup> The gut microbiome involves the various microbes along with their genes and the functions it exhibits. <sup>[10]</sup> It plays a critical role in maintaining the overall health of an individual by supporting digestion, metabolism, immunity, and mental well-being.



Table 1. Major functions of Gut microbiome [11,12,13,14]

Digestion and Metabolism	<ul style="list-style-type: none"> <li>• Breaks down complex carbohydrates, fibres, and proteins that the human body cannot digest on its own</li> <li>• Fermentation of dietary fibres by gut microbes produces short-chain fatty acids (SCFAs) such as butyrate, acetate, and propionate, which provide energy for colon cells and have anti-inflammatory effects</li> <li>• Plays a key role in the synthesis of Vitamins K and B</li> </ul>
Regulates Immunity	<ul style="list-style-type: none"> <li>• Gut microbes help regulate immune responses, preventing excessive inflammation while also protecting against pathogenic infections</li> <li>• The SCFAs activates the production of inflammatory cytokines</li> </ul>
Gut barrier structure	<ul style="list-style-type: none"> <li>• The gut microbiome is also responsible for maintaining the gut barrier integrity by reducing the metabolic endotoxemia</li> </ul>
Neurological	<ul style="list-style-type: none"> <li>• The gut is in connection with the brain through the enteric nervous system. Neurotransmitters such serotonin, dopamine are produced in the gut, which controls the mood, happiness and mental status of an individual</li> </ul>

### Gut Dysbiosis

In a healthy state, the gut microflora is well-balanced, where commensal and pathogenic bacteria coexist in harmony. The commensal bacteria dominate, helping to suppress pathogenic microbes and protect the host. Any imbalance or disruptions in the gut microflora causes overgrowth of pathogenic bacteria, leading to a condition called gut dysbiosis.<sup>[15]</sup> This microbial shift can exacerbate intestinal inflammation and compromise the

gut barrier function. Dysbiosis is predominantly caused by intake of high fatty foods, high sugar foods, prolonged antibiotic use, environmental pollutants and psychological stress.<sup>[16,17,18,19]</sup> Gut dysbiosis has been linked to several health issues, notably inflammatory bowel diseases (IBD) such as crohn's disease and ulcerative colitis; obesity, type 2 diabetes, rheumatoid arthritis and even mental health disorders. Emerging researches have suggested a possible relation of gut dysbiosis with the eye disorders such as Age-Related Macular Degeneration (ARMD), Diabetic Retinopathy, Uveitis, Glaucoma and Dry Eye Disease through the gut-eye axis.<sup>[2,20,21,22]</sup>

### Ocular Surface Microbiota

Much similar to the gut microbiota, recent studies have established the presence of Ocular Surface Microbiota (OSM). The OSM also includes microorganisms ranging from bacteria to fungi, that do not cause any infection or inflammatory response, but rather significantly contributes in maintaining the ocular surface homeostasis by modulating immune responses and providing a barrier against pathogenic invaders. Also, the presence of conjunctiva associated lymphoid tissue (CALT) acts as an additional line of defence mechanism.<sup>[23,24]</sup> Alterations in this microbial ecosystem have been associated with various ophthalmic conditions, such as dry eye disease, blepharitis, and keratitis. Certain studies also indicate a connection between gut dysbiosis and the composition of ocular surface microbiota. Any disbalance in the gut microflora can also affect the OSM leading to various ophthalmic diseases.<sup>[25,26]</sup>

### Role of *Agni* in Digestion and Metabolism

The term *Agni* according to *Brahmasutra* is said to indicate the presence of life in the body.<sup>[27]</sup> In *Ayurveda*, *Agni* is considered to be the body's metabolic fire or energy that is responsible for the digestion, assimilation, absorption and transformation of the ingested food into energy. It is the one that is responsible for the metabolic activities, maintaining the body's homeostasis and thereby sustaining life. *Agni* is the essential life force that governs an individual's overall health. Any derangement in the functioning of *Agni*, it leads to various diseases and can even lead to death.<sup>[28]</sup> Table 2. Enumerates the functions of *Agni* in relation with the Digestion and Metabolism.

Table 2. Functions of *Agni* in relation to Digestion and Metabolism [29,30,31]

Function	Understanding
<i>Dahana</i>	<ul style="list-style-type: none"> <li>• <i>Dahanam</i> <i>Dahah</i> (Burning, Combustion or Oxidation)</li> </ul>
<i>Pachana</i>	<ul style="list-style-type: none"> <li>• <i>Chaturvidha Annapana Pachati</i> (Digestion/Enzymatic reactions)</li> </ul>
<i>Bhinna Sanghata</i>	<ul style="list-style-type: none"> <li>• Breaking down/Disintegration</li> </ul>
<i>Tapana</i>	<ul style="list-style-type: none"> <li>• Production of Heat</li> </ul>
<i>Parivartana</i>	<ul style="list-style-type: none"> <li>• Transformation</li> </ul>
<i>Parinama</i>	<ul style="list-style-type: none"> <li>• Conversion</li> </ul>
<i>Vivechana</i>	<ul style="list-style-type: none"> <li>• <i>Vivechayati cha Dosha-rasa-mutra-Purishani</i> (Excretion of metabolic wastes)</li> </ul>

### Relation of *Agni* and *Pitta Dosha* with respect to *Netra*

According to *Acharya Charaka*, *Agni* is classified into 3 types, namely *Jatharagni*, *Bhutagni* (metabolic factors acting at the level of *Mahabhuta*) and *Dhatvagni* (metabolic factors acting at the level of *Dhatus* or tissues) [32]. According to *Acharya Sushruta*, *Agni* is considered as *Pitta Dosha* (fundamental bio-humor which regulates body temperature and metabolic activities). The qualities of *Agni* and *Pitta Dosha* closely resemble each other and cannot be distinguished. The production of heat and process of digestion is seen as a result of *Pitta*, which is considered as *Antaragni* (Digestive fire in the body) or *Agni* itself. *Acharya Sushruta* has classified *Agni* depending on the *Pitta Dosha* as – *Pachakagni* (*Agni* responsible for digestion), *Sadhakagni* (*Agni* responsible for Intelligence, Self-esteem), *Alochakagni* (*Agni* responsible for Visual perception), *Ranjakagni* (*Agni* responsible for assimilation) and *Brajakagni* (*Agni* responsible for complexion); out of which *Pachakagni* is responsible for the digestive functions and *Alochakagni* governs the function of vision. [33] Apart from the functions such as *Dahana* and *Pachana*, *Agni* is also responsible for *Darshana* (visual perception). The *Netra* (eye) is the primary site of *Pitta Dosha*. [34] Although *Netra* is *Panchabhoutika*, it is predominantly governed by *Agni Mahabhuta* (Fundamental element representing fire). [35] *Alochaka Pitta* (*Pitta Dosha* responsible for the functioning of eye) is further divided into two types - *Chakshur Vaisheshika*, which is responsible for visual perception, and *Bhuddhir Vaisheshika*, which manages

the interpretation and recollection of visual information [36]. Among the five types of *Pittas*, *Pachaka Pitta* (*Pitta Dosha* responsible for the digestion and metabolism) is regarded as the most important, as it nourishes and supports the functions of the other *Pitta Dosha* subtypes. [32,37]. Hence, any derangement in the *Pachakagni* or *Pachaka Pitta* will affect the *Alochaka Pitta* or *Alochakagni*, thereby causing *Netra Rogas*. [38] Table 3, Depicts the types of *Agni* and *Pitta* and their relation with *Mahastrotas* and *Netra*.

Table 3. Relation of the different types of *Agni* and *Pitta* with *Mahastrotas* and *Netra*

	<i>Mahastrotas</i> (Gastrointestinal Tract)	<i>Netra</i> (Eye)
<i>Agni</i>	<ul style="list-style-type: none"> <li>• <i>Jatharagni</i></li> <li>• <i>Bhutagni</i></li> <li>• <i>Dhatvagni</i></li> <li>• <i>Pachakagni</i></li> <li>• <i>Ranjakagni</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Alochakagni</i></li> </ul>
<i>Pitta</i>	<ul style="list-style-type: none"> <li>• <i>Pachakapitta</i></li> <li>• <i>Ranjakapitta</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Alochakapitta</i></li> </ul>

### Concept of *Kala*

*Kala* is described as the structure that separates the *Dhatu* (Body tissues) from the *Ashaya* (Body cavities). The *Ashaya* is the cavity that contains the *Dhatu*, while *Kala* serves as the lining of the *Ashaya*, acting as the interface between the *Dhatu* and its *Ashaya*. [39] *Acharya Sushruta* states that *Kala* is encircled by *Snayu* (Connective tissue elements) and covered by *Jarayu* (Membrane) and *Kapha* (Mucous or mucin). [40] By this description, *Kala* can be considered to be the mucous membrane or the epithelium. There are seven types of *Kala* and out of which, *Pittadhara Kala* (gastro-intestinal mucosa) and *Purishadhara Kala* (mucosa of colon and rectum) can be considered relevant to gastrointestinal tract.

*Pittadhara Kala* is described as that which is situated in between *Amashaya* (stomach) and *Pakwashaya* (large intestine). It is also considered as the *Sthana* (seat) of *Pachaka Pitta* and is involved in *Chaturvidha Annapana Pachana* (digestion and metabolism of solid, semi-solid, liquid and chewable type of foods). [41] Contemplating on terms of the modern science, *Pittadhara Kala* can be understood as the mucous



membrane lining the stomach and small intestine. It is at these sites where the food ingested undergoes digestion. Mucous membrane also plays an important role in digestion by secreting mucin that helps in binding of the food and acts as protective covering of the gut. [42]

*Purishadhara Kala* is said to be present in the *Antah Koshta* (within the alimentary canal), starting from the part of *Koshta* (digestive tract) associated with *Yakrit* (liver) and is spread throughout the *Koshta*. Its main function is *Mala Vibhajana* (breakdown and excretion of solid/ liquid waste), which specifically occurs in the *Undukastam* (Caecum). [43] *Purishadhara Kala* can be understood as the mucous membrane of the large

intestine which is involved in the elimination of the waste in the form of stools. [44]

#### Gut Microbiome, *Agni* and *Kala*

A healthy gut microbiome is important and necessary for the overall health of an individual. Similarly, in *Ayurveda* proper functioning of *Agni* is considered essential for the physiological status and development of an individual. *Kala* is the mucous membrane lining the stomach, small and large intestine involved in the digestive process. Table 4 shows the similarities in the functions of a normal gut microbiome, *Agni* and *Kala*. [45]

Table 4. Similarities in the Functions of Gut Microbiome, *Agni* and *Kala*

Factors	Gut Microbiome	<i>Agni</i>	<i>Kala</i>
Role in Digestion	Contains trillions of microbes producing enzymes and metabolites. Breaks down complex food substances via fermentation and enzymatic action	<i>Agni</i> is the digestive fire. Through the activities like <i>Dahana</i> , <i>Pachana</i> , <i>Bhinna Sanghata</i> , <i>Parivartana</i> and <i>Tapana</i> ; ensures proper digestion of ingested food	<i>Pittadhara Kala</i> is the <i>Sthana</i> of <i>Pachakagni</i> and Involved in <i>Anna – Pana Pachana</i>
Nutrient Absorption	Aids in the absorption of minerals and synthesizes essential vitamins	Ensures proper transformation of the food and absorption of sara (nutrient part) of food	<i>Pittadhara Kala</i> being the <i>Adhsthana</i> of <i>Agni</i> is also involved in functions of absorption of <i>Sara</i> . <i>Purishadhara Kala</i> is also involved in the separation of <i>Mala</i> , thereby assisting in the absorption of <i>Sara</i>
Immune System Support	Regulates the immune response, through the Gut-Associated Lymphoid Tissue (GALT).	Produces <i>Ojas</i> (essence of immunity and vitality)	<i>Pittadhara Kala</i> being the <i>Sthana</i> of <i>Pitta</i> , responsible for proper digestion and ultimately leading to the production of <i>Ojas</i>
Disease Prevention	Prevents pathogen overgrowth and chronic inflammation	Prevents formation of <i>Ama</i> which is the root cause of diseases	<i>Ama</i> is formed when the <i>Agni</i> is hampered. <i>Pachaka Pitta</i> which is a part of the <i>Pittadhara Kala</i> , which when functions properly, prevents <i>Ama</i> and thus the diseases
Mental Health Connection	Communicates with the brain via the gut-brain axis (neurotransmitters, vagus nerve)	Influences <i>Medha</i> , <i>Buddhi</i> , <i>Manas</i> (mental clarity, memory, and emotions)	<i>Agni</i> ( <i>Pachakagni</i> or <i>Pachaka Pitta</i> ), seated in the <i>Pittadhara Kala</i> has its effects on the <i>Manas</i> . If afflicted with <i>Shoka</i> (grief), <i>Krodha</i> (anger) etc, then <i>Agni</i> is hampered.



Waste Elimination	Assists in forming faeces. Metabolizes bile acids and toxins.	Helps in <i>Mala Utpatti</i> (formation of urine, stool, and sweat)	<i>Kala</i> is a structure which is covered with <i>Kapha</i> or <i>Mucin</i> which aids in digestion and elimination. Primary function of <i>Purishadhara Kala</i> is <i>Mala Vibhajana</i>
Response to Dietary Changes	Altered rapidly by food choices, fibre, polyphenols, prebiotics, etc.	Deeply affected by <i>Ahara</i> (food) quality, quantity, and timing	<i>Pittadhara Kala</i> is the <i>Sthana</i> of <i>Pachakagni</i> and hence change in <i>Ahara</i> affects the Digestion
Influence on Vitality	Healthy microbiome improves energy, metabolism, and supports the overall development of an individual	Balanced <i>Agni</i> maintains <i>Bala, Ojas</i> and longevity	Influences Digestion, Metabolism and Elimination of wastes and hence affects the overall health status

### Role of *Ama*

The term *Ama* literally refers to the undigested food material. [46] It is the unprocessed or undigested toxic metabolic waste that is formed as a result of impaired digestion or metabolism. Improper functioning of *Agni* is considered to be the cause of the formation of *Ama*. This *Ama* then acts as a percussor of the pathological activities in the body, ultimately leading to various diseases. [47]

### *Ama* and *Netra Vikaras*

*Netra Vikaras* are elaborately explained by our *Acharyas*. The *Nidana* (Causative factors) of the *Netra Vikaras* can be broadly classified under three categories – *Ahara* (dietary), *Vihara* (lifestyle-related) and *Manasika* (psychological). Even though there is no direct mentioning of *Ama* as a part of *Nidana*, the factors responsible for the causation of *Ama* and *Netra Vikaras*

are similar. This implies that *Ama Utpatti* (formation of metabolic toxins) invariably occurs in *Netra Vikaras* and vice-versa. *Acharyas* have also mentioned specific *Netra Sama* (Eye condition present along with *Ama*) and *Netra Nirama* (Eye condition present without *Ama*) *Lakshanas* (Symptoms). *Netra Sama Lakshanas* include *Udirna Vedana* (severe pain), *Raga* (redness), *Shotha* (swelling), *Gharsha* (irritation/foreign body sensation), *Nistodha* (pricking type of pain), *Ashru* (secretions or watering of the eye); while *Netra Nirama Lakshanas* include *Manda Vedana* (mild pain), *Kandu* (itching), *Prashanta Samrambha - Ashru* (mild swelling and reduced secretions) and *Prasanna Varnata* (clarity of vision and eye). [48,49] Analysing the patient for these *Lakshanas* will help the physician in understanding the *Roga* (disease) and in curating an appropriate treatment protocol that eliminates the root cause. Table 5 gives the similarities in the *Nidana* of *Ama Utpatti* and *Netra Vikaras*. [50, 51]

<i>Nidana</i>		<i>Ama</i>	<i>Netra Roga</i>
<i>Ahara</i> (Dietary factors)	<i>Atimatra/ Ati dravanna nishevanath</i> (intake of excessive quantity of food/ intake of excessive liquids)	✓	✓
	<i>Abhojana</i> (fasting or not taking food)	✓	✓
	<i>Vishamashanat</i> (untimely intake of food)	✓	-
	<i>Guru</i> (heavy), <i>Dushita</i> (contaminated), <i>Vishtambi</i> (foods having sticky- tenacious property, causing obstruction to body)	✓	-



	channels), <i>Vidahi</i> (foods that cause inflammation) <i>Ahara</i>		
	<i>Asatmya Ahara</i> (incompatible foods)	✓	-
	<i>Shukta aranala, Amla, Kulattha, Masha nishavanath</i> (intake of fermented foods, sour foods, horsegram, blackgram)	-	✓
<i>Viharaja</i> (Lifestyle factors)	<i>Veghadharana</i> (suppression of natural urges)	✓	✓
	<i>Ratrijagarana</i> (being awake in the night)	✓	✓
	<i>Diwaswapna</i> (sleeping in the daytime)	✓	✓
	<i>Vishamashayana</i> (sleeping in improper posture)	✓	✓
	<i>Dhumanishevana</i> (excessive exposure to smoke and pollutants)	-	✓
	<i>Atishigrayana</i> (travelling very fast)	-	✓
<i>Manasika</i> (Psychological factors)	<i>Irshya</i> (envy)	✓	-
	<i>Bhaya</i> (fear)	✓	-
	<i>Krodha</i> (anger)	✓	✓
	<i>Shoka</i> (grief)	✓	✓
	<i>Lobha</i> (greed)	✓	-
	<i>Moha</i> (temptation/delusion)	✓	-
	<i>Chinta</i> (worry)	✓	✓
	<i>Klesha</i> (distress)	-	✓
Others	<i>Vireca-Vamana-Sneha Basti Vibhramath</i> (improper administration of the purificatory therapies)	✓	-
	<i>Vamana Atiyogat</i> (excessive implementation of therapeutic emesis)	-	✓

### Gut dysbiosis and Concept of *Ama*

Studies have established the relevance of gut dysbiosis in the causation of various disorders ranging from those affecting the Gastro-intestinal tract, Metabolic disorders, Lifestyle disorders, Skin diseases, Eye diseases and as

well as those related to Central Nervous System. In *Ayurveda*, *Ama* is considered the root cause of almost all the diseases. In *Netra Vikaras* as well, *Ama* is associated and hence the treatment is also focused primarily on the elimination of the *Ama*. Table 6 gives an insight into the similarities of Gut dysbiosis and concept of *Ama*.

Factors	Gut Dysbiosis	<i>Ama</i>
Definition	Imbalance in the Gut microbiota	It is the undigested food or undigested metabolic toxic waste



Causative factors	Improper diet, Excessive use of antibiotics, Stress, Poor lifestyle, Environmental pollutants	Faulty diet and lifestyle, <i>Mandagni</i> , Stress
Effect On Digestion and Metabolism	Gut dysbiosis leads to leaky gut syndrome, impairing the nutrient absorption and further causing reduced metabolism	<i>Ama</i> causes <i>Strotorodha</i> (obstruction in the body vessels), impaired digestion. It affects the circulation and absorption of the <i>Ahara Rasa</i> (essence of food after digestion)
Release of Toxic substances	There is release of Pro-inflammatory metabolites, short chain fatty acids, Lipopolysaccharides and other endotoxins	<i>Ama</i> itself is a metabolic toxin. This <i>Ama</i> when sustained in the body for a prolonged period of time can lead <i>Ama Visha</i> (Highly toxic state, in which the <i>Ama</i> spreads quickly in the body)
Impact on Immunity	Gut dysbiosis triggers inflammation and causes imbalance in the immune regulation. It also induces autoimmunity	Presence of <i>Ama</i> impairs digestion, assimilation and thereby the production of <i>Ojas</i> , which is responsible for the immunity and vitality of an individual

### Hypothesis of Gut-Eye Axis

In recent years, numerous studies have explored the emerging concept of the gut-eye axis, highlighting the influence of gut health on ocular physiology and pathology. A growing body of evidence suggests that gut dysbiosis plays a pivotal role in the onset and progression of various ocular diseases. The hypothesis of the gut-eye axis proposes that unhealthy dietary habits, modern lifestyle factors and environmental pollutants contribute to gut dysbiosis, leading to increased intestinal permeability or leaky gut. This condition allows the translocation of endotoxins, inflammatory cytokines such as interleukins (IL), lipopolysaccharides (LPS), tumour necrosis factor (TNF), and pathogenic microbes into the systemic circulation. [52] Once in the bloodstream, these pro-inflammatory mediators contribute to systemic inflammation, which can compromise the integrity of the blood-retinal barrier (BRB) and alter the ocular surface microbiota, thereby contributing to the pathogenesis of ocular conditions [1, 53]. Dysbiosis also causes reduced production of short chain fatty acids (SCFA), which further triggers intestinal inflammation. Gut microbiome is also responsible for the regulation of stress levels, and hence dysbiosis leads to increased oxidative stress which has detrimental effect on the various parts of the eye including the retinal vessels [4,52,53,54,55]. Figure 1 depicts the schematic representation of the Gut-eye axis.

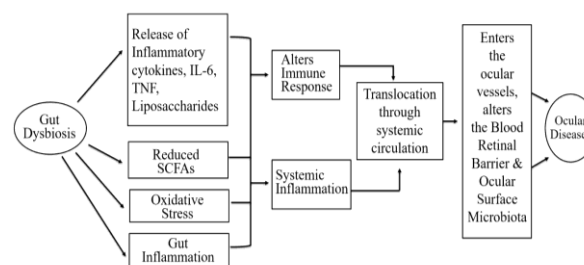


Figure 1. Schematic representation of the Gut-eye axis

### *Samanya Samprapti of Netra Rogas*

*Acharyas* have described in detail about the causative factors of *Netra Rogas* and as well as the *Samprapti* (pathogenesis). Indulgence in *Achakshushya Nidanans* (factors that are detrimental to eyes) and *Agni Dushtikara Nidanans* (factors that cause derangement in *Agni*) results in *Agnimandya* (reduced *Agni*), which subsequently leads to the formation of *Ama*. Consequently, *Dosha Dushti* (vitiation of body humors) and *Mala Sanchaya* (accumulation of metabolic waste) occur. Later the vitiated *Doshas* undergo *Urdhwagamana* (upward movement) through the *Siras* (body channels) towards the *Shiras* (head). The aggravated *Doshas* (fundamental body humors) eventually localize in different parts of the *Netra*, leading to the manifestation of *Netra Rogas*. [56,57] *Acharya Charkapani*, in *Vimanasthana*, while commenting on the types of *Vyadhi* (disease), explains *Amashaya Samuttha Vyadhi* (diseases originating from the stomach) and *Pakshawashaya Samuttha Vyadhi* (diseases originating from the intestine). Any disease that



occurs due to the *Pitta* and *Kapha Dushti* arises from *Amashaya* and any disease that occurs due to *Vata Dushti* will originate from *Pakwashaya*.<sup>[58]</sup> Figure 2 gives a schematic representation of the *Samprapti* of *Netra Rogas*.

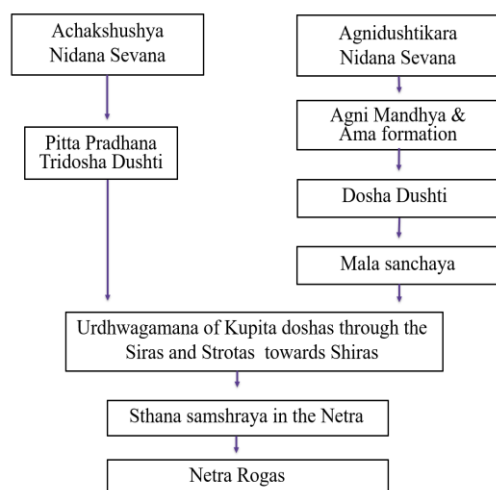


Figure 2. Schematic representation of the *Samprapti* of *Netra Rogas*

### Similarities between Gut-Eye Axis and *Samprapti* of *Netra Rogas*

A comparative analysis of the gut-eye axis theory and the *Samprapti* of *Netra Rogas* described in Ayurvedic texts reveals significant parallels. The modern concept of dysbiosis and the systemic spread of inflammatory mediators affecting the eyes can be correlated with the *Ayurvedic* understanding of *Ama* and aggravated *Doshas*, which, through *Vimarga Gamana* (abnormal movement), localize in the *Netra*. Once the *Doshas* reach the *Netra*, several *Netra Rogas* are produced. *Ayurveda* emphasizes that diseases occur due to the derangement in the *Tridoshas*, and that originates either from the *Amashaya* or *Pakwashaya*, indicating the pivotal role of the gut in disease development. This comparative understanding reinforces the foundational principles of *Ayurveda* and also affirms the relevance of gut health in maintaining ocular well-being.

### Treatment Aspects

The treatment modalities of gut-dysbiosis includes Probiotics, Prebiotics and Synbiotics. Intake of live microorganisms in appropriate quantities is Probiotic while Prebiotics are Carbohydrates that are not digestible, rich in fibre and act as food to the gut

microbes. Synbiotics are the combination of Prebiotics and Probiotics. Studies have shown that intake of these, help in regulating the gut inflammation and improve the gut health. Results are also seen in ocular conditions such as dry eye disease and uveitis.<sup>[4, 52, 25]</sup> Other treatment methodologies include Intermittent fasting and Faecal Microbiota Transplantation (FMT). Intermittent fasting is the restriction of food intake to certain number of times in a day; not taking food for a few days or alternate days. Researches in animals have shown it to reduce inflammation, reduce the oxidative stress and improving the gut-barrier integrity.<sup>[4]</sup> FMT is a procedure in which gut microbes are transferred from a healthy donor to a diseased recipient. This is done with an objective to establish the balance of the gut microbes and enhance the overall health of the individual. Studies have shown that FMT can regulate the ocular surface microbiota and alleviates dry eye. It has also shown to have its effect on retina by reducing retinal inflammations.<sup>[59]</sup>

In *Ayurveda*, the *Chikitsa* (therapeutic approach) primarily targets the elimination of *Ama*, enhancement of *Agni*, and re-establishment of *Dosha* equilibrium. The initial phase of *Ama* management involves *Nidana Parivarjana* (elimination of causative factors) and *Langhana* (therapies that cause lightness of the body).<sup>[60]</sup> Subsequently, the *Sama Dosha* is addressed through a sequential regimen comprising *Deepana* (appetite stimulation), *Pachana* (digestive stimulation), *Snehana* (oleation), *Swedana* (sudation), and ultimately *Shodhana Karma* (purificatory procedures).<sup>[61]</sup> Among the *Shodhana* therapies, *Virechana* (therapeutic purgation) and *Vamana* (therapeutic emesis) are employed to eliminate *Sama Doshas* localized in the *Koshta*. A study conducted in Japan demonstrated alterations in the gut microbiota of individuals following *Virechana* and *Basti* (medicated enema) procedures, alongside reported subjective improvement in clinical symptoms.<sup>[62]</sup> These findings suggest that *Shodhana Karma* exerts modulatory effects on the gut microbiome, thereby supporting its therapeutic potential in addressing gut dysbiosis.

Similarly, *Acharyas* have explained the first line of treatment for *Netra Vikaras* as *Langhana*. It should be followed for the first five nights of the disease presentation.<sup>[63]</sup> *Acharya Yogaratnakara* describes the *Chikitsa* for *Sama Netra Rogas*. This includes *Netra Seka* (eye irrigation therapy), *Langhana*, *Swadu – Tikta Bhojana* (intake of foods having sweet & bitter taste), *Lepa* (application of medicated pastes) and *Swedana*



*Karma*.<sup>[64]</sup> *Acharya Sushruta* has considered *Abhishyanda* (conjunctivitis) to be the root cause of all the *Netra Rogas*<sup>[65]</sup> and hence *Abhishyandavat Chikitsa* (treatment principles of *Abhishyanda* disease) should be employed initially and can be considered the general line of treatment. *Madhavakara* mentioned *Langhana*, *Alepana* (medicated paste application), *Swedana*, *Siravyadha* (bloodletting procedure), *Virechana*, *Anjana* (collyrium) and *Ascyotana* (instillation of medicated liquids to eyes) as the intervention for *Abhishyanda*.<sup>[66]</sup>

### Conclusion

The recognition of a connection between the gut and the eye has significantly expanded the understanding of disease pathogenesis and has shifted the focus of therapeutic approaches. Although concepts like the gut microbiome and gut dysbiosis are recent developments in modern science, these can be well interpreted within the framework of *Ayurveda*. Gut microbiome can be linked under the umbrella of *Agni* in *Ayurveda* while Gut Dysbiosis can be studied in the view of *Ama*. The similarities in the ideas of pathogenesis, only validates the precision of our *Acharyas*. *Ayurveda* with its focus on eliminating the root cause, has always propagated the importance of gut health. Hence, it can be concluded that the concepts of *Agni* and *Ama* can be taken into consideration to understand Gut-Eye axis in *Ayurveda*.

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