

RASAYANA PILLS IN CATARACT- AN INTEGRATION OF ANCIENT KNOWLEDGE AND SCIENTIFIC EVIDENCES

ABSTRACT

Introduction: Cataract is a principal cause of blindness in the world. Surgery, the major prevailing therapeutic approach for cataract is laced with various complications that include iris prolapse, raised intraocular pressure, infection, cystoid macular oedema and posterior capsular opacification. So world is looking towards more robust and natural ways to prevent cataract.

Aim: *Rasayana* therapy (specially *Caksusya Rasayana*) have been known to play an important role in prevention and cure of eye disorders. This manuscript intends to highlight hypothesis along with the scientific evidences in favour of role of *Rasayanas* in prevention and cure of cataract

Methodology: Extensive internet search and literature search related to Ayurvedic texts on *Rasayana* was conducted. Local Ayurveda experts were contacted to know about commonly used *Rasayana* preparations in cataract. Based on that, *Rasayana* components of these single preparations/polyherbal preparations were searched for their antioxidant, aldose reductase inhibitor and antiglycating activity.

Results: Metadata analysis and perusal of ancient texts on Ayurveda and scientific studies on the evidences in favour of some *Rasayanas* and some specific *Caksusya Rasayana* show ability of *Rasayana* to act as anticataract agents by acting through one or the other molecular mechanism. It is also important to note that some of these *Rasayanas* like *Yashthimadhu*, *Shunthi*, *Haridra*, *Amalaki*, *Tulsi*, *Pippali* and *Triphala Rasayana* are very common component of daily kitchen use and can be a better therapy for patient compliance.

Conclusion: From the metadata analysis it may be concluded that most of the *Rasayanas* possess antioxidant, antiglycating and aldose reductase inhibitory activity, either singly or simultaneously and thus they can prevent or revert changes responsible for cataract pathogenesis. So it is pertinent to mention here that use of *Rasayana* therapy have the potentials to work against the development of cataract and should be explored for scientific evidences for mechanism of action.

Keywords: *Antioxidants; Cataract; Free Radicals; Caksusya Rasayana*

1. INTRODUCTION

Cataract, a principal cause of blindness in the world is characterized by the clouding of the eye's natural lens, due to aggregation of proteins in the lens resulting in clouding of the lens and formation of cataract. According to most recent estimates by World Health Organization (WHO), 47.8% of global blindness is due to cataract whereas in India cataract is the principal cause of blindness accounting for 77.5% of blindness [1]. India is one of the signatories in a program "Vision 2020" for elimination of avoidable blindness that can occur due to numerous reasons like aging, infection in new born babies, injury or poor development prior to birth or during childhood or due to complications of various diseases like diabetes or on exposure to toxic substances like UV radiations and various drugs such as corticosteroids or diuretics. There is strong scientific evidence that free radicals and the oxidative stress play an important role in the pathogenesis of cataract [2].

In the early stages of the disease, optimal refractive management and advice on glare reduction can reduce the impact of cataract formation. Surgery is considered when these measures are no longer adequate for the patient's visual needs. The major therapeutic step that can be taken to cure cataract is surgery, but it has its own limitations. Significant intraoperative complications of phacoemulsification in experienced hands are rare. Early post-operative complications (iris prolapse, raised IOP and infection) and most common late complications are Cystoid Macular Oedema (CMO) and Posterior Capsular Opacification (PCO) [3]. So there is an urgent need of more robust and natural ways to prevent cataract. One of the important factors that can play a role in prevention of any and many diseases is the diet of people.

Rasayana chikitsa or rejuvenation (making young again) therapy is one of the traditional anti-cataract strategies in Ayurveda. However complete prevention or cure of cataract is possible only if anti-cataract therapy is applied before a critical age. *Rasayana* is one of the eight branches of Ayurveda

and are special herbs, fruits or any other form of medication that destroys the old age and disease through the conservation, transformation, and revitalization of energy. To live long and healthy life is the desire of every person, so the main aim of Ayurvedic rejuvenation therapy or *Rasayana* therapy is to restore spirit and attain longevity. It is also known to reverse the disease process and prevent re-occurrence. *Rasayana* therapy is used as a preventive therapy which replenishes the vital fluids of our body, thus keeping us away from diseases [4]. It is one of the important traditional therapies that implies *Caksusya Rasayana* for treatment and prevention of eye disorders. Further the '*caksusya-rasayana*' (preservation and promotion of ocular health) approach of Ayurveda certainly provide safe and clinically effective ophthalmic drugs having diversified effects may be judiciously used to tackle intractable problems of the eye. This manuscript intends to highlight hypothesis along with the scientific evidences in favour of role of commonly used *Rasayanas* that are inadvertently used in kitchen and other *Rasayanas* in prevention and cure of cataract.

2. MATERIALS

Extensive internet search and literature search related to Ayurvedic texts on *Rasayana* was conducted. Pathogenesis of cataract and role of *Rasayana* in various disorders was also reviewed. Local Ayurveda experts were contacted to know about commonly used *Rasayana* preparations in cataract. Based on that, *Rasayana* components of these single preparations/polyherbal preparations were searched for their antioxidant, aldose reductase inhibitor and antiglycating activity.

2.1 Pathogenesis of cataract

A cataract is a cloudy or opaque area in the lens of the eye that ultimately results in the loss of vision in people over the age of 40 years. The pathways involved in the pathogenesis of cataract are oxidative stress, non-enzymatic glycation and polyol pathway [2, 5, 6].

2.1.1 Oxidative Stress

Oxidative stress is the main cause involved in formation of cataract. On exposure to Reactive Oxygen Species (ROS) like peroxide, superoxide and hydroxyl radicals, UV radiations, smoking and other environment factors, the proteins of the eye lens undergo aggregation and post translational modifications [2]. Hydrogen peroxide (H_2O_2), which is derived from sources both inside and outside the lens, has been considered as the major oxidant in the pathogenesis of cataract. The healthy eye lens contains antioxidants like glutathione, ascorbate and catalase that protect lens proteins against ROS. Glutathione is one of the most important antioxidant found in eye lens. Reduced glutathione (GSH) reacts with ROS and is converted to its oxidized form (GSSG). GSH is restored through the action of the enzyme glutathione reductase (GR). H_2O_2 is eliminated by GSH, or through the action of the enzymes glutathione peroxidase and catalase. Although there is a protective mechanism in the eye lens, yet there is development of oxidative stress. It can occur when there is an imbalance between the production of Reactive Oxygen Species (ROS) and the cellular antioxidant defence mechanisms (protective mechanism). At the same time with increasing age, the activity of these defence mechanisms decreases resulting in protein aggregation and ultimately lens opacification and cataract.

2.1.2 Non Enzymatic Glycation

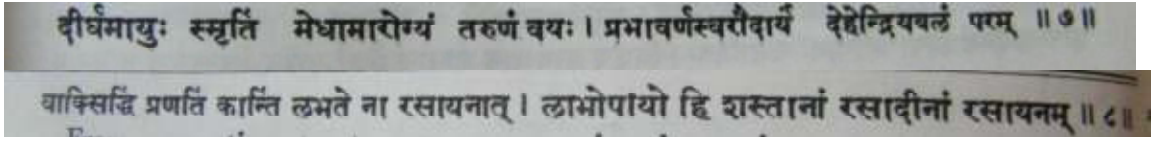
In hyperglycaemic conditions, the increased glucose levels in the aqueous humour may get attached to the lens proteins without the help of enzymes. This process is called non-enzymatic glycation, which leads to the formation of ketoamines termed as Amadori Products and further on oxidation gives rise to Advanced Glycation End products (AGEs) [5]. Accumulation of AGEs results in the generation of free radicals like superoxide radicals (O_2^-) and hydrogen peroxides (H_2O_2), which are involved in development of cataract.

2.1.3 Polyol Pathway

In diabetes, there is high concentration of glucose in the aqueous humour, which is passively transported into the lens. The enzyme Aldose Reductase (AR) catalyzes the conversion of glucose to sorbitol through the polyol pathway and it results in intracellular accumulation of sorbitol which further leads to osmotic changes resulting in degeneration of hydropic lens fibers, electrolyte imbalance and formation of cataracts [6].

2.2 Role of Rasayana in cataract

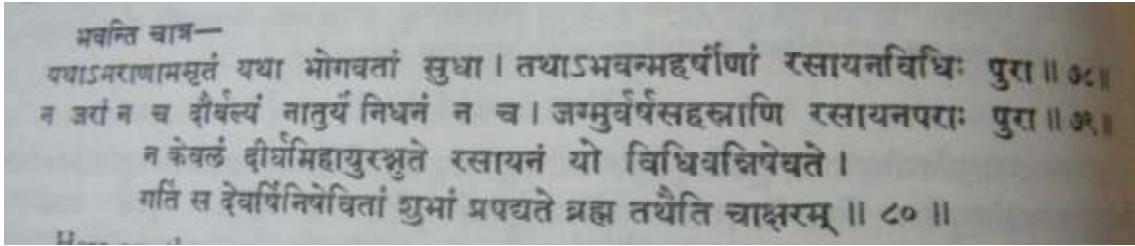
2.2.1 Definition of Rasayana [7]



*dirghamāyuh smṛtiṁ mēdhāmārōgyaṁ taruṇaṁ vayah|
prabhāvarṇasvaraudāryaṁ dēhēndriyabalaṁ param||7||
vāksiddhiṁ praṇatiṁ kāntiṁ labhatēnā rasāyanāt|
lābhōpāyō hi śastānāṁ rasādīnāṁ rasāyanam||8||*

The excerpts from Ayurveda demonstrate that with the application of Rasayana treatment, one attains longevity, memory, intelligence, freedom from disorders, youthful age, excellence of luster, complexion and voice, oratory, optimum strength of physique and sense organs, respectability and brilliance. It means the attaining the excellent Rasa etc.

2.2.2 Rasayana benefits as per Ayurveda [8]



*yathamranaamamritam yatha bhogvatam sudha!
Tathabhavnamharsheenam rasayanavidhi pura!!
Na jaram na ch daurbalyam naaturyam nidhanm na ch!
Jagmurvarshashasatraane rasaayanapraa pura!!
Na kewalam deeraghmehayurshrunte rasayanam yo vidhivatreshevate!
Gatim sa devarsheeneshevitam shubham prapdhate brahma tatheti chaaksharm!!*

The excerpts narrate that as was the nectar to the gods and ambrosia for the serpents, so was the Rasayana for the great sages in early times. The persons using Rasayana treatment in early ages lived very long life unaffected by old age, debility, illness and untimely death. One who uses the Rasayana treatment methodically attains not only long life but also the auspicious status enjoyed by the godly sages.

2.2.3 Theory and concept of Rasayana

In terms of Ayurveda, the physical structure consists of 7 dhatus i.e. Rasa (nutrition part of blood), Rakta (Blood cells), Mamsa (Muscles and Soft tissue), Medha (Lipids), Asthi (Bones and Cartilages), Majja (Marrow) and Sukra (Vital fluid). The word Rasayana consists of term 'rasa' which means nutrition part of blood and 'ayana' which means circulation and promotion or path. In other words Rasayana means nutrition and its transportation in the body. The main concept of Rasayana therapy is that according to Ayurveda, the health of all dhatus (tissues) of the body is influenced by the qualities of 'Rasa dhatu'. So any medication, which improves the quality of 'Rasa'(Rasayana) should strengthen the quality of all dhatus of the body and when the quality of all dhatus enhances or strengthens, it results in longevity, strong immune system to fight against diseases, development of body and youthfulness [9]. This therapy is normally recommended after 45 yrs of age, in both male and female. The Rasayana measures and remedies produce their effect at the level of Rasa by directly acting as a nutrient by promoting nutrient value of plasma, at the level of Agni by promoting biofire system responsible for digestion and metabolism or at the level of Srotas by promoting

microcirculation and tissue perfusion. Other than the above mentioned modes of action, most of the *Rasayanas* exhibit specific action on various organs and tissues and thus they are used for specific indications like *Medhya Rasayana* as brain tonic, *Hrdya Rasayana* as cardiotonic, *Twacya Rasayana* as skin tonic, *Kesya Rasayana* as hair tonic, *Caksusya Rasayana* as eye tonic etc.

2.3.4 Mechanism of action of Rasayana

It has been studied that generation of free radicals and oxidative stress are involved in pathogenesis of cataract. Free radicals (electrically charged molecules) attack lens cells, cross through cell membranes to react with the nucleic acids, proteins, and enzymes present in the lens. This attack by free radicals is known as oxidative stress, causing cells to lose their structure, function and ultimately destroy them. Free radicals are continuously produced by our body's use of oxygen such as in respiration and some cell-mediated immune functions. They are also generated on an exposure to toxic substances, environmental pollutants, smoke, automobile exhaust, radiations etc. Normally, a balance exists between the amount of free radicals generated in the body and the antioxidant defence systems, which scavenge free radicals, preventing them to cause hazardous effects in the eye lens. However with age, there is decrease in the activity of antioxidant defence systems leading to oxidative stress and subsequent disease development.

Rasayanas are rejuvenating agents, nutritional supplements and possess strong antioxidant activity. They exhibit antagonistic actions on the oxidative stressors and thus prevent formation of different free radicals. They have been found to be a rich source of antioxidants [10]. It has been reported that antioxidant activity of any '*Rasayana*' is 1000 times more potent than ascorbic acid, α -tocopherol and probucol [11]. *Rasayanas* act as preventive antioxidants, attempt to stop formation of ROS [12], scavenge free radicals [13], repair and reconstitute through repair enzymes [14].

2.3.5 Rasayanas beneficial role in cataract

It is evident from literature that formation of free radicals plays important role in development of cataract [2]. Therefore, antioxidants are used as a preventive measure in cataract. As it has been discussed earlier that *Rasayanas* has potent antioxidant activity, so it can prove beneficial in cataract. Different *Rasayanas* which exhibit anticataract activity has been enlisted in Figure 1.

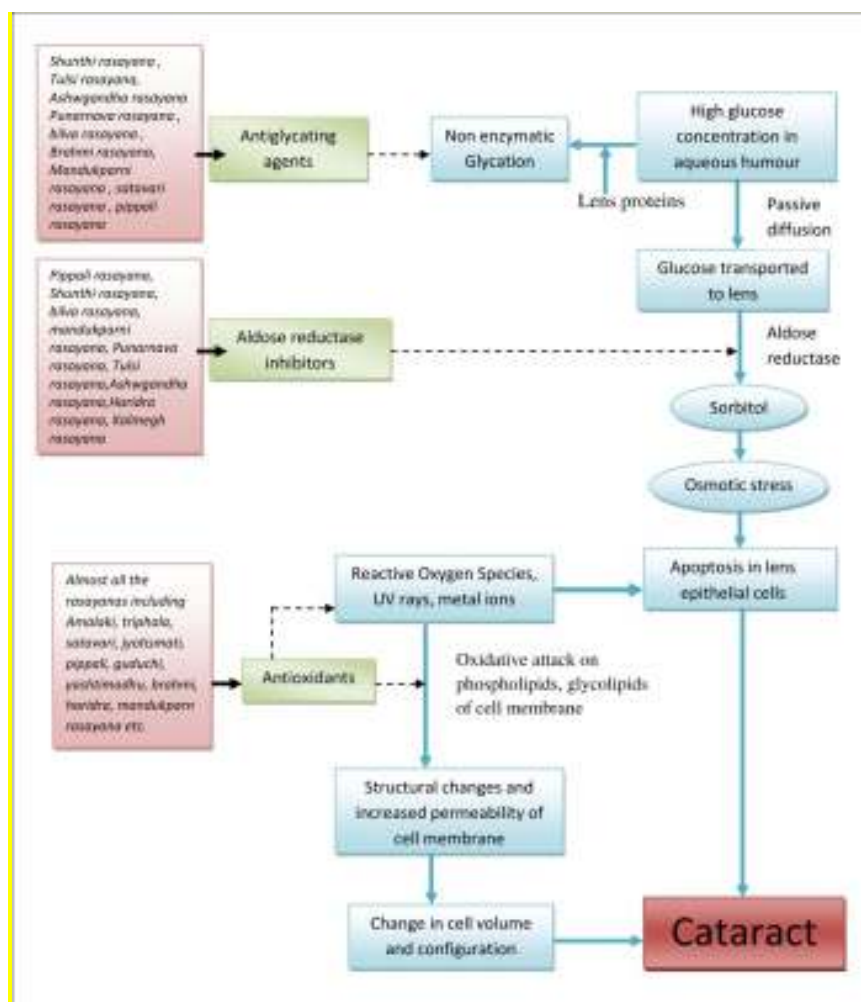


Figure 1. Diagrammatic representation of mechanism of action of various Rasayanas

2.3.6 Potential Rasayanas in Ayurveda for cataract

2.3.6.1 Amalaki Rasayana

Amalaki Rasayana is herbal formulation mentioned in Ayurveda to prevent cataract. It is extensively used in making Ayurvedic medicines because of its miraculous actions. According to Ayurveda regular usage of Amla will make you live more than 100 years like a youth. It is supposed to rejuvenate all the organ systems of the body, provide strength and wellness. It keeps us away from all the diseases by boosting our immune system. *Emblica officinalis* as the main ingredient that is rich source of vitamin C; so, it possesses antioxidant as well as free radical scavenging activity to minimize free radical induced damage in cataract. Regular use of Amalaki Rasayana makes eyes healthy. Various studies confirm the total phenolic and tannin content, free radical scavenging activity, superoxide radical scavenging activity and reducing power [15] of *Emblica officinalis*. It is also known to possess aldose reductase inhibitory activity [16].

2.3.6.2 Ashwagandha Rasayana

Dried roots of *Withania somnifera*, commonly known as "Indian Winter cherry" or "Indian Ginseng". The name Ashwagandha is from the Sanskrit language and is a combination of the word Ashva, meaning horse, and gandha, meaning smell. The root has a strong aroma that is described as "horse-like." It is one of the most important herb of Ayurveda (the traditional system of medicine in India) used for millennia as a Rasayana for its wide ranging health benefits. Ashwagandha is commonly available as a churna, a fine sieved powder that can be mixed with water, ghee (clarified butter) or honey. A herbal formulation containing Ashwagandha has also shown an anti-oxidant activity which is having natural antioxidant, self replicating and sustained action. The studies reveal that it acts as

antioxidant [17], antiglycating agent [18] and aldose reductase inhibitor [19]. It contains withanolides, piperidine and pyrrolidine alkaloids, flavonol glycosides and phenolic acids.

2.3.6.3 *Bilva Rasayana*

Also known as the "Wood Apple", *Aegle marmelos* or Bael, is a species native to India. *Bilva* tree is considered to be sacred to the Hindus. A famous drink known as *sharbet* (Syrup) is made from the bael fruit and it has been known for its medicinal values since 2000 BC. It contains protein, beta-carotene, vitamins, thiamine, riboflavin and vitamin C, aegelin [20], lupeol [21], cineol [22], citral [23], citronellal [24], cuminaldehyde [25], eugenol [26], marmesinin [27] as the chief constituents. Studies confirm that it is an antioxidant [28], antiglycating agent [29] as well as inhibitor of aldose reductase [30]. So, it plays significant role in prevention of cataract.

2.3.6.4 *Brahmi Rasayana*

It is known as *Jalanimba* or *Bacopa monniera*. The name *Brahmi* is derived from the word "*Brahma*", the mythical "creator" in the Hindu pantheon. This extracted oil is very beneficial and can be used to treat a number of different ailments in Ayurveda as well as Japanese traditional medicine. *Bacopa monniera* contains luteolin, apigenin, quercetin, hersaponin alkaloid viz herpestine [31-33]. It is responsible for antioxidant activity [34].

2.3.6.5 *Guduchi Rasayana*

Also known as *Tinospora cordifolia*, or Amrita, is an immune system boosting herb that can potentially reduce the symptoms of allergic rhinitis. It is a promising anti-cancer herb and may provide benefits for people with diabetes. Alcoholic root extract has antioxidant defence mechanism in alloxan induced diabetic rats. The herb has strong free radical scavenging properties against reactive oxygen and nitrogen species as revealed by electron paramagnetic resonance spectroscopy. *Guduchi* is also a powerful *Rasayana* (longevity enhancer) even by itself, but especially when combined with complementary herbs. It contains alkaloids- berberine, palmatine, tembetarine, magnoflorine [35-39], sesquiterpenoid-tinocordifolin [40]. *Guduchi* have tendency to act as antioxidant [41] and inhibit aldose reductase [42].

2.3.6.6 *Haridra Rasayana*

Haldi (*Curcuma longa*) is commonly used spice in most of kitchens in India and abroad. Curcumin is an important active component of *haldi*. *Haridra*'s ability to reduce oxidative stress makes it helpful in the management of conditions such as leukoplakia, diabetes mellitus, chronic eye disease and tissue injury. *Haridra* inhibits aldose reductase enzyme [19]. Also it is an antioxidant [43], antiglycating agent as it exhibited significant inhibitory activity against AGEs formation [44]. It is potent antioxidant that can neutralize free radicals due to its chemical structure and it also boosts the activity of the body's own antioxidant enzymes.

2.3.6.7 *Jyotismati Rasayana*

Popularly being described as *Jyotishmati*, this plant has an important role in enhancing cognitive function and the natural luminosity (*jyoti*) of the mind (*mati*), commonly known as *Malkangni*, *Jyotishmati*, Intellect Tree, Black oil, Bitter sweet, is an important Indian medicinal plant (*Celastrus paniculata*,) belonging to family Celastraceae. The phytochemical profile of *Jyotismati* shows the presence of terpenoids, flavonoids, glycosides and saponins. Petroleum ether extracts of *Celastrus paniculatus* seeds exhibited significant role in medicinal chemistry for formulation of life saving drugs. *Jyotismati* oil is used in formulation of Ayurvedic eye drops for the treatment for cataract. The strong antioxidant activity of this plant has been evaluated by phytochemical examination [45].

2.3.6.8 *Mandukparni Rasayana*

Also known as Gotu kola, Indian Pennywort, Jal Brahmi and has been used since ancient times as a medicinal herb. *Centella asiatica*, almost whole plant is of great importance. A study revealed that it contains alkaloids, flavonoids, phenols and tannins [46]. It possesses antioxidant [47], aldose reductase inhibitory activity [48] as well as antiglycating activity [49].

2.3.6.9 *Pippali Rasayana*

It is known as *Piper longum* or long pepper. It is having slender, aromatic, perennial climber, with woody roots and numerous wide ovate, cordate leaves. The active constituents responsible for the desired activity are α -terpineol, 1, 8-cineol, citral, α -pinene, piperolnol, vitamin A, C, E, K and β -carotene [50]. *Pippali* is a centre of attraction as sources of effective antioxidants Vitamins A, Vitamin E, Vitamin K are the major vitamins found in the *Pippali*. So it has the potential to prevent cataract. It is evident from the study that *Pippali* proteins act as antioxidants by inhibiting lipid peroxidation and by scavenging free radicals [51]. A study has been conducted to detect aldose reductase inhibitory activity of *Piper longum* [52].

2.3.6.10 *Punarnava Rasayana*

It is rightly called *Punarnava* (*Boerhavia diffusa*) as it brings back lost vigour and vitality. This is a miracle herb with wonderful health benefits and medicinal uses. Regular consumption of *Punarnava* root decoction or the dried root powder mixed with honey daily has been recommended for all the disorders of the eyes like night blindness, glaucoma, gradually reducing vision, cataract and persistent irritation in the eyes. It contains sitosterol, esters of sitosterol, punarnavine, boerhaavia acid, boeravinone, palmitic acid and other flavonoids and phenols responsible for antioxidant activity [53]. The fresh juice of its roots instilled into eyes, mitigates the ailments of the eyes like night blindness and conjunctivitis.

2.3.6.11 *Satavari Rasayana*

It is a very well known *Rasayana* that contains parts of *Asparagus racemosus*, belonging to family Asparagaceae. *Satavari* means "who possesses a hundred husbands or acceptable to many". In Ayurveda, this amazing herb is known as the "Queen of herbs", because it promotes love and devotion. The health benefits of *Satavari* are innumerable and include fertility, relief from pre-menstrual syndrome, cancer, diabetes, hangover, cataract, rheumatism, tuberculosis, depression, neurodegenerative diseases, and convulsions. It also reduces urinary tract infections and blood cholesterol. Asparagus is a source of vitamin A, which is essential for good vision. Due to the presence of antioxidants, it helps in defending the retina from the damage caused by the oxygen-free radicals. The presence of the amino acid glutathione in asparagus also helps in reducing the risk of eye ailments such as cataracts and night blindness. Apart from this, it contains polycyclic alkaloid-Aspargamine A, pyrrolizidine alkaloid [54,55], isoflavones known as 8-methoxy- 5, 6, 4-trihydroxy isoflavone-7-O-beta-D-glucopyranoside [56], polysacharides [57], flavanoids- quercetin, rutin and hyperoside are present in flower and fruits [58]. The antioxidant, antiglycating activity and aldose reductase inhibitory activity of *Satavari* has been studied [59].

2.3.6.12 *Shunthi Rasayana*

Shunthi or *sonth* as is popularly called is dried form of ginger, botanically called *Zingiber officinale*. *Shunthi/sonth* is prepared after drying ginger by processing it through lime water. *Shunthi/sonth* is one of the constituent of commonly used *Trikatu* powder. It is beneficial in prevention of eye disorders. *Zingiber officinale* contains gingerol which is very effective agent for anticipation of ultra violet B (UVB)-induced reactive oxygen species production [60] and also it contains 2-(4-hydroxy-3-methoxyphenyl) ethanol responsible for aldose reductase inhibitory activity [61]. It is also revealed that *Shunthi* possesses antiglycating activity [62].

2.3.6.13 *Triphala Rasayana*

Triphala is listed in Ayurveda system of medicine and also referenced in traditional Indian texts *Charaka samhita* and *Sushruta samhita*. It is an important medicine of *Rasayana* group and is believed to promote health, immunity and longevity. As per ancient experiences, Indian people are saying that "One Doesn't need to have a mother to take care of you, as long as you take *Triphala* every day." The word *Triphala* means "three fruits." *Triphala* is a very famous and traditional herbal combination used extensively by Ayurvedic healers. This formulaton mainly contains equal parts three herbs, i.e. *Terminalia belerica* (*Vibheetaki*), *Terminalia chebula* (*Haritaki*) & *Embllica officinalis* (*Amla*). Although *Triphala* is most commonly used to cleanse and tone the digestive tract, it is in reality an Ayurvedic *Rasayana*--a rejuvenative herbal blend that delivers benefits to the physiology as a whole.

On its phytochemical analysis, it was depicted that *Triphala* contains alkaloidal content, tannins and phenolic compounds, flavonoids, saponins and anthraquinon glycosides [63]. This polyherbal formulation is rich in antioxidant and free radical scavengers thus prevent lipid peroxidation [64]. Consumption of *Maha Triphala Ghrit* along with milk has been indicated in cataract prevention.

2.3.6.14 *Tulsi Rasayana*

Holi basil (*Ocimum sanctum*) popularly known in India as '*Tulsi*' is worshipped every morning by most Hindus. It is perhaps the most sacred plant in India and is referred to in Ayurveda for its healing and life giving properties. Basil juice is an effective remedy for eye disorders and night-blindness caused by deficiency of vitamin A. Vitamin C, Vitamin A, ursolic acid and the essential oils in *Tulsi*, are excellent anti oxidants and protects the body from nearly all the damages caused by the free radicals. Eyewash with water soaked with few leaves of *Tulsi* soothes eyes and reduces stress. A regular consumption can protect from all the damages done by the free radicals, such as cataract, macular degeneration, glaucoma, vision defects, ophthalmia etc. *Tulsi* is a good antioxidant [65], antiglycating agent [66] and aldose reductase inhibitor [19, 67] and ultimately beneficial in prevention of cataractogenesis.

2.3.6.15 *Yashtimadhu Rasayana*

Yashtimadhu is also commonly known as Liquorice (*Glycyrrhiza glabra*) renowned for its roots. It contains Semilicoisoflavone B (aldose reductase inhibitor), other than this it contains flavonoids responsible for antioxidant [68], aldose reductase inhibitory and antiglycating activity [69]. It is recommended as *Caksusya Rasayana*, washing eyes with *Yashtimadhu* soaked water has been recommended for preventing eye disorders including cataract.

3. RESULTS AND DISCUSSION

From Table 1, it is very much clear that the *Rasayanas* possess anticataract activity and demonstrate the same through established mechanism. It has been found that these *Rasayanas* act through their antioxidant, antiglycating and aldose reductase inhibitor activity. Metadata analysis and perusal of ancient texts on ayurveda and scientific studies on the evidences in favour of some *Rasayanas* and some specific *Caksusya Rasayana* show ability of *Rasayana* to act as anticataract agents by acting through one or the other molecular mechanism. It is also important to note that some of these *Rasayanas* like *Yashtimadhu*, *Shunthi*, *Haridra*, *Amalaki*, *Tulsi*, *Pippali* and *Triphala Rasayana* are very common component of daily kitchen use and can be a better therapy for patient compliance. As cataract is much more prevalent in diabetics and keeping in view all the molecular mechanisms through which these *Rasayanas* could exert anticataract activity, it can be suggested that diabetics should be suggested to use these *Rasayanas* to keep away from cataract.

Table 1: Rasayanas having anti-cataract activity

S. No.	Rasayana	Main Composition	Mechanism of action
1.	Amalaki Rasayana	Fruits of <i>Embolica officinalis</i>	Antioxidant, AR inhibitor
2.	Ashwgandha Rasayana	<i>Withania somnifera</i>	Antioxidant, AR inhibitor, antiglycating agent
3.	Bilva Rasayana	<i>Aegle marmelos</i>	Antioxidant, AR inhibitor, antiglycating agent
4.	Brahmi Rasayana	<i>Bacopa monniera</i>	Antioxidant
5.	Guduchi Rasayana	<i>Tinospora cordifolia</i>	Antioxidant, AR inhibitor
6.	Haridra Rasayana	<i>Curcuma longa</i>	Antioxidant, AR inhibitor, antiglycating agent
7.	Jyotismati Rasayana	<i>Celastrus paniculatus</i>	Antioxidant
8.	Mandukparni Rasayana	<i>Centella asiatica</i>	Antioxidant, AR inhibitor, antiglycating agent
9.	Pippali Rasayana	<i>Piper longum</i>	Antioxidant, AR inhibitor
10.	Punarnava Rasayana	<i>Boerhaavia diffusa</i>	Antioxidant
11.	Satavari Rasayana	<i>Asparagus racemosus</i>	Antioxidant, antiglycating agent, AR inhibitor
12.	Shunthi Rasayana	<i>Zingiber officinale</i>	Antioxidant, AR inhibitor, antiglycating agent
13.	Triphala Rasayana	fruits of <i>Terminalia belerica</i> , <i>Terminalia chebula</i> & <i>Embolica officinalis</i>	Antioxidant
14.	Tulsi Rasayana	<i>Ocimum sanctum</i>	Antioxidant, AR inhibitor, antiglycating agent
15.	Yashtimadhu Rasayana	<i>Glycyrrhiza glabra</i>	Antioxidant, AR inhibitor, antiglycating agent.

AR- Aldose reductase

4. CONCLUSION

Although there are significant advancements in modern medicine for curing the cataract, yet traditional medicine viz Rasayana therapy remains one of the important pillars of preventing and curing cataract. This manuscript catches up the eyes towards the scientific evidences in favour of some Rasayanas and some specific Caksusya Rasayana that have the ability to act as anticataract agents by acting through one or the other molecular mechanism. It is also important to note that some of these Rasayanas like Yashtimadhu, Shunthi, Haridra, Amalaki, Tulsi, Pippali and Triphala Rasayana are very common component of daily kitchen use. From the metadata analysis it may be concluded that most of the Rasayanas possess antioxidant, antiglycating and aldose reductase inhibitory activity, either singly or simultaneously and thus they can prevent or revert changes responsible for cataract pathogenesis. So it is pertinent to mention here that use of Rasayana therapy have the potentials to work against the development of cataract and should be explored for scientific evidences for mechanism of action.

REFERENCES

- [1] John N, Rachel J, Vashist P, Murthy GV. Rapid assessment of avoidable blindness in India. PLoS One. 2008; 3:e2867. doi:10.1371/journal.pone.0002867
- [2] Ottonello S, Foroni C, Carta A, Petrucco S, Maraina M . Oxidative stress and age-related cataract. Ophthalmologica. 2000; 214: 78-85.
- [3] Yorston D. Cataract complications. Community Eye Health Journal. 2008; 21(65):1-3.
- [4] Chulet R, Pradhan P. A review on rasayana. Phcog Rev. 2009; 3(6):229-34.
- [5] Odjakova M, Popova E, Al Sharif M, Mironova R. Plant-derived agents with anti-glycation activity 2012; <http://dx.doi.org/10.5772/48186>

- 447 [6] Pollreis A, Schmidt-Erfurth U. Diabetic cataract—pathogenesis, epidemiology and
448 treatment. *Journal of Ophthalmology*. 2010; 2010:1-8.
- 449 [7] Sharma PV. Charak Samhita, Section 6, Chapter 1, Qtr 1. Varanasi: Chaukhambha
450 Orientalia; 1998, p. 3-4, Shloka 7-8.
- 451 [8] Sharma PV. Charak Samhita, 4th Edition, Section 6, Chapter 1, Qtr 1. Varanasi:
452 Chaukhambha Orientalia; 1998, p. 12, Shloka 78-80.
- 453 [9] Panday KK. Comprehensive human physiology. Varanasi: Chowkhamba Karishnadas
454 Academy; 2011.
- 455 [10] Brahma S.K, Debnath PK. Therapeutic importance of rasayana drugs with special reference
456 to their multi-dimensional actions. *Aryavaidyan*. 2003; 16:160–3.
- 457 [11] Sharma HM, Hanna AN, Kauffman EM, Newman HA. Inhibition of human low-density
458 lipoprotein oxidation in vitro by Maharishi Ayurveda herbal mixtures. *Pharmacol Biochem*
459 *Behav*. 1992; 43(4):1175–82.
- 460 [12] Sies H, Murad F. Antioxidants in Disease Mechanisms and Therapy. *Advances in*
461 *Pharmacology*. New York: Academic Press; 1996.
- 462 [13] Cadenas E, Packer L. Hand Book of antioxidants. New York: Plenum Publishers; 1996.
- 463 [14] Halliwell B, Aruoma OI. DNA and free radicals. Boca Raton Press: Minuteman press; 1993.
- 464 [15] Samarakoon SMS, Chandola HM, Shukla VJ. Evaluation of antioxidant potential of
465 amalakayas rasayana: A polyherbal ayurvedic formulation. *International Journal of Ayurveda*
466 *Research*. 2011; 2(1):23-8.
- 467 [16] Suryanarayana P, Kumar PA, Saraswat M, Petrash JM, Reddy GB. Inhibition of aldose
468 reductase by tannoid principles of *Embllica officinalis*: implications for the prevention of sugar
469 cataract. *Mol Vis*. 2004; 10:148-54.
- 470 [17] Shahriar M, Hossain I, Sharmin FA, Akhter S, Haque A, Bhuiyan MA. Invitro antioxidant and
471 free radical scavenging activity of *Withania Somnifera* Root. *Iosr Journal of Pharmacy*. 2013;
472 3(2):38–47.
- 473 [18] Babu VP, Gokulakrishnan A, Dhandayuthabani R, Ameethkhan D, Kumar CV, Ahamed MI.
474 Protective effect of *Withania somnifera* (Solanaceae) on collagen glycation and cross-
475 linking. *Comp Biochem Physiol B Biochem Mol Biol*. 2007; 147(2):308-13.
- 476 [19] Halder N, Joshi S, Gupta SK. Lens aldose reductase inhibiting potential of some indigenous
477 plants. *J Ethnopharmacol*. 2003; 86:113-6.
- 478 [20] De Smet PA. The role of plant derived drugs and herbal medicines in healthcare. *Drugs*.
479 1997; 54(6):801-40.
- 480 [21] Shu YZ. Recent natural products based drug development: a Pharmaceutical industry
481 perspective, *J Nat Prod*. 1998; 61(8):1053-71.
- 482 [22] Biswas K, Chattopadhyay I, Banerjee RK, Bandyopadhyay U. Biological activities &
483 medicinal properties of neem (*Azadirachta indica*). *Curr Sci*. 2002; 82(11):1336-45.
- 484 [23] Chattopadhyay I, Biswas K, Bandyopadhyay U, Banerjee RK. Turmeric & curcumin:
485 biological actions & medicinal applications. *Curr Sci*. 2004; 87:44-53.
- 486 [24] Bandyopadhyay U, Biswas K, Chattopadhyay I, Ganguly CK, Chakraborty T, Battacharya K,
487 et al. Gastroprotective effect of neem (*Azadirachta indica*) bark extract: Possible
488 involvement of H⁺ K⁺ ATPase inhibition and scavenging of hydroxyl radical. *Life Sci*. 2002;
489 71(24):2845-65.
- 490 [25] Chattopadhyay I, Bandyopadhyay U, Banerjee RK. Mechanism of antiulcer effect of neem
491 (*Azadirachta indica*) leaf extract: effect on H⁺K⁺ATPase, oxidative damage and apoptosis.
492 *Inflammopharmacology*. 2004; 12(2):153-76.
- 493 [26] Chattopadhyay I, Bandyopadhyay U, Biswas K, Maity P, Banerjee RK. Indomethacin
494 inactivates gastric peroxidase to induce reactive oxygen mediated gastric mucosal injury &
495 curcumin protect it by perverting peroxidase inactivation & scavenging reactive oxygen.
496 *Free Radical Biology & Medicine*. 2006; 40(8):1397-408.
- 497 [27] Swarnakar S, Ganguly K, Kundu P, Banerjee A, Maity P, Sharma AV. Curcumin regulates
498 expression & activity of matrix metalloproteinases 9 & 2 during prevention & healing of
499 indomethacin induced gastric ulcer. *J Biol Chem*. 2005; 280(10):9409-15.
- 500 [28] Upadhya S, Shanbhag KK, Suneetha G, Naidu BM, Upadhya S. A study of hypoglycemic
501 and antioxidant activity of *Aegle marmelos* in alloxan induced diabetic rats. *Indian J Physiol*
502 *Pharmacol*. 2004; 48(4):476–80.
- 503 [29] Panaskar SN, Joglekar MM, Taklikar SS, Haldavnekar VS, Arvindekar AU. *Aegle marmelos*
504 correa leaf extract prevents secondary complications in streptozotocin-induced diabetic rats
505 and demonstration of limonene as a potent antiglycating agent. *Journal of Pharmacy and*
506 *Pharmacology*. 2013; 65(6):884-94.

- [30] Sankeshi V, Kumar PA, Naik RR, Sridhar G, Kumar MP, Gopal VV, et al. Inhibition of aldose reductase by *Aegle marmelos* and its protective role in diabetic cataract. *J Ethnopharmacol.* 2013; 149(1):215-21.
- [31] Bhandari P, Kumar N, Singh B, Kaul VK. Bacosterol glycoside, a new 13, 14-seco-steroid glycoside from *Bacopa monnieri*. *Chem Pharm Bull.* 2006; 54(2):240-1.
- [32] Ghosh T, Maity TK, Singh J. Antihyperglycemic activity of bacosine, a triterpene from *Bacopa monnieri*, in alloxan-induced diabetic rats. *Planta Med.* 2011; 77(8):804-8.
- [33] Bhandari P, Kumar N, Gupta AP, Singh B, Kaul VK. A rapid RP-HPTLC densitometry method for simultaneous determination of major flavonoids in important medicinal plants. *J Sep Sci.* 2007; 30(13):2092-6.
- [34] Mathur A, Verma SK, Purohit R, Singh SK, Mathur D, Dua VK et al. Pharmacological investigation of *Bacopa monnieri* on the basis of antioxidant, antimicrobial and anti-inflammatory properties. *Journal of Chemical and Pharmaceutical Research.* 2010; 2(6):191-8.
- [35] Kumar S, Verma NS, Pande D, Srivastava PS. In vitro regeneration and screening of berberine in *Tinospora cordifolia*. *J Med Arom Plant Sci.* 2000; 22:61.
- [36] Bisset NG, Nwaiwu J. Quaternary alkaloids of *Tinospora* species. *Planta Medica.* 1983; 48:275-9.
- [37] Pachaly P, Schneider C. Alkaloids from *Tinospora cordifolia* Miers. *Arch Pharm.* 1981; 314:251-6.
- [38] Qudrat-I-Khuda M, Khaleque A, Ray N. *Tinospora cordifolia*.I. constituents of the plant fresh from the field. *Sci Res.* 1964; 1:177-83.
- [39] Padhya MA. Biosynthesis of isoquinoline alkaloid berberine in tissue cultures of *Tinospora cordifolia*. *Indian Drugs.* 1986; 24:47-8.
- [40] Maurya R, Handa SS. Tinocordifolin, a sesquiterpene from *Tinospora cordifolia*. *Phytochemistry.* 1998; 49:1343-6.
- [41] Premanath R, Lakshmi N. Studies on Anti-oxidant activity of *Tinospora cordifolia* (Miers.) leaves using in vitro models. *Journal of American Science.* 2010; 6(10):736-43.
- [42] Nadig PD, Revankar RR, Deth SM, Narayanaswamy SB, Aliyar MA. Effect of *Tinospora cordifolia* on experimental diabetic neuropathy. *Indian J Pharmacol.* 2012; 44:580-3.
- [43] Choi HY. Antioxidant activity of *Curcuma longa* L. novel foodstuff. *Mol Cell Toxicol.* 2009; 5(3):237-42.
- [44] Gutiérrez RMP, Diaz SL, Reyes IC, Gonzalez AMN. Anti-glycation effect of spices and chilies uses in traditional mexican cuisine. *Journal of Natural Products.* 2010; 3:95-102.
- [45] Verma A, Ahirwar AK. Phytochemical examination and evaluation of in-vitro antioxidant potential activity of *Celastrus paniculatus* seeds extract. *International Journal of Scientific Research.* 2014; 3(1):46-8.
- [46] Desai SS, Shruti K, Sana S, Sapna P, Zainab M, Swati H, et al. Phytochemical analysis, free radical scavenging and antioxidant profiling using chromatographic techniques for *Centella asiatica*. *International Journal of Biotechnology and Bioengineering Research.* 2013; 4(7):687-96.
- [47] Adtani P, Malathi N, Chamundeeswari D, Dinesh MG. In-vitro antioxidant activity of ethanolic extracts of *Centella asiatica* L., *Oregano vulgare* sub.sp hirtum and *Ocimum basilicum* L. via five model systems. *Indian Journal of Research in Pharmacy and Biotechnology.* 2014; 2(3):1230-6.
- [48] Matsuda T, Kuroyanagi M, Sugiyama S, Umehara K, Ueno A, Nishi K. Cell differentiation inducing diterpenes from *Andrographis paniculata* Nees. *Chem Pharm Bull.* 1994; 42:1216-25.
- [49] Maramaldi G, Togni S, Franceschi F, Lati E. Anti-inflammaging and antiglycation activity of a novel botanical ingredient from african biodiversity (Centevita™). *Clinical. Cosmetic and Investigational Dermatology.* 2014; 7:1-9.
- [50] Meghwal M, Goswami TK. Nutritional constituent of black pepper as medicinal molecules: A review. *Open Access Scientific Reports.* 2012; 1(1): doi:10.4172/scientificreports.129.
- [51] Dinesha R, Chikkanna D. Antioxidant activities of pippali (*Piper longum*) proteins. *Indian Journal of Pharmaceutics and Drug Analysis.* 2014; 2(11):811-4.
- [52] Kumar S, Sharma S, Vasudeva N. Screening of antidiabetic and antihyperlipidemic potential of oil from *Piper longum* and Piperine with their possible mechanism. *Expert Opinion on Pharmacotherapy.* 2013; 14(13):1723-36.
- [53] Bhardwaj R, Yadav A, Sharma R. Phytochemicals and antioxidant activity in *Boerhavia diffusa*. *International Journal of Pharmacy and Pharmaceutical Sciences.* 2014; 6(1):344-8.

- [54] Sekine T, Fukasawa N, Kashiwagi Y, Ruangrunsi N, Murakoshi I. Structure of asparagamine A, a novel polycyclic alkaloid from *Asparagus racemosus*. Chemi Pharma Bull. 1994a; 42(6):1360-2.
- [55] Sekine T, Ikegami F, Fukasawa N, Kashiwagi Y, Aizawa T, Fujii Y, et al. Structure and relative stereochemistry of a new polycyclic alkaloid, asparagamine A, showing anti-oxytocin activity, isolated from *Asparagus racemosus*. J Chem Soc Perkin Trans. 1995; 1:391-3.
- [56] Saxena VK, Chourasia S. A new isoflavone from the roots of *Asparagus racemosus*. Fitoterapia. 2001; 72(3):307-9.
- [57] Kamat JP, Boloor KK, Devasagayam TP, Venkatachalam SR. Antioxidant properties of *Asparagus racemosus* against damage induced by gamma-radiation in rat liver mitochondria. J Ethnopharmacol. 2000; 71(3):425-35.
- [58] Sharma SC. Constituents of the fruits of *Asparagus racemosus* Willd. Pharmazie. 1981; 36:709-710.
- [59] Vadivelan R, Dipanjan M, Umasankar P, Dhanabal SP, Satishkumar MN, Antony S, et al. Hypoglycemic, antioxidant and hypolipidemic activity of *Asparagus racemosus* on streptozotocin-induced diabetic in rats. Advances in Applied Science Research. 2011; 2(3):179-85.
- [60] Ghosh AK, Banerjee S, Mullick HI, Banerjee J. *Zingiber officinale*: A natural gold. International Journal of Pharma and Bio Sciences. 2011; 2(1):283-94.
- [61] Li Y, Tran VH, Duke CC, Roufogalis BD. Preventive and protective properties of *Zingiber officinale*(Ginger) in diabetes mellitus, diabetic complications, and associated lipid and other metabolic disorders: A Brief Review. Evidence-Based Complementary and Alternative Medicine. 2012; 2012: 1-10.
- [62] Saraswat M, Suryanarayana P, Reddy PY, Patil MA, Balakrishna N, Reddy GB. Antiglycating potential of *Zingiber officinalis* and delay of diabetic cataract in rats. Molecular Vision. 2010; 6:1525-37.
- [63] Varma RK, Manjusha R, Harisha CR, Shukla VJ. Pharmacognostical and physiochemical analysis of triphaladi yoga: an ayurvedic polyherbal formulation. Journal of Pharmaceutical and Scientific Innovation. 2012; 1(6):9-12.
- [64] Shashildhara CS, Bharath Raj KC, Aswathanarayana BJ. A comparative study of anti cataract activity of triphala and its constituents. International Research Journal of Pharmacy. 2012; 3(5):407–10.
- [65] Devi PU. Radioprotective, anticarcinogenic and antioxidant properties of Indian holy basil *Ocimum sanctum* (tulsai). Indian Journal of Experimental Biology. 2001; 39:185-90.
- [66] Kaewnarin K, Shank L, Niamsup H, Rakariyatham N. Inhibitory effects of lamiaceae plants on the formation of Advanced Glycation Endproducts (AGEs) in model proteins. Journal of Medical and Bioengineering. 2013; 2(4):224-7.
- [67] Pavithra N, Sathish L, Kumar SM, Venkatarathanamma VA, Pushpalatha H, Bhanuprakash Reddy G, et al. In-vitro studies on α -Amylase, α -Glucosidase and aldose reductase inhibitors found in endophytic fungi isolated from *Ocimum sanctum*. Current Enzyme Inhibition. 2015; 11(2):129-36.
- [68] Chopraa GPKP, Saraf BD, Inam F, Deo SS. Antimicrobial and antioxidant activities of methanol extract roots of *Glycyrrhiza glabra* and HPLC analysis. International Journal of Pharmacy & Pharmaceutical Sciences. 2013; 5(2):157-60.
- [69] Alqahtani A, Hamid K, Kam A, Wong KH, Abdelhak Z, Razmovski-Naumovski V, et al. The pentacyclic triterpenoids in herbal medicines and their pharmacological activities in diabetes and diabetic complications. Curr Med Chem. 2013; 20(7):908-31.