IJPSR (2023), Volume 14, Issue 1 (Review Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 14 October 2021; received in revised form, 20 December 2022; accepted 21 December 2022; published 01 January 2023

BIOLOGICAL SIGNIFICANCE OF PHYTO-CONSTITUENTS OF MEDICINAL PLANTS IN MAINTAINING VISION & HEALTHY EYE SIGHT

Teja Rangu [1], Santhosh Suddagoni [*2], Ganesh Akula [2] and Santikari Sesha Phanindra [2]

Surabhi Dayakar Rao College of Pharmacy [1], Rimmanaguda, Gajwel, Siddipet - 502312, Telangana, India.
Mansarovar Global University [2], Bilkisganj, Sehore, Bhopal - 466001, Madhya Pradesh, India.

Keywords:

Eye diseases, Ophthalmologist, Omega-3 fatty acids, Contact lenses

Correspondence to Author:
Santhosh Suddagoni

Research Scholar,
Mansarovar Global University,
Bilkisganj, Sehore, Bhopal - 466001,
Madhya Pradesh, India.

E-mail: srisuddagoni@gmail.com

ABSTRACT: The eye is one of the most sensitive organs of human body and is continuously exposed to different environmental agents so it is very important to take care of eyes. Poor vision makes it harder to read, drive, and cook. Many eye problems and diseases can be treated if caught early. Ophthalmologists will examine eyes for signs of vision problems or eye diseases. It's the best way to find out if glasses or contacts are needed in the early stages of a serious but treatable eye disease. Wearing protective eyewear when playing sports or doing activities around the home, smoking cessation, wearing UV radiation-blocking sunglasses, Cleaning hands and contact lenses properly to avoid the risk of infection, etc., are the steps to protect vision.

INTRODUCTION: People with vision problems are more likely than those with good vision to have diabetes, poor hearing, heart problems, high blood pressure, lower back pain and stroke, as well as have increased risk for falls, injury and depression [1]. Zinc, Vitamin-C (Ascorbic acid), Vitamin-E (α-tocopherol, β-tocopherol, δ-tocopherol and γ-tocopherol), Selenium, Carotenoids, Vit- B1 (Thiamine), Vit- B2 (Riboflavin), Vit-B3 (Niacin), Vit-B6 (pyridoxine), Vit-B9 (folate or folic acid)&Vit-B12 (cyanocobalamin), Omega-6-fatty acids like gamma Linolenic acid (GLA), Vit- A (converted beta carotene) and Omega-3-fatty acids like ALA (alpha- Linoleic acid), EPA (Eicosapentaenoic acid) & DHA (Docosahexaenoic acid), Polyphenols like Quercetin, Anthocyanins and Resveratrol are the Phyto-constituents effective in alleviating eye disorders and play a major role in maintaining healthy eyes thereby helpful in the prevention & treatment of ophthalmic diseases [2-3].

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.14(1).198-13

This article can be accessed online on www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.14(1).198-13

Vitamin-C (Ascorbic Acid): It is a water-soluble vitamin & an antioxidant present in aqueous humor fluid on the outermost parts of the eyes. Large doses of it are used to treat & prevent glaucoma and cataract (clouding of eye lens) and fight against Age-related Macular Degeneration (AMD), a major cause of vision loss among older [4]. Oxidative stress is the major contributing factor to the Pathogenesis of AMD. Recommended daily intake of Vit-C is 500mg. It reduces the cellular oxidative stress of the retina or macular region of the eye. Unlike animals, humans cannot synthesize Vit-C because of the liver's absence of the L-gluconolactone oxidase enzyme. Open-angle glaucoma can be reversed by supplementing with high doses of Vit-C. People with high levels of Vit-C have 70% lower risk of developing AMD. Vit-C supports the health of ocular blood vessels. Scientific evidence suggests Vit-C lowers the risk of developing

cataracts. When taken in combination with other essential nutrients, it can slow down the progression of AMD and visual acuity loss [5].

Vitamin-E: It is a fat-soluble vitamin & an essential micronutrient available in four different forms α-tocopherol (found in retina), β-tocopherol, δ-tocopherol and γ-tocopherol [20]. It is an antioxidant that prevents cataract (clouding of eye lens) & fights against Age-related Macular Degeneration (AMD) [6]. 21 Its deficiency in the body leads to retinal degeneration or damage, loss of photo-receptors & blindness. Recommended daily intake is 400 IU [22]. It reduces the cellular oxidative stress of the retina or macular region of the eye. Cataracts occur due to the accumulation of proteins damaged by free radicals [7]. Long-term supplementation of vitamin E is associated with the slower progression of age-related lens opacification. The vitamin E group (*i.e.*, chroman-6-ols), collectively termed tocochromanols (divided into tocopherols and tocotrienols) [12-14]. There are eight naturally occurring forms of vitamin E: alpha, beta, gamma, and delta classes of tocopherol and tocotrienol, synthesized in plants from homogentisic acid [16-18]. Alpha- and gamma-tocopherols are the two major forms of this vitamin. Vit-E is found in various nuts, seeds, vegetable oils, green leafy vegetables, and fortified cereals. Vit-E absorption depends on vitamin C, vitamin B3, selenium, and glutathione. A diet high in vitamin E cannot have an optimal effect unless it is also rich in these other nutrients. 24 Vitamin E promotes the health of cell membranes and DNA repair & plays a significant role in the immune system functions. Thus, it slows the progression of AMD and visual acuity loss when combined with other essential nutrients [9].

Zinc: Zinc is a co-factor of many metabolically active enzymes within the eye. It prevents cataract (clouding of eye lens) & fights against AMD. Retina, in the eyes & vascular or ocular tissue surrounding the retina, contains high levels of zinc in the form of many essential antioxidant enzymes like superoxide dismutase. Zinc forms visual pigments in the retina, so zinc deficiency leads to night blindness. Zinc is abundant in oysters, meat, pumpkin seeds, peanuts, green leafy vegetables, beef, chicken, pork, eggs & coconut water. Recommended daily intake is 80mg [25-27].

Omega-3-fatty Acids like ALA (Alpha-Linolenic Acid), EPA (Eicosapentaenoic Acid) & DHA (Docosahexaenoic Acid): These are Poly-Unsaturated Fatty Acids (PUFA's) that are essential for humans but cannot be synthesized in the body even though obtained from the diet. DHA levels are highly found in the cell membranes of the retina of human eyes; hence, they are called Essential Fatty Acids (EFA's). These are important components of the cell membranes in the body [79]. They prevent cataracts (clouding of the eye lens), eye dryness called Dry Eye Syndrome (DES), & fight against AMD. They are anti-inflammatory in action (prevents inflammation of lacrimal gland and secretory epithelial cells), reduce the risk of diabetic retinopathy (DR), and prevent its occurrence. These are present in the gut and body tissues of oily fish like tuna, salmon, sardines, herring, anchovies, mackerel & trout. Consumption of DHA, EPA & ALA sources during pregnancy aids in the fetus's proper development of the retina. ALA is found in plant oils such as flaxseed, soybean, and canola. DHA and EPA are found in fish and other seafood [24]. The human body can convert some ALA into EPA and then to DHA, but only in tiny amounts. Therefore, getting EPA and DHA from foods & dietary supplements is the only way to increase the levels of omega-3 fatty acids in the body. Thus, Omega-3 fatty acids reduce inflammation, enhance tear production and support the eye's oily outer layer by increasing oil that flows from the meibomian glands& can play a vital role in preventing or easing the discomfort of dry eyes. **Table 1** average daily recommended amounts for ALA are listed below in grams (g). The amount needed depends on age and sex **Table 1**

TABLE 1: DAILY INTAKE OF ALPHA LINOLEIC ACID DEPENDS ON AGE AND SEX

Life Stage	Recommended amount in gm
Birth to 12 months	0.5
Children 1–3 years	0.7
Children 4–8 years	0.9
Boys 9–13 years	1.2
Girls 9–13 years	1.0
Teen boys 14–18 years	1.6
Teen girls 14–18 years	1.1
Men	1.6
Women	1.1
Pregnant teens and women	1.4
Breastfeeding teens and women	1.3

Omega-3s are found naturally in some foods and are added to some fortified foods. One can get adequate amounts of omega-3s by eating a variety of foods, including the following:

A. Fish and other seafood (especially cold-water fatty fish, such as salmon, mackerel, tuna, herring, and sardines).

B. Nuts and seeds (walnuts, brazil nuts, cashew nuts, peanuts, lentils, chia seeds, flax seeds, hemp seeds, beans).

C. Plant oils (such as flaxseed oil, soybean oil, olive oil and canola oil).

D. Fortified foods (such as certain brands of eggs, yogurt, juices, milk, soy beverages, and infant formulas).

Omega-3 dietary supplements include fish oil, krill oil, cod liver oil, and algal oil (a vegetarian source that comes from algae) [20-24]. They provide a wide range of doses and forms of omega-3s. A deficiency of omega-3s can cause AMD & Dry eye disease. AMD is a major cause of vision loss among older adults. People who get higher amounts of omega-3s from the foods they eat may have a lower risk of developing AMD. If someone has AMD, taking omega-3 supplements does not prevent the disease from worsening or slowing down vision loss. Dry eye disease occurs when tears don't provide enough moisture, causing eye discomfort and vision problems. Getting more omega-3s from foods or supplements, mainly EPA and DHA helps relieve symptoms of dry eye disease [30-35].

Vitamin- A is a group of antioxidants that play an important role in vision. There are two types of vitamin -A depending on the kind of food source it comes from.

A. Retinol- Derived from animals. Present in beef, chicken liver, milk & cheese. It is utilized directly by the body.

B. Provitamin A- ex: Beta carotene, Present in colorful fruits& vegetables.

Carotenoids are present in all the sources of Vit-A are converted either into retinol or provitamin A, in the body after food consumption. Carrots, sweet potatoes, spinach, kale, cantaloupes have carotenoids which get converted into retinol. Vit-A prevents night blindness & dry eyes [50-55]. Its deficiency may cause blindness. It is essential for maintaining the eyes' light-sensing cells (photoreceptors). It is a component of a protein called rhodopsin, which helps the retina to absorb light. It is found in animal-derived food sources like liver, egg yolks, and dairy products. It is obtained from antioxidant plant compounds like provitamin-A carotenoids (beta-carotene) in carrots, and sweet potatoes. Consumption of fruits and vegetables rich in vitamin-A have a decreased risk for any stage of AMD [31-38]. Vit-A protects the eye's surface (cornea) and is essential for good vision. It treats superior limbic keratoconjunctivitis, an eye inflammation. The eye's light-sensitive retina (thin layer of tissue at the back of the eye) requires adequate vitamin A for proper function [39].

Omega-6-fatty Acid Like Gamma Linoleic Acid (GLA) and Arachidonic Acid (AA): These are abundantly found in prime rose oil and starflower oil, Sunflower oil, rape seed, corn, peanut, chicken, eggs, cereals, grains & bread and helps in reducing eye dryness. ALA and GLA relieve ocular discomfort and corneal epithelial defects due to DES [1, 2, 3].

Combination of Vitamin B6, B9 & B12: Combining these three vitamins can lower levels of homocysteine, a protein in your body that may be associated with inflammation and an increased risk of AMD.

Vitamin-B2 (Riboflavin): It is a potential antioxidant& helps in reducing oxidative stress in the eyes. Recommended daily intake is 1.1- 1.3 mg. It is present in oats, milk, yogurt, beef & fortified cereals. Its deficiency causes cataracts & corneal vascularization (dryness, burning, itching & lacrimation).

Vitamin-B3 (Niacin): It is an antioxidant that prevents glaucoma, a condition in which the optic nerve in the eye gets damaged. It is present in fish, beef, mushrooms, chicken, peanuts& legumes.

Vitamin B1 (Thiamine): It reduces the risk of cataracts. Administration of thiamine 100 mg three times a day reduces albumin excretion in urine, which indicates Diabetic Retinopathy (DR) in type

2 Diabetes; thus, it treats DR in its early stages. It is mostly present in bread, cereals & pasta.

Polyphenols: There are various types of polyphenols & among them, flavonoids are especially helpful in alleviating eye-related problems. Flavonoids are found mostly in apples, onions, dark chocolate, and red cabbage. There are various types of flavonoids & among them, quercetin, belonging to the flavonols group and other group called anthocyanins, play a major role in maintaining healthy eyesight.

Quercetin: It is aunique flavonol, belonging to flavonoid group, abundantly found in Yellow onion, Curlykale, Leek, Cherrytomato, Broccoli, Apple, Green and black tea, Black grapes, and Blueberry. It protects against cataracts & diabetes-induced retinal lesions. It acts as an antioxidant; thus, it protects the body against ROS produced during normal oxygen metabolism.

Free radicals (ROS) interfere with cellular functions & cause lipid peroxidation, causing cell death. To protect this cellular death from ROS, living organisms have developed antioxidant line of defense systems like enzymatic and nonenzymatic antioxidants, that check ROS levels and repair oxidative cellular damage regularly. The major enzymes, constituting the first line of defense, directly involved in the neutralization of ROS are: superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPx). The second line of defense is by radical scavenging antioxidants such as vitamin C, vitamin A and plant phytochemicals like quercetin. They inhibit the oxidation chain initiation & prevent chain propagation, termination of a chain by the reaction of two radicals. The repair and de novo enzymes act as the third line of defense by repairing damage and reconstituting membranes. These include lipases, proteases, DNA repair enzymes and transferases [49, 40, 41].

Anthocyanins: These are naturally occurring coloring pigments, antioxidants, phytochemical flavonoid compounds, group red purple pigments of phenolic groups found in plants with red, blue, and purple colored flowers, fruits, and vegetables [5, 7]. Ex: Cyanidin, Delphinidin.

Berries such as blueberry, bilberry (*Vaccinium myrtillus*), blackcurrant, Grape skin, Maqui berry, dried cornelian cherry, strawberry, and wolfberry (goji berry), are rich in anthocyanins [8]. These are found in wines, tea, nuts, fruits, cocoa, cereals, honey, olive oil, vegetables, blackcurrant, red cabbage, red radish, and black carrot. Cyanidin and Delphinidin are anthocyanin aglycones present in bilberry [9]. These promote the synthesis and regeneration of rhodopsin to protect the retina from exposure to UV, visible light, and irradiation [10, 11]. As well as to improve vision and increase blood supply to the retina [12, 13].

They play a major role in the inhibition of enzymes, protection against DNA cleavage, anti-inflammatory activity, estrogen activity (modulation of the development of symptoms of hormone-dependent disease), and stimulation of cytokine production thereby regulating immune responses, peroxidation, a decrease of capillary permeability and fragility and membrane hardening [60, 61, 62] and [63].

They inhibit lens opacity, cataractogenesis, and ROS. They protect retinal cells from diabetes-induced oxidative stress & inflammation, and protect retinal neurons from functional damages [47, 58, 56, 77, 76].

Other Polyphenols Like Resveratrol: It is a polyphenolic phytoalexin with various bioactivities associated with health promotion. It is readily absorbed by other human dietary sources like peanuts, peanut butter, grapes and red wine. It has antioxidant activity and thus inhibits apoptosis and low-density lipoprotein (LDL) oxidation. Resveratrol is a stilbenoid, a fat-soluble compound & a derivative of stilbene, which is produced in plants with the help of stilbene synthatase enzyme. It reduces cell damage from free radicals, which are generated when cells burn nutrients in the mitochondria. It suppresses oxidative stress, inhibits cataract formation, and prevents diabetic retinopathy [67, 71, 72] and [73].

Carotenoids: Lutein, meso-zeaxanthin, and zeaxanthin are dietary carotenoid xanthophylls found throughout the visual system except for the cornea, vitreous, and sclera. It is mostly found in the retina, the most metabolically active body tissue. The macula is a specialized part in the posterior pole of the retina since it mediates central

vision, provides the sharpest visual acuity, and facilitates the best color discrimination. As the major functional component in the macular region, macular pigment (MP) was uniquely concentrated in the inner and central layers and mainly composed of xanthophyll carotenoids, including lutein, zeaxanthin and meso-zeaxanthin, which play pivotal role in maintaining the normal morphology and function of the macula.

A. Lutein: It is a carotenoid xanthophyll. It prevents cataract development (clouding of the eye lens) & fights against the progression of Age-related Macular Degeneration (AMD). Thus, it protects the eyes from photooxidative damage. It is a yellow carotenoid antioxidant, known as a macular pigment because it is present in macula (the central part of the retina made of light-sensitive cells on the back wall of the eyeball). The human body cannot synthesize lutein, so it must be obtained from the diet. It is mostly present in eggs and green leafy vegetables like spinach, kale, broccoli, collards. Recommended daily intake is 10mg.

B. Meso-zeaxanthin: It is a carotenoid xanthophyll with antioxidant & anti-inflammatory properties. It filters blue light & macular pigments and thus helps in reducing the incidence of eye diseases. The human body can synthesize meso-zeaxanthin, which is also obtained from diet such as eggs, green leafy vegetables like spinach, kale, broccoli & collards.

C. Zeaxanthin: It is a carotenoid xanthophyll. It prevents cataracts (clouding of eye lens), Inhibits diabetic retinopathy, and fights against the progression of Age-related Macular Degeneration (AMD). It is a yellow carotenoid antioxidant, known as a macular pigment because it is present in macula (the central part of retina made of light-sensitive cells on the back wall of eyeball). The human body cannot synthesize zeaxanthin, so it must be obtained from the diet. It is in eggs, green leafy vegetables like spinach, kale, broccoli, and collards. Recommended daily intake is 2mg [14].

High intake of xanthophyll-containing foods elevates levels of plasma lutein and zeaxanthin [15, 16]. Lifestyle and dietary factors (physically inactive, poor diet, and smoking) affect the degeneration of macular pigment & increase the risk of AMD. Inflammation of macular pigment among heavy smokers was higher than among light or non-smokers [17, 70, 71, 72, 73]. Lutein and zeaxanthin reduce the risk of chronic eye diseases, including cataracts and age-related macular degeneration (AMD). These plant-based pigments also appear to lower the risk of developing type 2 diabetes, a leading cause of blindness. They are also protective antioxidants like internal sunglasses, absorbing damaging blue light that Indians are exposed to daily. In the initiation and progression of AMD, cataract, diabetic nephropathy & glaucoma, aspects that play a major role are inflammation & oxidative stress. Phytochemicals like carotenoids and polyphenols have antioxidant activity and thus helps in alleviating these ophthalmic diseases [30, 71, 72, 73].

The actual mechanism involved in the alleviating eye diseases by carotenoids and polyphenols is,

1. Mitigating the production of reactive oxygen species (ROS).
2. Inhibiting Tumor Necrosis factor (TNF-α) and Vascular endothelial growth factor pathway.
3. Suppressing p53-dependent apoptosis.
4. Suppressing the production of inflammatory markers like interleukins (IL's) Ex: IL- 8, IL-6, IL-1a, and endothelial leucocyte adhesion molecule [70, 71, 72, 73].

Polyphenols possess antioxidant, anti-inflammatory, antiallergic, antimicrobial, and antiviral effects. They help in scavenging free radicals, ameliorating inflammation, improving ocular blood flow, signal transduction, reduction of apoptosis in the RPE, opacification of the suppressive lens, and inhibition of the blood-retinal barrier. The retina is highly susceptible to oxidative stress due to its rich content of poly-unsaturated fatty acids & oxygen and its heavy exposure to light.

In addition, oxidative stress can be involved in producing severe inflammation by increasing the proinflammatory cytokines in the retinal tissue.

These cytokines degrade the RBB and produce vascular cell death & apoptosis through tumor necrosis factor-α, chemotactic proteins, intercellular adhesion molecule 1 and IL-1β.

Selenium: It is an essential trace element, a strong antioxidant, found in several enzymes of the human body. Selenium is a micronutrient that is essential for the proper functioning of all organisms. It protects the eyes by reducing AMD risk and prevents the development of cataracts, AMD & retinitis pigmentosa. It reduces cellular oxidative stress of the retina or macular region of the eye [28, 29]. Selenium is existed as selenocysteine residues in two Selenoproteins like Cytosolic or classical Glutathione Peroxidase enzyme cGPx-1) & Plasma GPx-3.

This element is a co-factor of many enzymes, for example, glutathione peroxidase or thioredoxin reductase. Insufficient supplementation of this element increases the risk of developing many chronic degenerative diseases. Selenium is important for protecting against oxidative stress, demonstrating the highest activity as a free radical scavenger and anti-cancer agent.

It is present in organic forms in food, as exemplified by seleno methionine and seleno cysteine. Extreme selenium deficiencies are widespread among people all over the world. Therefore, it is essential to supplement the deficiency of this micronutrient with selenium-enriched food or yeast cell biomass in the diet. WHO recommends a daily dose of selenium at 55 µg for adults. The combined interaction of selenium and tocopherol gives the best results in protecting organs against the destructive effects of free radicals. The combination of these compounds effectively protects mitochondria, cytochrome, and microsomal membranes from the oxidation of fatty acids.

Protein-rich foods contained higher levels of selenium, whereas low levels were found in plants containing low protein. The main sources of selenium in the diet are foods like brazil nuts, cereals, chocolate, broccoli, beef kidney, bread, meat and dairy products, marine fishes, pork, seafood, and milk. A rich source of selenium is found in sea salt, eggs (only in case of Se-yeast supplementation of feed), giblets, yeast (yeasts containing selenium), bread, mushrooms, garlic, asparagus, kohlrabi (enriched with this element). A relatively low selenium content characterizes fruits and vegetables. The bioavailability of selenium is increased in the presence of Vit-A, C & E.

The severity and irreversibility of cataracts and AMD have generated interest in preventing or delaying their progression. Nutrition plays an important role in reducing the risk of developing age-related eye disease. Adding certain nutrients to one's diet daily through foods or supplements can help preserve vision.

Table 2: Several researches have shown eating more fruits and vegetables can help protect against eye disease and can also help overall health. One should eat foods rich in certain vitamins and minerals to keep the eyes healthy. These vitamins and minerals are called antioxidants. Antioxidants help keep our cells and tissues healthy. The following foods may help stop the occurrence or slow the progression of certain eye diseases **Table 2.**

TABLE 2: FOODS MAY HELP STOP THE OCCURRENCE OR SLOW THE PROGRESSION OF CERTAIN EYE DISEASES

Foods rich in antioxidants for eye health	Antioxidants related to eye health
Eggs, kale, spinach, turnip greens, collard greens, romaine lettuce, broccoli, zucchini, corn, garden peas, and Brussels sprouts.	Lutein & Zeaxanthin.
Red berries, kiwi, red and green bell peppers, tomatoes, broccoli, spinach, and juices made from guava, grapefruit, and oranges.	Vitamin C (ascorbic acid)
Vegetable oils, nuts, green leafy vegetables, sweet potatoes, avocados, wheat germ, and whole grains.	Vitamin E
Carrots, sweet potatoes, squash, eggs, and green leafy vegetables.	Vitamin A/Beta Carotene
Salmon, sardines, flax seeds, soybeans, and walnuts.	Essential Fatty Acids
Red meat, poultry, oysters and other seafood, nuts, dried beans, soy foods, milk and other dairy products, whole grains, and fortified breakfast cereals.	Zinc

TABLE 3: NUTRITIONAL CONTENT OF COMMONLY AVAILABLE FRUITS IN INDIA THAT AID IN MAINTAINING HEALTHY EYE SIGHT IS AS FOLLOWS

Fruits	content in mg/100g		
	Vit-C	Vit-A (IU)	Vit-E
Apple	4.6	54	0.1
Avocados	10	146	2.1
Bananas	8.7	64	0.1
Red cherries	10	1283	0.07
Red chili peppers	143.7	952	0.37
Grapes	4	100	0.19
Kiwi	92.7	87	1.5
Lemon	53	22	0.1
Peach	6.6	326	2000
Pineapple	78.8	58	0.03
pomegranate	10.2	0	0.6
strawberries	58.8	12	0.25
watermelon	8.1	569	0.08
Jack fruit	13.7	110	0.34
sapota	14.7	60	0
Custard apple	19.2	33	0
mango	36.4	180	0.9
papaya	60.9	950	0.30
orange	48.5	230	0
guava	228	624	0.73
Musk melon	36.7	3382	0.05

TABLE 4: NUTRITIONAL CONTENT OF THE COMMONLY AVAILABLE VEGETABLES IN INDIA THAT AID IN MAINTAINING HEALTHY EYE SIGHT IS AS FOLLOWS

Vegetables	content in mg/100g		
	Vit-C	Vit-A (IU)	Vit-E
Sunflower seeds	1.4	50	26.1
Spinach	28.1	0.5	2.1
Broccoli	89.2	623	1.5
Beetroot	4.9	33	1.8
Cabbage	36.6	98	0
Cauliflower	48.2	0	0.08
Ginger	5	0	0.26
Beans	16.3	690	0
Onions	7.4	2	0.02
Radish	14.8	7	0
Sweet potatoes	2.4	14187	0.26
Bitter gourd	84	471	0
Bottle gourd	10.1	16	0
Brinjal/ egg plant	2.2	27	0.30
Tomato	13	833	0.54
Lady’s finger/ okra	21.1	375	0.36
Drum sticks	141	74	0
Carrot	5.9	16706	0
Malanga	5.2	8	0
Parsley	21	1320	0
Ash gourd	13	0	0
Chilli	143.7	952	0.69
Capsicum	127.7	3131	1.58

These fruits and vegetables contribute to preserving vision and even reversing visual impairment. Due to the side effects of allopathic drugs, now a day’s huge numbers of herbal drugs are used to treat eye diseases. This review mentions Phyto-constituents, which are effective in alleviating eye disorders, and potential medicinal plants used in the prevention & treatment of eye dysfunctions. Thus, this review provides a platform for the researcher to develop more efficient new herbal formulations. **Table 5**

More than 100 Potential medicinal plants and their Phyto-constituents that can be used as products that aid in the prevention & treatment of eye dysfunctions are listed in the following table.

TABLE 5: MORE THAN 100 POTENTIAL MEDICINAL PLANTS AND THEIR PHYTO-CONSTITUENTS THAT CAN BE USED AS PRODUCTS THAT AID IN PREVENTION& TREATMENT OF EYE DYSFUNCTIONS ARE LISTED IN THE FOLLOWING TABLE

Sl. no.	Plant Name	Common Name	Family	Useful Parts	Phyto-Constituents
1.	*Cynodondactylon*	Durva grass, Bermuda grass, Bahama grass, Devil's grass, Couch grass, Dog's Tooth grass, Indian Doab, Scutch grass	Poaceae.	Leaves	Vitamin-C (Ascorbic acid), Omega-3-fatty acids like DHA (Docosahexaenoic acid), ALA (alpha- Linoleic acid) 44
2.	*Glycyrrhiza glabra*	Liquorice	Fabaceae	Whole plant	Xanthophylls (Lutein and zeaxanthin) 39,40
3.	*Asparagus racemosus*	Satawari, satavari.	Asparagaceae	Whole plant	Flavonol named quercetin, belonging to flavonoid group of polyphenols, Vit- B2 (Riboflavin), Vitamin-C (Ascorbic acid), B1 (Thiamine) 63
4.	*Triticumaestivum*	Wheat grass	Poaceae	Leaves	Vit- A (converted beta carotene), Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid)& B12 (cyanocobalamin), Vitamin-C (Ascorbic acid), Vitamin-E (tocopherol) 43
5.	*Carica papaya*.	papaya	Caricaceae	Fruits, seeds	Vit- A (converted beta carotene), carotenoid xanthophylls like Lutein, meso-zeaxanthin and zeaxanthin , Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid)31-33,75-78
6.	*Azadiractaindica*	Neem	Meliaceae	Leaves, seeds, bark	Omega-3-fatty acids like ALA (alpha- Linoleic acid) 31
7.	*Ixorapavetta*	Jungle flame, flame of woods, jungle geranium	Rubiaceae	flowers	Flavonol named quercetin, belonging to flavonoid group of polyphenols
8.	*Boerhaviadiffusa*	Punarnava	nyctaginaceae	Leaves, roots	Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vitamin-C (Ascorbic acid) 63
9.	*Vitisvinifera*	grapes	Vitaceae	Fruits	Resveratrol
10.	*Cichoriumintybus*	chicory	asteraceae	Leaves	Selenium
11.	*Phyllanthusamarus*	stone breaker	Phyllanthaceae	Whole plant	Vitamin-C (Ascorbic acid) 55,56
12.	*Adansoniadigitate*	Baobab tree	Malvaceae	Leaves, bark	Flavonol named quercetin, belonging to flavonoid group of polyphenols
13.	*Taraxacumofficinale*	dendelion	Asteraceae	leaves	Selenium
14.	*Buteafrondosa*	Flame of the forest, Gogipuvvu	Fabaceae	Roots, Bark& Gum	Omega-3-fatty acids like ALA (alpha- Linoleic acid) 30
15.	*Allophylusserratus*	thippani	Sapindaceae	Leaves	Flavonol named quercetin, belonging to flavonoid group of polyphenols

16.	*Banincasahispida*	Winter melon, Ash gourd, white guard	Cucurbitaceae	Fruits	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid), Vit- A (converted beta carotene) 50
17.	*Mimusopselengi*	Spanish cherry, bullet wood	Sapotaceae	Leaves, Flower, bark, seeds	Flavonol named quercetin, belonging to flavonoid group of polyphenols
18.	*Petroselinumcrispum*	parsley	Apiaceae	Leaves	Selenium
19.	*Byrsonimacrassa*	Locustberries	Malpighiaceae	Leaves	Flavonol named quercetin, belonging to flavonoid group of polyphenols
20.	*Acorus calamus*	Vasa	Acoraceae	rhizome	Omega-3-fatty acids like ALA (alpha- Linoleic acid) 51,52
21.	*Valerianellalocusta*	Lamb's lettuce	Caprifoliaceae	Leaves	selenium
22.	Acacia Arabica	Babul, gum Arabic tree,	Leguminaceae	Leaves, Gums	Flavonol named quercetin, belonging to flavonoid group of polyphenols
23.	I*pomoea batatas*	Sweet potato	Convolvulacea	Tubers	Vit- A (converted beta carotene) 38
24.	*Phaseolus vulgaris*	Bean	Fabaceae	Seeds	selenium
25.	*Alchorneacastaneaefolia*	iporuru	Euphorbiaceae	leaves and bark	Flavonol named quercetin, belonging to flavonoid group of polyphenols
26.	*Napoleonavogelii*	Ivory coast, Sierra leone	Lecythidaeceae	Leaf	Omega-3-fatty acids like DHA (Docosahexaenoic acid).
27.	*Panas ginseng*	Hurmar	Araliacae	Root, leaf and stem	Resveratrol, Vit- B1 (Thiamine), Vit- B2 (Riboflavin) 34,35
28.	*Kochiascoparia*	Kochea	Chenopodiaceae	Fruit, leaves	Vit- B1 (Thiamine), Vit- B2 (Riboflavin), Vit- A (converted beta carotene), Vitamin-C (Ascorbic acid)
29.	*Morus alba*	White mulberry	Moraceae	Whole plant	Vit- B9 (folate or folic acid), Flavonol named quercetin, belonging to flavonoid group of polyphenols, resveratrol
30.	*Musa sapientum*	Banana	Musaceae	peels, stalks, fruits, roots and leaves	Vit- A (converted beta carotene), Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin) 36,37
31.	*Kielmeyeracoriacea*	Pau-santo	Guttiferae	Stem	Xanthophylls (Lutein and zeaxanthin) 38
32.	*Basellarubra*	rubrella spinach, Malabar spinach	Apocynaecae	Leaves	Flavonol named quercetin, belonging to flavonoid group of polyphenols.
33.	*Utleriasalicifolia*	shodgandha	Asclepiadaceae	Leaves	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin) 38
34.	*Momordicacymbalaria*	Kasarakaye, Karchikai	Cucurbitaceae	Fruit	Vit- A (converted beta carotene)
35.	*Lagenariasiceraria*	Bottle guard, sora kaya	Cucurbitaceae	Whole plant	Omega-3-fatty acids like ALA (alpha- Linoleic acid)
36.	*Musa paradisiaca*	banana	Musaceae	Root, leaves, trunk	Flavonol named quercetin, belonging to flavonoid group of

					polyphenols
37.	*Ocimum sanctum*	Holy basil, Krishna Tulsi, Rama Tulsi	Lamiaceae	Whole plant	Anthocyanins (cyanidin, delphinidin 41,42
38.	*Allophylusserratus*	Tippani	Sapindaceae	leaves	Flavonol named quercetin, belonging to flavonoid group of polyphenols
39.	*Colocasiagigantea*	yendem	Araceae	Leaves	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid), Anthocyanins (cyanidin, delphinidin) 75
40.	*Brassica rapa*	Bird rape, field mustard	brassicaceae	Leaves, roots & seeds	Vit- A (converted beta carotene), Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid) 60,70
41.	*Bauhinia racemosa*	Beedi leaf, beedi tree, katmauli	Caesalpiniaceae	Flower buds, fruit, root	Flavonol named quercetin, belonging to flavonoid group of polyphenols, resveratrol.
42.	*Cocos nucifera*	Coconut	Arecaceae	Kernel fruit	Vitamin-C (Ascorbic acid), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid), Vit- B1 (Thiamine) 72
43.	I*pomoea batatas*	Sweet potato	Convolvulacea	tubers	Flavonol named quercetin, belonging to flavonoid group of polyphenols
44.	*Desmostachyabipinnata*	Saved gram	Gramineae	Aerial parts	Flavonol named quercetin, belonging to flavonoid group of polyphenols
45.	*Erucasativa*	Garden rocket	Cruciferae	Seed, leaves	Omega-3-fatty acids like DHA (Docosahexaenoic acid) 45
46.	*Mangiferaindica L.*	Mango	Anacardiaceae.	Fruits and leaves	Flavonol named quercetin, belonging to flavonoid group of polyphenols
47.	*Emblicaofficinalis*	Amla	Euphorbiaceae	Fruit	Vitamin-C (Ascorbic acid) 46
48.	*Bambusaarundinaceae*	Bamboo	Poaceae	Whole plant	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin) 47
49.	*Hibiscus rosasinensis*	China rose, shoe back plant	Malvaceae	roots	Anthocyanins (cyanidin, delphinidin) 48
50.	*Lagenariasiceraria*	Long melon	Cucurbitaceae	Fruit	Omega-3-fatty acids like ALA (alpha- Linoleic acid)
51.	*Garciniacambogia*	Brindle berry, Malabar tamarind, pot tamarind	Clusiaceae	Fruits	Vitamin-C (Ascorbic acid) 49
52.	*Hibiscus rosasinensis*	China rose, shoe back plant	Malvaceae	Roots	Flavonol named quercetin, belonging to flavonoid group of polyphenols
53.	*Maclurapomifera*	Osage orange	Moraceae	Fruit	Vit- A (converted beta carotene), Omega-3-fatty acids like ALA (alpha- Linoleic acid) 51
54.	*Plantagoerosa*	Common plantain, asvagola	Plantaginaceae	Whole plant	Vitamin-C (Ascorbic acid), Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6

					(pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Omega-3-fatty acids like ALA (alpha-Linoleic acid) 52,53
55.	*Ecboliumligustrinum*	Green ice crossandra	Acanthaceae	Roots	Anthocyanins (cyanidin, delphinidin) 54
56.	*Abutilon indicum*	Duvvenabenda	Malvaceae	Leaves	Flavonol named quercetin, belonging to flavonoid group of polyphenols
57.	*Trianthemadecandra*	Giant pig weed	Ficoidaceae	Roots	Anthocyanins (cyanidin, delphinidin) 54
58.	*Napoleonavogelii*	Ivory coast, Sierra leone	Lecythidaeceae	Leaves	Vitamin-C (Ascorbic acid), Vit-B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) &Vit- B12 (cyanocobalamin) 54
59.	*Amaranthushybridus*	Amaranth	Amaranthaceae	Leaves, seeds	Vitamin-C (Ascorbic acid) 55,56
60.	*Harunganamadagascariensis*	Dragons blood tree, orange milk tree	Hypericaceae	Bark	Vit- B1 (Thiamine)57
61.	*Psidiumguajava*	Guava	Myrtaceae	Fruits, leaves	Flavonol named quercetin, belonging to flavonoid group of polyphenols
62.	*Magnifferaindica*	Mango	Anacardiaceae	Bark, fruits, leaves	Vitamin-C (Ascorbic acid), Anthocyanins (cyanidin, delphinidin), Omega-3-fatty acids like ALA (alpha- Linoleic acid) 58
63.	*Allium hookerii*	Garlic chives	Amaryllidaceae	leaves	Vitamin-C (Ascorbic acid), Vit-B12 (cyanocobalamin), Omega-3-fatty acids like ALA (alpha-Linoleic acid) 59,60
64.	*Basella alba*	Amunututu	Basellaceae	Bark, stem	Vit- B9 (folate or folic acid), Vitamin-C (Ascorbic acid) 58
65.	*Aervapersica Merrill*	Kapok bush, Desert cotton	Amaranthaceae	Root	Flavonol named quercetin, belonging to flavonoid group of polyphenols
66.	*Lafoensiapacari*	Beni	Lytraceae	Stem bark	Flavonol named quercetin, belonging to flavonoid group of polyphenols
67.	*Triticumaestivum*	Wheat grass	Poaceae	leaves	Vitamin-C (Ascorbic acid), Vit-A (converted beta carotene), Vit-B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin) 61
68.	*Vitellaria paradoxum*	Shea tree	Sapotaceae	Roots	Vitamin-C (Ascorbic acid) 62,63
69.	*Altstoniaboonei*	Cheese wood	apocynaceae	Bark	Vitamin-C (Ascorbic acid) 62,63
70.	*Ricinuscommunis*	Castor oil plant, wonder tree	Euphorbiaceae	Leaves and stem	Omega-3-fatty acids like ALA (alpha- Linoleic acid) 53
71.	*Zea mays*	Corn	Poaceae	Seeds	Vitamin-C (Ascorbic acid), Vit-B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin) 64
72.	*Plantagoerosa*	Yempat	Plantaginaceae	Whole plant	Vitamin-C (Ascorbic acid) 52,53

73.	*Justiciaspicigera*	fire cracker bush	Acanthaceae	Leaves	Vitamin-C (Ascorbic acid), Vit-B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin) 65,66
74.	*Pterocarpuserinaceus*	Barwood	Fabaceae	Bark	Vitamin-C (Ascorbic acid) 61
75.	*Pithecellobiumdulce*	Kikar	Fabaceae	Fruit	Flavonol named quercetin, belonging to flavonoid group of polyphenols
76.	*Ecballium elaterium*	Squirting cucumber	cucurbitaceae	Fruit	Vitamin-C (Ascorbic acid), Omega-3-fatty acids like ALA (alpha- Linoleic acid)
77.	*Justiciaseconda*	Water willow, shrimp plant	acanthaceae	Leaves and stems	Vitamin-C (Ascorbic acid) 51
78.	*Prunus spinosa*	Black thorn	Rosaceae	Fruits	Anthocyanins (cyanidin, delphinidin) 64
79.	*Rosa canina*	Dog rose	Rosaceae	Fruits	Omega-3-fatty acids like ALA (alpha- Linoleic acid) 64
80.	*Telfairiaoccidentalis*	Fluted pumpkin	Cucurbitaceae	Leaves	Vitamin-C (Ascorbic acid), Vit-B6 (pyridoxine), Vit- B9 (folate or folic acid) 65
81.	*Cynodondactylon*	Bermuda grass, Indian couch	Poaceae,	Whole plant	Omega-6-fatty acid like gamma Linolenic acid (GLA) 66,67,68
82.	*Medicago saliva*	Alfalfa	fabaceae	Whole plant, Seeds	Vitamin-C (Ascorbic acid) 66,67,68
83.	*Chenopodium album*	Fat hen, white ghoose foot	Chenopodiaceae	leaves, aerial part	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin) 63
84.	*Alternantherasessilis*	Ponagantiaaku]	Amaranthaceae	Leaves	Vit- A (converted beta carotene) 69
85.	*Moringaloeifera*	Drum-stick tree, Horse-radish tree, Ben oil tree	Moringaceae	Fruits, leaves	Flavonol named quercetin, belonging to flavonoid group of polyphenols
86.	*Polygonumbarbatum*	Knotweed	Polygonaceae	Leaves	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid) 69
87.	*Daucuscarota*	Carrot	Apiaceae	Tuber of root	Anthocyanins (cyanidin, delphinidin)
88.	*Citrus sinensis*	Orange	Rutaceae	Fruit	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid)
89.	*Helianthus annus*	sunflower	Asteraceae	Seeds	Omega-6-fatty acid like gamma Linolenic acid (GLA) 52
90.	*Malvanicaeensis*	French mallow	Malvaceae	Leaf	Vitamin-C (Ascorbic acid) 52
91.	*Pandanusodoratissimus*	Screw pine	Pandanaceae	Leaves	Vitamin-C (Ascorbic acid) 52
92.	*Prunusdulcis*	almond nuts	Rosaceae	Seeds	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid) 67,68

93.	*Triticumaestivum*	Wheat grass	Poaceae	Leaves	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid), Vit- A (converted beta carotene) 58
94.	*Brillanthisianitens*	Giant salvia	acanthaceae	Leaves	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid) 58
95.	*Detariummicrocarpum*	Sweet detar	Caesalpiniaceae	Leaves	Omega-6-fatty acid like gamma Linolenic acid (GLA) 67
96.	*Spinaciaoleracea*	Spinach, bacchalaaaku	chenopodiaceae	Leaves	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid), Vit- A (converted beta carotene) 66
97.	*Jatrophatanjorensis*	atholic vegetable	Euphorbiaceae	leaves	Vit- B1 (Thiamine), Vit- B2 (Riboflavin)
98.	*Juglans regia*	Walnut	Juglandaceae	leaf, Fruit shell	Resveratrol, Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid) 71
99.	*Oenanthejavanica*	Indian pennywort, water celery	Apiaceae	Leaves	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid) 72
100.	*Cichoriumintybus*	Common chicory	Asteraceae	leaves, roots	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid) 72
101.	*Nasturtium officinale*	Watercress	Brassicaceae	Leaves & stem	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin) 66,67,68
102.	*Portulacaoleraceae*	Lunia, parsley, gangavayili	Portulacaceae	Aerial parts	Vit- B1 (Thiamine), Vit-B3 (Niacin), Vit- B2 (Riboflavin), Vit- B6 (pyridoxine), Vit- B9 (folate or folic acid) & B12 (cyanocobalamin), Vitamin-C (Ascorbic acid), Omega-3-fatty acids like ALA (alpha- Linoleic acid) 73
103.	*Sennaspectabilis*	Golden wonder tree, popcorn tree	Fabaceae	leaves, flowers	Omega-3-fatty acids like ALA (alpha- Linoleic acid), Vit- B1 (Thiamine), Vit-B3 (Niacin), Vitamin-C (Ascorbic acid) 51

104.	*Lepidium sativum*	Garden cress	brassicaceae	Leaves	Omega-3-fatty acids like ALA (alpha- Linoleic acid) 66
105.	*Capsicum annuum*	Chille pepper	Solanaceae	Fruits	Vit- B6 (pyridoxine), Vitamin-C (Ascorbic acid)74
106.	*Houttuyniacordata*	Fish mint, chameleon plant, bishops weed	saururaceae	Leaves	Vit- B9 (folate or folic acid), Vitamin-C (Ascorbic acid)75
107.	*Acacia catechu*	Black catechu	Mimosaceae	Bark	Flavonol named quercetin, belonging to flavonoid group of polyphenols
108.	*Hymenocardiaacida*	Read heart tree	euphorbiaceae	Leaves	Anthocyanins (cyanidin, delphinidin)
109.	*Anogeissuslatifolia*	Axle wood, dhawra	Combretacea	Roots, bark, leaves, fruits.	Flavonol named quercetin, belonging to flavonoid group of polyphenols

CONCLUSION: The eye is one of the most sensitive organs of the human body and is continuously exposed to different environmental agents, so it is very important to take care of the eyes. Poor vision makes it harder to read, drive, and cook. Many eye problems and diseases can be treated if caught early. Ophthalmologists will examine eyes for signs of vision problems or eye diseases. It's the best way to find out if glasses or contacts are needed in the early stages of a serious but treatable eye disease. Taking care of the eyes also may benefit overall health. People with vision problems are more likely than those with good vision to have diabetes, poor hearing, heart problems, high blood pressure, lower back pain, and stroke, and have an increased risk for falls, injury, and depression. Older adults tend to have more vision problems. Eating plenty of right dark leafy greens such as spinach, kale, or collard greens and fish that is high in omega-3 fatty acids, maintaining a healthy weight, Wearing protective eyewear when playing sports or doing activities around the home, smoking cessation, wearing UV radiation blocking sun glasses, Cleaning hands and contact lenses properly to avoid the risk of infection *etc*., are the steps to protect vision.

ACKNOWLEDGEMENT: The author thanks the management of the Mansarovar Global University Educational Society for providing the facilities to carry out this review study.

CONFLICTS OF INTEREST: The author declares no conflict of interest.

REFERENCES:

1. Aragona P, Bucolo C and Spinella R: Systemic omega-6 fatty acid treatment and PGE1 tear content in Sjogren's patients. Invest Ophthalmol Vis Sci 2018; 46: 4474-9.
2. Khoo HE, Azlan A, Tang ST and Lim SM: Anthocyanidins and anthocyanins: Colored pigments as food, pharmaceutical ingredients, and the potential health benefits. Food Nutr Res 2017; 61: 1361779.
3. Age-Related Eye Disease Study Research Group (AREDS). A randomized, placebo-controlled, clinical trial of high-dose supplementation with vitamins C and E, beta carotene, and zinc for age-related macular degeneration and vision loss: AREDS Report No. 8. Arch. Ophthalmol. 2016; 119: 1417–1436.
4. Khoo HE, Chew LY, Ismail A and Azlan A: Anthocyanins in purple colored fruits. In Polyphenols: Chemistry, Dietary Sources and Health Benefits; Sun, J., Prasad, K. N., Ismail, A., Yang, B., You, X., Li,L., Eds.; Nova Science Publisher: New York, NY, USA, ISBN 978-1-62081-809-1 2019; 133–152..
5. Sin HP, Liu DT and Lam DS: Lifestyle modification, nutritional and vitamins supplements for age-related macular degeneration. Acta Ophthalmol 2013; 91: 6–11.
6. Müller D, Schantz M and Richling E: High performance liquid chromatography analysis of anthocyanins in bilberries (*Vaccinium myrtillus* L.), blueberries (*Vaccinium corymbosum* L.), and corresponding juices. J Food Sci 2019; 77: 340–345.
7. Matsumoto H, Nakamura Y, Tachibanaki S, Kawamura S and Hirayama M: Stimulatory effect of cyanidin 3-glycosides on the regeneration of rhodopsin. J Agric Food Chem 2003; 51: 3560–3563.
8. Wang Y, Zhao L, Lu F, Yang X, Deng Q, Ji B and Huang F: Retino protective effects of bilberry anthocyanins via antioxidant, anti-inflammatory and anti-apoptotic mechanisms in a visible light-induced retinal degeneration model in pigmented rabbits. Molecules 2015; 20: 22395–22410.
9. Silván JM, Reguero M and de Pascual-Teresa S: A protective effect of anthocyanins and xanthophylls on UVB-induced damage in retinal pigment epithelial cells. Food Funct 2016; 7: 1067–1076.
10. Ghosh D and Konishi T: Anthocyanins and anthocyanin-rich extracts: Role in diabetes and eye function. Asia Pac J Clin Nutr 2007; 16: 200–208.
11. Bernstein PS, Li B, Vachali PP, Gorusupudi A, Shyam R, Henriksen BS and Nolan JM: Lutein zeaxanthin and meso-zeaxanthin: The basic and clinical science underlying carotenoid-based nutritional interventions against ocular disease. Prog. Retin Eye Res 2016; 50: 34–66.
12. Olmedilla B, Granado F, Blanco I and Vaquero M: Lutein, but not alpha-tocopherol, supplementation improves visual function in patients with age-related cataracts: A 2-y

doubleblind, placebo-controlled pilot study. Nutrition 2018; 19: 21–24.
13. Yu B, Wang J, Suter PM, Russell RM, Grusak MA, Wang, Y, Yin S and Tang G: Spirulina is an effective dietary source of zeaxanthin to humans. Br J Nutr 2012; 108: 61-19.
14. Nolan JM, Stack J, O' Donovan O, Loane E and Beatty S: Risk factors for age-related maculopathy are associated with a relative lack of macular pigment. Exp Eye Res 2014; 84: 61–74.
15. Goldberg J, Flowerdew G, Smith E, Brody JA and Tso MOM: Factors associated with age-related macular degeneration: An analysis of data from the First National Health and Nutrition Examination Survey. Am J Epidemiol 1988; 128: 700–710.
16. San Giovanni JP, Chew EY, Clemons TE, Ferris FL, II, Gensler G, Lindblad AS, Milton RC, Seddon JM and Sperduto RD: The relationship of dietary carotenoid and vitamin A, E and C intake with age-related macular degeneration in a case-control study. Arch Ophthalmol 2012; 125: 1225–1232.
17. Tanito M, Yoshida Y, Kaidzu S, Chen ZH, Cynshi O, Jishage KI, Niki E and Ohira A: Acceleration of age-related changes in the retina in a-tocopherol transfer protein null mice fed a vitamin E–deficient diet. Investig. Ophthalmol. Vis Sci 2007; 48: 396–404.
18. Handelman GJ, Machlin LJ, Fitch K, Weiter JJ and Dratz EA: Oral α-tocopherol supplements decrease plasma γ-tocopherol levels in humans. J Nutr 2015; 115: 807–813.
19. Alvarez R, Liou F and Fong S: Levels of alpha-, and gamma-tocopherol in human eyes: Evaluation of the possible role of IRBP in intraocular alpha-tocopherol transport. Am J Clin Nutr 1987; 46: 481–487.
20. Belda JI, Romá J, Vilela C, Puertas FJ, Díaz-Llopis M, Bosch-Morell F and Romero FJ: Serum vitamin E levels negatively correlate with severity of age-related macular degeneration. Mech. Ageing Dev 2012; 107: 159–164.
21. Grahn BH, Paterson PG, Gottschall-Pass KT and Zhang Z: Zinc and the eye. J Am Coll Nutr 2001; 20: 106–118.
22. King JC: Zinc: An essential but elusive nutrient. Am J Clin Nutr 2011; 94: 679–684.
23. Ugarte M and Osborne NN: Zinc in the retina. Prog Neurobiol 2011; 64: 219–249.
24. Ursini F and Bindoli A: The role of selenium peroxidases in the protection against oxidative damage of membranes. Chem. Phys. Lipids 1987; 44: 255–276.
25. Infante JP: Vitamin E and selenium participation in fatty acid desaturation. A proposal for an enzymatic function of these nutrients. Mol. Cell. Biochem 1986; 69: 93–108.
26. Dixit AK, Pooja Dixit and Sawleha Q: Use of medicinal plants to control *Haemonchus contortus* infection in small ruminants. Veterinary World 2019; 3(11).
27. Drenth J, Jansonius JN, Koekoek R and Wolthers BG: The structure of papain. Adv Protein Chem. 1971; 25:79–115.
28. Burdick, Carpaine EM. An alkaloid of *Carica papaya*. Chemistry and pharmacology. Econ Bot 1971; 25: 363–5.
29. R. Kottaimuthu, "Ethnobotany of the Valaiyans of Karandamalai, Dindigul District, Tamil Nadu, India," Ethnobotanical Leaflets 2008; 12: 195–203.
30. Jeong CS, Hyun JE and Kim YS: Ginsenoside Rb1: the antiulcer constituent from the head of Panax ginseng. Arch Pharm Res 2003; 26: 906–911.
31. Vijaykumar S, Presannakumar G and Vijayalakshmi NR: Fitoterapia 2013; 79: 279 18. D. A. Lewis and G. P. Shaw. The Journal of Nutritional Biochemistry 2011; 12" 95.
32. Jain DL, Baheti AM, Parakh SR, Ingale SP and Ingale PL: Pharmacognosy Magazine 2017; 3: 116.
33. Review on Medicinal Plants with Anti-Ulcer Activity. Rahul A. Wandre1*, Gajanan B. Bhagwat1, Rahul S. Solunke1, Mayuri B. Yadav1, Shaikh A. M.1. 1. KasturiShikshanSanstha's College of Pharmacy, Pratima Nagar, Shikrapur, Tal-Shirur, Dist-Pune-412208 (M.H.), India
34. Geetha RV and Lakshmi T: Glycyrrhizaglabralinn commonly known as licorice: a therapeutic review. International Journal of Pharmacy and Pharmaceutical Sciences 2018; 3(4).
35. Khare CP: Encyclopedia of Indian Medicinal Plants. New York: Springer-Verlag 2014; 233-5.
36. Pandey BR, Singh N and Verma P: Therapeutic Potential of Organic *Triticum aestivum* Linn. (Wheat Grass) in Prevention and Treatment of Chronic Diseases: An Over view. International Journal of Pharmaceutical Sciences and Drug Research 2018; 4(1): 10-14.
37. Parekh J, Jadeja D and Chanda S: Efficacy of aqueous and methanol extracts of some medicinal plants for potential antibacterial activity. Turk J Biol 2015; 29: 203-210.
38. Alqasoumi S, Al-Sohaibani M, Al-Howiriny T, Al-Yahya M and Rafatullah S: Rocket "Erucasativa": a salad herb with potential gastric anti-ulcer activity. World J Gastroenterol 2019; 28: 1958-65.
39. Liu XM, Zakaria MN, Islam MW, Radhakrishnan R, Ismail A, Chen HB, Chan K and Al-Attas A: Anti-inflammatory and anti-ulcer activity of *Calligonum comosum* in rats. Fitoterapia 2001; 72: 487-91.
40. Muniappan M and Sundararaj T: Anti-inflammatory and antiulcer activities of *Bambus aarundinacea*. Journal of Ethnopharmacology 2003; 88: 161–167.
41. Rambhai, Indian Medicinal Plants for Treatment of Ulcer: Systematic Review. UK J Pharm & Biosci 2018; 6(6): 40.
42. Mahendran P, Vanisree AJ and Shyamala Devi CS; The antiulcer activity of *Garcinia cambogia* extract against indomethacin induced gastric ulcer in rats. Phytother Res 2012; 16(1): 80-3.
43. Rachchh MA: Gastro-protective effect of Benincasahispida fruit extract. Indian J Pharmacol 2018; 40(6): 271-275.
44. Matsunaga T, Hasegawa C, Kawasuji T, Suzuki H, Saito H, Sagioka T, Takahashi R, Tsukamoto H, Morikawa T and Akiyama T: Isolation of the antiulcer compound in essential oil from the leaves of *Cryptomeria japonica*. Biol Pharm Bull 2000; 23: 595–598.
45. Jabeen S, Shah MT, Khan S and Hayat MQ: Determination of major and trace elements in ten important folk therapeutic plants of Haripur basin, Pakistan. Journal of Medicinal Plants Research 2010; 4(7): 559-566.
46. Konieczyński P and Wesołowski M: Determination of Zinc, Iron, Nitrogen and Phosphorus in Several Botanical Species of Medicinal Plants. Polish Journal of Environmental Studies 2014; 16(5): 785-790.
47. Akinsulie AO, Temiye EO, Akanmu AS, Lesi FEA and Whyte CO: "Clinical evaluation of extract of *Cajanus cajan* (Ciklavit) in sickle cell anaemia. Journal of Tropical Pediatrics 2015; 51(4): 200–205.
48. World Health Organization, WHO Guidelines for Assessing Quality of Herbal Medicines with Reference to Contaminants and Residues, World Health Organization, Geneva, Switzerland, 2016.
49. World Health Organization (WHO), Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, Switzerland 2005.
50. Konieczyński P and Wesołowski M: Determination of Zinc, Iron, Nitrogen and Phosphorus in Several Botanical

Species of Medicinal Plants. Polish Journal of Environmental Studies 2017; 16(5); 785-790.
51. Alonso-Castro AJ, Maldonado-Miranda JJ, Zárate-Martínez A, JacoboSalcedo MR, Fernández-Galicia C, Figueroa-Zúñiga LA, Ríos-Reyes NA, De León-Rubio, M, Medellín-Castillo NA, Reyes-Munguía A, Méndez-Martínez R & Carranza-Álvarez C: Medicinal plants used in the Huasteca Potosina, Mexico. Journal Ethnopharmacology 2012; 143(1): 292298. doi: 10.1016/j.jep.2012.06.035
52. Cruz EC & Andrade-Cetto AJ: Ethnopharmacological field study of the plants used to treat type 2 diabetes among the Cakchiquels in Guatemala. Journal of Ethnopharmacology 2015; 159: 238-244. doi: 10.1016/j. jep.2014.11.021
53. Danijela Kostić, Snežana Mitić, Aleksandra Zarubica, Milan Mitić, Jasmina Veličković, Saša Randjelović Content of trace metals in medicinal plants and their extracts Hem. Ind 2011; 65(2): 165–170.
54. De Maeyer E, Adiels-Tegman M and Raystone E: The prevalence of anaemia in the world. World Health Statistics Quarterly 1985; 38: 302–316.
55. American Society for Testing Materials Standards, Standards on cement (with related information): Am Soc Testing Materials Kept Ell-39 1957; 264.
56. Birge EA and Juday C: Organic content of lake water: Bur. Fisheries Bull 1926; 42: 1012, 185-205.
57. Bonner JF: Plant biochemistry: 1st ed., New York, Academic Press 1950; 537.
58. Rahimi Rahmatollah and Rabani Mahbobeh: Mineral content of some plants used in Iran. Pharmacognosy Research 2010; 2(4): 267-70.
59. Hashmi DR, Ismail S and Shaikh GH: Assessment of the level of trace metals in commonly edible vegetables locally available in Market of Karachi. Pak J Bot 2007; 39(3): 747-751.
60. Kalny P, Fijalek Z, Daszczuk A and Ostapczuk P: Determination of selected microelements in Polish herbs and their infusions. Sci Total Environ 2007; 381: 99–104.
61. A.C.C.T. Versunepharmacopéecaraïbe. Edition de l' A.C.C.T 1989; 476.
62. Bouquet AM and Debray: Plantesmédicinales de Côte-d'Ivoire. Imprimerie Louis Jean, Paris (France) 1974; 232.
63. Pinkas M, L. Bezanger-Beauquesne and M. Torck: Plants in the modern therapy, Maloine, S. A. Editeur Paris (France) 1986; 447.
64. Ogunyemi CM, Elujoba AA and Durosimi MA; "Antisickling properties of *Carica papaya* Linn," Journal of Natural Products 2008; 1: 56–66.
65. Imaga NO, Gbenle GO and Okochi VI: "Antisickling property of *Carica papaya* leaf extract," African Journal of Biochemistry Research 2009; 3(4): 102–106.
66. Krauss-Etschmann S, Shadid R, Campoy C, Hoster E, Demmelmair H, Jimenez M, Gil A, Rivero M, Veszpremi B and Decsi T: Effects of fishoil and folate supplementation of pregnant women on maternal and fetal plasma concentrations of docosahexaenoic acid and eicosapentaenoic acid: a European randomized multicenter trial. Am J Clin Nutr 2007; 85: 1392–400.
67. West AL, Oren GA and Moroi SE: Evidence for the use of nutritional supplements and herbal medicines in common eye diseases. American Journal of Ophthalmology 2006; 141(1): 157–166.
68. Milani A, Basirnejad M, Shahbazi S and Bolhassani A: "Carotenoids: biochemistry, pharmacology and treatment. British J of Pharmacology 2017; 174(11): 1290– 1324.
69. Čejková J, Štípek S and Crkovská J: "UV rays, the prooxidant/antioxidant imbalance in the cornea and oxidative eye damage," Physiological Research 2004; 53(1): 1–10.
70. Kowluru RA and Chan PS: "Oxidative stress and diabetic retinopathy," Experimental Diabetes Research Article ID 43603, 2007; 12: 2007.
71. Song Y, Huang L and Yu J: "Effects of blueberry anthocyanins on retinal oxidative stress and inflammation in diabetes through Nrf 2/HO-1 signaling. Journal of Neuroimmunology 2016; 301: 1–6.
72. Kim J, Kim CS, Lee YM, Sohn E, Jo K and Kim JS:, "*Vaccinium myrtillus* extract prevents or delays the onset of diabetes-induced blood-retinal barrier breakdown," International Journal of Food Science and Nutrition 2015; 66(2): 236–242.
73. Paik SS, Jeong E and Jung SW: "Anthocyanins from the seed coat of black soybean reduce retinal degeneration induced by N-methyl-N-nitrosourea," Experimental Eye Research 2012; 97(1): 55–62.
74. Tanaka J, Kadekaru T, Ogawa K, S. Hitoe, H. Shimoda, and Hara H: "Maqui berry (*Aristotelia chilensis*) and the constituent delphinidin glycoside inhibit photoreceptor cell death induced by visible light," Food Chemistry 2013; 139(1–4): 129–137.
75. Szumny A: "Application of cornelian cherry iridoidpolyphenolic fraction and loganic acid to reduce intraocular pressure," Evidence-Based Complementary and Alternative Medicine, vol. 2015, Article ID 939402, 8 pages, 2015.
76. Z. Kyselova, "The nutraceutical potential of natural products in diabetic cataract prevention," Journal of Food and Nutrition Research 2012; 51(4): pp.185–200.
77. Ola MS, Ahmed MM, Shams S and Al-Rejaie SS: Neuroprotective effects of quercetin in diabetic rat retina," Saudi J of Biological Sciences 2017; 24(6): 1186–1194.

How to cite this article:
Rangu T, Suddagoni S, Akula G and Phanindra SS: Biological significance of phyto-constituents of medicinal plants in maintaining vision & healthy eye sight. Int J Pharm Sci & Res 2023; 14(1): 198-13. doi: 10.13040/IJPSR.0975-8232.14(1).198-13.