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Medicinal plants with antiocular activities

Amit Semwal, Virendra Kumar, Saraswati Prakash Bhatt, Kumar Ashok

Shree Dev Bhoomi Institute of Education, Science and Technology, Poundha, Dehradun, Uttarakhand, India.

Abstract
This review summarizes the literature on antiocular activities of medicinal plants used for the treatment of ocular disorder in the indigenous system of medicine. Herbal medicine have been used as traditional treatment for numerous human diseases for thousands of years in many parts of the world. Herbal medicine is still the mainstay of about 75–80% of the world population, mainly in the developing countries, for primary health care because of better cultural acceptability, better compatibility with the human body and lesser side effects. Eye is one of the most sensitive organ of human body and is permanently exposed to different environmental agents. The common ocular diseases are glaucoma, conjunctivitis, cataract, ocular allergies, ocular inflammation etc. Cataract is the main cause of blindness in the world, responsible for approximately 50% of the existing cases in both developed and developing countries. Glaucoma is a group of eye diseases that damage the optic nerve. Glaucoma remains a leading cause of blindness in adults over 60 years. Conjunctivitis is the disease when the mucous membrane on the inner surface of the eyelid is irritated. Conjunctiva is a thin, translucent membrane lining the anterior part of the sclera and inside of the eyelids. In this short review an attempt has been made to review some of the medicinal plants which proved to be beneficial in the treatment of different ocular disease such as *Cassia fistula* (L.), *Capsicum frutescens* L., *Capparis zeylanica* L., *Catharanthus roseus* L., *Camellia sinensis* (L.) Kuntze, *Caesalpinia volkensii* Harms, *Buddleja officinalis* Maxim, *Cheilanthes glauca* (Cav.) Mett, *Centella asiatica* (L.) Urb., *Curcuma longa* Linn., *Emblica officinalis, Erythrina indica* Lam., *Eucalyptus deglupta*, *Eugenia borinquensis*, *Eugenia jambolana*, *Ginkgo biloba* L., *Lantana camara* L, *Mangifera indica* L., *Ocimum sanctum* Linn, *Plantago ovata* Forssk., *Tagetes erecta* L., *Tamarindus indica* L., *Terminalia arjuna* L., *Tinospora cordifolia, Tribulus terrestris* L., *Withania Somnifera* Linn., *Zingiber officinalis.* The eye infection is caused by various microorganisms *Streptococcus pneumonia, Haemophilus influenzae, Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa.* Due to side effects of allopathic drugs, now a day's huge numbers of herbal drugs are used for treatment of ocular diseases.

Keywords: Ocular diseases, glaucoma, conjunctivitis, ocular infection, cataract, herbal drugs

Introduction
From ancient times, plants have been used for curing several ailments of mankind and pet animals. Even today with advancement of allopathic medicine, tribal people and rural population are still dependent on the herbs and plants of medicinal interest. Some reports revealed that more than 80% of the world population rely on herbal and traditional medicine [1, 2]. Herbal medicine is still the mainstay of about 75–80% of the world population, mainly in the developing countries, for primary health care because of better cultural acceptability, better compatibility with the human body and lesser side effects. Ethnobotanical expeditions are necessary for the progress of the tribal welfare. The world is endowed with a rich wealth of medicinal plants. These plants are a local heritage with global importance.

Ocular Disease
Glaucoma
Glaucoma is a group of eye diseases that damage the optic nerve. The optic nerve is the main nerve to the eye (located in the back of the eye) that is responsible for transmitting electrical impulses to the brain [3]. Damage usually occurs as a result of elevated pressure of the fluid (aqueous humor) in the eye. This damage results in gradual visual changes and then loss of vision. There are several recognized risk factors for glaucoma, such as an increased intraocular pressure (IOP), aging, family history, high myopia, systemic hypertension, cardiovascular disease, migraine headaches, peripheral vasospasm and prior nerve damage [4]. Possible factors leading to glaucoma include glutamate-induced neurotoxicity, nitric oxide based damage, disruption of neurotrophic factor transport and immune-induced neurodestruction. Glaucoma is sometimes called the silent thief because it can slowly steal your sight before you realize anything's wrong.

i) Open angle (wide angle, chronic simple) glaucoma
It is probably a genetically predisposed degenerative disease affecting patency of the trabecular meshwork which is gradually lost past middle age. The i.o.t. rises insidiously and progressively. Ocular hypotensive drugs are used on a longterm basis and constitute the definitive treatment in majority of cases.

ii) Angle closure (narrow angle, acute congestive) glaucoma
It occurs in individuals with a narrow iridocorneal angle and shallow anterior chamber. The i.o.t. remains normal until an attack is precipitated, usually by mydriasis. The i.o.t.r ISES rapidly to very high values (40-60 mmHg). It is an emergent condition; failure to lower i.o.t. quickly may result in loss of sight.

Cataract
A cataract is opacity of the lens that interferes with vision, and is the most frequent cause of visual impairment worldwide, especially for the elderly because the incidence of cataracts increases with increasing age. From a public health perspective, it is important to identify the risk factors that affect the development and progression of cataract. Cataract is a

multifactorial disease process and is induced by various toxic factors, environmental, stressors, and gene mutations. Although the etiology of each cataract type remains elusive, cataracts are known from studies on many animal models and humans to be associated with damage or death of lens epithelial cells (LECs) [5]. Cataract is the leading cause of blindness worldwide and covers around 42% of overall visual impairment. Cataract is mainly responsible for almost 80% blindness in India [6]. Cataract is also produces by the advanced glycation end products (AGE) is cause of blindness world-wide [7].

Types of Cataract

Based on the causes of the cataract, there are five important types of cataracts seen among humans [8, 9]. Various types of cataracts are described in Table 1.

Table 1: List of various type of cataracts

Type of Cataract	Causative factor	Vulnerable People
Senile Cataract	This cataract is caused due to the opacity of the eye lens by natural ageing process.	Elderly persons, mostly those over the age of 60 years.
Traumatic Cataract	This cataract is caused due to some physical damage to the eye lens capsule, such as that due to the entry of a difficult-to-remove foreign object	People working in hazardous conditions such as welders and those in glass furnaces
Complicated Cataract	This cataract is the complication of some other chronic disease in the person.	Patients of diabetes, emphysema, asthma, etc.
Congenital Cataract	This cataract is caused in infants if the mother had contracted German measles during pregnancy	Newborn infants.
Toxic Cataracts	This cataract is caused due to long term use of medicines or chemicals that are toxic to the eyes	People using eye drops containing prednisone and cortisone for a long time. Also, Smokers asthey inhale toxic fumes which affect the eye lens.

Etiology of Cataract

- Limited consumption of lactose-containing foods (milk products). In animal studies, galactose, a component of lactose, has been shown to promote cataracts formation.
- A riboflavin deficiency has been implicated in cataracts development. Therefore, a supplemental dosage of riboflavin, 10-50 mg/day, may help treat or at least slow the progression of cataracts formation.
- Early development of cataract of lens is due to the increased rate of sorbitol formation, caused by hyperglycemia. Glycosylation of retinal proteins and retinal micro vascular abnormalities lead to retinopathy and blindness [8].
- Glycosylation of lysine residues of lens proteins also causes cataract formation [8, 10, 11].
- Diabetes, oxidation of lens, dehydration, daylight, diet and lipid peroxidation attributes to the generation of lens opacification in elderly persons [12].

Signs of Cataract

Signs of a cataract develop slowly over time.

- Cloudy or blurry vision
- A halo is seen around lights or lights are too bright
- Poor night vision
- Double vision
- Colors seem faded [13].

Conjunctivitis

Conjunctivitis is the disease when the mucous membrane on the inner surface of the eyelid is irritated [14]. Conjunctiva is a thin, translucent membrane lining the anterior part of the sclera and inside of the eyelids. It has 2 parts, bulbar and palpebral. The bulbar portion begins at the edge of the cornea and covers the visible part of the sclera; the palpebral part lines the inside of the eyelids (Figure 1). Inflammation or infection of the conjunctiva is known as *conjunctivitis* and is characterized by dilatation of the conjunctival vessels, resulting in hyperemia and edema of the conjunctiva, typically with associated discharge [15] he prevalence of conjunctivitis varies according to the underlying cause, which may be influenced by the patient's age, as well as the season of the year. Viral conjunctivitis is the most common cause of infectious conjunctivitis both overall and in the adult population [16-22] and is more prevalent in summer [23]. Bacterial conjunctivitis is the second most common cause [16-18,21-22] and is responsible for the majority (50%-75%) of cases in children [23]; it is observed more frequently from December through April[23].Allergic conjunctivitis is the most frequent cause, affecting 15% to 40% of the population,[24] and is observed more frequently in spring and summer [23].

Infectious Conjunctivitis

Viral Conjunctivitis

Viruses cause up to 80% of all cases of acute conjunctivitis [17, 22, 25]. The rate of clinical accuracy in diagnosing viral conjunctivitis is less than 50% compared with laboratory confirmation. Manycases are misdiagnosed as bacterial conjunctivitis. Between 65% and 90% of cases of viral conjunctivitis are caused by adenoviruses [26]. and they produce 2 of the common clinical entities associated with viral conjunctivitis, pharyngoconjunctival fever and epidemic keratoconjunctivitis [27]. Pharyngoconjunctival fever is characterized by abrupt onset of high fever, pharyngitis, and bilateral conjunctivitis, and by periauricular lymph node enlargement, whereas epidemic keratoconjunctivitis is more severe and presents with watery discharge, hyperemia, chemosis, and ipsilateral lymphadenopathy [28]. Lymphadenopathy is observed in up to 50% of viral conjunctivitis cases and is more prevalent in viral conjunctivitis compared with bacterial conjunctivitis [26].

Bacterial Conjunctivitis

Bacterial conjunctivitis can be contracted directly from infected individuals or can result from abnormal proliferation of the native conjunctival flora. [29]. Contaminated fingers, [23]. Oculogenital spread [30] and contaminated fomites [31]. Arecommonroutes of transmission. In addition, certain conditions such as compromised tear production, disruption of the natural epithelial barrier, abnormality of adnexal structures, trauma, and immunosuppressed status predispose to bacterial conjunctivitis [30]. The most common pathogens for bacterial conjunctivitis in adults are staphylococcal species, followed by *Streptococcus pneumoniae* and *Haemophilus influenzae*. In children, the disease is often caused by *H influenzae*, *S pneumoniae*, and *Moraxella catarrhalis* [32]. The course of the disease usually lasts 7 to 10 days (Figure 1) [27].

Fig 1: Bacterial Conjunctivitis, Hyperacute bacterial Conjunctivitis, Viral Conjunctivitis

Symptoms Included: Itchy, watery, bloodshot eyes, pain and, on occasion, blurred vision [33].

Ocular Infection

Bacterial eye infections

The eye infection is caused by various microorganisms *Streptococcus pneumonia, Haemophilus influenzae, Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Staphylococcus epidermidis, Bacillus cereus, Chlamydia trachomatis* and *Neisseria gonorrhea* [34-38]. The most common causative agents for external ocular infections are *S. aureus* and *S. epidermidis* [34, 35]. Trachoma is caused by *C. trachomatis*. It is the world's leading infectious cause of blindness and the leading cause of ocular morbidity [39]. According to WHO, there are 146 million people worldwide with trachoma. Symptoms of bacterial eye infections include burning; irritation, tearing and usually a mucopurulent or purulent discharge. Eyelids may be stuck together, particularly in the mornings. Although bacterial eye infections are usually considered to be self-limiting [40], if left untreated they may develop into more serious, sight-threatening conditions.

Fungal eye infections

The eye infections caused by various fungal species are *Fusarium solani, Fusarium oxysporum, Aspergillus Niger, Aspergillus flavus, Candida albicans* and *Penicillium notatum* [41-44]. These infections are difficult to treat and can cause blindness [45]. Symptoms include redness, blurring vision and photophobia. Amphotericin B and Natamycin are of topical ocular use as treatment for fungal eye infections [45-47].

Viral eye infections

Viral infection to the eye is caused by *Herpes simplex virus-1, Adenovirus* and *Coxsackie virus* [48-50]. HSV-1 ocular infection is the leading cause of blindness in developed countries [49]. Over 95% of ocular herpes infections are caused by HSV-1 [51]. To date, 51 human adenovirus serotypes have been described, grouped into six species (A–F). In particular, species D infects the eyes [50]. Viral eye infections are highly contagious and are spread by contact, usually with objects which have come into contact with the infected person's eye secretions. For example, the virus can be transmitted when infected persons touch their eyes and then touché another surface (e.g. door handle) or share an object that has touched their eyes (e.g. a towel or pillow case) [52].

Ocular injuries

In the working place, usually related to exposure to industrial chemical substances e.g. acid and alkaline, radiation energy e.g. ultra-violet light or even direct trauma. Ocular injuries by saps of plants are uncommon but can result in serious ocular complications [53].

List of herbs which are used in the treatment of glaucoma

S. No	Common name	Botanical name	Action in relation to Glaucoma	Reference
1.	Forskolin (kaffir potato)	Coleus forskohlii	Reduce fluid production by improving the level of cyclic AMP, Activates the adenylate cylase	[54-55]
2.	Ginkgo biloba	Ginkgo biloba	Protect retinal photoreceptor against light induced damage	[56-58]
3,	Dan shen/ asian red sage	Salvia miltiorrhiza	Inhibit TNF alpha induced activation of Nkkβ and protect against ganglion cell loss	[58]
4.	Pycnogenol	French maritime pine bark(pinus pinaster	Protect vascular endothelial cell by A β induced injury	[58]
5.	Resveratrol	Skin of red grapes	Antioxidant	[58]
6.	Grape seed extract	Grape seeds	Scavenges free radicals and nitric acid	[58-59]
7.	Quercetine	Red wine, ginkgo biloba extract	Inhibit the release of NO and TNF α	[58-60]

8.	Ginseng	Panax ginseng	Neuroprotection by inhibiting NMDDA also attenuate glutamate induced toxicity	[61]
9.	Fennel	Foeniculum vulgare	Antioxidant and NO scavenging	[62]
10.	Indian Gooseberry	Emblica officinalis	Antioxidants	[63]
11.	Marijuanna	Cannabis sativa	Act on CB1 receptor to control the IOP	[63-66]
12.	Oregano	Organum vulgare	Antioxidants(neutralize naturally occurring highly reactive oxygen molecule(free radicals)	[67]
13.	Pansy	Viola species	Antioxidants	[67]
14.	Shepherds purse	Cap-sella bursa pastoris	Antioxidant	[67]
15.	Jaborandi	Pilocarpus, various species	Choline esterase inhibitors	–
16.	Bilberry	Vaccinium myritilleus	Retard the breakdown of Vit.c Protect against breakdown of rhodospin	[67-68]
17.	Omega 3 fatty acid	Algae, nut oil, flaxseed, canola, soyabean	Modify the activity of retinal enzymes	[69]
18.	Arctigenin	Torreya nucifra Atrium lappa	Inhibit TNF α and NO production	–
12.	Oregano	Organum vulgare	Antioxidants(neutralize naturally occurring highly reactive oxygen molecule(free radicals)	[67]
13.	Pansy	Viola species	Antioxidants	[67]
14.	Shepherds purse	Cap-sella bursa pastoris	Antioxidant	[67]
15.	Jaborandi	Pilocarpus, various species	Choline esterase inhibitors	–
16.	Bilberry	Vaccinium myritilleus	Retard the breakdown of Vit.c Protect against breakdown of rhodospin	[67-68]
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18.	Arctigenin	Torreya nucifra Atrium lappa	Inhibit TNF α and NO production	–

List of Chinese herbs which are used in the treatment of glaucoma [70]

S. No.	Common name	Botanical name	Action in Relation to Glaucoma
1.	Hoelen	Poria cocos	promote diuresis, eliminate dampness, invigorate spleen, alleviate phlegm retention
2.	Atractylodes	Atractylodes macrocephala	invigorate the spleen, deprive dampness and promote diuresis
3.	Polyporus	Polyporus umbellatus	promote diuresis, for dampness retention syndrome
4.	Alisma	Alisma orientale	promote diuresis, eliminate dampness, expel heat
5.	Plantago seed	Plantago asiatica	clear away heat, promote diuresis, improve visual acuity
6.	Pinellia	Pinellia ternata	deprive dampness and eliminate phlegm, disperse stagnation
7.	Arisaema	Arisaema erubescens	deprive dampness and eliminate phlegm
8.	Bamboo	Phyllostachys nigra	clear away heat to cool the blood, clear away lung heat to eliminate phlegm
9.	Platycodon	Platycodon grandifolium	eliminate phlegm
10.	Chih-shih	Citrus aurantium	activate vital energy circulation and eliminate phlegm, disperse stagnation
11.	Citrus	Citrus reticulata	deprive dampness and eliminate phlegm
12.	Antelope horn	Saiga tatarica (now substituted by Procarpa guttorosa, or other species)	clear away heat, calm the liver, clear away liver-fire to improve visual acuity
13.	Gardenia	Gardenia jasminoides	purge fire, clear away heat and promote diuresis, cool blood, remove blood stasis
14.	Moutan	Paeonia suffruticosa	clear away heat, cool the blood, promote blood circulation, remove blood stasis
15.	Bupleurum	Bupleurum chinense	let off heat, disperse stagnated liver energy
16.	Mentha	Mentha haplocalyx	clear away heat from head and eye
17.	Prunella	Prunella vulgaris	clear away liver-fire and calm liver yang, eliminate phlegm and disperse stagnation
18.	Peony	Paeonia lactiflora	calm liver yang, soothe the liver, astringe
19.	Chrysanthemum	Chrysanthemum morifolium	clear away heat, clear away liver-fire to treat eye disease, calm the excess liver energy
20.	Vitex	Vitex trifolia	expel the wind and heat, ease the eye and the head
21.	Phragmites	Phragmites communis	clear away heat, promote diuresis
22.	Scute	Scutellaria baicalensis	clear away heat and deprive dampness
23.	Rehmannia	Rehmannia glutinosa	produce essence and enrich blood, nourish yin
24.	Lycium fruit	Lycium barbarum	nourish yin, enrich blood, benefit essence, and improve visual acuity

Medicinal plants used in treatment of cataract

S. No	Scientific name	Common name	Family	Part used	References
1.	*Abrus precatorius L.*	(Crab's Eye)	Fabaceae	Leaf	[71]
2.	*Acorus calamus* L.	(Sweet flag)	Araceae	Root	[72]
3.	*Adhatoda vasica* (L.)	(Adusa)	Acanthaceae	Flower	[73]
4.	*Aegle marmelos* (L.)	Correa (Bael)	Rutaceae	Leaf	[73-75]
5.	*Ageratum conyzoides* L.	(Goat weed)	Compositeae	Leaf	[76]
6.	*Ajuga bracteosa*	(Bugleweed)	Lamiaceae	Leaf	[77]
7.	*Alangium lamarckii*	Thwaits (Akol)	Alangiaceae	Root bark	[78]
8.	*Allium cepa* L.	(Onion)	Amaryllidaceae	Bulb	[79]
9.	*Allium sativum* L.	(Garlic)	Liliaceae	Bulb	[80-81]
10.	Benth. et Hook	(Dahurian angelica root)	Apiaceae	Root	[82-83]
11.	*Aralia elata* (Miq) Seem.	(Japanese Angelica-tree)	Araliaceae	Whole palnt	[84]
12.	*Artemisia annua* L.	(Sweet Wormwood)	Asteraceae	Leaf, stem	[85]
13.	*Aster koraiensis* Nakai	Nakai (Korean starwort)	Asteraceae	Aerial parts	[86]
14..	*Azadirachta indica*	(Neem)	Meliaceae	Whole plant	[87-88]
15.	*Barleria prionitis* Linn	(Karunta)	Acanthaceae	Leaf	[89-92]
16.	*Bidens pilosa* L.	(Spanish Needle)	Asteraceae	Leaf	[93]
17.	*Biophytum sensitivum* (L.)	(Life Plant)	Oxalidaceae	Leaf	[73]
18.	*Bobgunnia madagascariens*	(Snake bean)	Fabaceae	Seed	[94]
19.	*Brassica oleracea* var. italica	(Cabbage)	Brassicaceae	Flower	[95]
20.	*Brassica juncea* (L.)	(Mustard greens)	Brassicaceae	Leaf	[96]
21.	*Brickellia arguta* B. L. Rob.	(Pungent brickellbush)	Asteraceae	Leaf	[97-98]
22.	*Brillantaisia patula* Ver texto	(Nkon – kohomaneeh)	Acanthaceae	Whole plant	[99]
23.	*Buddleja officinalis* Maxim.	(Pole butterflybush)	Scrophulariaceae	Flower	[100]
24.	*Butea monosperma* (Lam.) Taub.	(Dhak)	Leguminosae	Root	[101]
25.	*Caesalpinia volkensii* Harms	(Msoro)	Leguminosae	Leaf	[76]
26.	*Caesalpinia bonduc* (L.)	(Gray nicker bean)	Caesalpiniaceae	Leaf	[73]
27.	*Camellia sinensis* (L.) Kuntze	(Green tea)	Commelinaceae	Inflorese nces	[102]
28.	*Catharanthus roseus* L.	(Rose Periwinkle)	Apocynaceae	Whole plant	[103]
29.	*Capparis zeylanica* L.	(Indian caper)	Capparidaceae	Leaf, root	[104]
30.	*Capsicum frutescens* L.	(African devil)	Solanaceae	Leaf or whole plant	[105, 76]
31.	*Carissa edulis* (A.Rich.) Stapf.	(Thungulu)	Apocynaceae	Leaf	[106]
32.	*Cassia fistula* (L.)	(Golden shower tree)	Fabeaceae	Leaf	[73]
33.	*Ceasalpinia digyna* Rottler	(Teri pod)	Caesalpiniaceae	Root	[107]
34.	*Centella asiatica* (L.) Urb.	(Indian pennywort)	Umbelliferae	Leaf	[108-189]
35.	*Cheilanthes glauca* (Cav.) Mett	(Doradilla)	Adiantaceae	Leaf	[110]
36.	*Chloroxylon swietenia* DC	(East Indian Satin Wood)	Rutaceae	Stem bark	[111]
37.	*Cineraria maritime* L	(Silver ragwort)	Compositae	Whole plant	[112]
38.	*Cistanche deserticola* Ma	(Desertbroomrape)	Orobandaceae	Whole plant	[113]
39.	*Cleistocalyx operculatus*	(Water fairy flower)	Myrtaceae	Flower bud	[114]
40.	*Clerodendrum* genus L.	(Glorybower)	Lamiaceae	Root	[115]
41.	*Coffea benghalensis* Roxb. ex Schult.	(Cori ful)	Rubiaceae	Flower	[116]
42.	*Colebrooekea oppositifolia* Sm	(Dhurseli)	Lamiaceae	Leaf, root	[117]
43.	*Corydalis turtschaninovii* Besser	(Corydalis tuber)	Fumariaceae	Tuber	[118]
44.	*Crataegus pinnatifida* Bunge	(Hawthorn tree)	Rosaceae	Leaf	[119]
45.	*Crotalaria brevidens* Benth.	(Ethiopian rattlebox)	Fabaceae	Leaf	[76]
46.	*Curcuma longa* Linn.	(Turmeric)	Zingiberaceae	Rhizome	[120-124]
47.	*Dendrobium huoshanense*	(Orchids)	Orchidaceae	Leaf	[125]
48.	*Dregea volubilis*	(Sneeze Wort)	Asclepiadaceae	Leaf	[126]
49.	*Duranta repens L.*	(Golden Dewdrop)	Verbenaceae	Leaf, stem	[127]
50.	*Emblica officinalis*	(Amla)	Euphorbiaceae	Fruit, seed	[128-131]
51.	*Emilia sonchifolia*	(Sadamandi)	Asteraceae	Leaf	[132]
52.	*Enicostemma hyssopifolium*	(Indian gentian)	Gentianaceae	Arial parts	[133]
53.	*Erigeron annuus*	(Annual fleabane)	Asteraceae	Leaf, stem	[134]
54.	*Ervatamia divaricata*	(Crape Jasmine)	Apocynaceae	Whole plant	[135]
55.	*Erythrina indica* Lam.	(Indian Coral Tree)	Fabaceae	Root	[136]

56.	*Erythrina stricta*	(Tiger claw)	Fabaceae	Leaf	[137]
57.	*Eucalyptus deglupta*	(Rainbow Eucalyptus)	Myrtaceae	Leaf	[138]
58.	*Eugenia borinquensis*	(Guayabota De Sierra)	Myrtaceae	Leaf	[139]
59.	*Eugenia jambolana*	(Jambu)	Myrtaceae	Leaf	[140-151]
60.	*Excoecaria cochinchinensis*	(Chinese-Croton)	Euphorbiaceae	Aerial part	[152]
61.	*Ficus golmerata* L.	(Cluster Fig Tree)	Moraceae	Whole palnt	[114]
62.	*Flueggea virosa*	(White berry-bush)	Euphorbiaceae	Leaf, stem	[152]
63.	*Ginkgo biloba* L.	(Maidenhair Tree)	Ginkgoaceae	Leaf	[153-154]
64.	*Gymnema sylvestre*	(Gymnema)	Asclepiadaceae	Whole plant	[155-156]
65.	*Hydrocotyl bonariensis* Lam	(Pennywort)	Apiaceae	Leaf	[157]
66.	*Khaya senegalensis*	(African mahogany)	Meliaceae	Leaf	[152]
67.	*Lantana camara* L.	(Spanish Flag)	Verbenaceae	Leaf	[158]
68.	*Mangifera indica* L.	(Mango)	Anacardiaceae	Bark, Leaf	[140, 159]
69.	*Magnolia fargesii*	(Beaver Tree)	Magnoliaceae	Flower buds	[160]
70.	*Momordica charantia* Linn	(Bitter Gourd)	Cucurbitaceae	Fruit	[161-164, 150]
71.	*Morinda citrifolia* L.	(Canary wood)	Rubiaceae	Whole palnt	[114]
72.	*Moringa oleifera* Lam	(Drumstick Tree)	Moringaceae	Leaf	[165]
73.	*Mucuna priiriens*	(Velvetbean)	Fabaceae	Seed	[150]
74.	*Ocimum basilicum* L.	(Sweet basil)	Lamiaceae	Leaf	[158]
75.	*Ocimum sanctum* Linn	(Tulsi)	Labiatae	Leaf	[166-167, 132, 134]
76.	*Oxalis corniculata* L.	(Chari amilo)	Oxalidaceae	Leaf	[128, 88]
77.	*Plantago ovata* Forssk.	(Desert Indian wheat)	Plantaginaceae	Seed	[168]
78.	*Platycodon grandiflorum*	(Balloon flower)	Campanulaceae	Flower	[145]
79.	*Pleurotus florida*	(Oyster mushroom)	Tricholomataceae	Whole plant	[169]
80.	*Pleurotus ostreatus*	(Oyster mushroom)	Tricholomataceae	Whole Plant	[170]
81.	*Polygonum orientale* L	(Ladyfingers)	Polygonaceae	Aerial part	[152]
82.	*Potentilla fulgens* L.	(Barren strawberries)	Rosaceae	Root	[171]
83.	*Psoralea corylifolia* L.	(Babchi)	Fabaceae	Seed	[114]
84.	*Pterocarpus marsupium*	(Indian kino)	Fabaceae	Bark	[172-174]
85.	*Pueraria lobata*	(Kudzu vine)	Leguminosae	Root	[175-176, 155]
86.	*Pyrus pashia*	(Melu)	Rosaceae	Fruit	[177, 88]
87.	*Salvia miltiorrhiza*	(Spanish Flag)	Lamiaceae	Root	[178]
88.	*Santalum album* L.	(Sandal)	Santalaceae	Wood	[179]
89.	*Scrophularia ningpoensis*	(Ningpo figwort)	Scrophulariaceae	Root	[180]
90.	*Scutellaria baicalensis*	(Radix Scutellariae)	Labiateae	Root	[181-182]
91.	*Silybum marianum*	(Silymarin)	Asteraceae	Seed	[183-185]
92.	*Solanum virginiatum* Linn	(Berkateli)	Solanaceae	Root	[186]
93.	*Stellera chamaejasme* L.	(Stellera)	Thymelaeaceae	Root	[187]
94.	*Syzygium aromaticum*	(Clove)	Myrtaceae	Dried flower Buds	[188]
95.	*Syzygium malaccense*	(Malay Apple)	Myrtacea	Leaf	[140]
96.	*Tagetes erecta* L.	(Marigold flower)	Asteraceae	Flower	[189]
97.	*Tamarindus indica* L.	(Indian Date)	Fabaceae	Leaf, flower, fruit	[191-192]
98.	*Terminalia arjuna* L.	(Arjun tree)	Combretaceae	Bark	[192]
99.	*Terminalia bellerica*	(Vibhethaki)	Combretaceae	Seed, fruit	[193]
100.	*Terminalia chebula*	(Harethaki)	Combretaceae	Fruit	[193]
101.	*Terminaria triptera*	(Ham krai)	Combretaceae	Stem bark	[194]
102.	*Tinospora cordifolia*	(Guduchi)	Menispermaceae	Stem, root, Flower	[195, 150]
103.	*ToxicodendronSuccedaneum* Mill.	(Rhus tree)	Anacardiaceae	Leaf, stem	[138]
104.	*Tribulus terrestris* L.	(Devil's eyelashes)	Zygophyllaceae	Leaf, Flower	[195]
105.	*Tridax procumbens* L.	(Vettukayapundu)	Compositae	Whole plant	[88]
106.	*Trigonella foenum-graecum* L.	(Methi)	Fabaceae	Seed	[196-197, 174]
107.	*Tylophora indica*	(Indian Ipecac)	Asclepiadaceae	Whole plant	[198]
108.	*Vaccinium myrtillus* L.	(Bilberry)	Ericaceae	Leaf	[199-201]
109.	*Vitex nugundo* L.	(Nirgundi)	Verbenaceae	Leaf	[202-203]
110.	*Vitis vinifera* L.	(Grapes)	Vitaceae	Seed	[204]
111.	*Warburgia ugandensis*	(Uganda greenheart)	Canellaceae	Leaf	[205]
112.	*Withania Somnifera* Linn.	(Ashwagandha)	Solanaceae	Leaf	[206, 132]
113.	*Zingiber officinalis*	(Ginger)	Zigiberaceae	Rhizome	[207]

Medicinal plants used in treatment of conjunctivitis

S. No.	Scientific name	Common name	Family	Part used	References
1.	*Abelmoschus esculentus* (L.)	Okra	Malvaceae	Fruit, flower	[208, 209]
2.	*Acacia arabica* (Lam.) Willd	Babul	Mimosaceae	Bark	[210, 211]
3.	*Acacia macracantha* Humb	Faique	Mimosaceae	Bark	[212]
4.	*Aegle marmelos* L. Correa	Bilva patri	Rutaceae	Leaf, fruit	[213-215]
5.	*Ageratum conyzoides*	Goat weed	Compositae	Leaf	[216-220]
6.	*Albizia lebbeck* (L.)	Woman's tongues Tree	Mimosaceae	Leaf, Bark	[221, 222]
7.	*Annickia chlorantha*	African whitewood	Annonaceae	Bark	[223]
8.	*Azadirachta indica* L.	Neem	Meliaceae	Whole plant	[224, 225]
9.	*Berberis asiatica* L.	Kingod	Berberidaceae	Root	[226-230]
10.	*Bidens pilosa* L.	Spanish Needle	Asteraceae	Leaf	[231, 232]
11.	*Boerhavia diffusa* L./	Atukamamidi	Nyctaginaceae	Leaf, root	[233, 234]
12.	*Borago officinalis* L.	Borraja	Boraginaceae	Leaf, flower	[212]
13.	*Caesalpinia volkensii*	Msoro	Leguminosae	Leaf	[235]
14.	*Camellia sinensis* (L.)	Green tea	Commelinaceae	Inflorescences	[235]
15.	*Commelina erecta* L.	slender dayflower	Commelinaceae	Inflorescences	[236]
16.	*Dichrocephala integrifolia*	Kuntze. / Wedahan	Compositae	Leaf	[237, 238]
17.	*Dissotis rotundifolia* (SM)	Triana/ Dissotis	Melastomataceae	Leaf	[239]
18.	*Ervatamia divaricata* (L.)	Burkill/ Crape Jasmine	Apocynaceae	Whole plant	[224, 240]
19.	*Flacourtia indica* (Burm.f.)	Merr. / Rakatsonk	Flacourtiaceae	Leaf	[221]
20.	*Foeniculum vulgare* Mill	Fennel	Apiaceae	Leaf, flower	[212]
21.	*Fumaria officinalis* L	Paptra	Fumariaceae	Leaf, stem, flower	[211]
22.	*Heliotropium indicum* L./	Hatisuri	Boraginaceae	Leaf, root	[241-243]
23.	*Juniperus procera* Hochst. ex Endl	African Juniper	Cupressaceae	Sap	[235]
24.	*Kalanchoe densiflora* Rolf	Air Plant	Crassulaceae	Leaf	[235]
25.	*Lophira tanceotata* Van Tiegh ex Keay/	Red iron wood	Ochnaceae	Leaf	[244, 245]
26.	*Memecylon umbellatum* Burm.f	Ironwood	Melastomataceae	Leaf, root	[246]
27.	*Mimosa pudica* Linn	Chuimui	Mimosae	Leaf	[247, 248]
28.	*Ocimum gratissimum* L	Alfavaca	Lamiaceae	Leaf	[249, 250]
29.	*Pelargonium graveolens*	Rosas blancas	Geraniaceae	Flower	[212]
30.	*Psidium guajava* Linn	Guava	Myrtaceae	Flower	[251, 252]
31.	*Rosa centifolia* L	Rosa de Castilla	Rosaceae	Flower	[212]
32.	*Thespesia populnea* (L.) Corr	Indian Tulip tree	Malvaceae	Fruit, flower	[252]
33.	*Xanthium indicum* Koenig	Gokharu	Asteraceae	Leaf	[221]

Conclusion

Herbal medicine is the most ancient form of health care known to man. Herbs have been used in all cultures since history records were recorded. Herbal medicine has such an extraordinary influence that numerous alternative medicine therapies treat their patients with herbal remedies, including naturopathy, orthomolecular medicine, and ayurveda. Approximately 25 percent of all prescription drugs are derived from trees, shrubs, or herbs. Herbal medicines are popular due to their efficiency, low toxicity and absence of side effects [253]. Ayurveda is one of such inherited tradition of health and longevity. A wide variety of plants have been found to have effective against number of ocular diseases like cataract, glaucoma, infection, conjunctivitis etc. In this review the information is recorded as common name, scientific name, family, part used & reference of the plants used in treatment of ocular diseases. This review helps the researcher to develop new formulations and toxicity studies which will beneficial for the society in future era and also helps in the development of effective medicine which are used in ocular disease.

Herbs which are used in the treatment of glaucoma

Chrysanthemum morifolium
(Chrysanthemum)

Alisma orientale
(Alisma)

Phyllostachys nigra
(Bamboo)

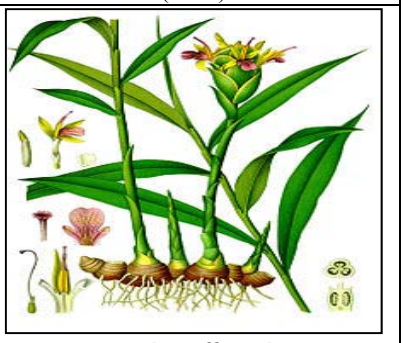
		
Gardenia jasminoides (Gardenia)	**Phragmites communis** (Phragmites)	**Lycium barbarum** (Lycium fruit)
		
Plantago Asiatica (Plantago seed)	**Polyporus umbellatus** (Polyporus)	**Prunella vulgaris** (Prunella)

		
Rehmannia glutinosa (Rehmannia)	**Scutellaria baicalensis** (Scute)	**Vitex trifolia** (Vitex)

Herbs which are used in the treatment of gataract		
		
Morinda citrifolia (Canary wood)	**Abrus precatorius** (Crab's Eye)	**Acorus calamus** (Sweet flag)

 **Adhatoda vasica** (Adusa)	 **Emblica officinalis** (Amla)	 **Aegle marmelos** (Bael)
 **Brassica juncea** (Mustard greens)	 **Buddleja officinalis** (Pole butterflybush)	 **Butea monosperma** (Dhak)
 **Caesalpinia bonduc** (Gray nicker bean)	 **Capsicum frutescens** (African devil)	 **Cassia fistula** (Golden shower tree)
 **Catharanthus roseus** (Rose Periwinkle	 **Centella asiatica** (Indian pennywort)	 **Corydalis turtschaninovii** (Corydalis tuber)

 **Curcuma longa** (Turmeric)	 **Dendrobium huoshanense** (Orchids)	 **Duranta repens** (Golden Dewdrop)
 **Duranta repens** (Golden Dewdrop)	 **Emilia sonchifolia** (Sadamandi)	 **Eucalyptus deglupta** (Rainbow Eucalyptus)
 **Eugenia jambolana** (Jambu)	 **Allium sativum** (Garlic)	 **Ginkgo biloba** (Maidenhair Tree)
 **Gymnema sylvestre** (Gymnema)	 **Mangifera indica** (Mango)	 **Momordica charantia** (Bitter Gourd)

 **Azadirachta indica** (Neem)	 **Ocimum basilicum** (Sweet basil)	 **Platycodon grandiflorum** (Balloon flower)
 **Psoralea corylifolia** (Babchi)	 **Pueraria lobata** (Kudzu vine)	 **Pyrus pashia** (Melu)
 **Bobgunnia madagascariens** (Snake bean)	 **Withania Somnifera** (Ashwagandha)	 **Zingiber officinalis** (Ginger)

Herbs which are used in the treatment of Gonjunctivitis		
 **Dissotis rotundifolia** (Triana/ Dissotis)	 **Acacia macracantha** (Faique)	 **Albizia lebbeck** (Woman's tongues Tree)

Berberis asiatica
(Kingod)

Bidens pilosa
(Spanish niddle)

Dichrocephala integrifolia
(Kuntze./Wedahan)

Ervatamia divaricata
(Burkill/ Crape Jasmine)

Mimosa pudica
(Chuimui)

Ocimum gratissimum
(Alfavaca)

Rosa centifolia
(Rosa de Castilla)

Thespesia populnea
(Indian Tulip Tree)

Xanthium indicum
(Gokharu)

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