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Review Article

Review on Pharmacological and Therapeutic Potential of *Cuscuta* species

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Abstract

The plant genus *Cuscuta*, belongs to the family Cuscutaceae, has been traditionally used as therapeutic treasure against various metabolic and neurological diseases such as mental abstraction, headache, spleen disease, jaundice, diabetes mellitus and hypertension. There are numerous secondary metabolites have been identified that are considered as phytochemical constituents, such as alkaloids, flavonoids, lignins, steroids, phenolic acids, fatty acids, glycosides and polysaccharides. Due to the presence of these bioactive ingredients, various ethnopharmacological actions including anticancer, antiviral, antisapasmodic, antihypertensive, antibacterial, antioxidant, diuretic, antihypertensive were explored. This review brings eyesight for the explorations of novel therapeutic agents for the various ailments of mankind.

Keywords: Therapeutic treasure; Phytoconstituents; Pharmacological activity

Introduction

Dodder (*Cuscuta*) is a parasitic plant; having attraction on wide range of plants like agricultural and horticultural crops such as alfalfa, lespedeza, flax, potatoes, chrysanthemum, vine, ivy and petunias [1]. *Cuscuta* is a group of 100-70sp., they are yellow, orange, red or green parasitic plants. *Cuscuta reflexa* commonly known as dodder is also called as devil's hair, witch's hair, love vine, amarber or akashabeta. *C.reflexa* is a homoparasite and also an extensive climber. It contains low level of chlorophyll and photosynthetic activity; completely depends on the host for its energy. Dodder has the capacity to recognize its host plant and also choose an appropriate host between other plants by some volatile compounds that are released by the host plants [2]. *C.reflexa* imbibes nutrients through the vascular tissue of the host plant and grows on it [3]. According to WHO, 80 percent of the world population now using herbal medicines. In ancient Chinese and Japanese medicine, dodder (*Cuscuta planiflora*) seeds are grained in to fine powder and converted to a tablets or encapsulated form to treat osteoporosis, osteoarthritis and general muscular pains [4]. Dodder was now used in Ayurveda to treat jaundice: Some researchers found that dodder possessed antidepressant, anticonvulsant, antibacterial, cytotoxic and hepatoprotective effect. Dodder has some phytochemical substances like phenols, aromatic substances. *C.reflexa* is a rootless, leafless plant and it twinned into other plants for gaining their nutrients. It was commonly called as akashvalli or dodder. Even though wide spread occurrence of Dodder, more than 6 species are found in India. It will grow only on thorny or shrubs and sometimes [5]. It will spread one host to another host by haustorium a special branched organ. Haustorium will penetrate the host cell, which will absorb the water and other nutrients from the host plant. It doesn't attach to the ground and growing with the help of seeds with hard coating and even the seeds can withstand for more than 10 years [6]. This *Cuscuta reflexa* species is investigated for antitumor, anticonvulsant, antioxidant, and induced alopecia activities along with it poses some chemical constituents causcutin, amarbelin, beta-sterol, stigmasterol, bergenin, etc. The genus *Cuscutta* L. is the one of the herbal constituents in pharma, foods and curative tonics that is used to nourish various body parts [7] (Table 1).

Botanical Identification *[9]*	***Synonyms***	***Common names***
Kingdom : Planate Subkingdom : Tracheobionta Superdivision : Spermatophyta Division : Angiosperms Class : Eudicots Subclass : Asterids Order : Solanales Family : Cuscutaceae Genus : *Cuscutta* Species : *Reflexa Roxb*.	Tamil : verillakothan English : Dodder plant Hindi : Amarabela Sanskrit : Akashvalli, Amaravalli, Khavalli. Punjabi : Zarbut Malayalam : Moodillathal Urdu : Akashbel Bengali : Akashbel	Arabic : Hamoul,Shubbak, Dabaie French : Cuscuteafleursplanes, cuscutea petites fleurs. Germany : klee-seide;ouendel-seide; Thymin-seide. Italy : Cuscuta Del trifoglio; cuscuta piccolo. Portuguese : (ipo-de-chumbo, Espaguete Spanish : CuscutaDel trebol, Epitimo

Table 1: Botanical classification, Synonyms and Common names of *Cuscutta* species [8].

Worldwide distribution of Cuscuta

Cuscuta (dodder) is commonly found throughout the temperate and tropical regions of the world. This is rarely found in cool temperature; in this condition only four species occur in northern Europe. *Cuscuta approximata* commonly known as alfalfa dodder native to Eurasia and Africa and also found in North America. *C.australis* occurs in large parts of tropical and subtropical Africa as well as in Southern Europe, Asia and Australia. It also occurs in Madagascar. *C.campestris* (golden dodder, field dodder) occurs in America, East and Southern Africa, Northern Africa, Asia and the Indian Ocean islands. *C.reflexa* Roxb. (Giant dodder) originate from tropical and subtropical parts of Asia and America. *C.australis* occurs in wattle localities e.g. along water courses, and occurs from sea level up to 2000m altitude [10-12]. *C.campestris* has a wide tolerance of climatic conditions from warm temperature to sub-tropical and tropical conditions. *C.californica* native to Western North America and commonly called as California dodders. *C.gronovii* was found in United States, Canada, France, Germany, Luxembourg, Netherland and Italy. It grows on temperate forest habitats. *C.denticulata* commonly known as desert dodder or small toothed dodder, inhabitant to the deserts of the South-Western United States and Northern Mexico. *C.salina* (salt marsh dodder) occurs as resident plant of Western North America. *C.compacta* (compact dodder) grows on woody plants and distributed across the Eastern and Midwestern USA, Eastern Canada and Mexico. *C.japonica* commonly known as Japanese dodder found in Asia. *C.coryli* known as hazel dodder is a perennial plant and native to North America [13, 14].

Morphological characteristics

Dodder stem has a long, twinning, branched, glabrous, pale greenish yellow or dotted with red stem. The flower established as glabrous, curved, long ovate, oblong, obtuse, fleshy, pedicles short, 1.5 mm long, white (or) pink in color. Their seeds are large, black and glabrous having 2-4 seeds. Some specifications to be mentioned here, like which is the most common species of plant, it exhibits parasitic interaction [15].

Figure 1: Morphological appearance of *Cuscutta* sp.,

Phytochemical evaluation of Cuscuta sp

Based on the type of characteristic pattern, each type of *Cuscutta* sp., have different type of phytochemical activity. Diverse types of phytocomponents have been isolated based on the host and plant nutrition, which includes flavonoids [16], Dulcitol β, Mannitol, Sitosterol, Lycopene, Apigenin-7-β-rutinoside, 6-7 dimethoxy coumarin, quercetin, hyperoside [17,18], Propenamide, Reflexin, lutein, carotene, amarbellin, palmitic, oleic, stearic, linolenic acids, leuteolin, cuscutin, cuscutalin, kaempferol, kaempferol-3-Oglucoside, astragallin, benzopyrones, glucopyranosides, quercetin-3-O-glucoside, bergenin [19, 20]. One more important phytocomponent is LUPEOL extracted and isolated from *Cuscutta reflexa*, which exhibits pharmacological activities such as an antimicrobial, anti-inflammatory, antitumor, antiprotozoal and chemoprotective properties [21]. When act as an anti- inflammatory agents, lupenol leads to decrease interleukin-4 production by using T-helper type 2- cells. In preliminary level of screening, different type of phytoconstituents have been separated [22] includes flavonoids, glycoside, alkaloids, phytosterol, tri-terpenoids and steroids [23]. *Cuscuta reflexa* plant also contained polyphenols and flavonoids [24]. *Cuscuta reflexa* has a specific enzyme that is choline kinase which acts as mitochondrial enzyme [25]. Carboxymethylcellulose (CMC ase) also recover from *Cuscutta reflexa*. These enzymes have been free of β-glucosidase and other enzyme activities [26, 27]. The specific phytocomponent, neoxanthin was identified which involved in light driven deep oxidation like a xanthophyll cycles and also helpful for protection against photodamage of the plant. Some other components were isolated from *Cuscuta* along with five known components, through the spectral analysis sequence determination method. And these components pose strong inhibitory activities against α-glucosidase. *C. reflexa* contain highly unusual carotenoid composition [28], it does not contain neoxanthin. Combined analysis of HPLC and MASS spectrometry are used to detect tissues of *C. reflexa* and find out two types of Xanthophyll; one is lutein 5-6 - epoxide and the other one is 9-cis-violaxanthina [29]. These components are used to for potential photo activity of reflexin [30] presented in Table 2.

Plant Name	Plant part	Solvent system used	Extraction method	Name of Separation technique	Phytochemicals	References
C.reflexa	Whole plant	MeOH	Maceration	CC	7'-(3',4'-dihydroxyphenyl)-N-[(4-methoxyphenyl)ethyl] propenamide 7'-(4'-hydroxy,3'-methoxy-phenyl)-N-[(4-butylphenyl)ethyl] propenamide 6,7-dimethoxy-2H-1-benzopyran-2-one 2-(3-hydroxy-4-methoxyphenyl)-3,5-dihydroxy-7-O-β-D-glucopyranoside-4H-1-benzsopyrane-4-one 3-(3,4-dihydroxyphenyl)-2-propen-1-ethanoate	[31]

				HPLC	6,7,8-trimethoxy-2H-1-benzopyran-2-one 3-(4-O-β-D-glucopyranoside-3, dimethoxyphenyl)-2-propen-1-olKaempferol Quercetin Lupeol β-sitosterol Galic acid	[32]
		Aq. EtOH EtOH	Soxhlet -------- 	TLC VLC 	Quarcetin Odoroside H 21-hydroxyodoroside H Neritaloside Stropeside N-trans and cis feruloyl tyramines Ethyl caffeate Coumarins Ursolic acid- sitosterol Glucoside 4-O-p-coumaroyl- D-glucoside	[33] [34]
		n-hex	Soxhlet	GC-MS	Heneicosanoic acid Pentadecanoic acid Hexadecanoic acid -330.50 gmol-1 Heptadecanoic acid Octadecanoic acid -280.45 gmol-1	[35]
	Stem	EA	Maceration	GC-MS	1,2,3 Propanetriol, 1-acetate, Benzofiran 2,3,dihydro Glycerol 1,2-diacetate 1 H- 1,2,4-triazol-5-amine 1-ethyl-2-methoxy-4-vinylphenol Triacetin D- glucitol, 4-O-hexyl 3,4,5-trimethoxy cinnamic acid Hexadecanoic acid, ethyl ester 3,6- di methoxy phenanthrene 3,5- di- tert- Butyl-4-hydroxyanisol Vanillin 3- aminopyrrolidine Cetene Sarcosine, N- isobutyryl, tetradecyl ester 4-((1E)-3-hydroxyl-1-propenyl)-2-methoxy phenol 1-octadecene Scoparone	[36]

		Pet Eth	Soxhlet	CC	Hexadecanoic acid, ethyl ester Isorhamnetin Isorhamnetin -3-O-glucoside Isorhamnetin -3-O-robinobioside 2-Methoxy-4-vinyl phenol Benzofuran-2,3-dihydro 3,5-di-tert-Butyl-4-hydroxyanisole	[37]
		MeOH	Maceration	GC-MS	Hexatriacontane - 506.98 gmol-1 n-Hexadecanoic acid - 330.50 gmol-1 Scoparone Hexadecanoic acid methyk ester 1,3-Benzenediamine, N,N,N',N'te-tramethyl-Phenol, 4(3-hydroxy1prope-nyl), 2-methoxy Phenol, 2,4 bis (1,1dimethylethyl); \2,3,5,6-Tetramethyl para phenylene diamine Pregn-4-ene-18-oic acid Swarmalin Cis-swarmelin	[38]
	AP	MeOH	Maceration	Reverse phase HPLC	Coumarin 5,6,7-trimethoxycoumarin	[39]
					An antiviral protein with molecular eight about 14,000---18,000 Dalton	[38]

Fil: filament; Aq: aqueous; MeOH: methanol; EtOH: ethanol; Pet. eth: petroleum ether; n-hex: n-hexan; EA: ethyl acetate; DMC: dichloro methane; CC: column chromatography; HPLC: high performance column chromatography; TLC: thin layer chromatography; VLC: vacuum liquid chromatography; GC-MS: gas chromatography-mass spectrometry.

Table 2: Phytochemical profile of various *Cuscuta* species.

Pharmacological activities of Cuscuta species

Plants therapeutic potential varied ranges from direct administration of the leaves, seeds, barks, roots and stems to the extracts and decoctions from different parts of the plants. Many *Cuscuta sp.,* being rich sources of diverse phytochemicals are popular components of various folk medicinal systems. *Cuscuta sp.,* are used in traditional medicine as a diaphoretic, diuretic, purgative, antihelminthic and tonic as well as a treatment for itching and bilious disorders. Seeds, stem and whole plant are utilized as prescription treat different types of ailments. *Cuscuta reflexa* is a treasured medicinal herb and widely used in conventional medicinal system of various Asian countries for treating multiple disorders. It is called a miracle therapeutic plant in the ethanobotany, and a wide array of chemical compounds has been isolated with diverse medicinal properties enlisted in table-3.

Species	*Plant part*	*Preparation method*	*Traditional uses*	*References*
C.reflexa	Whole plant	Paste	Treatment of swollen testicles, gout and joint pain, causes abortion, anti rheumatic, analgesic.	[40,41, 42,43, 44, 45, 46]
		Maceration	Infection treatment	[47]
		Infusion	Anti-poisonous	[48]
		Juice	Anti septic, useful in itching skin and jaundice	[49, 50]
		Powder	Anti-fertility agent, astringent, diaphoretic.	
		Pills	Anti tuberculosis.	[51]
		Decoction	Useful in skin disease, used for jaundice, cough, blood purification, bronchitis, fever, sex stimulation, anti diarrheal, anti inflammatory, anti ulcer, anti dandruff., fracture joining.	[52] [50, 52, 54,55,56,57,58,59]
	Stem	Decoction	Hepatoprotective, anti diarrheal, useful in constipation, stomach disorders, urinary infections, jaundice, epilepsy, cholera, asthma	[56, 15]
		Paste	Anti-hair fall, anti rheumatic, useful in skin diseases	[13, 56]
		Juice	Jaundice treatment	[60,56]
		Crushed	Blood purifier, purgative, good for brain, fever, anthrax in cattle	[61, 62]
		Decoction	Effective in bilious disorders and fever	[40,63]
			Cause abortion	[56]
	Seeds		Carminative, antihelmintic, sedative, diuretic, useful in ulcer, liver disorders	[16,64]
		Poultice	Pain reliever	[65]
		Extract	Cold treatment	[66]
	Leaves		Anti hypertensive, anti diarrheal, useful in jaundice	[67] [68,69]
		Juice	Effective in scabies, eczema, inducing sterility	
	Fruits		Antipyretic, cough reliever	[70]
C.chinensis	Whole plant	Juice	Anti ulcer, anti inflammatory, wound healer, jaundice treatment	[71]
		Dressing	Useful in painful inflammations	[72]
		Paste	Anti ulcer and wound healer	[72]
	Seeds		Carminative, tonic, diuretic, sedative, diaphoretic	[73]
	Stem		Joining fractures	[72]
		Paste	Expectorant, carminative, tonic, anthelmintic, purgative, diaphoretic, anti-inflammatory, analgesic	[73]
C.japonica	Leaves		Antihypertensive	[74]

C.australis	Seeds	Decoction	Brain tonic Laxative, antihelminthic, astringent, emollient, sedative, sudorific, liver and kidney tonic, useful in sores and measles	[75]

Table 3: Traditional therapeutic potential of *Cuscuta* species.

Hepatoprotective activity

Cuscuta epithymum is traditionally used as a liver tonic. Hepatoprotective activity with alcoholic extracts of stem of *Cuscuta reflexa* and aqueous extracts of stem of *Cuscuta reflexa* was studied against paracetamol induced hepatotoxicity in rats [76]. The histopathological changes (steatosis, necrosis etc.) were partly or fully prevented in animals treated with two extracts. Ethanolic extracts of *C.australis* also appeared as liver protector against acetaminophen intoxication in an animal model. The methanolic extracts of stem of *C.reflexa* were evaluated for hepatoprotective activity by observing its effects on carbon tetrachloride induced hepatotoxicity in liver histoarchitecture and alteration in certain biological parameters. Seeds of *C.chinensis* are commonly employed to nourish and improve hepatic disorders. Oxidative stress can stimulate the development of acetaminophen induced hepatotoxicity.

Anti-tumor activity

Some species of the genus Cuscuta afford alkaloids with indolic nuclei that are considered potential antitumor substance. *C.chinensis* is a popular antitumor prescription in the Unani medicine system. Oral administration of the plant extract at a dose of 1g/kg delayed the appearance and growth of skin papilloma and reduced the chances of carcinoma [77]. *Invivo* anticancer potential of *C.relexa* was determined by using murine model. Alcoholic extract and its chloroform fraction were found more potent. It showed highest toxicity against human breast cancer cell lines. The seed extract of *C.kotschyna* induced apoptosis in breast cancer cell line [78]. The major active phytoconstituents of *C.kotschyna* flavonols, quercetin has been found to reduce cell viability of quite a cost of cancer cell lines. Administration of chloroform and ethanol extracts of *C.relexa* showed antitumor activity against Ehrlich ascites carcinoma tumor in mice at doses of 200 and 400mg/kg body weight orally. It results in a significant decrease in tumor volume and viable cell count but increased non-viable cell count and mean several time, thereby increasing the life span of the tumor-bearing mice. *C.campestris* also has anticancer agents [79, 80].

Anti-oxidant activity

Plants can play a key role to fulfill prerequisite for exploration of biocompatible, effective and economic antioxidants. Many investigators have employed different qualitative and quantitative approaches to detect antioxidants in various *Cuscuta species.* Stem collected from different host and extracted with various solvents were analyzed for quantity of phenolics and flavonoids content. Their antioxidant capacity was measured by using a variety of assays including reducing power, DPPH scavenging activity, percent inhibition of linoleic acid peroxidation. *Invitro* antioxidant activity of *C.reflexa* stems were investigated by estimating the degree of non-enzymatic hemoglobin glycosylation. Ethyl acetate and ethanol extract showed higher activity than other fractions, and very close and identical in the magnitude and comparable to the standard antioxidant agents [81].

Anti-bacterial activity

Crude ethanolic extract of *C.reflexa* showed antimicrobial activity against *E.coli* and *S.sonnei. C.relexa* collected from different seasons showed antibacterial activity against *Staphylococcus aureus*, *Staphylococcus epidermidis, E.coli, Micrococcus luteus, Pseudomonas aeroginosa* [82]. The antimicrobial efficacy was concentratedely dependent against all the tested strains. The methanol extract of *C.reflexa* exhibited antibacterial and free radical scavenging activities. *Xanthomonas campestris* (XC) is a widely spread infectious agent causing a huge loss in food crops with viable symptoms and leave shedding. Aqueous decoction and infusion extract of *C.pedicellata* were evaluated for

antibacterial activity against diverse pathovars of XC using invitro well diffusion method. The Methanolic extract also showed promising high antimicrobial activity.

Antipileptic & anticonvulsive activity

C.reflexa showed significantly reduction in the duration of convulsion in tonic seizure induced by pentyleneterazole in mice. It also reduces the tonic extension convulsion induced by maximum electroshock-induced convulsions [83]. The ethanolic extract has anticonvulsant property and may probably affect both the Gamma Amino Butyric Acid (GABA) aminergic- and glycine-inhibitory mechanism. The main active chemical constituent is flavonoid which is responsible for depressant activity. The processed extracts showed a significant anticonvulsive property by altering the levels of catecholamine and brain amino acids in mice.

Hypoglycemic activity

The hypoglycemic activity of methanol and chloroform extracts of whole plants of *C.reflexa,* investigate in oral glucose tolerance tests in Long Evans rats. Both methanol and chloroform extracts of *C.reflexa* whole plant demonstrated significant oral hypoglycemic activity in glucose-loaded rats. It was further reported that these two compounds act at multiple targets to ameliorate hyperglycemia [84].

Anti-HIV activity

The crude water extracts of *C.reflexa* exhibited anti-HIV activity which could be due to combinatory effects with compounds of different modes of action. The methanol extract of *C.reflexa* exhibited anti-bacterial and free radical scavenging activity [85]. The methanolic extract of *C.campestris* showed weak anti-HIV activity.

Effect on blood pressure

Alcoholic extract of *C.reflexa* have positive inotropic and cardiotonic activities on the perfuse frog heart. In a series of experiments on dog blood pressure, it caused a fall in blood pressure [23]. Ethanolic extract of the stem of *C.reflexa* caused a dose dependent decrease in arterial blood pressure and heart rate in pentothal-anaesthetized rats. Hypotensive and brady cardiac effects of *C.reflexa* were found to be independent of cholinergic receptor stimulation or adrenergic blockade [86].

Relaxant & spasmolytic action

Aqueous and alcoholic extracts of *C.reflexa* stems showed relaxant and spasmolytic action on small intestine of guinea pig and rabbit. Extracts also exhibited acetyl choline like action [87].

Cholinergic action

The effects of the stem extract of *C.reflexa* resembled acetylcholine when tested on isolated rabbit ileum and frog rectus abdominals and heart. These effects were blocked by atropine. Effect of the extract on isolated frog rectus abdominal muscle was blocked by pancuronium and potentiated by neostigmine [88].

Diuretic activity

Aqueous and alcoholic extracts of *C.reflexa* showed diuretic activity in Wistar rat [89]. *C.epithymum* has mild diuretic activity and it is used to treat sciatica and scurvy. *C.europaea* seeds are used to treat psoriasis and it also has a diuretic activity. *C.reflexa* seeds are carminative [89]. *C.racemosa* has small diuretic activity and used for treatment of wounds [90].

Anti-diabetic activity

The methanol and aqueous extracts showed significant reduction in blood glucose during OGTT in diabetes rats. The treatment also resulted an improvement in body weights, decreased Hb1c and restored lipid profile. Methanolic extracts of *C.reflexa* has significant

antidiabetic effects and improves metabolic alterations. Antidiabetic activity of *C.chinensis* was evaluated in dexamethasone-induced insulin-resistant human liver carcinoma (HepG2) cells. *C.chinensis* polysaccharides can reduce blood sugar level in Type-2 Diabetes. The efficacy was tested on alloxan-induced diabetes in a mice model [91].

Hair growth activity

Plants as hair growth promotors have found their use in almost all traditional medicinal systems. The petroleum ether and ethanolic extract of *C.reflexa* were given in male swiss albino rats. *C.reflexa* extract is useful in the treatment of alopecia. This study was shown to be capable of promoting follicular proliferation or preventing hair loss in cyclophosphamide-induced hair fall [92].

Anti-inflammatory effect

In different phases of pathogenesis of cancer, inflammatory reactions play a decisive role. Invitro and invivo tests, aqueous and alcoholic extracts of stem of *C.reflexa* and its ethyl acetate fraction showed remarkable anti-inflammatory activity. *C.reflexa* significantly suppressed inflammation by reducing edema volume up to 80 percent in rats. *C.campestris* markedly inhibited carrageenan-induced edema in rats. *C.chinensis*, showed the potential for treatment of brain inflammation by suppressing the inflammatory responses [93, 94].

Immunological activity

Ethanolic extract of *C.chinensis* showed considerable adjuvant potentials towards cellular and humoral immune responses in mice models and can be used as vaccine adjuvant. Extract enhanced specific antibodies (IgG, IgG1 and IgG2b) to a noticeably high level by affecting Th1 and Th2 cell functions. Kaempferol was identified as the main flavonoid of methanol fraction. Based on several research findings, Kaempferol has potential to treat chronic inflammatory and autoimmune diseases [95]. *C.australis* may act as an immunopotentiator for mammals by increasing the percentage of Phagocytosis.

Anti-obesity activity

C.pedicellata is widely used for management of obesity. Ethanolic extract of *C.pedicellata* has significantly reduced the body weight along with serum lipid profile in high-fat diet fed rats [96]. Recently, the results proved that polyphenols are reported to possess anti-obesity activity.

Effect on melanin production

C.chinensis can promote melanogenesis of amelanotic melanocytes and improved the tyrosinase activities. Furthermore, it significantly enhanced skin melanin and tyrosinase production. It has been reported that in invitro and invivo, the seed aqueous and ethanolic extracts of *C.chinensis* have melanogenesis effect. Consumption of *C.chinensis* extract with milk reduced the melatonin synthesis and thus ameliorated the elimination of melisma [97].

Effect on the reproductive system

C.reflexa has an anti-fertility effect. Methanolic extract arrested the normal estrus cycle and decreased ovarian and uterus weight in adult female mice. *C.reflexa* is rich in flavonoids, as the result reported that flavonoids act as an antifertility agents *C.chinensis* extract, and its isolations can improve reproductive systems of both males and females. Ethanolic extract of *C.chinensis* may improve erectile dysfunction conditions. An herbal formula, KH-204 containing *C.chinensis,* ameliorates erectile dysfunction by its antioxidant and lipid profile improving property [98].

Anti-aging activity

In Chinese herbal medicinal system, *C.chinensis* is an important antichanging prescription. Polysaccharides of *C.chinensis* can exhibit

anti-aging effects by scavenging free radicals and opposing lipid peroxidation. Ethanolic extract of *C.chinensis* significantly supposed the non-enzymatic glycosylation of D-galactose induced rat aging model [99]. Various experimental researches showed that it can regulate immune responses, prolong cell cycle, positively affect body metabolism, improve physiology of internal body organs, and stress management, which proves its anti-aging effects.

Anti-hypertensive & anti-osteoporotic activity

In Pentothal anesthetized rats, ethanolic extract of *C.reflexa* decreased arterial blood pressure and heart beat rate. Four caffeoylquinic acid derivatives were isolated from the active fraction having inhibitory effects on Angiotensin Converting Enzyme (ACE) activity. Presence of these metabolites at least in part is responsible for the anti-hypertensive activity extract. *C.chinensis* effectively boasted tissue regeneration of damaged bones by promoting the formation of osteoblasts from their precurse cells. Five flavonoids were isolated from which Kaempferol and hyperoxide were found osteogenic in nature [100].

Reno protective effects

In Wister rats, aqueous and alcoholic extract of *C.reflexa* exhibited substantial diuretic activity. *C.chinensis* has been used as a kidney tonic since ancient time. Research suggests that *C.chinensis* extract ameliorates renal functions and regulates urine concentration [101].

Conclusion

Cuscuta genus has enormous therapeutic potential since ancient civilizations. The phytoconstituents such as flavonoids, alkaloids, lignans, polysaccharides, steroids, volatile oils and resins are encountered as important bioactive ingredients of the plant. This plant considered as a miracle genus having broad spectrum of pharmacological activities. Doctations, extracts, paste, powder, juice and infusions from various parts of plant impart therapeutic nature against numerous ailments of human beings. Unraveled explorations of these plant medicinal properties, only few species are identified. With the advent of modern scientific technologies, yet to be found out, the other functions of rest of the species. Limitations of this study might include that, only fewer animal studies are employed for the detection of its efficacy of their pharmacological activities. Hence, this reviews, pave a path for the exploration and novel therapeutic measure for the various ailments of human welfare with safe margin.

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