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CUSCUTA REFLEXA- CHEMICAL CONSTITUENTS AND ITS PHYTOCHEMICAL EVALUATION -A LITERARY REVIEW

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Abstract

Cuscuta (Dodder) is a genus of about 100-170 species of yellow, orange or red (rarely green) parasitic plants. Cuscuta reflexa is a member of the Cuscutaceae family. Species of cuscuta are found almost everywhere in the world, although cuscuta is more often called dodder in English-speaking countries. Cuscuta is a parasitic plant. It has no chlorophyll and cannot make its own food by photosynthesis. Instead, it grows on other plants, using their nutrients for its growth and weakening the host plant. Agriculturalists consider cuscuta a destructive weed and attempt to eradicate it. It parasitizes wild and cultivated plants, and is especially destructive to such commercially valuable crops as flax, alfalfa, beans, and potatoes. It also grows on such common ornamentals as English ivy, petunias, dahlias, and chrysanthemums. For medicinal purposes, herbalists use it in their various preparations .Much work has been done to find its chemical ingredients.

Key words:*cuscuta,medicinal ,chemical ingredients,herbalist*.

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INTRODUCTION:

Cuscuta is a leafless plant with branching stems ranging in thickness from thread-like filaments to heavy cords. The seeds germinate like other seeds. The stems begin to grow and attach themselves to nearby host plants. Once they are firmly attached to a host, the cuscuta root withers away. The mature plant lives its entire life without attachment to the ground. Dodder flowers range in color from white to pink to yellow to cream. Some flower in the early summer, others later, depending on the species. The seeds are minute and produced in large quantities. They have a hard coating, and can survive in the soil for 5-10 years or more.

Dodder seeds sprout at or near the surface of the soil. While dodder germination can occur without a host, it has to reach a green plant quickly; dodder grows toward the smell of nearby plants. If a plant is not reached within 5 to 10 days of germination, the dodder seedling will die. Before a host plant is reached, the dodder, as other plants, relies on food reserves in the embryo; the cotyledons, though present, are vestigial.

phytochemical investigation for evaluation of medicinal properties by various group of workers ,a literary review.

In the year 1935, R. R. Agarwal and S. Dutt, worked on the hot alcoholic extract of the stem of Cuscuta reflexa, reported the isolation of a major white crystalline compound cuscutalin $C_{18}H_{10}O_4$ which did not give any aldehydic or ketonic group test and is assumed to be an a, P-unsaturated lactone. One more yellow crystalline solid cuscutin $C_{15}H_{12}O_9$ has also been isolated from this study. Previously initial Barbeyg in 1895 also isolated cuscutin from another species of Cuscuta namely C. epithymum.

Further investigation on the constituents of oil from dried seeds of C.reflexa resulted, re isolation of cuscutalin as major compound, which was previously obtained from hot alcoholic extract of the sun dried stems of C.reflexa. In addition to this a transparent light greenish, sem idrying oil was also obtained. The oil consists of linolenic, linoleic, oleic, stearic and palmitic acid. Ayellow colouring matter amarbelin $C_{18}H_{16}O_7$ 'H_2O (1) has also been obtained in the form of lemon yellow needles. The unsaponifiable matter contained a phytosterol. K. W. Gopinath et al. examined in detail the stem and seeds of C. reflexa and reported their failure to identify either cuscutalin or amarbelin, isolated earlier by Agarwal and Dutt, and obtained instead β-sitosterol and a flavonoid pigment kaempferol (2) from the seeds of C. reflexa.

Reinvestigation of the chemical constituents of the stem of C. reflexa was under taken by M. K. Jain and R. K. Mishra11 in 1963, who successively extracted the dried stem with petroleum ether and alcohol. The petroleum ether extract on careful chromatography afforded a white solid identified as β-sitosterol reported earlier by Gopinath et al., while kaempferol (2) and bergenin (3) the alcoholic extract of the plant. These studies were in complete agreement with the report of K. W. Gopinath el al.

Earlier report on variation in the chemical constituents of C. reflexa, parasitic on different trees led S. S. Subramanian and A. G. R. Nair to re-examine C. reflexa (stem and seeds), growing on different trees viz Melia azadirachta (Azadirachia indica, Neem),Eugeniajambolana and Anacardium occidentale. Studies were carried out on fresh stems collected separately from these trees and were

extracted with hot methanol. Dulcitol (4) and flavonoid pigment astragaline (5), the 3-glycoside of kaempferol, were obtained from methanolic extract of stems, neither cuscutaline nor cuscutin could be isolated as reported earlier. In addition to the stem berries of C. reflexa, growing on Melia azadirachia (Azadirachia indica) were also examined and were found to contain dulcitol (4), myricetin (6) and kaempferol (2), probably as their 3-glycoside (7, 5).

The variation observed in the chemical constituents of this parasitic plant may be ascribed to the influence of the host plants. Such influence in the chemical constituents of parasitic plants such as *Santalum album* has been reported by R.A. Srimathi *et al.,* and S.S. Subramanian and A.G.R. Nair. In view of establishing the effect of host plant on chemical constituents of C. reflexa, studies were carried out on methanol extract of fresh stem of *C. reflexa* growing in *Glycosmis triphylla,* dulcitol (4) was found to be present as a major component, in addition to luteolin (8) and qucrcetin (9) which were present in trace amount. This is an example of the influence of the host plant on the chemical constituents of the parasite.

In a later report carotene content were studied in genera *Lathraea*, *Orobanche* and *Cuscuta* of the parasitic plants and it was observed that except for few varieties of *Cuscuta,* the parasites are low in carotenes, the ones present are mainly xanthophylls and carotene epoxides with an α-structure. Conflicting reports on the chemical constituents of *C. reflexa led* S.A. Khan and co-workers to undertake the systematic investigation of the chemical composition, of the parasite grown on botanically different species of host plants *viz Zizyphus jujube, Clerodendron inerme. Citrus medica* and *Acaria arabica*. It was observed that the constituents of *C. reflexa* does not vary with the change of the host plant. Various extractives of the parasite, growing on differences in the chemical constituents reported earlier might have arisen due to the foreign impurities from the host plants. The above studies on the petroleum ether and alcoholic extracts of *Cuscuta reflexa*, growing on different host plants were found to contain β-sitosterol, bergenin (3) and kaempferol (2). This is the first contradictory report based on the influence of host plant on the chemical constituents of *C. reflexa.*

In a subsequent study, a group reported the isolation of three flavonoids from *C. epithymum.* The two flavonol heterosides were identified as kaempferol (2) and quercetin (9) respectively, linked with glucose and galactose (5, 10 and 11, 12) in the 3-position, along with free querectin. Few studies on aerial parts of *C. lehmanniana* growing on elm tree in Tashkent area led in the isolation of methyl ester of *p*-coumaric acid and cuscutin (hexadecyl ester of 3,5-dihydroxy cinnamic acid, 13). The chemical structure of cuscutin was confirmed by the alkaline hydrolysis which produced 3,5-dihydroxy cinnamic acid and hexadecyl alcohol.

Further investigation on C. campestris and C. sanveolens by V. Istudor and co-workers led to the isolation of common chemical components in both species. The effects of host plant on chemical components of C. campestris were also studied. C. campestris harvested on Beta vulgaris and Zea mays, demonstrated that the host plant affected the metabolism of parasite.

Two flavones, isorhamnetol (14)

and azaleatin (15) and three tritcrpcnc aglycons from saponoside hydrolysis, as well as steroid were isolated from C. campestris.

In the year of 1985 S. Sharma et a1.reported that the lipid level of C. reflexa was related to the lipid content of the host plant Medicago saliva, Helianthus annuus, Pisum sativum and Lantana camara. Parasitizing by the dodder significantly increased the total lipid level of the hosts. The increase was mainly due to enhancement in neutral lipid fraction. The level of phospholipids in the parasite was always higher than its hosts. It was also found that the triacylglyccrols were the major neutral lipids of C. reflexa vine, and these were at much higher levels than in the stems and the petiols of the host plants.In contrast, free fatty acids and total free sterols were present in lower amounts in the parasite than in its host plants. Behenic acid, a higher fatty acid, constituted 10% of free fatty acids of C reflexa, although this fatty acid could not be detected in the host plants.

In the year of 1988 experiments were carried out to study the effects of an auxin (IAA) and anti auxin (TIBA) and their interaction on the flowering of Cuscuta, a short day plant, using in vitro technique. It was found that IAA at low concentration promoted the flowering while at high concentration inhibited the same. In 1990 F. Tommasi et.al. reported that seedling of parasitic plant C. reflexa synthesize ascorbic acid (AA), but the conversion of galactono-y-lactone (GL) to AA is low in Cuscuta compared to the other angiosperms.

Maragenin (16), a triterpcnoid, from crude petroleum ether extract of C. reflexa has been isolated and its chemical nature was determined by U. S. Srivastava and co-workers.In the year of 1992, A. G. R. Nair and G. Thirupurasumdari isolated 6,7-dimethoxycoumarin (scoparone), 6-hydroxy-7-methoxy-4- (4-hydroxy phenyl)-coumarin (melanettin), quercetin and hyperoside from C. reflexa collected over Bougainvillea spectabilis.

J. Szykula and co-workers,in the year of 1994, isolated n-pentacosane, n-heptacosane, n-octacosane, n-nonacosane, n-triacontane, n-hentriacontane,1-triacontanol and 0-sitosterol

From C. chinensis. In the same year, working on the same specie, S. Yahara and et al.isolated from a 50% methanol extract, a new tryptophane alkaloid, cuscutamine (17) and two new liganans named cuscutosides A (18) and B (19) along with four known flavonoids, three liginans, pinoresinol, epipinoresinol, pinoresinol-4-O-glucoside, arbutin (20), chlorogenic acid (21) and caffeic acid (22) and p-coumaric acid (23). Their structure were characterized by spectroscopic means.

Analytical studies of fatty acids contents of the seeds of C. chinensis Lam, was carried out by GC/MS/DS and nine components were identified. The unsaponifiables of lipid soluble fraction were separated by silica gel flash chromatography into six fractions. The major components of sterols were separated by silver nitrate-silica gel complex flash chromatography and identified by MS, m.p., optical rotation, GC and IR, as [i-sitosterol, stigmasterol, O5-avenasterol (24), campesterol (25) and cholesterol.

Investigating on the parasitic plant C. chilensis and its host plant Sophora macrocarpa, M. G. Ruben et al., found that matrine (26), sophoranol (27) and methylcytisine (28) were present in C. chilensis and its host plant. Kaempferol (2) and its 3-O-glucoside (5) were present in C. micrantha, growing on Convolvulus arvensis.

K. Miyahara and co-workers31 examined the seeds of Cuscuta chinensis in the year of 1996. Two novel pure acylated trisaccharides named cus-1 and cus-2 were isolated together with a mixture of resin glycoside-like compounds. Their structures were defined as a-L-rhmnopyranosyl-(1 -3)-[2-0-(l1 S)-1 I -hydroxytetradecanoyl]-[4-0-(2R,3R)-3-hydroxy-2-methylbutyryl]-a-L-rhamnopyranosyl-(1-2)-[6-O-acetyl]-D-glucopyranose (29) and a-L-rhmnopyranosyl-(I -3)-[2-0-(11 S)-11-hydroxyhexadecanoyl]-[4-O-(2R,3R)-3-hydroxy-2methylbutyryl]-a-L-rhmnopyranosyl-(1 -2)-[6-O-acetyl]-D-glucopyranose (30), respectively. They are considered to be closely related to so called resin glycoside in terms of structure and biosynthesis.

Eight major phenolic constituents32 from C. reflexa and C. platyloba parasitizing on different host plants were isolated and identified by W, NMR and MS data. The compounds

Identified included 5-caffeoylquinic acid, 3,5-di-caffeoylquinic acid (31) 3,4-dicaffeoylquinic acid (32), quercetin (9) and its O-glycosides (10) as well as kaempferol-3-β-galactosides (11) and kaempferol-3-O-β-glucoside (5). Reflexa cultivated in green house yielded mainly hydroxyl cinnamic acid derivatives, whereas field grown plant showed the ability to synthesize flavonoids as well. C. plaryloba was characterized by the accumulation of flavonoids in addition to caffeic acid esters.

In the year of 1997 a Chinese group C. Guo et al. working on the plant C. australis isolated the chemical constituents from the seeds. The six compounds identified were austragalin (5), kaempferol (2), quercetin (9), β-sitosterol 3-O-β-D-xylopyranoside and lacceroic acid. In the same year H. Gou and J. Li working on the same part of the same plant isolated six flavonoids, four of them were identified as kaempferol (2), quercetin (9), astragalin (5) and hyperoside-Australiside A, a new diterpenoid glucoside, was isolated together with thymidine, caffeic acid (22) *p*-coumaric acid (23) and caffeic- β-D-glucoside from *C.* australis. Based on spectral analysis and physiochemical properties the structures of these five compounds were elucidated. N. Mahmood and co-workers, investigating the water extracts of *C. reflexa*, isolated the anti-HIV active compounds and identified them to be caffeoyl quinic acid (21) and its 3,5- and 3,4-dicaffeoyl derivatives (31-32) and flavanones (33-39). U. Chatterjee and el al, in the year of 1997, extracted and purified carboxymethyl cellulose, from the angiosperm parasite *C. reflexa*, free from β-glucosidase and other enzyme activities.

Again K. Miyahara el al., working on the seeds of C. chinensis, isolated four new glycosidic acids, named cuscutic acid A-D (40-43) along with known organic acids, acetic acid, proplonic acid, (2S)-2 methylbulyric acid, tiglic acid, (2R, 3R)-nilic acid, (11S) convolvulinolic acid and (11S)-jalapinolic acid from the alkaline

hydrolysate of the ether insoluble resin glycoside-like fraction. The compounds were characterized on the basis of chemical and physical data.

In the year of 1998, E. Anis and co-workers isolated, hydroxyoleanene alkanoates (44, 45) from C. reflexa, their structures were determined by spectroscopic means. In the next year, they also reported nine compounds including coumarin, indentified as 6, 7, 8-trimethoxy-2H-1-benzopyran-2-one (46), stigmasterol, lupeol, α-amyrin, β-amyrin, oleanolic acetate, α-amyrin acetate, β-amyrin acetate and oleanolic acid. Their structures have been established with the help of spectral data. In the same year, C. Guo et al. determined the amount of quercetin (9) and kaempferol (2) in the seeds of C. australis by HPLC.

Z. Wang and Z. He, investigating the seeds of C. chinesis isolated ten compounds namely sesamin (47), kaempferol (2), kaempferol-3-*O*-glycoside (5), trihydroxyaurone (48) quercetin (9), hyperoside, palmatic acid, stearic acid, β-sitosterol and daucosterol. Their structures were established by chemical and spectral methods. Among them only sesamin (47) was a new compound.

Recently in 2002, E. Anis and co-workers reported the isolation and structural elucidation of two new compounds namely 7′-(4′-dihydroxyphenyl)-N-[(4-methoxyphenyl) ethyl] propenamide (49) and 7'-(4'-hydroxy-3'-methoxyphenyl)-N- [(4-butylphenyl) ethyl] propenamide (50) together with five known compounds, 6, 7, 8-trimethoxy-2H-1- benzopyran-2-one (46), 6, 7-dimethoxy-2H-1-benzopyran-2-one (scoparone), ethyl 3-(3,4- dihydroxyphenyl)2-propenoate (51), 3-(4-*O*-β-D-glucopyranoside-3, 5-dimethoxy phenyl)-2- propenol (52), and 2-(3-hydroxy-4-methoxyphenyl)-3, 5-dihydroxy-7-*O*-β-D-gluco pyranoside-4H-1-benzopyran-4-one (53).

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