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Phytochemistry and Pharmacology of Genus *Cercis*: A Review

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Abstract: The genus *Cercis*, belonging to the Fabaceae family, is widely distributed in China and traditionally employed in Chinese medicine to treat various disorders, like irregular menstruation, pain, cough and carbuncle swelling. Despite the availability of numerous scientific studies on this genus, reviews that comprehensively cover its phytochemistry and pharmacology remain limited. This review aims to systematically consolidate the scientific literature on the phytochemistry and pharmacology of eight *Cercis* species, retrieved from databases like PubMed, Web of Science, SciFinder, Google Scholar, and the China National Knowledge Infrastructure platform. Based on a thorough analysis of the literature, more than 100 compounds have been identified from *Cercis* species, including flavonoids, phenols, terpenoids, lignins, dibenz[b,f]oxepins and others. Extracts and chemical constituents derived from *Cercis* species exhibited significant antioxidant, analgesic, anti-inflammatory, antitumor, antibacterial activities. These findings contribute to a deeper understanding of the medicinal potential of *Cercis* species and their potential applications in healthcare.

Keywords: *Cercis*; phytochemistry; pharmacology; bioactivity; flavonoid.

1. Introduction

The genus *Cercis* within Fabaceae family encompasses eight species distributed across temperate regions, namely *C. chinensis*, *C. glabra*, *C. chuniana*, *C. chingii*, *C. racemosa*, *C. siliquastrum*, *C. canadensis* and *C. griffithii* [1]. According to the Zhongyao Dacidian, the wood, bark, flowers, and fruits of C. chinensis possess diverse pharmacological properties, leading to their extensive application in traditional Chinese medicine. For example, the wood was used to treat irregular menstruation, stagnation abdominal pain and urination dripping pain. Its bark has been utilized in treating

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rheumatism pain, carbuncle swelling, bruises and other injuries. The flowers possess curative effects for heat, bleeding, sores, rheumatism muscle pain, while the fruits are employed in treating coughs[2]. To further enhance the understanding and utilization of *Cercis* plants, a comprehensive literature search was conducted using keywords "*Cercis*", "chemical constituents", "pharmacological activity", "bioactivity" in databases including PubMed, Web of Science, SciFinder, Google Scholar, and China National Knowledge Infrastructure platform. Based on the analysis of literature, the phytochemical and biological activities of *Cercis* plants were summarized, providing valuable insights for future research and comprehensive exploitation of these medicinal resources.

2. Phytochemistry

Up to now, more than 100 chemical constituents have been successfully isolated and characterized from *Cercis* plants. These compounds primarily fall into five categories: flavonoids, terpenoids, phenols, lignans and dibenzo[b,f]oxepines. Phytochemical investigations indicate that a majority of these compounds were extracted from the leaves and flowers, particularly flavonoids and phenols. These chemical entities are pivotal in contributing to the plants' significant medicinal potential in the treatment of diverse disorders.

2.1. Flavonoids

Flavonoids, a class of ubiquitous natural compounds, exhibit diverse biological activities including anti-inflammatory and antioxidant properties[3]. To date, 45 flavonoids (**1-45**) were isolated from *Cercis* plants (Table 1, Figure 1). Among these, 22 are glycosides [4–16]. Structurally, the flavonoids in *Cercis* plants include flavonols (**1-26**), flavonoids (**27-31**), isoflavone (**32**), flavan-3-ols (**33-36**), dihydroflavonoids (**37-39**), dihydroflavonols (**40-43**), chalcone (**44**) and flavone dimer (**45**). Dihydroflavones, particularly kaempferol derivatives, are the most prevalent. Notably, the phenolic hydroxyl groups in the A and B rings are frequently methylated and partially glycosylated. The hydroxyl group at C-3 position of C ring is typically glycosylated, with a diverse array of glycosyl units including monosaccharides such as glucose, rhamnose, galactose, xylose, and disaccharides like rutinoside. Additionally, the C-3 hydroxyl group in flavonols is commonly esterified with gallic acid.

Table 1. Table 1. Flavonoids isolated from *Cercis* species

No.	Compound name	Source	References
1	kaempferol	*C. chinensis*/leaf, flower, fruit; *C. glabra*/leaf, flower, fruit	[4–9]
2	kaempferol-3-O-β-D-galactoside	*C. canadensis*/leaf	[10]
3	afzelin	*C. canadensis*/leaf; *C. chingii*/leaf; *C. gigantean*/leaf; *C. chinensis*/leaf, stem, flower, fruit； *C. glabra*/leaf, fruit	[4,6,8–13]
4	astragalin	*C. chinensis*/leaf, fruit	[4–5]
5	kaempferol-3-O-β-D-rutinoside	*C. glabra*/leaf	[9]
6	quercitrin	*C. canadensis*/leaf； *C. chinensis*/leaf, flower, fruit; *C. chingii*/leaf; *C. gigantean*/leaf; *C. siliquastrum*/leaf; *C. glabra*/leaf	[4–6,9–10,13]
7	quercetin-3-O-β-D-glucoside	*C. canadensis*/leaf; *C. chinensis*/leaf; *C. siliquastrum*/leaf	[10]

8	quercetin-3-O-β-D-galactoside	*C. chinensis*/leaf; *C. chingii*/leaf; *C. gigantean*/leaf	[10]
9	3-O-methylquercetin	*C. chinensis*/flower	[14]
10	myricetrin	*C. canadensis*/leaf; *C. chinensis*/leaf, flower, fruit; *C. chingii*/leaf; *C. siliquastrum*/leaf	[4–6,10,13]
11	myricetin-3-O-β-D-galactoside	*C. chinensis*/ leaf	[10]
12	myricetin-3-O-β-D-arabinoside	*C. chingii*/leaf	[10]
13	myricetin-3-O-β-D-xyloside	*C. chingii*/leaf	[10]
14	isorhamnetin-3-O-β-D-glucoside	*C. chinensis*/flower	[6]
15	quercetin	*C. chinensis*/leaf, stem, flower, fruit; *C. glabra*/leaf, flower	[4–7,9,8,11,14]
16	isorhamnetin	*C. glabra*/leaf	[9]
17	myricetin	*C. chinensis*/leaf, stem; *C. glabra*/leaf	[5,9,11]
18	myricetin-3-O-(2''-O-galloyl)-α-L-rhamnoside	*C. chinensis*/leaf, stem	[11]
19	rutin	*C. chinensis*/flower	[15]
20	laricitrin 3-O-hexoside	*C. chinensis*/fruit	[13]
21	syringetin 3-O-hexoside	*C. chinensis*/fruit	[13]
22	syringetin-3-O-(2''-O-galloyl)-rutinoside	*C. chinensis*/leaf, stem	[11]
23	syringetin-3-O-rutinoside	*C. chinensis*/leaf, stem	[11]
24	kaempferol-3-O-α-rhamnopyranoside	*C. chinensis*/flower	[12]
25	kaempferide-3-O-α-L-rhamnopyranoside	*C. glabra*/fruit	[8]
26	fisetin	*C. chinensis*/flower	[12]
27	apigenin	*C. chinensis*/flower	[6]
28	luteolin	*C. chinensis*/leaf, flower, fruit; *C. glabra*/flower	[4–7]
29	7,8-dihydroxyflavone	*C. glabra*/flower	[7]
30	baicalin	*C. glabra*/flower	[7]
31	vicenin-2	*C. chinensis*/fruit	[5]
32	genistein	*C. glabra*/flower	[7]
33	(-)-epicatechin-3-O-gallate	*C. chinensis*/leaf, stem	[11]
34	epicatechin	*C. chinensis*/fruit	[13]
35	(-)-epigallocatechin-3-O-gallate	*C. chinensis*/leaf, stem	[11]
36	(+)-catechin	*C. chinensis*/leaf, stem, root; *C. glabra*/fruit	[8,11,16]
37	3',5,5',7-tetrahydroxyflavanone	*C. chinensis*/flower	[14]
38	liquiritigenin	*C. chinensis*/leaf, stem	[11]
39	(2R)-naringenin	*C. chinensis*/flower; *C. glabra*/flower	[7,14]

40	(2R,3R)-3,5,7,3',5'-pentahydroxyflavan	*C. chinensis*/flower	[14]
41	dihydromyricetin	*C. chinensis*/root	[16]
42	dihydrorobinetin	*C. chinensis*/root	[16]
43	[+]-taxifolin	*C. chinensis*/flower	[14]
44	2',4'-dihydroxy-4-methoxychalcone	*C. chinensis*/leaf, stem	[11]
45	myricetin-3-O-rhamnoside-(C7-I-O-C7-II)-myricetin-3-O-rhamnoside	*C. glabra*/leaf	[9]

2.2. Terpenoids

Terpenoids are a kind of important natural products composed of several isoprene molecules [17]. To date, 15 terpenoids (**46-60**) have been reported in *Cercis* plants (Table 2, Figure 2), including 4 monoterpenes (**46-49**), 2 norsesquiterpenes (**50-51**), 6 sesquiterpenes (**52-57**), 1 diterpene (**58**) and 2 triterpenes (**59-60**) [4,7,18,19].

Table 2. Terpenoids isolated from *Cercis* species

No.	Compound name	Source	References
46	genipin	*C. glabra*/flower	[7]
47	geniposide	*C. chinensis*/aerial part	[18]
48	linalool	*C. chinensis*/leaf	[19]
49	citral	*C. chinensis*/leaf	[19]
50	β-lonone	*C. chinensis*/leaf	[19]
51	2,6-dimethyl-6-(4-methyl-3-pentenyl)-bicyclo[3.1.1]hept-2-ene	*C. chinensis*/leaf	[19]
52	β-selinene	*C. chinensis*/leaf	[19]
53	(-)-α-selinene	*C. chinensis*/leaf	[19]
54	α-farnesene	*C. chinensis*/leaf	[19]
55	nerolidol	*C. chinensis*/leaf	[19]
56	(+)-α-longipinene	*C. chinensis*/leaf	[19]
57	γ-elemene	*C. chinensis*/leaf	[19]
58	phytol	*C. chinensis*/leaf	[4]
59	ursolic acid	*C. chinensis*/leaf	[4]
60	friedelin	*C. chinensis*/aerial part	[18]

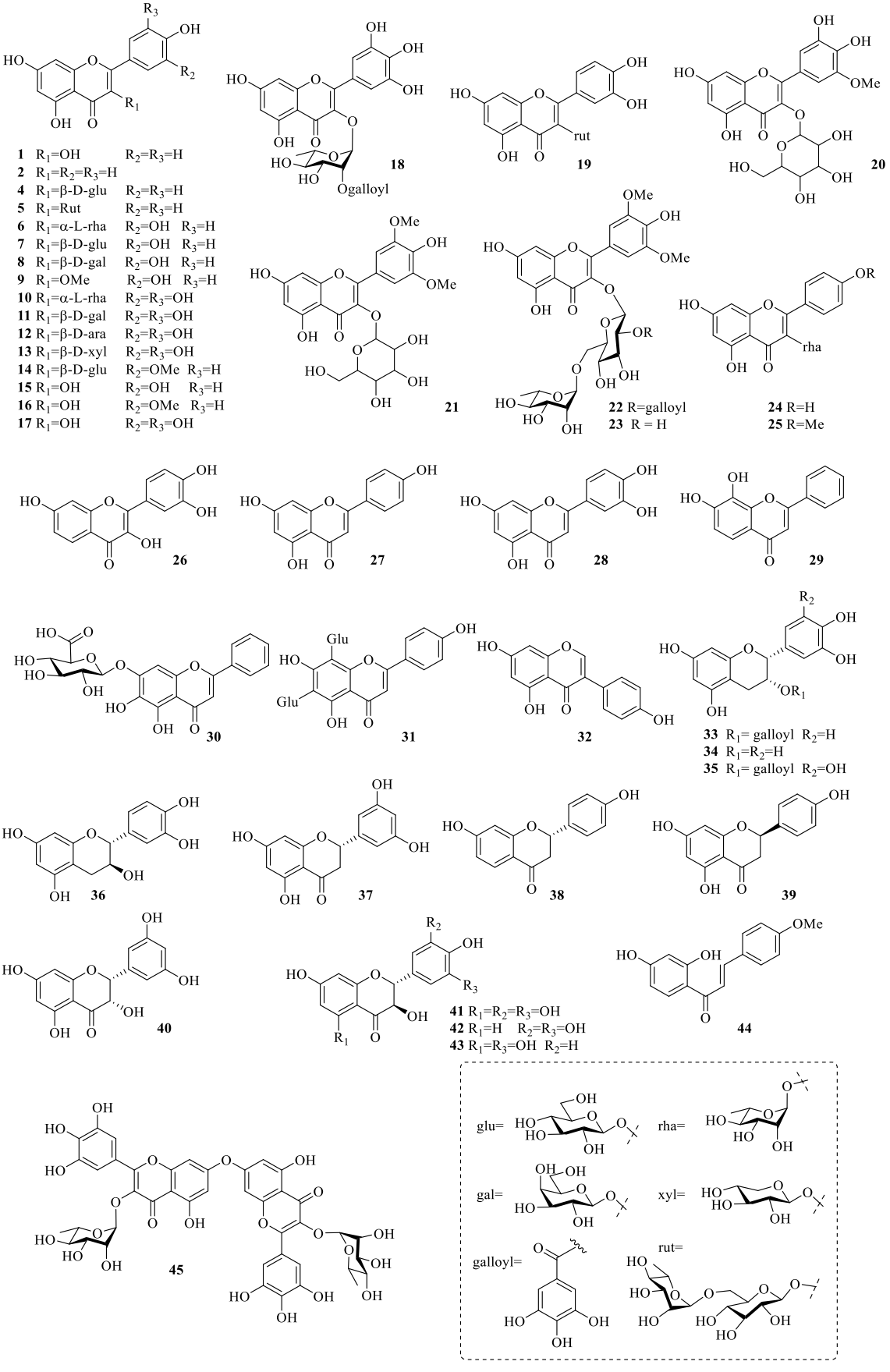

Figure 1. Flavonoids isolated from *Cercis* species

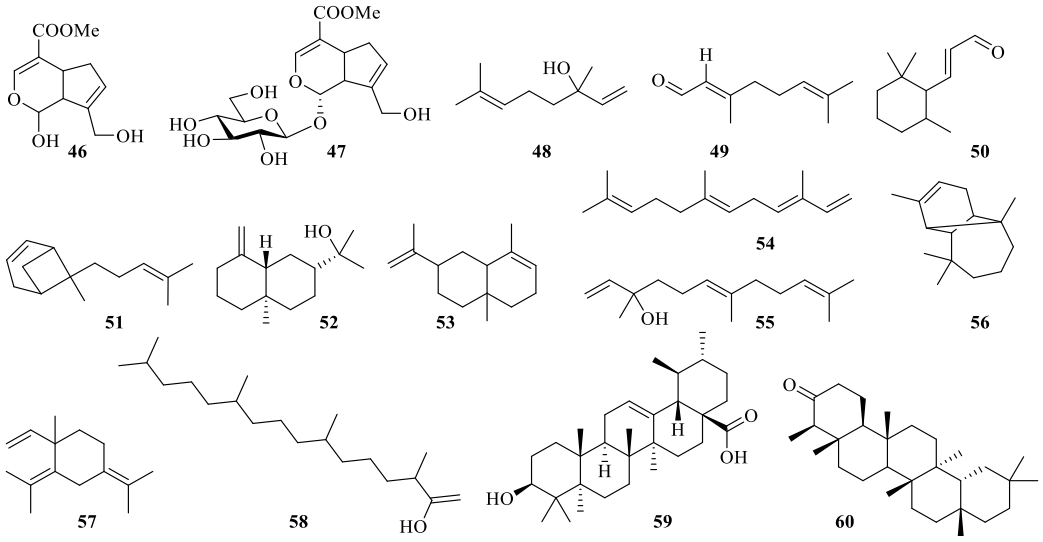

Figure 2. Terpenoids isolated from *Cercis* species

2.3. Phenolics

A total of 23 phenolic compounds (**61-83**) have been isolated from the leaves, fruits, and flowers of the genus *Cercis* (Table 3, Figure 3). These compounds are mainly derivatives of phenol, gallic acid, cinnamic acid and stilbene [5-7,9,11-13,16,18,20]. Among them, stilbenes stand out as a class of phenolic metabolites commonly found in edible plants. Stilbenes are characterized by the presence of two aromatic rings linked by an ethylene bridge [21], and an example provided is resveratrol (**79**, 3,4',5-trihydroxystilbenes). The presence of these phenolic compounds in *Cercis* plants suggests a range of potential biological activities, including antioxidant, anti-inflammatory, and other health-promoting properties.

Table 3. Phenols isolated from *Cercis* species

No.	Compound name	Source	References
61	gallic acid	*C. glabra*/leaf	[9]
62	methyl gallate	*C. chinensis*/fruit	[13]
63	vanillic acid	*C. glabra*/flower	[7]
64	protocatechuic acid	*C. glabra*/flower	[7]
65	2-methoxyhydroquinone	*C. glabra*/flower	[7]
66	hydroxybenzoic acid	*C. glabra*/flower	[7]
67	glucogallin	*C. chinensis*/fruit	[5]
68	ellagic acid	*C. chinensis*/fruit	[5]
69	ethyl gallate	*C. chinensis*/flower	[12]
70	tachioside	*C. chinensis*/aerial part	[18]
71	3,4,5-trimethoxyphenyl -1-O-β-apiofuranosyl(1"→6')-β-glucopyranoside	*C. chinensis*/aerial part	[18]
72	ceroffester A	*C. glabra*/leaf	[9]
73	ceroffester B	*C. glabra*/leaf	[9]
74	isoferulic acid	*C. glabra*/flower	[7]

75	nochlorogenic acid	*C. siliquastrum*/leaf, flower	[20]
76	chlorogenic acid	*C. siliquastrum*/leaf, flower	[20]
77	ferulic acid	*C. siliquastrum*/leaf, flower	[20]
78	isoliquiritigenin	*C. chinensis*/leaf, stem	[11]
79	resveratrol	*C. chinensis*/flower	[6]
80	piceatannol	*C. chinensis*/leaf, stem	[18]
81	3-methoxy-5-hydroxystilbene	*C. chinensis*/leaf, stem	[18]
82	trans-3,5,3',4'-tetrahydroxy-4-methylstilbene	*C. chinensis*/root	[16]
83	polydatin	*C. chinensis*/fruit	[13]

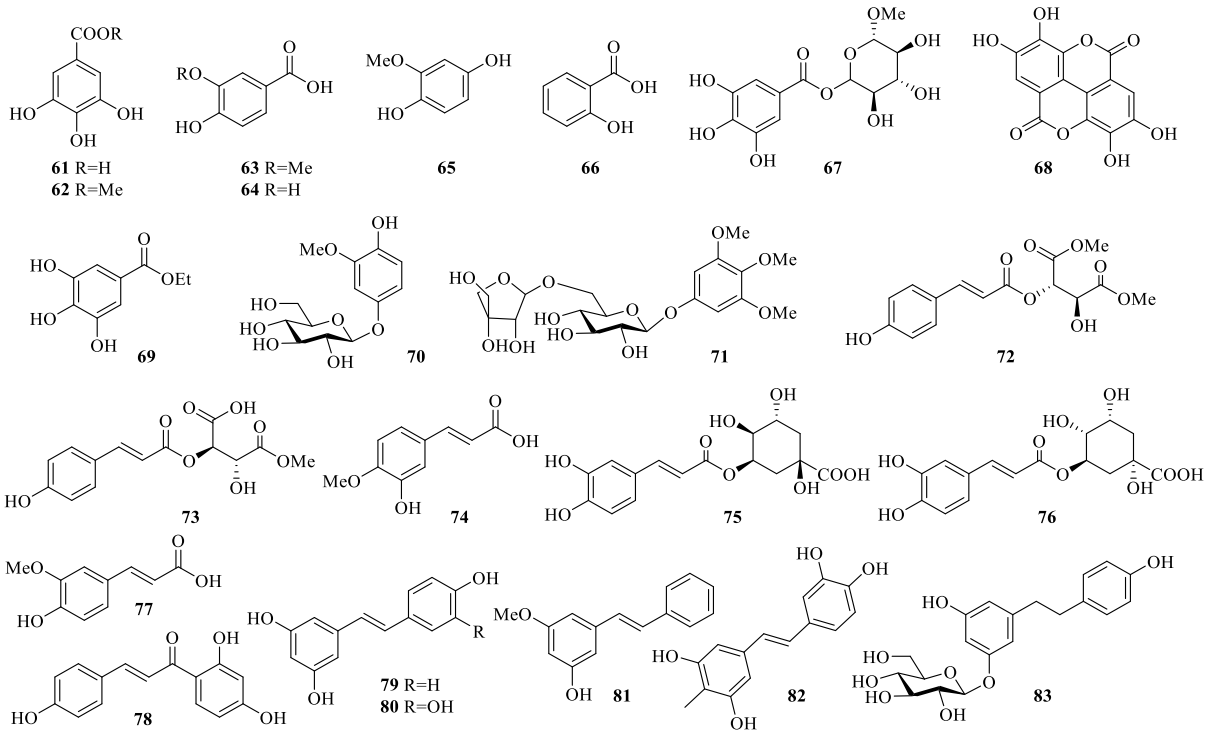

Figure 3. Phenols isolated from *Cercis* species

2.4. Lignans

So far, four lignans have been isolated from the leaves and stems of *C. chinensis*, and characterized as (+)-lyoniresinol-3a-O-β-D-xylopyranoside (**84**), (-)-lyoniresinol-3a-O-β-D-xylopyranoside (**85**), lingueresinol (**86**) and (+)-lyoniresinol-3a-O-β-D-glucopyranoside (**87**), respectively [11] (Figure 4).

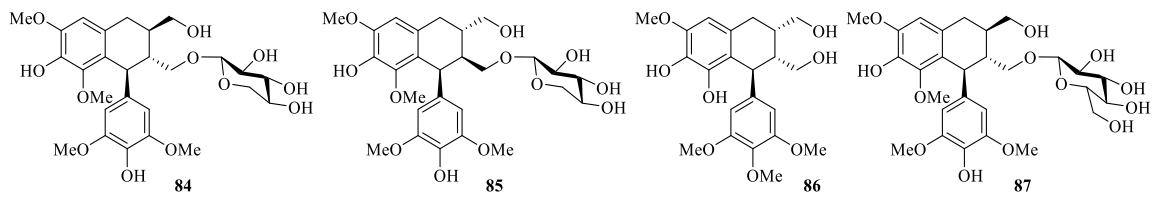

Figure 4. Lignans isolated from *Cercis* species

2.5. Dibenzo[b,f]oxepines

Although dibenzo[b,f]oxepines are relatively rare in plants, many studies have shown they have many pharmacological activities, such as antitumor, anti-hypertension, anti-inflammation, anti-depression, anti-psychosis, neuroprotection, anti-anxiety and so on [22]. According to the literature, 5 dibenzo[b,f]oxepines have been found in *Cercis* plants, namely pacharin (**88**), 6-methoxy-7-methyl-8-hydroxydibenz[b,f]oxepin (**89**), 1,8-dimethoxy-6-hydroxy-7-methyldibenz [b,f]oxepin (**90**), 1-hydroxy-6,8-dimethoxy-7-methyldibenz[b,f]oxepin (**91**) and bauhiniastatin 4 (**92**) [23] (Figure 5). The discovery of these dibenzo[b,f]oxepines in *Cercis* plants also adds to our understanding of the diversity of bioactive compounds found in plants and their potential uses in medicine.

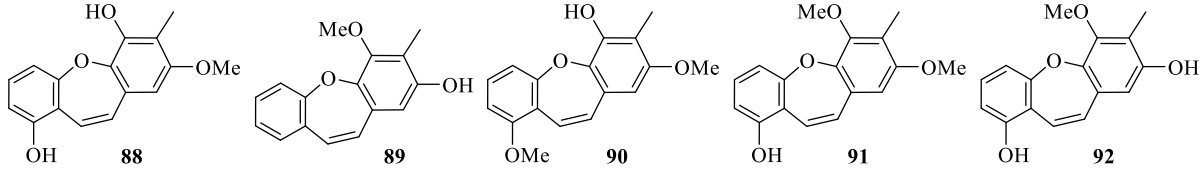

Figure 5. Dibenzo[b,f]oxepines isolated from *Cercis* species

2.6. Other Classes

In addition to the above chemical compounds, several other types of compounds have been reported from the genus *Cercis*. For example, esculin and 7-hydroxycoumarin (coumarins) [7], daucosterol [7], 5α-stigmast-9(11)-en-3β-ol [7] and β-sitosterol [2] (steroids), lithospermoside, dasycarponin and menisdaurin (cyanogenic glycosides) [16], as well as volatile oils [19,20,24].

3. Pharmacology

Cercis species exhibit a wide range of bioactivities, including antioxidant, analgesic and anti-inflammatory, antitumor, antibacterial and acetylcholinesterase inhibitory effects, which are attributed to their constituents, such as flavonoids and phenols.

3.1. Antioxidant Activity

The antioxidant activity of chemical compositions isolated from *C. glabra* leaves were evaluated by ABTS (diammonium 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonate), DPPH (2,2-diphenylpicrylhydrazyl) and PTIO (2-phenyl-4,4,5,5-tetramethylimidazoline-3-oxide-1-oxyl) methodologies [9]. Kaempferol (**1**), quercetin (**15**), isorhamnetin (**16**), myricetin (**17**), myricetin-3-O-rhamnoside-(C7-I-O-C7-II)-myricetin-3-O-rhamnoside (**45**) and gallic acid (**61**) showed ABTS radical scavenging rates of >86% at 1 mg/mL, similar to that of L-ascorbic acid (88.24 ± 0.83%). In particular, compounds **1**, **15**, **17** and **45** displayed lower IC_{50} values than L-ascorbic acid. Furthermore, compounds **15**, **17**, and **45** displayed strong scavenging rates against DPPH and PTIO radicals, suggesting their potential as novel antioxidants.

Na *et. al.* [11] reported the antioxidant activity of components identified from *C. chinensis* leaves and stems. Specifically, Myricetin-3-O-(2"-O-galloyl)-α-L-rhamnoside (**18**), syringetin-3-O-(2"-O-galloyl)-rutinoside (**22**) and piceatannol (**80**) significantly scavenged the DPPH and O_2^- radicals. Piceatannol (**80**) inhibit the lipid peroxidation initiated by Fe^{2+}/ascorbate in rat brain homogenates with IC_{50} value of 0.8 ± 0.01 μM, lower than BHA (1.0 ± 0.01 μM). Additionally, compounds **18**, **22**, and **80** exhibited cytoprotective effects by reducing thiobarbituric acid reactive substances.

The polysaccharides from *C. chinensis* leaves and flowers were found to show strong DPPH, hydroxyl radical scavenging and Fe^{3+} reducing capacities [25]. The total amount of polysaccharides extracted by ultrasonic and microwave methods was larger than that extracted by boiling method, and the antioxidant activity of the obtained polysaccharides were also stronger [26].

The pigment extracted from the *C. chinensis* flowers could effectively scavenge hydroxyl radical and super anionradical in vitro [27]. At a concentration of 0.48 mg/ml, the reducing power is identical

to that of 0.1mg/mL VC, and the hydroxyl radical and superanion radical eradication rates are 59.3% and 96.1%, respectively.

Wang *et. al.* [28–29] reported extracts from *C. chinensis* flowers were capable of scavenging superoxide anion radical ($\cdot O^{2-}$) and hydroxyl radical (·OH). The acetone and methanol fractions of *C. siliquastrum* leaves and flowers were tested to show high DPPH radical scavenging activity, with IC_{50} of 8.31±1.36, 4.78±1.84, 1.75±2.03 and 3.31±1.66 μg/mL, respectively, similar to the positive control (Trolox, IC_{50} = 1.41 ± 1.05 μg/ml).

Zhang *et. al.* [12] investigated active compounds of *C. chinensis* flowers with bio-assay guiding method, and evaluated their antioxidant activity by DPPH radical scavenging and FRAP (ferric ion reducing antioxidant parameter) assays. Ethyl gallate (**69**) exhibits strong activity against DPPH radical with the inhibition ratio 88.12 ± 1.03%, stronger than that of BHA (butyl hydroxy anisd, 60.12 ± 0.75%) and BHT (butylated hydroxytoluene, 79.03 ± 0.53%), but weaker than PG (propyl gallate, 90.66 ± 1.14%). Meanwhile, compound **69** exhibited significant activity against ABTS radical with inhibition ratio 94.96 ± 1.21%, very close to those of positive controls.

Tannins from *C. chinensis* leaves and *C. glabra* pods showed obvious DPPH radical scavenging activity with IC_{50} of 69.67 and 67.02 mg/L, lower than VC (76.65 mg/L), indicating that both plants are rich in natural antioxidants [30]. Interestingly, both ABTS and FRAP scavenging power showed significant decreases at various developmental stages, and were highest at stage I-closed bud flower clustered tightly [31].

In conclusion, the extracts and chemical constituents derived from the leaves, flowers, and pods of the *Cercis* genus possess noteworthy antioxidant activity. The primary active substances include flavonoids, phenols, polysaccharides, and pigments. The choice of extraction solvent, the method of extraction, and the plant's growth stage can significantly impact its antioxidative properties. Therefore, it is crucial to place greater emphasis on the extraction technology and the optimal harvest time to ensure maximum efficacy.

3.2. Analgesic and Anti-inflammatory Activity

The analgesic and anti-inflammatory effects of *C. chinensis* leaves and cortices were studied by Zhang *et. al.* [32–33] with writhing method and dimethyl benzene method, respectively. The results showed that both exhibited analgesic and anti-inflammatory effects in a dose-dependent manner, yet the cortices exhibited more substantial effects compared to the leaves ($p < 0.01, 0.05$). Notably, the water extract displayed better analgesic and anti-inflammatory actions than the ethanol extract.

Li *et. al.* [34] explored the analgesic effects of the active fractions from *C. chinensis* bark by hot plate method and acetic acid writhing method. They also screened for anti-inflammatory active fractions using various models, including edema induced by subcutaneous injection of egg white into the plantar in rats, xylene-induced auricle swelling in mice, and the chronic inflammatory model of granuloma caused by burying cotton balls in rats. Their study ultimately identified the ethyl acetate fraction as the primary active fraction, although the specific pharmacodynamic substances and their underlying mechanisms remain elusive.

According to Zhongyao Dacidian, the wood, bark, flowers and fruits of *C. glabra* possess strong analgesic effects [2]. These above experiment results not only provide scientific basis for the clinical application of *Cercis* species in anti-inflammatory and analgesic effects, but also indicate that the leaves may harbor untapped potential in this domain. Furthermore, they suggest that middle polar components are likely to be the primary active substances.

3.3. Antitumor Activity

The hexane fractions isolated from the leaves and flowers of *C. siliquastrum* were reported by Amer *et al.* [20] to induce cell cycle arrest, ultimately leading to cell death via apoptosis and necrosis, primarily due to impairments in the mitotic process. Additionally, Cho *et. al.* [35] found *Cercis* plants extracts exhibited more than 50% of inhibition on TNF-α production in lipopolysaccharide (LPS)-activated RAW264.7 cells at 100 μg/mL, suggesting the potential development of these extracts as a therapeutic option for TNF-α-mediated diseases, such as rheumatoid arthritis. Furthermore, Wang *et. al.* [19] reported the essential oil extracted from *C. chinensis* by steam distillation exhibited antitumor activity against K-562 human tumor cell lines, with IC_{50} of 65.66 μg/mL. Notably, this oil did not

exhibit inhibitory activity against BEL-7402, SGC-7901 and SPCA-1 cell lines, indicating its specificity in antitumor applications.

3.4. Antibacterial Activity

Yang *et. al.* [27] measured the antibacterial activity of pigment extracted from *C. chinensis* flowers. The results demonstrate that the pigment exhibits significant inhibitory effect against *E. coli* and *Staphyloccus aureus* and *Bacillus subtilis* at 0.48 mg/mL. The diameters of the inhibition zones against these bacteria were recorded as 9.46 mm, 9.36 mm, 8.14 mm, respectively. Amer *et. al.* [20] assessed the antimicrobial activity of *C. siliquastrum* flowers and leaves using a broth microdilution method on four bacterial pathogens and one fungal strain. The leaf hexane fraction showed potent antibacterial potential versus *Methicillin-Resistant Staphylococcus aureus* (MRSA), *Staphylococcus aureus*, and *Pseudomonas aeruginosa*, with MIC values of 0.024, 0.007, 0.048 mg/mL, respectively. Notably, the hexane fraction from the flowers of C. siliquastrum also exhibited strong inhibitory effects on the growth of MRSA, *Staphylococcus aureus*, *Candida albicans* and *Pseudomonas aeruginosa*, with MIC values of 0.048, 0.009, 0.08 and 0.039 mg/mL, respectively. These findings highlight the potential applications of Cercis plants in the development of antibacterial agents. However, further detailed studies are necessary to identify the effective substances and their specific mechanisms of action.

3.5. Other Activities

Apart from the pharmacology mentioned above, *Cercis* plants exhibit acetylcholinesterase inhibitory, tyrosinase inhibitory, antithrombotic, coagulant and α-glucosidase inhibitory activities.

Lou *et. al.* [9] reported that kaempferol (**1**), quercetin (**15**) and myricetin (**17**) showed moderate inhibitory activities against acetylcholinesterase at 1 mg/mL, with 85.27 ± 0.06%, 83.65 ± 0.48% and 82.21 ± 0.09%, respectively, compared with donepezil (91.17 ± 0.23%). Meanwhile, compounds quercetin (**15**), myricetin-3-O-rhamnoside-(C7-I-O-C7-II)-myricetin-3-O-rhamnoside (**45**) and gallic acid (**61**) showed strong tyrosinase inhibitory activities, with IC_{50} of 0.64, 0.65 and 0.59 mM, compared with kojic acid (0.63 mM). Xu *et. al.* [8] demonstrated kaempferide-3-O-α-L-rhamnopyranoside (**25**) and gallic acid (**61**) showed high inhibition against acetylcholinesterase with IC_{50} values of 0.391, 0.488 mg/mL, comparable to donepezil (0.096 mg/mL). Kim *et. al.* [36] analyzed the effect of 50% ethanolic extract of *C. chinensis* seed (CCS) on Aβ secretion in APPswe cells by Aβ enzyme-linked immunosorbent assay (ELISA), and found CCS dose-dependently decreased Aβ 1-42 secretion at 50 and 100 μg/mL, with IC_{50} of 45.02 μg/mL in Aβ 1-40 and 43.48 μg/mL in Aβ 1-42. This suggests that CCS has potential as a component for developing healthy functional foods and medications for Alzheimer's disease treatment.

He *et. al.* [37] evaluated antithrombotic activity of myricitrin isolated from *C. chinensis* leaves by fibrinogen (FIB), thrombin time (TT), activated partial thromboplastin time (APTT), and prothrombin time (PT) in vitro. FIB was significantly shortened, while TT, PT and APTT were significantly prolonged in myricitrin group compared with model group in vitro. These results revealed myricitrin had good antithrombotic effects. Yin *et. al.* [38] reported two novel heteroglycan (CCp-1、CCp-2) obtained from *C. chinensis* flowers could significantly shorten APTT, PT and TT, indicating they were effective coagulants. Zhang *et. al.* [12] found vanillic acid (**63**) isolated from *C. chinensis* flowers showed stronger α-glucosidase inhibitory activity (98.87% ± 1.16%) than that of acarbose (62.17% ± 0.72%), suggesting vanillic acid might be the potential inhibitor of on α-glucosidase for treatment of type 2 diabetes. Wang *et. al.* [39] found red pigment from *C. chinensis* flowers could decrease the serum contents of TC, TG and LDL-C significantly ($p < 0.05$) and increase serum level of HDL-C obviously($p < 0.01$).

4. Conclusions

In summary, extensive research has been conducted on the chemical constituents and biological activities of the genus *Cercis*, revealing a wealth of phytochemicals with potential medicinal value. Through phytochemical studies, over 100 compounds have been isolated, including flavonoids, phenols, terpenoids, lignans, dibenz[b,f]oxepins, and other bioactive molecules. These compounds and

crude extracts derived from *Cercis* species have exhibited diverse biological activities, suggesting the genus's significant medicinal importance. However, despite the promising findings, it is evident that the studies on *Cercis* are still lacking in systematicity and depth compared to those conducted on other Fabaceae plants. This gap in research indicates that further attention and investment are necessary to fully unlock the potential of *Cercis* species. Future work should focus on in-depth phytochemical investigations to discover novel compounds, as well as comprehensive pharmacological evaluations to determine the precise mechanisms and efficacy of these compounds. With continued research, *Cercis* may yield significant contributions to the field of natural product-based drug discovery and development.

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Competing Interests

The authors declare that there are no competing interests exist.

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