

Capparis spinosa L.: a natural source of pharmaceuticals

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Capparis spinosa L. (Caper) is an important source of different secondary metabolites of beneficial activities on human health. Phytochemical studies have shown the presence of many bioactive compounds such as spermidine, rutin, quercetin, kaempferol, stigmasterol, tocopherols, and carotenoids. Biological studies reveal important antimicrobial, antioxidative, anti-inflammatory, antidiabetic, immunomodulatory, and antiviral properties. The present review summarizes information concerning biological activities of some compounds isolated from *C. spinosa* for the management of several diseases.

Keywords:

Capparis spinosa, folk medicine, pharmaceuticals

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Body

Capparis spinosa L., which is known in Arabic as ‘Kabbar’, is one of the Capparidaceae family members. Caper genus contains more than 250 species, which are widely distributed throughout the different habitats ranging from Morocco to Crimea, Armenia and Iran [1,2]. Different parts of *C. spinosa* have been used as a traditional herbal remedy that has beneficial effects on human health.

The whole plant has been used for the treatment of rheumatism and as antimicrobial herbal source. Roots have been used as diuretic and against gastrointestinal problems and also to treat fever, rheumatism, paralysis, toothache, and kill worms in the ear. Bark root, which has a pungent taste, has been used as an appetizer, astringent, tonic, and antidiarrheic and to treat hemorrhoids and spleen diseases. Bark has also been used for gout and rheumatism, as expectorant and against chest diseases. An infusion of stem and root bark was used as antidiarrheic and febrifuge. Fresh fruits have been traditionally used for the treatment of type 2 diabetes, sciatica, and dropsy. Dried and powdered fruit combined with honey was used against colds, rheumatism, gout, sciatica, and backache. As a decoction, it was used for gastric pain and has been applied on the whole body to reduce severity of epilepsy seizures.

Seeds have been used against feminine sterility and dysmenorrhea and as antiproliferative and as HIV-1 reverse transcriptase inhibitor. Crushed seeds were used for ulcers, scrofula, and ganglions. The crushed leaves were applied as a poultice on the front against headache and to relieve toothache as well as an anti-inflammatory agent [3–10].

Chemistry

Preliminary screening of the alcoholic extract of *C. spinosa* revealed the presence of many biologically active chemical groups including alkaloids, glycosides, carbohydrates, tannins, phenolics, flavonoids, triterpenoids, volatile oil, and fatty acid, whereas the aqueous extract showed the presence of steroids, glycosides, carbohydrates, flavonoids, and saponins [11–13].

Biological activity

As there is insignificant scientific evidence regarding acute, subacute, and chronic toxicity owing to the usage of *C. spinosa*, it is considered a very imperative and safe herbal medicine used as antihyperlipidemic, antihypertensive, antihepatotoxic, and as a potential source of inhibitory bioactive compounds used in the traditional medicine such as antifungal, anti-inflammatory, antidiabetic, nuclear factor- κ B, and anticarcinogenic [6,14–20]. In ancient times, people used roots, leaves, buds, fruits, bark, and seeds of *C. spinosa* for several medicinal purposes and to treat diseases such as rheumatism, stomach problems, headache, and toothache. Table 1 represents the use of *C. spinosa* by people in ancient times.

The different parts of the plant include a wide variety of active secondary metabolites endowed with several documented biological activities used in the

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Table 1 The use of *Capparis spinosa* by people in ancient times

Treated diseases	Consumers	References
Cure hemorrhoids, dispel bad odors and spirits, dispel gases, kidney disease, skin diseases, liver disease, and diabetes	Ancient Arab	[21,22]
Cleaning ulcers, curing teeth pain, and protecting against palsy and spleen ache, sciatica, and all kinds of pains	Ancient Roman and Ancient Greek	[23]
Kill worms in the ears, rotting teeth and gums, stomach problems, accelerate menstruation, scorpion stings, obstruction in the liver, arousing appetite, and kidney disease	Ancient Egypt	[23]

Table 2 Pharmacological properties of *Capparis spinosa* L.

Part of the plant	Pharmacological activities	References
Fruits and flower buds	Treatment of rheumatism and inflammatory disorders and being antiallergic, antihistaminic, and antimutagenic	[24]
Fruits	Antidiabetic, hypolipidemic, diuretic, and anticomplement	
Aerial parts and roots	Antihepatotoxic	
Whole plant and roots	Antimicrobial	
Flower buds	Antiviral and immunomodulatory	
Aerial parts and fresh buds	Antioxidant	
Fruits	Antiapoptotic	
Leaves	Stimulating melanogenesis	
Aerial parts	Antiparasitic	
Seeds	Antiproliferative, HIV-1 reverse transcriptase inhibitory	

Table 3 Biological activities of the chemical constituents isolated from *Capparis spinosa* L.

Numbers	Compounds	Plant part	Biological activities	References
1	Kaempferol	Leaves	Expectorant, anticancer, antispasmodic, antihepatotoxic, antiviral, antiallergic, antibacterial, antihistaminic, antioxidant, and antiaggregant	[28,29]
2	Quercetin	Leaves	Antioxidant, antiviral, antibacterial, anti-inflammatory, antiallergic, antflu, antihistaminic, antipharyngitic, anticapillary-fragility, antiaggregant, antithrombic, antiatherosclerotic, anticancer, antispasmodic, and anti-HIV	[30–33]
3	Isorhamnetin	Leaves	Expectorant, antibacterial, antihistaminic, antioxidant, anticancer, antihistaminic, and antineoplastic	[34]
4	Apigenin	Fruits	Anti-inflammatory, antioxidant, antiviral, antibacterial, antiestrogenic, anti-HIV, antispasmodic, anticancer, antidermatitic, antimetastatic, antileukemic, and antimutagenic	[24,34]
5	Chrysoeriol	Fruits	Anti-inflammatory and antioxidant	[24,35]
6	Rhamnetin	Leaves	Antitumor, anti-inflammatory, and antioxidant	[34,36,37]
7	Rhamnozoin	Leaves	Antimicrobial	[38]
8	Kaempferol-7-rhamnoside	Leaves	Antimicrobial	[38]
9	Kaempferol-3,7-dirhamnoside	Leaves	Hypoglycemic and antioxidant	[39]
10	Kaempferol-3-rutinoside	Leaves	Antimicrobial	[38]
11	Kaempferol-3-glucoside-7-rhamnoside	Aerial part	Antimicrobial	[38]
12	Quercetin-3-glucoside	Leaves	Antimicrobial, antioxidant, and anticancer	[38,40]
13	Quercetin 3-glucoside-7-rhamnoside	Aerial part	Analgesic, anticancer, and antioxidant	[41]
14	Quercetin 7-rhamnoside	Leaves	Antiviral	[42]
15	Quercetin-3-rutinoside	Leaves	Antiviral, anti-inflammatory, anticapillary-fragility, antiherpetic, antiradicular, and antihepatotoxic	[31,33]
16	Xanthorhamnin	Aerial part	Anti-inflammatory, antirheumatic	[43]
17	Capparispinine	Roots	Antidiabetic	[44,45]
18	Capparispinine-26-O- β -d-glucoside	Roots	Antidiabetic	[44,45]

(Continued)

Table 3 (Continued)

Numbers	Compounds	Plant part	Biological activities	References
19	Cabadicine	Fruits	Anticancer	[41,46]
20	Cabadicine-26-O- β -d-glucoside hydrochloride	Roots	Antidiabetic	[44,45]
21	2-Thiophene-carboxaldehyde	Leaves	Nematicidal	[47]
22	Methyl-isothiocyanate	Leaves	Nematicidal, antifungal, and antibacterial	[47–50]
23	Benzyl-isothiocyanate	Leaves	Antifungal and antibacterial	[51]
24	Corchoionoside C	Fruits	Anti-inflammatory	[52]
25	<i>p</i> -Methoxybenzoic acid	Aerial part	Antihepatotoxic	[18]
26	Cappariloside A	Fruits	Antioxidant and anticancer	[41,46,53]
27	Cappariloside B	Fruits	Antioxidant and anticancer	[41,46,53]
28	Thymol	Leaves	Anti-inflammatory, cicatrizing activity	[54]
29	Isopropyl isothiocyanate		Antibacterial	[48–50]
30	Butyl isothiocyanate	Aerial part	Antifungal and antibacterial	[48–50]
31	sec-Butyl isothiocyanates	Aerial part	Antibacterial	[48–50]
32	Sinigrin	Aerial part	Anticancer, antifeedant, larvicide, mutagenic, phagostimulant, and antifungal	[34,55]
33	Stachydrine	Aerial part	Antimetastatic, antiarthritic, analgesic, anti-inflammatory, and anticancer	[46,56,57]
34, 35, 36	Glucocleomin, glucobrassicin, neoglucobrassicin (glucosinolates)	Aerial part	Antibacterial and antifungal	[58–62]
37	Ginkgetin	Leaves	Anti-inflammatory and antioxidant	[41,60]
38	Isoginkgetin	Aerial part	Anti-inflammatory and antioxidant	[41,60]
39	Isocodoncarpine	Fruits	Anti-inflammatory	[19]
40	Uracil	Fruits	Antiarthritic	[56]
41	γ -Tocopherol	Aerial part	Antioxidant and anticancer	[41,63]
42	Capparaside	Aerial part	Antioxidant, anticancer	[6,64,65]
43	Caffeic acid	Aerial part	Antihepatotoxic, antioxidant, anticarcinogenic, anti-HIV, antimicrobial, analgesic, antifu, antiaggregant, diuretic, and fungicide	[66–68]
44	Ferulic acid	Aerial part	Antihepatotoxic, antioxidant, analgesic, antiallergic, antibacterial, antiaggregant, antithrombic, analgesic, antiviral, antineoplastic, antimutagenic, and antitumor	[66–68]
45	Chlorogenic acid	Aerial part	Antioxidant, diuretic, analgesic, antibacterial, antiseptic, antiviral, anti-inflammatory, and fungicide	[34]
46	Cinnamic acid	Fruits	Antioxidant, antibacterial, antiviral, and antifungal	[24,69]
47	Syringic acid	Fruits	Antihyperglycemic and anticarcinogenic	[24,70,71]
48	<i>p</i> -Coumaric acid	Aerial part	Antihepatotoxic, antioxidant, fungicide, antibacterial, antispasmodic, and anticancer	[66,67]
49	α -d-Fructo-furanoside	Fruits	Antiarthritic	[56]
50	Quinic acid	Leaves	Anticancer	[72]
51	Daucosterol	Fruits	Antileukemic, antitumor, antispasmodic, and antiarthritic	[34,41,56]
52	Indol-3-methyl glucosinolates	Seeds	Anticarcinogenic	[73]
53	Campesterol	Roots	Nutraceutical	[41]
54	Stigmasterol	Roots	Nutraceutical	[23]
55	Vanillic acid	Aerial part	Anticancer, antibacterial, antioxidant, and anti-inflammatory	[37,74]
56	<i>p</i> -Hydroxybenzoic acid	Aerial part	Antimicrobial, antialgal, antimutagenic, antiestrogenic, anti-inflammatory, antiviral, antioxidant, and anticancer	[34,75]
57	Protocatechoic acid	Aerial part	Anticancer, antibacterial, antioxidant, and antiulcer	[34,76]
58	Cappaprenol-13	Roots	Anti-inflammatory, hepatoprotective	[41,77]
59	Adenosine	Roots	Analgesic, antiaggregant, sedative, vasodilator, and hypotensive	[34]
60	<i>B</i> -Sitosterol			[34,41]

(Continued)

Table 3 (Continued)

Numbers	Compounds	Plant part	Biological activities	References
		Aerial part	Antiadenomic, antibacterial, anticancer, antileukemic, nutraceutical, anti-inflammatory, hepatoprotective, antiviral, hypolipidemic, and antiprostaglandin	
61	B-Sitosterol- β -d-glucoside	Aerial part	Antileukemic, antitumor, antispasmodic, and hypoglycemic	[34]
62	Uridine	Aerial part	Anticancer, anti-HIV, and antiviral	[78,79]
63	Lutein	Leaves, buds, flowers	Antioxidant, antiradicular, antiatherosclerotic, antitumor, and cardioprotective	[34]
64	Linoleic acid	Leaves	Anticancer, anticoronary, and antihistaminic	[34]
65	Palmitic acid	Aerial part	Nutraceutical	[41]
66	Oleic acid	Leaves	Hypocholesterolemic, anti-inflammatory anticancer, and dermatitogenic	[34]
67	α -Tocopherol	Fruits	Antiaggregant, antiaging, anticancer, anti-inflammatory, antileukemic, antiherpetic, antioxidant, and antiradicular	[34]
68	Coumarin	Aerial part	Antiaggregant, antiandrogenic, antiedemic, anti-inflammatory, anticancer, antimutagenic, immunostimulant, chemopreventive, fungicide, and analgesic	[34]
69	5-(Hydroxy-methyl)furfural	Fruits	Antiarthritic	[56]
70	Spermidine	Aerial part	Antidiabetic	[44,45]
71	Flazin	Fruits	Anti-HIV agent, anti-inflammatory	[24,80]
72	Guanosine	Fruits	Antiparasitosis	[24,81]
73	Sakuranetin	Fruits	Anti-inflammatory, antimutagenic, and antipathogenic against <i>Helicobacter pylori</i> , <i>Leishmania</i> , and <i>Trypanosoma</i>	[24,82]

traditional medicine. The pharmacological properties of these parts are tabulated in Table 2.

Although frequently phytochemicals act synergistically with other compounds in the plants, instead of working alone, many chemical constituents were isolated from *C. spinosa* [25–27]. Some of them showed a wide variety of biological activities. Searching the available sources, and to the best of our knowledge, a summary of the compounds naturally isolated from *C. spinosa* and showed biological activity are presented in Table 3.

Conclusion

The different health promotion activities of *C. spinosa* makes it a good candidate for discovering a new series of naturally originated drugs.

C. spinosa L. has a wide range of applications in the traditional medicine. Recently, the pharmacology and chemistry of this plant have been extensively studied. Chemical studies of the different parts of *C. spinosa* have shown the presence of many beneficial compounds. Biological studies have revealed significant antidiabetic, antimicrobial, antioxidative, anti-inflammatory, immunomodulatory, and antiviral activities, providing a support to traditional medicinal uses. Nevertheless, despite its importance and variable

pharmacological studies available, future experimental and clinical trials are necessary to confirm the use of this species in medical practice.

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Conflicts of interest

There are no conflicts of interest.

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