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*Review Article*

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# Ethnomedicinal Uses, Phytochemistry and Pharmacology, of Capparis spinosa L: A Review

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## ABSTRACT

**Background:** Caper is an aromatic, medicinal, spontaneous plant and largely widespread in North Africa. It belongs to the family of Capparidacées and to the Capparis genus; it contains more than 350 species, used for various ends (food, medicine, ornamentation and cosmetic).

**Objective:** this review is conducted to summarize the pharmacological effect of plant Capparis spinosa, and main active phytochemical composition.

**Methods:** A narrative review article was conducted by researching several relevant search engines such as Google scholar, PubMed, ResearchGate, Scopus, BASE search by using Several Keywords related to Capparis spinosa. The analysis focused on studies reporting identified compounds and their biological effects.

**Result:** Capparis spinosa contained many biologically active chemicals groups including alkaloids, glycosides, tannins, phenolics, flavonoids, triterpenoids, steroids, carbohydrates, saponins and wide range of minerals and trace elements.

**Conclusion:** Capparis spinosa has several pharmacological qualities and a rich phytochemical profile, making it a valuable medicinal plant. Its many therapeutic benefits justify its continued use in conventional medicine and stimulate more clinical and pharmacological research.

**Keywords:** Capparis Spinosa, Phytochemical, Aromatic & Medicinal

## Introduction

Since ancient times, humanity has used various plants found in its environment to treat and cure all kinds of illnesses. According to the World Health Organization (WHO), approximately 65-80% of the world's population in developing countries, due to poverty and lack of access to modern medicine, relies primarily on traditional medicinal plants for their primary healthcare [1].

Medicinal plants have always held an important place in humanity's therapeutic arsenal. And despite the remarkable progress in synthetic organic chemistry during the twentieth century, more than 25% of medications prescribed in industrialized countries are derived directly or indirectly from plants. These plants represent a vast reservoir of potential compounds attributed to secondary metabolites, which have the advantage of exhibiting a wide diversity of chemical structures and possessing a very broad range of biological activities (antibacterial, anti-inflammatory, vasodilatory, anti-cancer, antioxidant, anti-atherogenic, antipyretic, analgesic) (Zeghad, 2009) [2]. Morocco boasts a significant wealth of plants, with approximately 42,000 species, nearly 600 of which are used in traditional medicine [3]

The caper bush is a perennial shrub widely cultivated in Mediterranean countries. It is grown for its flower buds, known as capers. In Morocco, the three main regions where the caper bush is traditionally cultivated are Taounate, Safi, and Taroudant. However, it also grows wild in several other regions. Morocco is currently the leading producer and exporter of capers in the Mediterranean basin and worldwide [4]. It boasts numerous qualities and has many culinary and therapeutic uses. It is an important source of minerals, vitamins, and bioactive compounds, which explain its use in traditional medicine. The

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different parts of the caper bush are known for their significant antioxidants, anti-inflammatory, and antidiabetic properties, among others [5-7].

This review article offers a thorough examination of the phytochemical components, historical applications, and pharmacological uses of Capparis spinosa.

**Botanical Appearance of Capparis Spinosa**

This perennial shrub has thick, deep roots, is voluminous, reaching a height of approximately 50–100 cm [8]. It is erect, precombined, or pendulous, with numerous branches, uni- or multi-branched, green, red, or yellow, reaching 4 m long [9]. The branches are twisted or straight, with or without simple hairs. The stipules are slightly curved, straight, bristly or spreading, antrorse or retrorse, orange, yellow, or green, reaching 6 mm long. The leaf stipules can be formed into spines, hence the name "spinosa".

The leaves are rounded or oval, lanceolate or oblong, elliptical or oblique, with an obtuse, tapered, acute, or cordate base and an acute, rounded, oblique, truncate, or obtuse apex. The leaf veins are prominent or not. The leaf texture can be glabrous, pubescent, and very dense. The petiole is grooved or entire, 0–2 cm [4].

The flowers are pinkish in color, with four sepals, four petals, and several stamens grouped in clusters [10].

The fruit is an oblong, ovoid, ellipsoid, or globose berry, green in color with well-defined longitudinal nerves, along which dehiscence occurs later. The seeds are one to several and are generally brown when ripe, immersed in a reddish or yellow pulp. The shape, color, and size of the seeds have been noted as having limited taxonomic value [11]. The seeds are 3–4 mm in diameter, globose, smooth, and brown [10].

The roots are sparsely branched and very deep; they can reach depths of 6 to 10 meters [12,13,7].

**Ecological Requirements**

As a typically xerophytic plant, the caper plant favors a rainy spring and a dry, hot summer with intense sunshine, with temperatures exceeding 40°C and average rainfall of 350 mm during the spring and winter seasons. High temperatures favor bud formation [14]. In arid and semi-arid areas, it can tolerate extreme climatic conditions, while adapting its leaves to become smaller (to prevent water loss) and its stems adopting a greater number of thorns [15]. Meanwhile, its roots, associated with nitrogen-fixing bacteria, allow their growth in infertile soils [16]. Caper is adapted to poor soils and widely distributed on rocky areas, mountains and grows on many types of soil, it is a rupicolous species that can be cultivated on different types of soils, including alfisols, regosols and lithosols, it shows a good response to volcanic or alkaline soils; it tolerates a pH of 6.1 to 8.5 [7,17].

**Importance of Spiny Caper**

**Medicinal Importance**

The first recorded use of Capparis spinosa L. was in 2000 BC by the Sumerians and the ancient Greeks and Romans for medicinal purposes [18]. It exhibits anthelmintic, cytotoxic, anti-inflammatory, antiarthritic, antioxidant, antimicrobial, cardiovascular, chondroprotective, antiallergic, antihistamine, immuno-modulating, anticarcinogenic, and antihepatotoxic activities [19]. It has been shown to be effective in the treatment of rheumatism [20]. Pickled capers are used as a food for diabetic patients due to the belief that they have hypoglycemic and hypolipidemic properties [21].

**Ecological Importance**

This shrub is considered an excellent material for windbreaks [22]. It grows on poor soil, particularly in dry areas, which binds and stabilizes soils and limits erosion [23]. It is also resistant to salinity, and its plant cover helps conserve soil water reserves [24]. It grows in winter and flowers fully in summer, when the surrounding flora exhibits minimal growth rates. This performance provides Capparis spinosa with a competitive advantage over other species; it therefore plays an important role in the dynamics of the Mediterranean ecosystem during a period of limited resources [25].

**Economic Importance**

Capers are commonly marketed in some Mediterranean countries such as Greece, Italy, Turkey, Morocco, and Spain, and are exported primarily to Central European countries, the United States, and the United Kingdom as a cured meat product. However, they are consumed primarily in their production areas, where they are integrated into the culinary culture [26]. These buds are selected by size, with the smallest being the most popular on the market [27]. The seeds of Capparis spinosa are marketed as herbaceous caviar in Iran due to their shape, which is very similar to that of caviar [28]. The current economic importance of caper supported by current growth in scientific interest to explore natural food sources rich in bioactive compounds has stimulated intense research on phytochemical aspects and potential use of caper berries [29].

**Chemical Composition of Capparis spinosa L. (Table 1)**

Several phytochemical studies have shown that Capparis spinosa contains a variety of active compounds in its various parts. Polyphenols and flavonoids are also present in caper [30,31]. Caper flower buds have been shown to contain the following flavonoids: quercetin, rutin, quercetin-3-rutinosides, quercetin-7-O-glucorhamnoside, kaempferol-3-rutinosides, and kaempferol 3-O-rhamnosyl-rutinoside [26,32,31]. The aerial part of the plant also contains quercetin 3-O-glucoside, quercetin 3-O-glucoside-7-O-rhamnoside, quercetin 3-O- [6'-α-L-rhamnosyl-6'-β D-glucosyl]-β-D-glucoside, and quercetin-7-O-D-glucopyranoside-β-L rhamnopyranoside [31].

Caper is also rich in hydroxycinnamic acids, including caffeic acid, ferulic acid, p-coumaric acid, and cinnamic acid [30,19]. Compounds homologous to polyphenolic compounds in particular: cappaprenole-12, cappaprenole-13 and cappaprenole-14 have been isolated from the plant [19]. Alkaloids are also present in caper, they are distributed mainly in the roots and seeds [30,19]. The high alkaloid content was found in the roots of the plant where stachydrine represents 87.43% of the total alkaloids. Three spermidine alkaloids (capparispine, capparispine26-O-β-D-glucoside and cadabicin 26-O-β-D-glucoside hydrochloride) were identified in the roots of the plant [20]. Cadadicine, a new alkaloid, was isolated from caper. Romeo and colleagues (2007) identified approximately 145 volatile compounds in caper. Aldehydes

(22.2%) and esters (21%) represent the most abundant chemical classes in the plant. Caper leaves mainly contain isothiocyanates, n-alkanes, terpenoids, phenylpropanoides, aldehydes, and fatty acids. The main components of this oil are thymol (26.4%), isopropyl isothiocyanate (11%), 2-hexenal (10.2%), and isothiocyanate butylate (6.3%). The volatile compounds in the ripe fruits and roots of the plant are mainly methyl isothiocyanate, isopropyl isothiocyanate, and sec-butyl isothiocyanate [19].

Glucocapperin (90%) represents the major glucosinolate in caper flower buds [30]. Other glucosinolates such as sinigrin, glucoiberin, and glucocleomine have also been isolated from the seeds and leaves of the plant. In addition, the same authors reported that indole glucosinates such as glucobrassicin, neoglucobrassicin, and 4-methoxyglucobrassicin are present in the roots of the plant [19]. Triterpenoids (α-amyrin), sterols, saponins, and small amounts of vitamin E, β-carotene, and vitamin C have been detected in the plant [33,30]. In addition, capers contain some mineral compounds such as sodium, potassium, and phosphorus [34,8]. Caper seeds also contain proteins, lipids, and fiber [35]. The seeds contain 34.6% oil, mainly composed of linoleic acid and oleic acid [56].

**Table 1: Chemical Composition of Capparis spinosa L**

| Part studied | Chemical composition | References |
|---|---|---|
| Roots | Sugars: glucose, arabinose, mannose, and galactose<br>Lipids: linoleic acid, oleic acid, essential oils, alkaloids, proteins | [37,7] |
| Leaves and Stems | Flavonoids such as kaempferol-7-rhamnoside, phenolic compounds, carotenoids, vitamin E, essential oils and alkaloids | [13,38 |
| Flowers | Tocopherols, carotenoids, vitamin C, phenolic compounds, glucosinolates, flavonoids | [39,37] |
| Fruits | Phenolic compounds, flavonoids, lipids, proteins, mineral salts (potassium, phosphorus, magnesium and calcium), vitamin C and alkaloids | [37,38] |
| Seeds | Vitamin E (a-tocopherols, y-tocopherol and 8-tocopherols) carotenoids, oleic acid, linoleic acid, sterols, lutin, glucosinolates, terpene and aliphatic alcohol, proteins | [40,38] |
| Capers (flower buds) | Phenolic compounds, glucosinolates, proteins, lipids, minerals, carotenoids, tocopherols, rutin, quercetin, saponin, vitamin C, capric acid | Lakrimi, 1997 |

## Biological Activities of the Caper Plant

### Antioxidant Activity

The natural substances extracted from the caper plant are also important antioxidants. Indeed, the methanolic extract of the plant's raw flower buds has shown antioxidant activity in various in vitro models, suggesting its potential use in pathological conditions of oxidative stress [33]. Several in vitro studies of the antioxidant activity and free radical scavenging power of Capparisspinosa have shown that topical application of its extracts, especially the methanolic extract, protects the skin against erythema caused by UV rays [32,41,42].

### Anti-inflammatory Activity

Several studies have shown that aqueous and methanolic extracts possess anti-inflammatory activity and have demonstrated that the methanol extract of caper has antihistamine and anti-allergic effects [43-45]. Caper exhibits anti-inflammatory activity, inhibiting carrageenan-induced ear edema in rats [46]. Satyanarayana and colleagues (2008) reported that caper has an anti-inflammatory effect, as capparenole-13 isolated from caper significantly inhibited carrageenan-induced ear edema in rats.

### Anti-hepatotoxic activity

The aqueous extract of C. spinosa exhibits hepatoprotective activity and has been used to treat liver pain, demonstrating significant anti-hepatotoxic activity [47]. Indeed, this extract is widely used to determine the anti-hepatotoxic activity of various plant constituents. p-Methylbenzoic acid, isolated from the methanolic fraction of the aqueous extract, has shown significant anti-hepatotoxic activity [48].

### Antihyperglycemic Activity

The aqueous extract of the plant has demonstrated antihyperglycemic activity in vivo without affecting blood insulin concentration [49]. Oral administration of the aqueous extract of the plant, 20 mg/kg for 14 days, resulted in a significant decrease in blood glucose levels in diabetic rats. Blood glucose levels were almost normalized after two weeks of daily oral administration of 20 mg/kg of the caper aqueous extract. Furthermore, this treatment led to a decrease in plasma triglyceride levels after one to two weeks and in cholesterol levels after four to seven days [50,51].

### Analgesic Activity

Analgesics are medications used to reduce or eliminate pain. They can act in two distinct ways: either at the level of the lesion by reducing sensitivity to nociceptive stimuli (peripheral analgesics), or at the level of the central nervous system (CNS), including the spinal cord and brain (central analgesics) [52]. Oral administration of Capparis spinosa L. extracts at doses of 100 mg/kg and 300 mg/kg have been observed to alleviate pain associated with rheumatoid arthritis and osteoarthritis [53]. This analgesic property was demonstrated by Meddour et al., 2019 [54]. Their research showed that two methanolic extracts, derived from the fruit and root bark of Capparis spinosa L., exhibited analgesic activity when administered orally, particularly against acetic acid-induced pain in rats.

### Anticancer Activity

Cancer is the second leading cause of death worldwide [55]. Experimental research has revealed that certain plants possess

anticancer properties on various types of tissue cells [56]. For example, the fruit extract of Capparis spinosa L. exhibits anticancer effects due to its richness in flavonoids, which represent the largest group of natural compounds recognized for their potent antioxidant properties. These flavonoids act by scavenging free radicals and preventing their harmful action in the carcinogenesis process [57]. Furthermore, according to Kulisic et al., 2012, the aqueous extract of Capparis spinosa contains volatile and non-volatile compounds that play a significant role in the prevention of colon cancer [58].

**Anti-sclerosis Activity**

Systemic sclerosis (SSC) is a disease of still unknown etiology, characterized by the onset of diffuse sclerosis affecting the skin, but also certain organs such as the lungs, digestive tract, and heart [59]. In a preliminary study, Cao et al. showed that an ethanolic extract of Capparis spinosa significantly inhibited fibroblast proliferation and reduced the expression of alpha-2 collagen mRNA and type I collagen protein in progressive systemic sclerosis, whereas it did not do so in normal skin cells [37]. The extract is therefore capable of inhibiting fibroblast and type I collagen proliferation in progressive systemic sclerosis [7]. The study of the ethanolic extract of the fruit of this same species on fibroblast ROS, Ha-Ras, and ERK.1-2 confirmed an effect against oxidative stress. This extract was tested on fibroblasts from normal skin and from the skin of patients with systemic sclerosis. It significantly reduced the production of O2, H2O2, and ROS in fibroblasts, and decreased H2O2-induced apoptosis in both normal fibroblasts and those from sclerotic tissue. Furthermore, it significantly lowers the expression of P-ERK.1/2 and Ha-Ras [37,60,61].

**Antibacterial, Fungicidal, and Antiparasitic Activities**

Various parts of Capparis spinosa, such as the stem, leaves, flower buds, and roots, have shown considerable antibacterial activity against Gram-positive and Gram-negative bacteria. The active ingredients of this plant are used as an antibiotic against infections caused by Escherichia coli, Staphylococcus aureus, Bacillus cereus, Pseudomonas aeruginosa, Staphylococcus typhirnurium, Micrococcus luteus, Shigella flexneri, Shigella dysenteriae, Staphylococcus epidermidis, Streptococcus faecalis, and Klebsiella pneumoniae [62-67].

Its seeds contain certain volatile oils that have shown antiviral activity against Vibrio cholerae, Vibrio agava, Vibrio inaba, and Vibrio eltor [7]. Similarly, its extracts have shown inhibitory activity against important pathogenic microbes such as Bacillus subtilis and Aspergillus niger, Aspergillus niger mutant black, Penicillium italicum, Penicillium chrysogenum, Aspergillus nidulans, Candida albicans, Candida glabrata, Aspergillus flavus, and Aspergillus parasiticus [62,37,67]. The fruits of Capparis spinosa have shown antibacterial activity against Gram-positive and Gram-negative bacteria, primarily against Lactobacillus planetarium, L. brevis, L. fermentum, and L. fermenter. It also exhibits lethal activity against major parasites such as Leishmania and Plasmodium falciparum [26,38,68]. These activities are likely due to the caper's high content of quaternary ammonium compounds and glucosinolates. Indeed, some quaternary ammonium compounds are effective against fungi, amoebae, and enveloped viruses [7].

**Other effects**

Many studies have shown that Capparis spinosa has other activities such as:

- Capparis is known to have Respiratory effects [69].
- Capparis can be used in Cardiovascular effects [70,71].
- Methanolic extracts of different parts of Capparis spinosa (leaves, stems and buds) were assayed as nematicidal agents against the root knot Meloidogyne incognita by the J2 paralysis bioassay [72].
- The methanolic extract of Capparis spinosa buds, rich in flavonoids such as quercetin and kaempferol derivatives, was proven to exert in vitro immunomodulatory effects in human peripheral blood mononuclear cells (PBMCs) [73].

**Conclusion**

Traditionally Capparis spinosa L. has been used for the treatment of various human ailments including gastrointestinal problems, hypertension, strangury, anemia, liver dysfunction, rheumatism, dropsy, antispasmodic, antidiabetic, analgesic, anthelmintic, anti-hemorrhoidal, general body tonic etc. Therefore, it is concluded that Capparis spinosa is promising medicinal plant with wide range of pharmacological and biology activities which could be utilized in several medical applications because of its effectiveness and safety.

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**References**

1. Muanda FN. Polyphenols study. PhD thesis. 2010.
2. Ould El Hadj MD, Hadj-Mahammed M, Zabeirou H. Medicinal plants importance. 2003.
3. Errajraji A, Ouhdouch F, El-Anssari N. Medicinal plant use. Med Mal Metab. 2010. 4: 301-304.
4. Chedraoui S, Abi-Rizk A, El-Beyrouthy M. Review of Capparis spinosa. Front Plant Sci. 2017. 8: 1845.
5. Ghourri M, Zidane L, Douira A. Medicinal plants catalog. Int J Biol Chem Sci. 2013. 7: 1688-1700.
6. Bouayyadi L, El Hafian M, Zidane L. Étude floristique et ethnobotanique. J Appl Biosci. 2015. 93: 8770-8788.
7. Tlili N, Saadaoui E, Sakouhi F. Morphology and composition. Afr J Biotechnol. 2011. 10: 2112-2118.
8. Özcan M, Hacıseferogulları H, Demir F. Chemical properties of capers. J Food Eng. 2004. 65: 151-155.
9. Bahrani MJ, Gask MR, Shekafandeh A. Influence of IBA and cutting length on rooting rate of wild caper. Middle East Russ J Plant Sci Biotechnol. 2008. 2: 78-79.
10. Bennaceur S, Draoui B, Bennamoun L, Touati B, Saad A, Bourmita Y. Sorption isotherm of Capparis spinosa. Energy Procedia. 2012. 18: 359-367.
11. Inocencio C, Rivera D, Obón MC. Revision of Capparis. Ann Missouri Bot Gard. 2006. 93: 122-149.
12. Baba A. Encyclopédie des plantes utiles. Rouiba: EDAS. 2000.
13. Iserin P, Masson M, Restellini JP. Medicinal plants encyclopedia. 2001.

14. Aytac Z, Kinaci G, Ceylan A. Yield and morphological characteristics of caper (Capparis spinosa L.). Pak J Bot. 2009. 41: 591-596.
15. Kdimy A, El Yadini M, Guaadaoui A. Phytochemistry and uses. Chem Biodivers. 2022. 19: e202200300.
16. Chalak L, Perin A, Elbitar A. Phenotypic diversity of Capparis spinosa. Biol Tunisie. 2007. 4: 28-32.
17. Koufan M, Belkoura I, Mazri MA. In vitro propagation. Horticulturae. 2022. 8: 737.
18. Romeo V, Ziino M, Giuffrida D, Condurso C, Verzera A. Flavour profile of capers (Capparis spinosa L.) from the Eolian Archipelago by HS-SPME/GC–MS, Food Chemistry. 2007. 1272-1278.
19. Shahrajabian MH, Sun W, Cheng Q. Chemical composition and uses. Bull Natl Res Cent. 2021. 45:131.
20. Fu XP, Wu T, Abdurahim M. New alkaloids from Capparis spinosa. Phytochem Lett. 2008. 1:59-62.
21. Huseini HF, Hasani-Ranjbar S, Nayebi N. Clinical trial on caper extract. Complement Ther Med. 2013. 21: 447-452.
22. Wang Q, Zhang M, Yin L. Genetic diversity. Biochem Syst Ecol. 2016. 66: 1-7.
23. Akkari H, B'chir F, Hajaji S, Rekik M, Sebai E, Hamza H, et al. Potential anthelmintic effect of Capparis spinosa (Capparidaceae) as related to its polyphenolic content and antioxidant activity. Veterinarni Medicina. 2016. 61: 308-316.
24. Olmez Z, Zeki Y, Ucler AO. 2004. Seed germination. Pak J Biol Sci. 2004. 7: 879-882.
25. Rhizopoulou S, Ioannidi E, Alexandredes N. Flower traits. J Arid Environ. 2006. 66: 635-647.
26. Inocencio C, Rivera D, Alcaraz F. Flavonoid content of capers. Eur Food Res Technol. 2000. 212: 70-74.
27. Douieb H, Benlemlih M. Fermented caper quality improvement. Internet J Food Saf. 2010. 12: 35-44.
28. Ara KM, Karami M, Raofie F. Application of response surface methodology for the optimization of supercritical carbon dioxide extraction and ultrasound-assisted extraction of Capparis spinosa seed oil. J Supercrit Fluids. 2014. 85: 173-182.
29. Allaith AAA. Assessment of the antioxidant properties of the caper fruit (Capparis spinosa L.) from Bahrain. J Assoc Arab Univ Basic Appl Sci. 2014. 19:1-7.
30. Panico AM, Cardile V, Garufi F. 2005. Protective effects on chondrocytes. Life Sci. 77: 2479-2488.
31. Satyanarayana T, Mathews AA, Vijetha P. Pharmacological review. Pharmacogn Rev. 2008. 2: 36-45.
32. Bonina F, Puglia C, Ventura D. Antioxidant and photoprotective effects of Capparis spinosa. J Cosmet Sci. 2002. 53: 321-335.
33. Tesoriere L, Butera D, Gentile C. Bioactive components. J Agric Food Chem. 2007. 55: 8465-8471.
34. Giuffrida D, Salvo F, Ziino M. 2002. Chemical constituents of capers. Ital J Food Sci. 14: 25-33.
35. Jiang HE, Li X, Ferguson DK. Discovery in Yanghai tombs. J Ethnopharmacol. 2007. 113: 409-420.
36. Pernet R. Capparidaceae plants. Plantes Méd Phytother. 1972. 6: 68-77.
37. Cao YL, Li X, Zheng M. Effect on fibroblast proliferation. Zhongguo Zhong Yao Za Zhi. 2008. 33: 560-563.
38. Tlili N, Elfalleh W, Saadaoui E. Ethnopharmacology review. Fitoterapia. 2011. 82: 93-101.
39. Gyan P, Mishra RS, Manish B. Caper as food source. 2019.
40. Rajesh P, Selvamani S, Latha A, et al. Review of Capparidaceae. Phcog Rev. 2009. 3: 378-387.
41. Aliyazicioglu R, Eyupoglu OE, Sahin H, Yildiz O, Baltas N. Phenolic components, antioxidant activity, and mineral analysis of Capparis spinosa L. Afr J Biotechnol. 2013. 12: 6643-6649.
42. Baghiani A, Ameni D, Boumerfeg S, et al. Antioxidant and xanthine oxidase inhibitory potentials of Capparis spinosa. Am J Med Med Sci. 2012. 2: 25-32.
43. Di Carlo G, Mascolo N, Izzo AA, Capasso F. Medicinal plants. Life Sci. 1999. 65: 337-353.
44. Zhou HF, Xie C, Jian R. Bioflavonoids and NF-kappa B inhibition. J Agric Food Chem. 2011. 59: 3060-3065.
45. Yang T, Liu YQ, Wang CH. Chemical constituents review. Zhongguo Zhong Yao Za Zhi. 2008. 33: 2453-2458.
46. Trombetta D, Occhiuto F, Perri D. Antiallergic effect. Phytother Res. 2015. 19: 29-33.
47. Handa SS, Sharma A, Chakraborti KK. Liver protecting drugs. Fitoterapia. 1986. 57: 307-349.
48. Gadgoli C, Mishra SH. 1999. Antihepatotoxic activity. J Ethnopharmacol. 1999. 66:187-192.
49. Negahdarizadeh M, Mokhtari M, Malekzadeh JM. Blood glucose effects. Armaghane Danesh. 2011. 16: 181-190.
50. Eddouks M, Lemhadri A, Michel JB. Antihyperglycaemic plants. J Ethnopharmacol. 2004. 94: 143-148.
51. Lemhadri A, Eddouks M, Sulpice T. Anti-obesity effects. Am J Pharmacol Toxicol. 2007. 2: 106-110.
52. Kouakou S. Kouakou G. Laba I.D. & Brou J. Evaluation of the analgesic activity of the aqueous extract of the leaves of Mitracarpus caber zucc (Rubiaceae), a medicinal plant from Côte d'Ivoire. International Journal of Biological and Chemical Sciences. 2010. 4: 1-62.
53. Maresca M. Effect on rat pain. J Ethnopharmacol. 2016. 193: 456-465.
54. Meddour A, Yahia M, Hambaba L. Safety evaluation. J Biol Res. 2019. 92: 5-10.
55. Torre LA, Bray F, Siegel RL. Global cancer statistics. CA Cancer J Clin. 2015. 65: 87-108.
56. Craig WJ. Health-promoting properties of herbs. Am J Clin Nutr. 1999. 70: 491S-499S.
57. Vargas AJ, Burd R. Quercetin pathways. Nutr Rev. 2010. 68: 418-428.
58. Kulisic-Bilusic T, Schmoller I, Schnabele K. Anticarcinogenic potential. Food Chem. 2012. 132: 261-267.
59. Bouvenot G, Devulder B, Guillevin L. Pathologie médicale. Paris. 1994.
60. Goetz P. Phytothérapie effects. Springer. 2010
61. Bouriche H, Karnouf N, Belhadj H. Free radical and antibacterial activities of Capparis spinosa. Adv Environ Biol. 2011. 5: 281-287.
62. Mahboubi M, Mahboubi A. 2014. Antimicrobial activity. Herba Pol. 2014. 60: 40-48.
63. Shayeb A. Chemical composition of essential oil and crude extract fractions and their antibacterial activities of Capparis spinosa L. and Capparis cartilaginea Decne. from Jordan : MSc thesis, Yarmouk University, Faculty of Science. 2012.
64. Fu XP, Alsa HA, Abdurahim M. Chemical composition of caper fruit. Chem Nat Compd. 2007. 43: 181-183.
65. Mahasneh AM, Abbas JA, El-Oqlah AA. Antimicrobial activity. Phytother Res. 1996. 10: 251-253.

66. Reid KA, Jager AK, Light ME. Pharmacological screening. J Ethnopharmacol. 2005. 2005. 97: 285-291.
67. Shahrour WG, Shatnawi MA, Al-Alawi M. Antimicrobial activity. Not Bot Horti Agrobo. 2024. 52: 13609.
68. Alnuaimy RJM, Al-Khan HIA. Effect of aqueous extract of Capparis spinosa L. on biochemical and histological changes in paracetamol-induced liver damage in rats. Iraq J Vet Sci. 2012. 26: 1-10.
69. Benzidane N, Charef N, Krache I. Bronchorelaxant effects of Capparis spinosa. J Appl Pharm Sci. 2013. 3: 85-88.
70. Zeggwagh NA, Michel JB, Eddouks M. Cardiovascular effect. Am J Pharmacol Toxicol. 2007. 2: 135-139.
71. Benzidane N, Imane K, Abderrahmane B. Vasomotor effects of Capparis spinosa. Proc Int Symp Medicinal Plants. 2012.
72. Caboni P, Sarais G, Aissani N. Nematicidal activity of compounds from caper. J Agric Food Chem. 2012. 60: 7345-7351.
73. Arena A, Bisignano G, Pavone B. Antiviral and immunomodulatory effect of a lyophilized extract of Capparis spinosa L. buds. Phytother Res. 2008. 22: 313-317.