Iraqi journal of Bioscience and Biomedical
Published Online First / 30 / June /2026.
p-ISSN: 3007-5491 / e-ISSN:3007-5505

Phytochemical Characterization and In Vitro Antioxidant Activity of Ficus carica L. leaves Extracts

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Received: 21/5/2026, Accepted: 22/6/2026, Published: 30/6/2026.

Abstract

The present work deals with the phytochemical studies and in vitro antioxidant activities of methanolic and aqueous extracts of Ficus carica (fig) leaves, a known medicinal plant. Leaves were collected for the study and methanolic and aqueous extracts were prepared for biological evaluation. Phytochemical screening showed the presence of flavonoids, polyphenols, and alkaloids, which are important therapeutic compounds. In quantitative assays, it was found that flavonoids in the methanolic extract were 241.51 ± 5.22 µg (as rutin equivalent) and in the aqueous extract, it was 198.24 ± 4.10 µg. The total phenolic content was 345.71 ± 2.33 mg and 284.89 ± 4.33 mg in the methanolic and aqueous extracts, respectively. Antioxidant activities were determined using DPPH and FRAP assays for both extracts. The methanolic extract showed scavenging percentages of 88.342 ± 0.051, 79.971 ± 0.098, 64.331 ± 0.214, and 55.854 ± 0.099% at concentrations of 0.5000, 0.2500, 0.1250, and 0.0625 mg/mL, respectively, in comparison to vitamin C in the DPPH assay. The aqueous extract displayed lower percentages: 75.311 ± 0.095, 62.351 ± 0.084, 42.121 ± 0.105, and 35.314 ± 0.059% at the same concentrations. Both extracts showed ferric reducing capacity in the FRAP assay, with the methanolic extract reaching 1.221 ± 0.145 at 0.64 mg/mL relative to Trolox. These results may further justify the use of Ficus carica leaves in the management of conditions associated with oxidative stress, thus giving credence to their traditional use in contemporary medicine.

Keywords: *Ficus carica*, antioxidant activity, phytosterols, riboflavin, schistosomiasis.

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Introduction

Quercetin in fig has been identified as an essential natural antioxidant and anti-inflammatory agent [1] .Moreover, *Ficus carica* contains a wide range of nutrients, including vitamins (7.1% thiamine, 6.2% riboflavin per 100 g), minerals (30% iron, 15.8% calcium, 14% potassium per 100 g), amino acids (notably aspartic acid and glutamine), protein, dietary fiber, and other important components [2].

Traditionally, this plant has been used for treating various health issues including ulcers, cancer, diabetes mellitus, inflammation, menstrual pain, paralysis, scabies, asthma, and gonorrhea. It also displays antipyretic, purgative, aphrodisiac, antioxidant, antimicrobial, antifungal, and hypotensive properties, and is used to control cough and vomiting[3] . Ficus trees play an essential role in rainforest ecosystems [4]..

Ficus carica (fig tree), Figs are the common name of a flowering plant that is well known in the Mediterranean and Western Asian regions. [5]F. carica is a member of the Moraceae family, which contains more than 800 species of trees, shrubs, and epiphytes that are cultivated in subtropical regions all over the world. [6] Different parts of Figs, such as leaves, fruits, seeds, phytosterols, and vitamins with different applications. (Figure 1) [7].

Figure (1) Filed picture of *F. carica*. Leaves (A and B)

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In more recent years, studies have reported that *F. carica* leaves contain active phytochemicals, especially phenolic types including flavonoids (quercetin, rutin, luteolin) and phenolic acids (chlorogenic acid, caffeic acid). These compounds are well-known for their antioxidant behaviours', which in turn induce immunity to kill infections such as schistosomiasis, a parasitic disease [8]. The genetic resources of *Ficus* species may contribute to breeding heat-resistant cultivars through genetic transformation, and their genes could be applied to modify economic crops in the future [9]. Additionally, recent studies have identified the health benefits of phenolic compounds in fig, including antioxidant, anti-inflammatory, anti-obesity, anti-diabetic, anti-cancer, and anti-Alzheimer's properties [10]. Cyanidin, a natural flavonoid present in fig, has therapeutic effects on cardiovascular disease and atherosclerosis, and it may decrease cellular lipid accumulation in macrophages and hepatocytes [11]. Furthermore, plant extracts are commonly considered a source of liquid organic fertilizers that stimulate natural processes and increase growth [12]. The application of abiotic-stress-tolerant *Ficus* genes in genetically modifying economic crops has also been proposed for future agricultural benefits [13].

Given all the above benefits, this study aimed to evaluate the biological potential of fig as a medicinal plant.

Materials and Methods

Collection and identification of *F. carica*

The plant material (Ficus carica) was collected from the gardens of the University of Baghdad, Al-Jadriya campus. The specimen was subsequently authenticated and taxonomically identified by the Iraqi Herbarium at the Department of Biology, College of Science, University of Baghdad.

Preparation of plant methanolic extract

About 50.0 g of dried leaf powder of F. carica was extracted with 250 mL of 80% methanol using a Soxhlet apparatus at 65°C for 3 hours. The extract obtained was concentrated with a rotary evaporator under reduced pressure to yield a dry methanol extract. This extract was kept at -20°C in a dark container until further use to avoid degradation of bioactive compounds. compounds [14].

Aqueous extraction of *F. carica*

According to Ruckmani *et al*. (2014) with modifications, fresh leaves of *F. carica* were cleaned with distilled water to remove dust and impurities. Then, 50.0 g of dried leaf was dissolved in 300 mL of distilled water and left at 60°C for 3 hours. The obtained extract was concentrated using a rotary evaporator under reduced pressure, producing a dry aqueous extract, which was stored at -20°C [14].

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Phytochemical screening

Preliminary phytochemical analyses were performed to identify the presence of main bioactive compounds in F. carica, including tannins, polysaccharides, alkaloids, saponins, flavonoids, phenolic compounds, and glycosides, according to Deyab *et al*. [15].

Quantification of phytochemicals (total flavonoids and phenolic contents)

Total flavonoid content (TFC): TFC was determined by the method of Hu et al. (2008). Dissolve 3.2 mg of each extract (methanolic and aqueous) in 5 mL of 50% methanol. To this, add 1 mL of 5% (w/v) sodium nitrite solution. Six minutes later, add 1 mL of 10% (w/v) aluminum chloride ($AlCl_3$) solution, and allow the contents to stand for 5 min before adding 10 mL of 10% (w/v) NaOH solution. Make the final volume up to 50 mL with distilled water and mix well; finally, measure the absorbance at 450 nm using a UV-VIS spectrophotometer. TFC was expressed as rutin ($y = 0.009x + 0.0084$, $r^2 = 0.9992$). $= 1.0537x + 0.0074$, $R^2 = 0.9953$.

Total phenolic content (TPC): TPC was measured according to Shafei (2016)[16] with alterations using Folin–Ciocalteu phenol reagent. 2.5 mL of Folin–Ciocalteu phenol reagent was mixed with 1 mL of each extract. After 5 min, 2 mL of sodium carbonate (0.75 g/10 mL) was added to the mixture and then allowed to stand for 10 min at 50°C. The absorbance was measured at 750 nm after cooling. TPC was calculated using the equation:

$$y = 1.0165x + 0.0198$$

$$R^2 = 0.9883$$

Antioxidant activity assays

Ferric reducing antioxidant power (FRAP) assay: The FRAP assay was performed according to Fu *et al* [17]. Prepared extracts were at concentrations of 0.04, 0.08, 0.16, 0.32, and 0.64 mg/mL. A volume of 1 mL of each was mixed with phosphate buffer (0.2 M, pH 6.6) and 1% potassium ferricyanide the absorbance was read at 700 nm. Data were compared with that of a Trolox standard curve, and the results were expressed as Trolox equivalents.

DPPH radical scavenging activity: The DPPH assay was carried out according to Fu et al. (2010)17. Methanolic and aqueous extracts were prepared at different concentrations (0.500, 0.250, 0.125, and 0.0625 mg/mL), 1 mL of DPPH was added to each tube, and then the tubes were kept for incubation at 37°C for 30 min. Absorbance was noted at 517 nm. The radical scavenging activity was calculated as:

$$DPPH\ radical\ scavenging\ activity\ (\%) = \left(1 - \frac{Absorbance\ of\ sample}{Absorbance\ of\ standard}\right) \times 100$$

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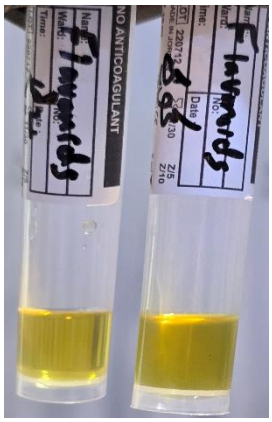
Results and Discussion

Phytochemical analysis

The phytochemical screening of *F. carica* leaves revealed the presence of alkaloids, flavonoids, polyphenolics, polysaccharides (in methanolic extract), and tannins, while saponins and polysaccharides (aqueous) were negative. Results are summarized in Table (1).

Table (1): Phytochemical analysis of *F. carica* leaves.

Detection test	Result	Observation (qualitative)
Alkaloids (Mayer + Dragendroff)	+	
Flavonoids	+++	

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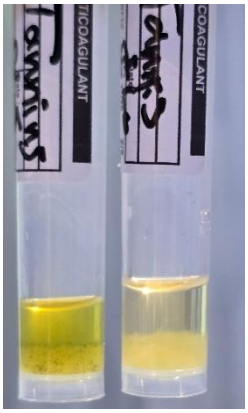
Detection test	Result	Observation (qualitative)
Polyphenolic	+	
Polysaccharides (methanolic)	++	
Tannins	++	

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Detection test	Result	Observation (qualitative)
Saponins	–	
Polysaccharides (aqueous)	–	Negative

Note: + mild, ++ moderate, +++ strong.

The presence of alkaloids, although mild, is significant due to their reported pharmacological effects, including anti-diabetic, anticancer, and anti-inflammatory activities [3]. The high flavonoid content indicates strong antioxidant capacity, as flavonoids are known for neutralizing free radicals, repairing oxidative damage, and promoting wound healing [18]. Polyphenols exhibit major roles in human health, including antioxidant, cancer suppression, and anti-allergic properties, and may reduce cardiovascular diseases [19]. Polysaccharides from *F. carica* have excellent anti-inflammatory, antibacterial, antioxidant, anti-tumor, and immunomodulatory characteristics, making them useful in pharmaceuticals and functional foods [20]. The moderate level of tannins contributes to hemostatic and anti-infective properties by forming a protective layer on damaged skin, further supporting the therapeutic potential of *F. carica* [21].

Quantitative assay for total flavonoids and total phenolic compounds

Total flavonoid and phenolic contents were estimated using standard curves for rutin and gallic acid. The methanolic extract contained 241.51 ± 5.22 µg flavonoids (as rutin equivalent) and the aqueous extract contained 198.24 ± 4.10 µg. Total phenolic content was 345.71 ± 2.33 mg and 284.89 ± 4.33 mg for methanolic and aqueous extracts, respectively.

Table (2): total flavonoid and total phenol content of *F. carica* methanolic and aqueous extracts

Ficus carica methanolic extracts	Ficus carica aqueous extracts
Total flavonoid content (mg QE/g)	
241.51±5.22	198.24±4.10

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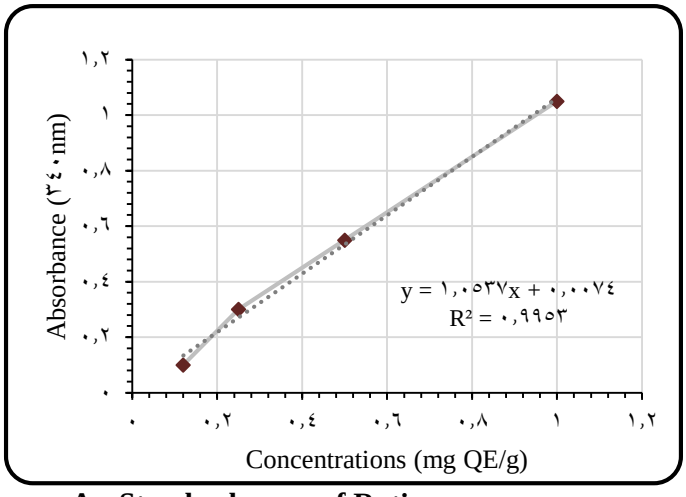
Total phenol content (mg GAE/g)	
345.71±2.33	284.89±4.33

Antioxidant activity

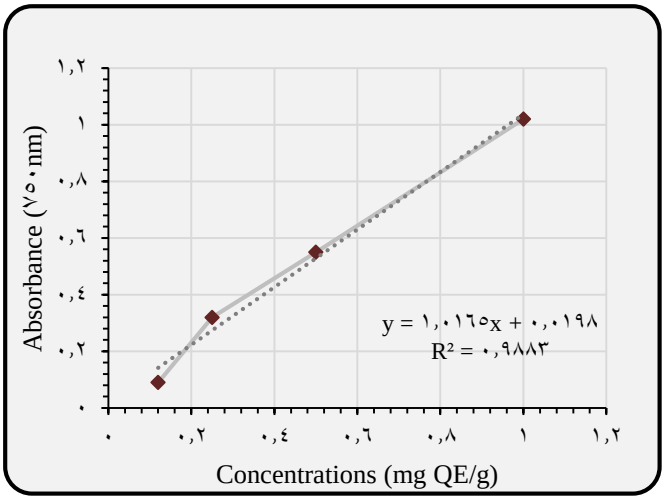
FRAP assay: Both methanolic and aqueous extracts showed high ferric reducing activity compared to Trolox (vitamin E) at all tested concentrations. At 0.64 and 0.32 mg/mL, methanolic extract gave values of 1.221 ± 0.145 and 0.985 ± 0.089, respectively; aqueous extract gave 0.784 ± 0.221 and 0.531 ± 0.174, respectively. Lower activity was observed at 0.16 and 0.08 mg/mL (table 3 and Figure 2).

Table (3): Ferric reducing antioxidant power of F.carica methanolic and aqueous extracts

Conc. (mg/mL)	Trolox (Vit. E) Mean±SD	*Ficus carica*	
		methanolic Mean±SD	aqueous Mean±SD
0.64	٠,٨٥٥±٠,١٠٥	١,٢٢١±٠,١٤٥	0.784±0.221
0.32	٠,٦٢١±٠,١٢١	٠,٩٨٥±٠,٠٨٩	0.531±0.174
0.16	٠,٥٠٥±٠,٠٩٨	٠,٧٥١±٠,٠٤٧	0.402±0.085
0.08	٠,٣٢٨±٠,١٠٣	٠,٥٥٧±٠,١٠٥	0.219±0.215



A. Standard curve of Rutin



B. stander curve of gallic acid

Figure (2): Reductive ability of *F. carica* extracts compared to Trolox (vitamin E).

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DPPH radical scavenging activity: Both methanolic and aqueous extracts of F. carica leaves showed concentration dependent DPPH radical scavenging activity. The antioxidant activity of the methanolic extract was found to be higher than the aqueous extract at all the concentrations tested. As ascorbic acid (Vitamin C) showed the highest DPPH scavenging activity in comparison to both extracts, however. At 0.5000 mg/mL, the scavenging activities of ascorbic acid, methanolic extract, and aqueous extract were 92.325 ± 0.114%, 88.342 ± 0.051%, and 75.311 ± 0.095%, respectively. In all the samples tested, antioxidant activity was seen to decrease with the decreasing concentration. The results are consistent with the results of Sweidan et al. (2023) that showed that extracts of Ficus carica leaves exhibited significant antioxidant activity likely due to the presence of the phytochemicals in the extract. (Table 4 and Figure 3).

Table (4): 1-1-Diphenyl-1-picrylhydrazyl radical scavenging assay of *F.carica* methanolic and aqueous extracts

Conc. (mg/mL)	Ascorbic acid (Vit. C) Mean%±SD	*Ficus carica*	
		methanolic Mean%±SD	aqueous Mean%±SD
0.5000	92.325±0.114	88.342±0.051	75.311±0.095
0.2500	87.385±0.089	79.971±0.098	62.351±0.084
0.1250	75.746±0.105	64.331±0.214	42.121±0.105
0.0625	69.954±0.077	55.854±0.099	35.314±0.059

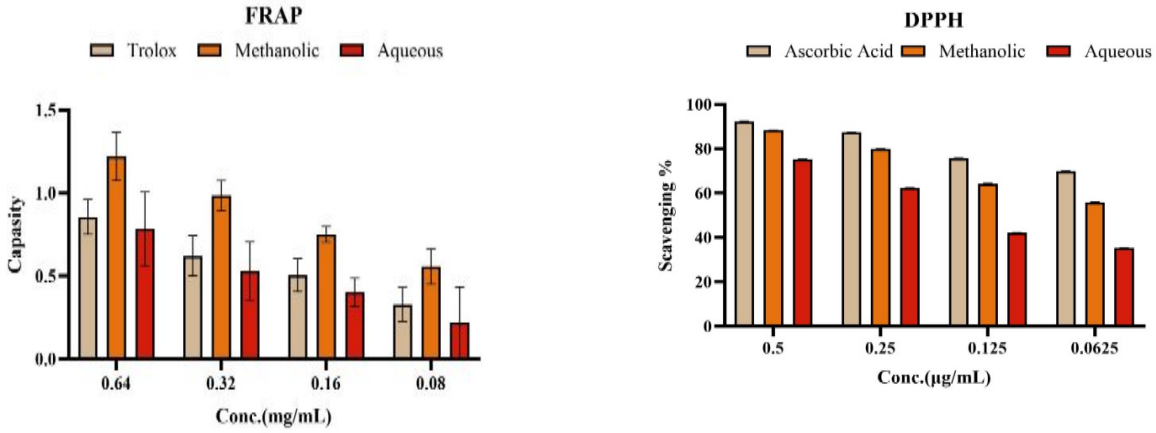

Figure (3): DPPH radical scavenging action of F. carica extracts compared to vitamin C.

These results indicate that the methanolic extract consistently outperformed the aqueous extract in both assays, likely due to its higher content of flavonoids and polyphenols, which are efficient hydrogen donors and radical scavengers.

Conclusion

Many important bioactive compounds such as flavonoids, polyphenols, alkaloids, and tannins were detected in both methanolic and aqueous extracts of Ficus carica L. local leaves but saponins were not found. The total flavonoid and total phenolic contents were higher in the methanolic extract than in the aqueous extract. Antioxidant activity measured by DPPH and FRAP assays was also higher in the methanolic extract. The values were very close to those of standard antioxidants (vitamin C and Trolox). In this study, it is indicated that Ficus carica leaves could be further developed for medicinal and health uses as they represent a potential source of natural antioxidants..

Acknowledgments

The authors are very thankful for the College of Biotechnology, Al-Nahrain University, for its academic support and guidance. They also thank the Medical City Directorate, Ministry of Health, Baghdad, for all facilities and help to conduct this research as per the official administrative facilitation letter issued in response to the College of Biotechnology letter No. 3574, dated 28/12/2025. Special thanks go to the Center of Training and Human Development for their cooperation in this work.

Author's Declaration

- We hereby confirm that all the tables in the manuscript are original and have been created by us.
- The authors hereby declare that all tables, data, and results presented in this manuscript are original and were prepared by the authors. The research work was conducted under official administrative facilitation granted by the Medical City Directorate, Ministry of Health, Baghdad, based on the request submitted by Al-Nahrain University / College of Biotechnology, letter No. 3574/3/2/2, dated 28/12/2025. This approval underscores our commitment to ethical research practices and the well-being of our participants.

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