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Phytochemical screening and antimicrobial activity of some medicinal plants

Alaa Hamady Obeid Al-Taei[1], Rasha Hadi Saleh[1,*], Samah Ahmed Kadhum[1], Aseel Mohammad Omran[1], Ruqaya Munther Jalil Ewadh[1], Hasanain Hasan Owadh[2]

[1]College of Pharmacy, University of Babylon, Hillah, Iraq
[2]Department of Pharmacology and Toxicology, College of Pharmacy, Al-Mustaqbal University, Babylon, Iraq

***Corresponding author:** Rasha Hadi Saleh, College of Pharmacy, University of Babylon, Hillah, Iraq
Tel.: +964-(0)7740338155
E-mail: rashahadi11@yahoo.com

Abstract

The antimicrobial activity of the aqueous and ethanolic extracts of *Myrtus communis*, *Ammi visnaga*, and *Equisetum arvense* was investigated against *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans* by using the agar well diffusion method. Serial concentrations (15%, 30%, and 50%) of the extracts of each plant were tested and compared with gentamicin (10 µg) and fluconazole (25 µg). Most of the extract concentrations showed a relatively high antimicrobial activity against all the tested microbes, and the ethanolic extract was more effective than the aqueous extract. The activity of plant extracts increased with the increasing extract concentration of *Myrtus communis*, which appeared to possess a more antimicrobial activity than the other plants assessed; in fact, its ethanolic extract exhibited the highest inhibition zone against *S. aureus* (32 mm). The ethanolic plant extracts at a concentration of 50% displayed the maximum activity against the herein assessed isolates. Moreover, *E. coli* showed a higher sensitivity to most extracts, while the lowest effect being noticed on *C. albicans*.

KEYWORDS

Ammi visnaga, *Equisetum arvense*, *Myrtus communis*, screening, antimicrobial activity

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1. INTRODUCTION

Medicinal herbs have served as a valuable source of remedies in local communities across the globe for millennia. Despite the overwhelming influences and reliance on contemporary medicine along with remarkable advancements in synthetic pharmaceutics, *Myrtus communis*, a small evergreen shrub abundant in foliage and a member of the Myrtaceae family, stands as a significant representative of the medicinal and aromatic plants [1]. The effectiveness of myrtle can be attributed to its chemical constituents, likely alkaloids, tannins, flavonoids, phenol, organic acids, anthraquinones, saponin, essential oils, and fatty acids [2]. *Ammi visnaga*, a plant with a ring-like structure, is a member of the Apiaceae family. It possesses a slight aromatic scent and an exceedingly bitter fla-

vour. This plant contains diverse chemical components: coumarins, γ-pyrones, flavonoids, and essential oils. The quality and quantity of these ingredients are contingent upon the section of the plant, the environmental conditions, and the inclusion of any bioregulators [3]. Finally, *Equisetum arvense*, an ancient fern plant, is a member of the Equisetaceae family. This particular plant is renowned for its abundance of invaluable natural compounds, such as saponins, phytosterols, triterpenoids, flavonoids, alkaloids, and minerals. It is also recognized for its therapeutic properties, as well as its antimicrobial and antioxidant efficacy [4]. This *in vitro* study aimed at screening selected plants for their antimicrobial capacity and at evaluating their use in the management of infections.

2. MATERIALS AND METHODS

Preparation of extracts: Aqueous extracts were prepared from 20 g of each plant (air-dried powder) placed in a conical flask (500 mL), and then by adding distilled water, boiling for 2 h, filtering through a filter paper, and centrifuging at 5,000 rpm for 10 min. The filtrate was then collected and concentrated in an oven at 45°C until dry. Dried extracts were then stored at 4°C until use. The ethanolic extract was prepared in the same way as the aqueous extract, but the water was replaced by ethanol (70%) and the heating was skipped.

Qualitative tests of phytochemicals: We tested for phenols with lead acetate and for tannin with ferric chloride, we undertook the saponin test by foam, and we tested for alkaloids through the Fehling's test and the Mayer's test [5].

Antimicrobial activity assessment: The antimicrobial activity of the aqueous and alcoholic extracts of *Myrtus communis*, *Ammi visnaga*, and *Equisetum arvense* at concentrations 15%, 30%, and 50% was evaluated against *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans* by using the disk diffusion test. In brief, 100 µL of different extracts at different concentrations for each plant were added to the wells of a plate that was previously streaked with microorganisms, then the plates were incubated at 37°C for 24 h. After that, the inhibition zone was evaluated for each plate (measured in mm). The test was performed in triplicates. Gentamicin (10 µg) and fluconazole (25 µg) were used as positive controls of antibacterial and antifungal activity, respectively [6].

3. RESULTS AND DISCUSSION

Phytochemical contents: According to the phytochemical tests undertaken for the aqueous and alcoholic extracts of *Ammi visnaga*, we detected the presence phenols (bulky white precipitates caused by lead acetate), tannin (black colour generated by ferric chloride 1%), and alkaloids (green colour), while saponin was not present. In *Myrtus communis* and *Equisetum arvense* the phytochemical tests detected the presence of phenols, tannin, alkaloids, and saponin. The knowledge of the phytochemical contents of medicinal plants is essential for researchers aiming to devise a new bioactive combination from natural sources that could be used for the synthesis of new drugs [7].

Antimicrobial activity: The effects of the various aqueous and alcoholic extract concentrations against the tested microbes are summarized in Table 1. The diameter of the inhibition zone increased along with the extract concentration, and at a concentration of 50% all microbes exhibited the highest zone of inhibition. *Myrtus communis* exhibited the maximum antimicrobial activity, while *E. coli* displayed a marked sensitivity towards most plant extracts. Aabed *et al*. [8] have shown that *Myrtus communis* extracts display antibacterial and antifungal activities. The myrtle extract activity has been linked to its chemical composition (e.g., flavanols, terpineol, acetate, linalyl, linalool, cineol, and tannins).

The present findings are similar to those of previous studies showing that the *Equisetum arvense* methanol extract exerts a higher antimicrobial activity than its aqueous extract against different bacteria, because the alcoholic extract contains more effective phytochemical compounds, such as essential oils that denature the bacterial adhesive proteins, prevent the transportation of proteins *via* the cell membrane, and disturb the cytoplasmic membrane [9].

In a study by Keddari *et al*. [10], the authors have found that *Ammi visnaga* has an antimicrobial activity; generally, this antimicrobial activity has been associated with khellin and visnagin, and these compounds are considered to possess antibacterial, antifungal, and antiviral activities. Different extracts exhibited different effects on the tested microorganisms, and these differences may be due to the differences in the structural nature of the microorganisms as well as to the different plant constituents.

4. CONCLUSION

The tested plant extracts exhibited different antimicrobial effects on the tested microbes and have a therapeutic promise for treating a number of diseases.

Table 1. The inhibitory zones (mm) of different microorganisms generated by the plant extracts assessed in our study.

Plant	Extract	Extract concentration	Inhibitory zone (in mm)		
			S. aureus	*E. coli*	*C. albicans*
M. communis	**aqueous**	15%	16	23	22
		30%	27	27	25
		50%	28	29	27
	alcoholic	15%	23	21	17
		30%	28	25	20
		50%	32	27	22
E. arvense	**aqueous**	15%	8	15	0
		30%	15	22	10
		50%	24	23	12
	alcoholic	15%	12	20	2
		30%	22	25	15
		50%	30	27	20
A. visnaga	**aqueous**	15%	10	14	0
		30%	13	15	5
		50%	20	18	6
	alcoholic	15%	15	20	0
		30%	19	22	5
		50%	24	24	15
Gentamicin (10 µg)			13	21	-
Fluconazole (25 µg)			-	-	12

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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