



REGULAR ARTICLE

ANTIMICROBIAL AND ANTIOXIDANT EVALUATION OF DIFFERENT SOLVENT EXTRACTS OF MEDICINAL PLANT: *FAGONIA MOLLIS* DELILE

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ABSTRACT

The present study was aimed to evaluation of the medicinal uses of *Fagonia mollis* by studying some active constituents, antioxidants and antimicrobial activities. *Fagonia mollis* Delile was collected from different sites from Tabuk, Saudi Arabia. The phytochemical analysis of the aerial parts of *F. mollis* indicated that the plant is rich in secondary compounds. *F. mollis* exhibited the highest content of tannins and saponins (19.9±1.68 and 16.8±1.32, mg/g D. W., respectively), followed by phenolics (11.6±0.72 mg/g D. W.), flavonoids (8.6±0.82 mg/g D. W.) and then alkaloids (5.6±0.64 mg/g D. W.). In the DPPH test system, the crud extract of *F. mollis*, with an IC₅₀ value of 1.51 mg ml⁻¹, but higher than that of the positive control catechol (0.37 mg ml⁻¹). In the present study the petroleum ether and methylene chloride extracts of *F. mollis* inhibit all pathogenic bacteria with different rates. Ethyl acetate extract has no effect on both *Escherichia coli* and *Klebsiella pneumonia*, while the acetone inhibited all the bacteria except *Escherichia coli* and *Staphylococcus aureus*. Methyl alcohol extract of plant on tested bacteria proved a broad spectrum antimicrobial potential. On the other hand, petroleum ether extract inhibited the growth of *Candida albicans* and *Mucor* spp (8 and 9.3 mm, respectively), but has no effect on the *Aspergillus fumigatus* and *A. niger*. The methylene chloride, Ethyl acetate and methyl alcohol extracts had no antifungal activities against all the pathogenic fungi. Acetone extract inhibited the growth of *A. fumigatus* (10.2 mm) but has no effect on the others. The above results revealed that *F. mollis* have an excellent anti-bacterial activity and can be used for disease therapy.

Keywords: *Fagonia mollis*, Phytochemical, Antioxidant, Antibacterial, Antifungal, Tabuk, Saudi Arabia

INTRODUCTION

Use of wild desert plants in medicine as antimicrobial agents and their cultivation is not a new practice, it has been common in many countries all over the world. The wild medicinal plants growing in the desert region of USA, Mexico, India, Egypt, Saudi Arabia and many other countries can be a good source for cultivating vast areas in the desert with the least ecological consequences in addition to the conservation of such resource [1]. The secondary metabolites or biochemical compounds are the basis of medicinal action in plants, and which can solve many disease conditions in human body [2, 3].

Ethnobotany is the study of the relationship between plants and people [4-6]. Many plants have been used since long time for preventing or treating various diseases, and many of them are antimicrobial. The extracts from plants are used for a variety of purposes in many countries [7-20].

The genus *Fagonia* consists of many plants and are common in many of the countries [21, 22]. The species from *Fagonia* exhibit some morphological differences and consists of shrubs, shrublets or herbs with some of its

peculiar characters [23]. *Fagonia mollis* is a genus of flowering plants in the family Zygophyllaceae. It is a perennial, glabrescent, hairy low shrub, which reaches up to 20-40 cm, with a woody base. Stems are many, branched, angular, and striate with stipular spines. Leaves are 3-foliolate with ovate-elliptic leaflets with mucronate-spinulose apex; the terminal leaflet is longer and broader than the 2 laterals. Flowers are pink and the fruit is an obconical-obovoid [24, 25].

Previous phytochemical study of this plant revealed the presence of flavonoid [26] and saponins [27]. Mahmoud and Gairola [28] study the traditional knowledge and use of medicinal plants (*F. mollis*) in the Eastern Desert of Egypt, revealed the aerial part uses in psychological fears. Therefore, the goal of the present work is to evaluation of the medicinal uses of *F. mollis* in Tabuk, Saudi Arabia by studying some active constituents, antioxidants and antimicrobial activities

MATERIALS AND METHODS

Plant sampling and preparation of the extract

Fagonia mollis Delile was collected from different sites from

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Tabuk (Tabuk is located in the Northern part of Saudi Arabia), Saudi Arabia during the period of May 2017. The identification of species was done according to Boulos [25]. It was dried at room temperature and grinded into a powder using a blender. Ten gram of dried plant powder was extracted using different solvents (Methanol, hexane, petroleum ether and ethyl acetate) by soaking overnight with periodical shaking. The solution was filtered and evaporated to dryness. The dried residue was dissolved in dimethyl sulfoxide (DMSO) and kept at -20 °C for future use [29].

Phytochemical analysis

Fagonia mollis was collected and prepared as previously mentioned. Total phenolics, flavonoids and alkaloids were estimated using spectrophotometric techniques adapted by Harborne [30], Sadasivam and Manickam [31] and Boham and Kocipai-Abyazan [32], respectively. Tannins were determined according to Van-Buren and Robinson [33], while Saponin content was estimated by the method adopted by Obadoni and Ochuko [34].

Determination of antioxidant activity

Antioxidant activity was determined by using a stable free radical (1,1-diphenyl-2-picrylhydrazyl) DPPH [35].

Antibacterial activity

Antibacterial activity of the extracts was determined against five bacterial strains, three gram-positive i.e., *Streptococcus pyogenes*, *Staphylococcus aureus* and *Bacillus subtilis* and two gram-negative i.e., *Klebsiella pneumoniae* and *Escherichia coli* using the disc diffusion method. A sterile paper disc (5 mm in diameter) was soaked in the crude extract of the studied plant and then placed over the surface of the inoculated nutrient agar in antibacterial assay [36]. All Petri dishes were incubated at 37 °C for 24 h. After incubation, the diameter of inhibition zone (cm) was measured for recording the clear zone and compared with the DMSO as a control. Experiments were performed in triplicate and mean inhibitory zone was calculated. The standard antibiotic of ampicillin and clotrimazole were used for comparison with the tested plant extracts.

Antifungal activity

Antifungal activity against three fungal strains (*Aspergillus fumigatus*, *Aspergillus niger*, *Candida albicans* and *Mucor* spp.) was determined by the disc diffusion [36]. Filter paper discs (5 mm in diameter) are prepared before use and sterilized in an autoclave for 20-30 min. A sterile

paper disc is wetted in the solution of crude extract (100 µl) and then placed over the surface of the inoculated PDA in the antifungal assay described by Culture plates were incubated at 28 °C for 72 h and zones of inhibition was recorded around the paper disc.

RESULTS AND DISCUSSION

Phytochemical constituents

In plants, secondary metabolites are not related to the normal growth and development, but are useful in defense mechanism of plants against environmental stresses and diseases [37, 38]. The phytochemical analysis of the aerial parts of *F. mollis* indicated that the plant is rich in secondary compounds. *F. mollis* exhibited the highest content of tannins and saponins (19.9±1.68 and 16.8±1.32, mg/g D. W., respectively), followed by phenolics (11.6±0.72 mg/g D. W.), flavonoids (8.6±0.82 mg/g D. W.) and then alkaloids (5.6±0.64 mg/g D. W.) (fig. 1).

The phytochemical analysis of *F. mollis* in this study are relatively agree with those mentioned by Sajid *et al.* [39] and Saeed *et al.* [40] on *F. cretica* from Pakistan, but higher than those reported by Eman *et al.* [41] and Hussain *et al.* [42] on *Fagonia arabica* and *F. cretica*, respectively. Comparing the obtained results to that for other plant species of the Egyptian flora, revealed that the phytochemical analysis of *F. mollis* agree with that obtained by Alghanem and El-Amier [43] on *Pergularia tomentosa* (Solanaceae) growing in arid region. While it higher than that attained by El-Amier *et al.* [19] on some wild Aizoaceae species.

Antioxidant activity

In plants, antioxidants are the radical scavengers and are involved in defense mechanism of plants [44, 45]. The antioxidant activity of the different concentration of methanolic extract of the *F. mollis* is presented in table 1. The DPPH assay is used to measure the antioxidant activity [46]. In the DPPH test system, free radical-scavenging activity of the crud extract of *F. mollis*, with an IC₅₀ value of 1.51 mg ml⁻¹, but higher than that of the positive control catechol (0.37 mg ml⁻¹).

There are previous reports about terpenoids and saponins of genus *Fagonia* [27, 47-48]. Phenolics and tannins are major compounds providing antioxidant activity [49]. Therefore, several studies reported that the antioxidant activity of the *Fagonia* could be attributed to chemical composition and concentration level [50-52].

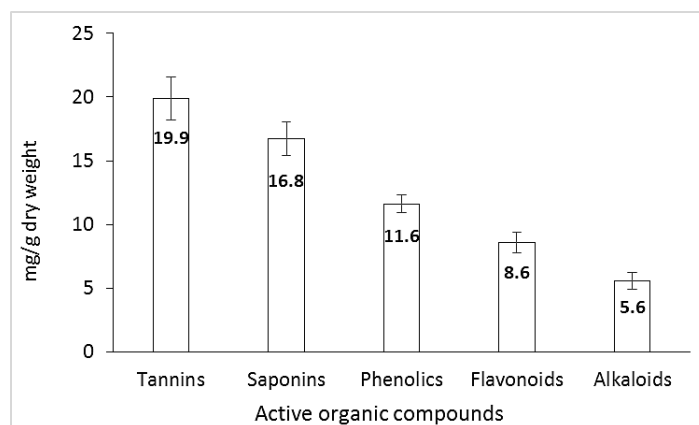


Fig. 1: Concentrations of the active organic compounds (mg/g dry weight) estimated in *Fagonia mollis*

Table 1: Percentage of DPPH radical scavenging activity of methanolic extract from *Fagonia mollis* aerial parts and catechol as standard

Treatment	Concentration (µg/ml)	Scavenging activity (%)	IC ₅₀ (mg/ml)
<i>Fagonia mollis</i>	1800	55.44	1.51
	1600	53.61	
	1400	49.27	
	1200	44.11	
	1000	39.62	
	800	33.67	
	600	27.89	
	400	13.21	
	200	7.69	
	Catechol	500	
400		51.22	
300		47.55	
200		39.44	
100		33.11	
50		12.88	

Antimicrobial activity assessment

Microbial contaminations including multidrug-resistant strains are among the main sources of death around the world. Healthcare system across the globe has been suffering from an extraordinary burden in terms of looking for the new and stronger antimicrobial compounds [53]. In the present study the petroleum ether and methylene chloride extracts of *F. mollis* inhibit all pathogenic bacteria with different rates (fig. 2). Ethyl acetate extract has no effect on both *Escherichia coli* and *Klebsiella pneumonia* but inhibited others. The acetone inhibited all the bacteria except *Escherichia coli* and *Staphylococcus aureus*. Methyl alcohol extract of plant on tested bacteria proved a broad spectrum antimicrobial potential. Similar results have been determined for

various extracts of *F. indica* [54], *F. cretica* [39, 55] and *F. olivieri* [56].

The presence of flavonoids, tannins and saponins are mainly responsible for antimicrobial properties [57-59]. Alkaloids can also fight against microorganisms [60].

On the other hand, petroleum ether extract inhibited the growth of *Candidia albicans* and *Mucor* spp (8 and 9.3 mm, respectively), but has no effect on the *Aspergillus fumigatus* and *A. niger* (fig. 2). The methylene chloride, Ethyl acetate and methyl alcohol extracts had no antifungal activities against all the pathogenic fungi. Acetone extract inhibited the growth of *A. fumigatus* (10.2 mm) but has no effect on the others. In another study, *Fagonia* extracts exhibited a pronounced antibacterial and antifungal activity [61, 56].

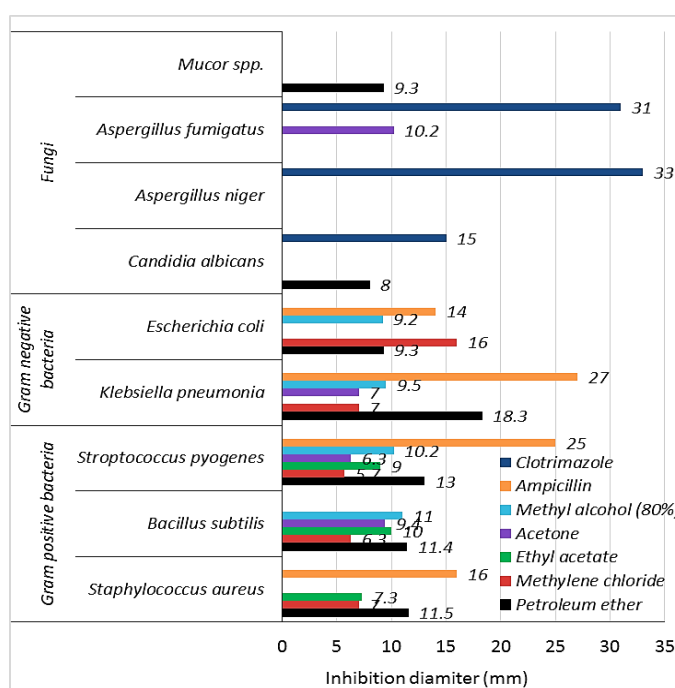


Fig. 2: Antimicrobial activity of different extract of *Fagonia mollis* and standard antibiotic. The recorded value is mean value of 3 replicates

CONCLUSION

The work herein indicates that, the phytochemical analysis of the aerial parts of *F. mollis* indicated that the plant is rich in secondary compounds. In the DPPH test system, the antioxidant activity of the crud extract of *F. mollis*, with an IC₅₀ value of 1.51 mg ml⁻¹, but higher than that of the positive control catechol (0.37 mg ml⁻¹). In the present study the petroleum ether and methylene chloride extracts of *F. mollis* inhibit all pathogenic bacteria with different rates. Also, methyl alcohol (80%) extract of plant on tested bacteria proved a broad spectrum antimicrobial potential. On the other hand, the methylene chloride, ethyl acetate and methyl alcohol extracts had no antifungal activities against all the pathogenic fungi.

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