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Research Article

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Potential of wild plant *Artemisia judaica* L. as sustainable source of antioxidant and antimicrobial compounds

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ABSTRACT

Artemisia judaica L. (Shih Balady, family Asteraceae), is a medicinal plant that grows in the desert, commonly used as tea by population in Egypt Sinai and of Saudi Arabia. The present study aims to evaluate antimicrobial and antioxidant activities of aerial parts of A. *judaica* collected from the inland desert (Wadi Hagoul) of Egypt. Total phenolics, tannins, alkaloids, flavonoids, and saponins were measured in the plant of interest. According to the reduction of DPPH the anti-oxidant activity was measured. Different extracts of A. *judaica* were screened for their antimicrobial activity against nine pathogenic microorganisms using filter paper disc assay. The secondary metabolites of A. *judaica* were examined and proved that it was rich in tannins and phenolics (13.29 and 7.62 mg/g dw). The IC_{50} values of A. *judaica* extract was 1.78 $mg.ml^{-1}$ compared to standard catechol (0.15 $mg.ml^{-1}$). In the present study, the extracts of A. *judaica* showed unusual activity depending on the type of bacteria and fungi. Also, ethyl acetate and methyl alcohol extracts showed considerable broad spectrum (77.78%, each) against both bacteria and fungi, followed by acetone, then methylene chloride and petroleum ether extracts. This study showed that A. *judaica* extracts could be used as antimicrobial substances in pharmaceutical and food preservation systems.

KEYWORDS: *Artemisia judaica*, asteraceae antimicrobial, antioxidant, secondary compounds

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INTRODUCTION

Nearly all cultures in the world depends on medicinal plants medicinal purpose. Around 60% of population continue to use herbal extraction in health care [1,2]. Many species of the genus *Artemisia* have been identified as aromatic and used in medicine [3]. *Artemisia Judaica* L. belongs to the family Asteraceae (Compositae) and known as wormwood (Arabic name, Shih Balady). It is a fragranced shrub that widely grows in the Arabian area [4]. A. *judaica* is used as a tea commonly by population in Egypt Sinai and of Saudi Arabia. In the Arabic area traditional medicine; A. *judaica* is used as a treatment for cardiovascular health, and many other diseases and dysfunctions [5, 6].

Secondary plant metabolites are active chemical defense against pathogens as well as they play an essential role in plant defense against herbivory or other interspecies defenses [7-10]. Phytochemical analysis of A. *judaica* which carried out by many authors [11-14] showed antioxidant activity [15,16], anti-malarial, antibacterial, anti-inflammatory [17,18], biopesticide [19]. In the current paper, we investigate the potential antioxidant and antimicrobial properties of A. *judaica* collected from the inland desert (Wadi Hagoul) of Egypt, to evaluate their medicinal potentiality and their future industrial uses.

MATERIALS AND METHODS

Plant Material

A. *judaica* aerial parts were collected from populations which grow in Eastern desert, wadi Hagul, Egypt during the flowering period (March 2018). The plant species were identified according to Boulos [4].

Phytochemical Analysis

A. *judaica* was phytochemically tested for secondary plant metabolites, tannins, alkaloids, flavonoids, saponins and total phenolic compounds [20-24].

Determination of the Radical Scavenging Activity

The antioxidant activity by DPPH was determined as described by Miguel [25].

Antimicrobial Activity Assessment

Preparation of the crude extracts

Plant extract was prepared by standard methods of Freedman *et al.* [26] and Su and Horvat [27]. In each solvent, the treated filtrate evaporates, and the dried residue was dissolved in dimethyl sulfoxide (DMSO) and reserved at -20°C for future use [28].

Antibacterial Assay

The plant extracts were examined for the presence of antimicrobial bioactivity by the method of Cappuccino and Sherman [29] using different bacterial species (*Bacillus subtilis*, *Escherichia coli*, *Klebsiella pneumonia*, *Staphylococcus aureus*, and *Streptococcus pyogenes*) and fungi (*Candida albicans*, *Aspergillus niger*, *Aspergillus fumigatus*, and *Mucor* spp.). From the Laboratory of Bacteriology, Department of Botany, Faculty of Science, Mansoura University, Egypt the tested samples were taken.

The filter paper discs are prepared with a diameter of 5 mm and sterilized in the autoclave for 20-30 minutes. Then taken by sterile forceps, soaked in DMSO solution and then placed over the surface of the inoculated nutrient agar. In 37°C the Petri dishes were incubated for 24 hours, While in fungi, A sterile disc set over the surface of the inoculated potato dextrose agar and incubated for 3-4 days at 28°C. After incubation for period of time, the inhibition zones diameter (mm) was calculated to record the clear zone to determine the most active extract against pathogenic microorganisms.

RESULTS AND DISCUSSION

Phytochemical Constituents

Plants are the basis of many natural products such as; alkaloids, amines, cyanogenic glycosides, flavonoids, glucosinolates, phenylpropanes, terpenes, saponins, steroids, etc. It is estimated that there are more than 200,000 chemical structures is synthesized by plants [30,31]. Analysis of secondary metabolites of A. *Judaica* showed high values of tannins and phenolics (13.29 and 7.62 mg/g dry weight, respectively). Besides, saponins, alkaloids, and flavonoids (3.55, 2.84 and 1.63 mg/g dry weight, respectively) showed comparable contents, (Figure 1). These results were consistent (compatible) with the results of Essiett and Akpan [32] on *Aspilia africana* and *Tithonia diversifolia* (Asteraceae) and Erol-Dayi *et al.* [33] on *Centaurea* species, but they were lower than some wild plants such as *Anthemis arvensis*, *Artemisia campestris*, *Senecio glaucus* and *Urospermum picroides* [34-36]. It is not surprising to discover that secondary metabolites of the plant have medicinal activities, as most of the prescriptions have plant based origin [30].

Antioxidant Activity

Most organisms own antioxidant systems against ROS [37]. Excessive ROS states have main action in diseases like idiopathic pulmonary fibrosis and respiratory distress syndrome [38]. The evaluation of the antioxidant activity evaluation in plant extracts is shown in Figure 2. By increasing the concentration of plant extract, a continuous corresponding increase in the scavenging activity. In methanol extract and standard antioxidant, the scavenging activities were 55.43% and 82.72%, respectively at 4000 μg.ml^{-1}.

The IC_{50} values of A. *judaica* extract was 1.78 mg.ml^{-1} compared to standard catechol (0.15 mg.ml^{-1}). According to Al-Ismail *et al.* [39], A. *judaica* extract showed moderate scavenging activity (IC_{50} ≥ 1 and ≤ 2 mg/ml). These results suggest that methanol extract of A. *judaica* has an obvious effect on scavenging of DPPH radical. Similar results were reported by Pandey and Singh [40] on the same genus *Artemisia*, El-Amier and Abdullah [41] on *Calligonum comosum* and Salem *et al*. [42] on *Silybum marianum*.

The plant extract potent antioxidant activity can be mainly attributed to phenolic content, as a result of heir hydroxyl group, and/or flavonoids that react with DPPH radical by donating hydrogen atom the free radicals [43], while a highly

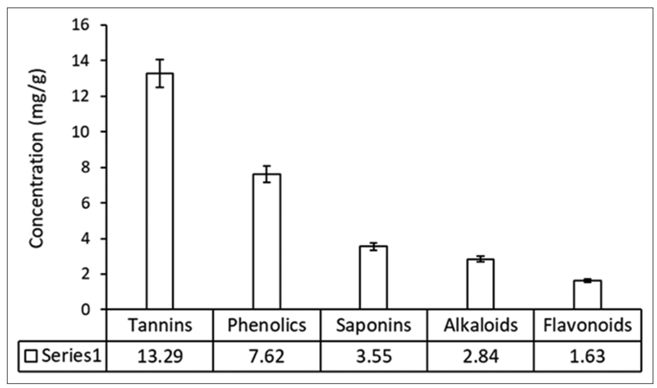

Figure 1: The concentration of the active constituents in mg/g dry weight for the *Artimisa judaica*

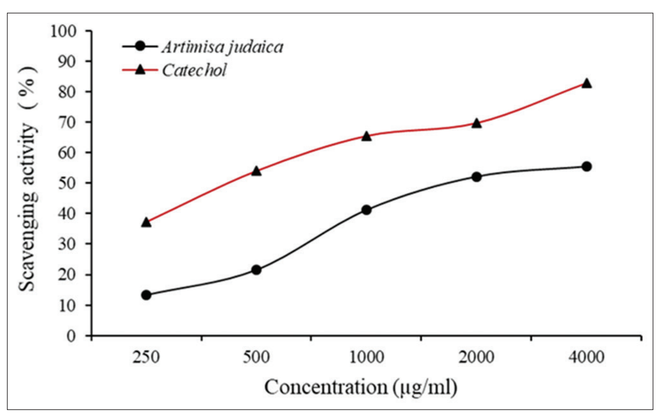

Figure 2: % of scavenging activity of *Artimisa judaica* extract and natural antioxidant catechol

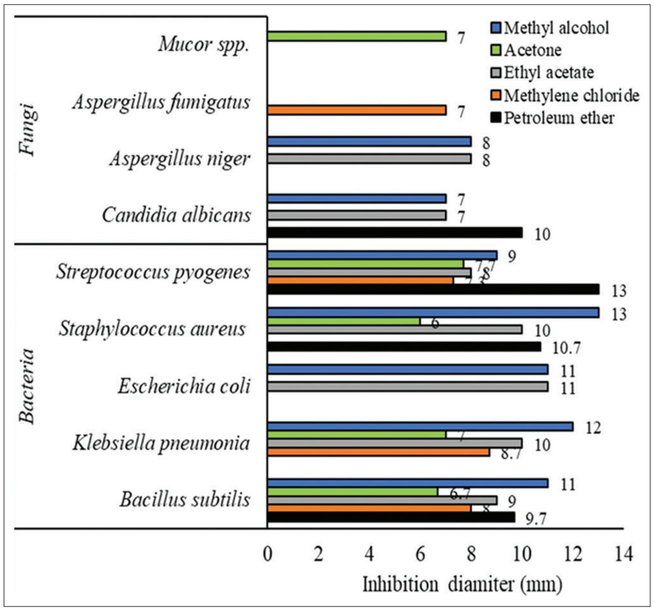

Figure 3: Antimicrobial activity of a different extract of *Artimisa judaica* against tested pathogen

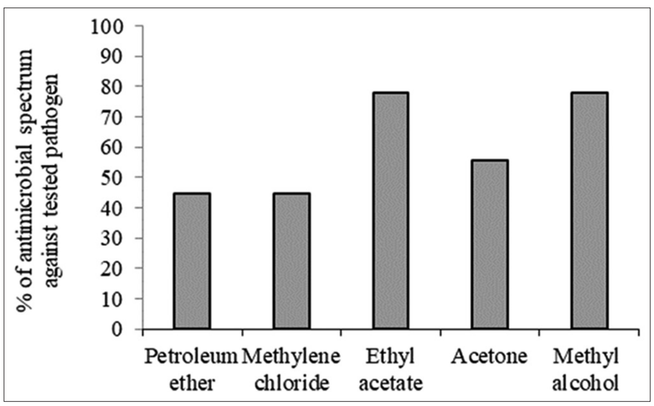

Figure 4: Percent of the antimicrobial spectrum of *Artimisa judaica* extracts against tested pathogen

positive correlation between total phenolic content and antioxidant activity was established in the case of many plant species [11,44,45].

Antimicrobial Activity Assessment

The plants showed well defined action agains microbes [46, 47]. In this investigation, the petroleum ether extract showed higher activity (Figure 3). The *Stroptococcus pyogenes* was the most potent inhibitor followed by *Staphylococcus aureus* and *Bacillus subtilis*. Methylene chloride does not act on *Escherichia coli* and *S. aureus* but inhibiting others. The ethyl acetate and methyl alcohol extracts inhibit all pathogenic bacteria with different rates. Previous reports supports these results [48, 49]. These results were similar to those of *Ocimum sanctum Xanthoxylum armatum*, *Cinnamomum zeylanicum*, and *Origanum majorana* as investigated by Joshi, *et al.* [50] and Iranbakhsh *et al.* [51] in *Datura stramonium* (*B. subtilis*, *E. coli*, and *S. aureus*).

On the other hand, petroleum ether extract had no antifungal activities on all the pathogenic fungi except *Candidia albicans* (Figure 3). The methylene chloride extract inhibited the growth of *Aspergillus fumigatus* only, and ethyl acetate extract does not affect both *A. fumigatus* and *Mucor* spp. But hindered others. No antifungal activities were detected with acetone extract on all the pathogenic fungi except *Mucor* spp. Methyl alcohol extract inhibited the growth of *C. albicans* and *A. fumigatus* (Figure 3). Abdel-Sattar *et al.* [52] reported *Achillea biebersteinii* and *Vernonia schimperii* was active against the same tested fungi strain. Also, these results were compared with other investigators [53-55].

The extracts of *A. judaica* showed action (77.78%, each) against microbes (Figure 4), followed by acetone (55.56%) then methylene chloride and petroleum ether extracts (44.44%, each). The pathogen *S. aureus* and *E. coli* (13 and 11 mm, respectively) were the sensitive bacteria in ethyl acetate and methylene chloride extracts, respectively, whereas *C. albicans* was sensitive fungi in petroleum ether extract (10 mm).

There are many actions for flavonoids in medicinal field [56]. Tannins are capable of inhibiting the digestive enzymes activity, and the nutritional effects of tannins are mainly linked with their interaction with protein [57]. Tannin-protein complexes are insoluble, and the protein digestibility is decreased [58]. Plant saponins are well known for their medicinal actions [59]. Alkaloids have profound effects on diseases [60, 61].

CONCLUSION

In the present study, *A. judaica* phytochemical analysis showed increase in the secondary compounds, and their extract showed moderate scavenging activity. The petroleum ether extract of *A. judaica* exhibited pronounced activity against bacteria than fungi. The methyl alcohol and ethyl acetate extracts showed inhibitory action on bacteria and fungi. The pathogen *S. pyogenes* was the most potent inhibitor followed by *S. aureus* and *B. subtilis*. Also, the pathogen *S. aureus*, *E. coli* and *C. albicans* were the most sensitive microorganism. This study revealed that *A. judaica* extracts could be an alternative in pharmaceutical and food preservation systems.

CONTRIBUTION OF AUTHORS

All Authors contribute in the study equally either in collection and analyzing of samples or preparation and writing the manuscript.

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