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Potential of wild plant *Urospermum picroides* as sustainable source of antioxidant and antimicrobial compounds

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Abstract: The Asteraceae family, which includes the *Urospermum* plant, has a long history of usage in traditional medicine for a wide range of ailments. *Urospermum picroides* is utilized for the treatment of a variety of disorders due to its therapeutic characteristics. The purpose of this study was to assess the antioxidant and antibacterial capabilities of crude extracts of *U. picroides* using preliminary phytochemical screening. The upper sections of *U. picroides* were obtained from the Egyptian coastline of the Deltaic Mediterranean coast. The extract was evaluated for its phenolic, flavonoid, alkaloid, saponin, and tannin content. The DPPH test was used to assess the antioxidant activity. The antioxidant activity of the extract varied between 7.98% at 50 mg/mL and 68.59% at 800 mg/mL, with IC_{50} value of 48.61 mg/ml. Both Gram-negative and Gram-positive bacteria were examined for antibacterial activity. Antimicrobial action was shown by the extract against the majority of the tested bacterial strains, especially *Escherichia coli*. Finally, *Urospermum picroides* extract includes bioactive chemicals and shows promise as a natural antibacterial and antioxidant, according to the research.

keywords: *Urospermum*, Asteraceae, DPPH, Antimicrobial, Phytochemical.

1. Introduction

Wild plants play a crucial role in the global ecosystem, contributing to biodiversity and ecological balance. These plants, often found in natural habitats and not cultivated by humans, support various forms of life by providing habitats, food sources, and contributing to the overall health of ecosystems [1,2]. The diversity of wild plant species is a cornerstone of resilient ecosystems, ensuring adaptability to environmental changes and promoting stability [3,4].

In addition to their ecological significance, wild plants hold cultural and traditional value. Many indigenous communities around the world have deep connections to specific wild plants, incorporating them into rituals, ceremonies, and traditional practices. These plants are often integral to the cultural identity and spiritual beliefs of these communities [5,6]. The medicinal properties of wild plants have been recognized for centuries, with many traditional healing practices relying on the knowledge of these plants. In modern times, scientific research continues to uncover the potential therapeutic benefits of various wild plant species, contributing to the development of pharmaceuticals and herbal medicines [7,8].

The Asteraceae family, also known as the Compositae family, is a huge family of flowering plants that may be found all over the globe, notably in the semi-arid regions of the tropics and subtropics. Globally, it is comprised of around 16,000 genera and 25,000 species. There are 98 genus and 228 species that belong to the Asteraceae family when it comes to the flora of Egypt [9]. This family offers a substantial number of representatives. Evergreen shrubs, subshrubs, and perennial rhizomatous herbs make up the vast bulk of the species that belong to this family. On the other hand, biennial and annual herbs are the most often seen [10]. There are only two species that belong to the genus *Urospermum*: *U. dalechampii* Schmidt and *U. picroides* (L.) Scop. ex. F.W. Schmidt. These two species are primarily found growing in the Mediterranean

region, southwest Asia, and Pakistan. However, it is also known as an introduced species in many other regions, such as North and South America, Australia, and southern Africa [10]. The Nile Delta, the Mediterranean coastal region, the Oases, and the Desert are the only areas in Egypt where the unique species *U. picroides* may be found growing wild.

The culinary and therapeutic properties of plants have been known for a long time. Many different bioactive chemical components found in plants have long been used in traditional medicine or as standalone active substances. It makes sense to use native plant species, either in their wild or cultivated form, as substitutes for artificial preparations. Multiple studies have shown the effectiveness of traditional herbal medicines. In the last twenty to twenty-five years, there has been a meteoric rise in the use of herbal therapies as an alternative and supplemental therapy [11]. This research set out to assess the antioxidant and antibacterial activity of *Urospermum picroides* extracts by conducting a preliminary phytochemical screening of the crude extracts.

2. Materials and Methods

2.1. Plant samples collection and preparation

In the spring of 2023, the above-ground portions of *Urospermum picroides* were collected from the deltaic Mediterranean coast of Egypt (31°29'51.17"N 31°23'2.55"E). Using the authentication procedures outlined by Boulos [10] and Tackholm [12], the specimens were confirmed. The specimens were quickly collected and sent to the lab in individual plastic bags. Following a 7-day period of desiccation in a shaded area at room temperature (28 ± 2 °C), the specimens were ground to a particle size of 3.0 mm using a grinder and then placed in paper bags.

2.2. Phytochemical Constituents

According to the tests reported by Stankovic [13], Chlopicka et al. [14], and Joshi et al. [15], respectively, the total phenolic, flavonoids, and alkaloids were determined and calculated. Using the technique given by Obadoni and Ochuko [16], the content of saponins was determined, while the level of tannins was measured using the method published by Van Burden and Robinson [17].

2.4. Antioxidant activities

The free radical known as DPPH (1,1-diphenyl-2 picrylhydrazyl) was used in order to carry out the evaluation of the antioxidant activity [18]. The mixture consisted of a volume of 1 mL of a DPPH solution with a concentration of 0.15×10^{-3} M. This solution was coupled with 1 mL of *Urospermum picroides* extract that was prepared at different concentrations (100, 200, 400, 600, 800, and 1000 mg/mL). For the purpose of creating a control, one mL of DPPH was mixed with one mL of the solvent. Light exclusion was performed on the combination, and it was then kept at room temperature for a period of thirty minutes prior to the experiment. The absorbance was then measured at a wavelength of 517 nm [19], which was the subsequent step. For the purpose of calculating the IC_{50} values, graphical techniques were used, and the antioxidant activity was depicted as follows:

%RSA = [1-A_sample/A_control]*100

2.4. Antibacterial Activity Assay

A modified Kirby-Bauer disc diffusion method, as described by Bauer [20], was used in order to evaluate the antibacterial activity of the samples. After being sterilized, the filter paper discs, which had a diameter of five mL and had been prepared in preparation, were soaked in the plant extracts that had been made in advance. After that, these discs were positioned on top of the nutrient agar medium that had been injected with the pathogenic microorganisms that were being examined for the antibacterial experiment [21]. Filter discs that had been soaked in 10 µl of solvent (DMSO) were used as a source of negative control. A period of twenty-four hours was spent with the Petri plates being kept in an incubator that was set at a temperature of 37 ℃. The last step was to determine the diameter of the zone of inhibition, which was measured in millimeters. The extract of *Urospermum picroides* was evaluated against two gram-positive bacteria, namely *Staphylococcus aureus* and *Bacillus cereus*, as well as three gram-negative bacteria, namely *Pseudomonas aeruginosa*, *Escherichia coli*, and *Salmonella typhi*.

3. Results and Discussion

3.1. Phytochemical Constituents

Phytochemistry is sometimes seen as an early offshoot of organic chemistry since it focuses on the chemical composition of plants and their many constituents. It is crucial to identify and discover pharmacologically active compounds derived from plants [22]. An in-depth analysis of the analytical data for *Urospermum picroides* revealed the unique traits of the plant and the diverse range of phytoconstituents that exhibited differences across the samples. The analyzed plant contains a significant amount of alkaloids, flavonoids, phenols, tannins, and saponins, as shown in Figure 1. Several chemical classes have been identified for their pharmacological effects on different illnesses. These classes consist of alkaloids, saponins, tannins, anthraquinones, and flavonoids. Abdel salam et al. [23] and Amer et al. [24] obtained a glucoside of urospermal A from the aerial portions of *Urospermum picroides*. Rychlewska et al. [25] extracted sesquiterpene lactones from *Urospermum dalechampii*. Giner et al. [26] isolated and identified 7 phenolic compounds from the aerial parts of *Urospermum picroides*. The identification of these phenolic compounds provides chemotaxonomic markers for the genus *Urospermum*.

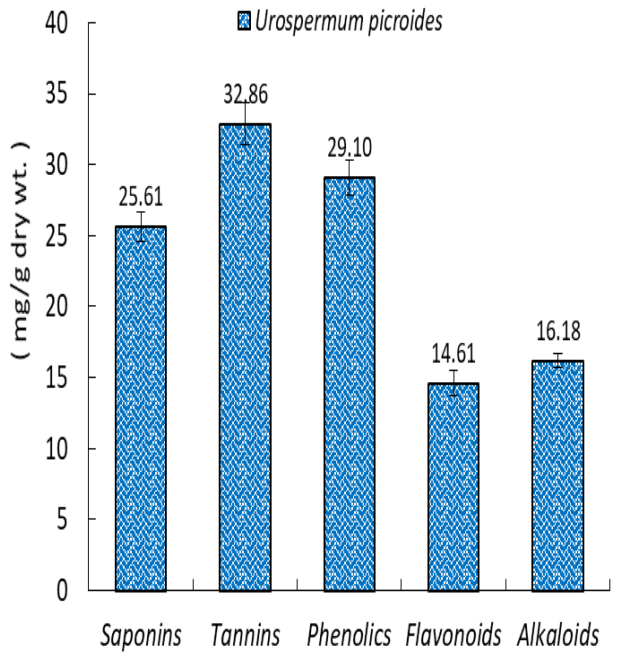

Figure 1. Active organic compounds (mg g^{-1} dry wt.) of *Urospermum picroides* collected from the coastal desert.

3.2. Antioxidant assay

There is a significant correlation between the presence of antioxidants and the protection of human cells from oxidative stress, which in turn reduces the risk of developing cancer [27]. An evaluation of the antioxidant capacity of the MeOH-extract of *Urospermum picroides* was carried out with the help of the free radicals 2,2-diphenyl-1-picrylhydrazyl (DPPH). It was established that the quantity of antioxidant that was required to reduce the initial concentration of DPPH by fifty percent (IC_{50}) equaled the amount of antioxidant activity that was measured. An inverse link exists between the IC_{50} and the antioxidant power, which means that as the IC_{50} decreases, the antioxidant activity increases. This association is oriented in the opposite way. The chemical catechol served as a standard for comparison throughout this work. Based on the results of the study, it can be concluded that the methanolic extract of the plant that was being investigated exhibited antioxidant activity that varied depending on the dose (P values less than 0.05). This activity was comparable to that of catechol, which served as a reference standard with regard to this activity (Table 1). At a dosage of 800 mg/ml, the extract of *Urospermum picroides* demonstrated a scavenging activity that was 68.59% effective. In spite of this, the antioxidant activity is at its lowest level when the concentration is at its lowest point (50 mg/ml), as seen in Table 1. The IC_{50} values of plant extract were found to be 48.61 mg/ml, which is much higher than the IC_{50} value of catechol, which was 15.23 mg/ml. This was established based on the results of the IC_{50}. The results of Abd-ElGawad et al. [27], Corenara et al. [28], and Leointi [29] are compatible with the findings of the present research of *Urospermum picroides*. This implies that the findings of these three groups are in agreement with one another.

The amount of bioactive chemicals, namely phenolic components like flavonoids, phenolic acids, ascorbic acid, and carotenoids, has been proven to be the primary factor in determining the antioxidant activities of plants, according to a number of studies [30]. In light of the findings of our research, it seems that this specific plant has compounds that are not

volatile, such as tannins, flavonoids, and phenolic substances .

Table 1. Scavenging activity percentage of DPPH and the IC_{50} values by *Urospermum picroides* MeOH extract and catechol as standard.

Plant species	Concentration (mg/ml)	Scavenging activity (%)	IC_{50} (mg/ml)
Urospermum picroides	800	68.59±1.78	**48.61**
	600	64.23±1.55	
	400	46.17±1.43	
	200	31.85±051	
	100	19.47±1.01	
	50	7.98±0.22	
	$LSD_{0.05}$	2.04***	
Ascorbic acid	400	78.49±2.62	**15.23**
	300	65.28±1.13	
	150	58.67±1.07	
	100	51.23±0.71	
	50	26.27±0.62	
	$LSD_{0.05}$	3.76	

3.3. Antibacterial Activity

The methanolic extract of *Urospermum picroides* has antibacterial properties by inhibiting the growth of bacteria to varying degrees, as shown by measuring the clear zones around the extracts (Table 2). The results showed that the majority of the extracts had much better antibacterial effects than the standard antibiotics when tested against various bacterial strains, with the exception of *S. typhimurium* (Table 2). The antibacterial activity of the *Urospermum picroides* extract is likely due to its alkaloids, phenolics, and tannins, especially the flavonoids which are known for their antimicrobial properties.

Polyphenols have been shown by Laouini and Ouahrani [32] and Kumar and Goel [33] to have antibacterial, antioxidant, and anticancer properties, as well as effectiveness against several pathogenic microbes. The antibacterial and anti-inflammatory properties of alkaloids are well recognized. Górniak et al. [35] claim that plants produce flavonoids in response to microbial infection.

Table 2. The antibacterial activities represented by the inhibition zone diameter (mm) of the extracted MeOH from *Urospermum picroides* and standard antibiotics.

Organism	*Urospermum picroides*	Standard antibiotic (10 mg L^{-1})		
		Ampicillin	**Cefotaxime**	**Tetracycline**
Gram-negative bacteria				
Salmonella typhi	18.14±0.15	16.31±0.11	11.42±0.04	0.0
Escherichia coli	23.62±0.14	21.57±0.17	12.04±0.03	19.64±0.13
Pseudomonas aeruginosa	19.08±0.12	13.06±0.09	0.0	9.44±0.02
Gram-positive bacteria				
Bacillus cereus	20.38±0.09	20.55±0.12	26.07±0.18	23.81±0.18
Staphylococcus aureus	15.61±0.08	18.92±0.14	20.95±0.19	19.57±0.07

4. Conclusion

Finally, the ecological, pharmacological, and cultural aspects of *Urospermum picroides'* biological activity are also worth noting. As a plant species, it helps local ecosystems in a number of ways, including as a food source, a place to live, and an example of how to adapt to harsh environments. The historic use of its leaves for both medicinal and culinary reasons gives it cultural value in certain areas. Recent studies have shown that the plant has a lot of secondary active compounds that fight bacteria and other microbes. To protect the wide variety of native plant and animal species, conservation efforts often focus on eradicating invasive species.

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