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Antioxidant and Phytochemical Analysis of *Pulicaria undulata* Methanolic Extract

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Abstract *Pulicaria undulata* (family Asteraceae), commonly referred to as *Pulicaria crispa*, was subjected to screening to determine its phytochemical composition and evaluate its antioxidant capacity. This species is widely distributed in desert environmemt. The plant was subjected to extraction using methanol, and the resulting extract was subsequently subjected to testing. Quantitative methods were used to measure the amounts of flavonoids, phenols, alkaloids, tannins, and saponins.. Additionally, qualitative phytochemical assays were utilized to ascertain the presence of bioactive compounds. The measurement of the antioxidant capacity of the extract was conducted utilizing DPPH (diphenyl-1,2-picryl hydrazyl). The results of the study authorized that the extract obtained from the above ground parts demonstrated the greatest degree of antioxidant scavenging action, as evidenced by an IC_{50} value of 59.54 mg/L. It is important to acknowledge, nonetheless, that this particular activity exceeds that of catechol when concentrations surpass an IC_{50} value of 19.95 mg/ml. The fact that these plants contain phytochemicals that work as antioxidants may be a strong reason why they were used in traditional medicine in the past..

keywords: *Pulicaria undulata*; Antioxidant; DPPH, Phytochemical.

1. Introduction

The development of functional foods and medicines made from medicinal and food plants has led to progress in many areas, including the mitigation of bodily ailments, diminished reliance on synthetic antibiotics, and enhanced longevity.

The use of medicinal plants for the management of various diseases has been extensive, mostly attributed to the existence of bioactive chemicals with therapeutic attributes [1]. The abundant availability of herbs to the human population has been extensively investigated to fully understand their medical attributes [2]. Phytoconstituents refer to the naturally occurring bioactive chemicals that are present in plants. Phytoconstituents collaborate with nutrients and fibers to constitute an integral component of the defense system against a diverse range of illnesses and stress circumstances [3].

The Egyptian desert encompasses around 95% of Egypt's total land area and is classified as one of the hyper-arid regions globally, characterized by low, variable, and irregular rainfall [4]. Approximately 95% of Egypt's territory is comprised of three major deserts, namely the Eastern Desert, Western Desert, and Sinai Peninsula [4,5]. The flora found in these desert regions has significant importance as it represents the primary form of natural plant life [4,5]. The Eastern Desert refers to the section of the Sahara Desert located to the east of the Nile River. The region under consideration encompasses a geographical expanse extending from the Nile Valley towards the east, including the Suez Gulf and the Red Sea. This territory spans around 223,000 square kilometers, constituting approximately 21% of Egypt's total land area. The Eastern Desert has more expanse compared to the Western Desert due to its predominant composition of elevated and precipitous mountain ranges that run parallel to the coastline in proximity. The region is also acknowledged as the Red Sea Hills.

Pulicaria undulata, often known as *P. crispa*, is a very prevalent species of desert vegetation. The plant in question is a perennial

herb or sub-shrub characterized by its little yellow blooms [6]. According to Boulos [7], this desert shrub is quite prevalent in the wild regions of Southern Egypt. In the context of Egypt, the substance referred to as "Dethdath" has been recognized for its potential use in treating inflammation and acting as an insect repellent, as documented by Maghraby et al. [8]. *Pulicaria undulata* has been documented in scientific literature as having potential anti-inflammatory properties [9]. Additionally, it is often consumed in the form of herbal tea. The elements of traditional medicine are used for their aromatic properties, as well as for their potential therapeutic effects in managing hypoglycemia and alleviating spasms. Polyunsaturated fatty acids, sterols, minerals, polysaccharides, terpenoids, proteins, and halogenated compounds are the principal chemicals that are produced by desert plants [10]. These molecules have the potential to be significant in the pharmaceutical and food industries.

The purpose of this research was to analyze the wild plant *P. undulata*, which was obtained from the Northern Eastern Desert, with the purpose of determining its chemical makeup and assessing its antioxidant activity.

2. Materials and Methods

2.1. Plant material

During the flowering period in May 2023, we collected viable specimens of *P. undulata* from indigenous xerophytes found in the northern region of the Eastern Desert, namely in Wadi Araba, Egypt (29°4'23.59"N, 32°15'48.90"E). The identification of plants was conducted with the assistance of Tackholm [11] and Boulos [7] as reference sources. The sample was subjected to manual cleaning, followed by three rinses with distilled water to eliminate any dust particles and residual substances. Subsequently, it was air-dried at an ambient temperature of 25 ± 3 °C in a shaded area for a period of several days until achieving total dryness. Finally, the dried sample was crushed into a fine powder. Subsequently, the specimens were carefully transferred into paper bags and stored at ambient temperature, shielded from direct light, until subsequent analysis was conducted.

2.2. Extraction

The standard solvent extraction method is used to separate parts of plants that have healing properties.[12]. The process of extraction involves the separation of soluble plant compounds from the insoluble cellular remnants. A total of 100 grams of each dried plant component was subjected to a three-day soaking process in 75% methanol solution at ambient temperature [12]. The process involves the gentle disruption and fragmentation of plant cell walls to release soluble phytochemical compounds. The filtration process is conducted following a period of three days. In this conventional methodology, heat is transferred through convection and conduction, while the selection of solvents determines the retrieval of molecules from samples [13]. The filtered and evaporated extracts were dissolved in dimethyl sulfoxide (DMSO) for subsequent application.

2.3. Phytochemical constituents

2.3.1. Qualitative phytochemical screening

The identification of phytochemical components was conducted in accordance with established protocols outlined by Farnsworth [14], Harborne [15], Sofowora [16], and Evans [17].

2.3.2. Quantitative determination of phytochemicals

The methodologies described by Sadasivam and Manickam [18], Harborne [15], Bohm and Kocipai-Abyazan [19], and Obadoni and Ochuko [20] were employed to assess the concentrations of tannins, saponins, flavonoids, alkaloids, and total phenols.

2.4. Antioxidant activities

The measurement of free radical scavenging activities was conducted using a methodology similar to that described by Bibi et al. [21]. After the addition of 180 µl of DPPH solution (in methanol), the sample solution in DMSO reached a final concentration of 100 g/mL. Following a 15-minute incubation period at a temperature of 37 ℃ under conditions of darkness, the absorbance of the samples was quantified at a wavelength of 517 nanometers using a microplate reader.

3. Results and Discussion

3.1. 3.1. Qualitative phytochemical screening

The selection of species for the research was informed by the utilization of local knowledge and existing literature on medicinal plants. According to the findings shown in Table 1, it is evident that several extracts included significant amounts of alkaloids, tannins, and terpenoids, which are important secondary metabolites. According to a study conducted by researchers [22], triterpenoids have been found to possess both analgesic and anticancer properties. According to the source [22], saponins possess hypocholesterolemic and antidiabetic properties, while triterpenoids exhibit analgesic and anticancer effects. Secondary metabolites play a significant role in enhancing the medicinal potential of plants. Table 1 presents the results of the qualitative phytochemical screening conducted on the powder and crude extract of *P. undulata*. The qualitative screening encompasses established methodologies that ascertain the presence or absence of phytochemicals in aqueous extracts.

During this study, the evaluation of phytoconstituents was assigned a numerical value ranging from negative one to positive four, based on the extent of the observed color alteration or the quantity of precipitate generated. Consequently, an evaluation of the bioactive compounds present in the indigenous plant was feasible by a qualitative analysis. The samples exhibited diverse quantities of alkaloids, flavonoids, phenols, saponins, and tannins, as indicated in Table 1. Nevertheless, certain samples have displayed the presence or lack of specific phytoconstituents, as indicated in Table 1. Research findings have demonstrated that the plant species under investigation lack the presence of anthraquinones.

Table 1. Qualitative phytochemical analysis of *P. undulata* collected from the inland desert (north sector of Eastern Desert).

Plant sample	Screening test								
	Alkaloids	Flavonoids	Phenols	Saponins	Tannins	Steroids	Glycosides	Anthraquinones	Terpenes
Pulicariaundulata	+++	+++	++	+++	++	+	+	-	-

3.2. Quantitively analysis of Some Secondary metabolites

P Phytochemistry, the study of the chemical makeup of plants and its many constituents, is generally regarded as one of the first branches of organic chemistry. It holds significant significance in the characterization and discovery of plant-derived molecules possessing therapeutic attributes [23]. The comprehensive assessment of the analytical findings for *Pulicaria undulata* demonstrated the distinct characteristics of the examined plant, as well as the diverse range of phytoconstituents that varied among different plant samples. Furthermore, the analysis indicated that the studied plant exhibited a high concentration of saponins, tannins, phenols, flavonoids, and alkaloids. The classes of chemicals, including alkaloids, saponins, tannins, anthraquinones, and flavonoids, have been recognized for their therapeutic properties against multiple pathogens. Consequently, these compounds have been traditionally employed for the treatment of diverse ailments, as indicated by studies conducted by Hassan et al. [24] and Usman and Osuji [25]

Table 2. Secondary compounds (mg g^{-1} dry wt.) of some plants collected from the inland desert.

Plant sample	Active organic compounds				
	Alkaloids	Flavonoids	Phenols	Saponins	Tannins
Pulicaria undulata	12.61±0.74	16.54±0.97	20.65±1.21	23.68±1.39	35.56±2.09

3.3. Antioxidant assay

Antioxidants have a crucial role in safeguarding human cells against oxidative stress, so significantly mitigating the likelihood of developing various forms of cancer [26]. The antioxidant action of *P. undulata* MeOH-extract was evaluated by comparing its ability to scavenge DPPH free radicals with that of catechol. The values of the half maximal inhibitory concentration (IC_{50}) were used in

order to indicate the scavenging effects that plant extracts and the standard had on the DPPH radical. The results are depicted in Figure 1. A decreased IC_{50} value signifies an enhanced ability to scavenge DPPH radicals. Following this, the findings provided confirmation that the extract derived from the aboveground parts exhibits the highest level of antioxidant scavenging action, as seen by an IC_{50} value of 59.54 mg/L. It is worth noting, however, that this activity surpasses that of catechol at concentrations exceeding an IC_{50} value of 19.95 mg/ml. The current findings pertaining to *Pulicaria undulata* align with the findings reported by Abed-ElGawad et al. [27], Corinara et al. [28], and Lieonti [29].

This study examines the comparative antioxidant activity of *P. undulata* shoot extract in relation to other wild plant extracts from various regions. Numerous studies have provided evidence indicating that the antioxidant capacities of plants are directly influenced by the number of bioactive molecules, namely phenolic components such as flavonoids, phenolic acids, ascorbic acid, and carotenoids [30]. According to our research, this plant is shown to possess nonvolatile chemicals, including tannins, flavonoids, and phenolics.

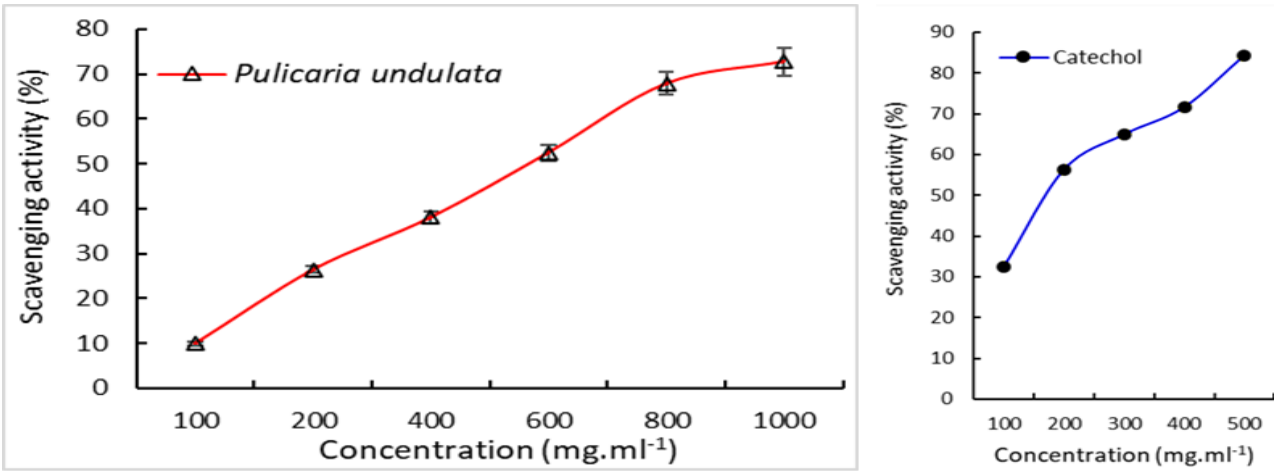

Figure 1. Scavenging activity percentage of DPPH by MeOH extract of *Pulicaria undulata* collected from the Egyptian desert and catechol as standard.

4. Conclusion

The application of specific botanical extracts is supported by the findings that have been given here. The botanical classification, the method of isolation, and the protocol for evaluation collectively impact the characteristics of the bioactive constituents present in botanical specimens. A robust association was seen between the antioxidant capacities and bioactive compounds, indicating that the latter are the predominant factors contributing to the potent antioxidant properties exhibited by these plants. The aforementioned discoveries provide an avenue for future investigation about the therapeutic capabilities of diverse botanical species, as well as the identification of a suitable solvent for the purpose of isolating economically feasible bioactive compounds.

4. References

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