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Phytochemical Analysis, Antioxidant and Antimicrobial Activities of Emergent *Cyperus laevigatus* L

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Abstract

Biological control is receiving increasing attention as an alternative means of disease control, especially where disease resistance or chemical control are not available. The aim of this study was to investigate the phytochemical analysis of emergent *Cyperus laevigatus* L and assess its antioxidant and antimicrobial activities. Methanol extract's preliminary phytochemical screening revealed differences in active secondary chemicals. For the rhizome, stem, and leaves, respectively, phenolics were found to be 267.06, 79.48, and 96.46 mg of gallic acid equivalent/g dry extract, flavonoids were 90.62, 27.78, and 34.47 mg of catechin equivalent/g dry extract; and tannins were 32.83, 12.46, and 23.35 mg of gallic acid equivalent/g dry extract. With an IC_{50} value of 30, 40, 42, and 51.76 mg/L for the rhizome, stem, and leaf, respectively, the DPPH antioxidant activity of the *C. laevigatus* extracted components showed that the rhizome extract is the most potent. The current findings indicate that *C. laevigatus* rhizome extract had superior antibacterial activity against the Gram-positive bacterial strains, while methanolic extract had a greater zone of inhibition against *Pseudomonas aeruginosa* and *Escherichia coli* (25.8 and 22.2 mm, respectively) (*Staphylococcus aureus* and *Bacillus subtilis*). The separation of pure components from the *C. laevigatus* extracts will be the focus of future research. Important biological results also suggested that more research on this plant may make it possible to find new medications made from natural sources.

Keywords: Cyperus laevigatus; Halophytes; Antibacterial; Antioxidant; Secondary metabolites

1. Introduction

Globally, there are wild plants that make up nature's biodiversity. About 60 to 80% of the world's inhabitants rely on plant medicines, and they offer a variety of food and herbal remedies [1, 2]. With a few oases here and there, Egypt's environment is mostly desert. The Gulf of Suez, Aqaba, the Mediterranean Sea, and the Red Sea all have extensive coastlines. A variety of plants and animals inhabit each geographical area, each one adapted to its ecosystem [3,4]. Salt swamplands, sandbanks, panes, sandy fertile zones, and lake shorelines are the five habitat types that may be found along Egypt's deltaic Mediterranean Sea coast [5]. Additionally, a large number of tasty species and/or species rich in nutrients can be found in Egypt's natural vegetation along the Mediterranean coast, making them valuable natural resources to produce food, fodder, and medicines [6].

Numerous native medicinal herbs are utilized both as food additions and for medical purposes [7]. The therapeutic value of these plants is due to their bioactive phytochemical constituents, which have been utilized for ages in traditional medicine to treat a wide range of ailments. The most active phytochemicals found in plants are glycosides, tannins, flavonoids, flavones, and alkaloids. These organic substances served as the foundation for contemporary medications as they are used today [8, 9]. Antioxidative phytochemicals and resistance to antimicrobial agents have received increasing attention worldwide for their potential role in preventing the risk of human diseases [10, 11].

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With 109 genera and almost 5,500 species, the Cyperaceae (sedge family) is the third-biggest family of monocots and the largest family of monocotyledons [12, 13]. With more than 600 species worldwide, particularly in pantropical and tropical regions, the *Cyperus* genus is the biggest in this family [14,15]. *Cyperus* species are broadly used as wildflowers in traditional medicines as an anthelmintic, carminative, diuretic, analgesic, stimulant, astringent, and colic remedy [16,17]. The biological activity of *Cyperus* spp. revealed that the plant as a drug has numerous therapeutic actions, such as antimicrobial, hepatoprotective, antiinflammatory, antimalarial, gastroprotective, and antidiabetic [15,18-22]. Previous phytochemical studies on *Cyperus* plants indicate the presence of aurones [23], quinones [24], sesquiterpenes, steroids [25], essential oils [26], nitrogenous compounds [27], phenolics [28], and flavonoids [29, 15].

Cyperus laevigatus L. (Family: Cyperaceae, syns. *C. mucronatus*), also called borbeit or Sa'ed in Egypt, is a tufted perennial sedge with crowded stems (up to 60 cm tall) or single stems on a long creeping rhizome [30,14]. *C. laevigatus* thrives in wet areas, especially in shallow brackish water, moist alluvial and sandy soils, near wells and springs, on the edges of salt marshes, and in alkaline habitats. In Egypt, *C. laevigatus* is commonly distributed in the Nile Delta, Oases, Mediterranean coast, Red Sea coast, Gebel Elba, and Sinai [14]. The aerial parts of the *C. laevigatus* alcoholic extract show tannins, phenolics, flavonoids, and glycosides in a preliminary phytochemical analysis. The plant alcohol extract has also been linked to a few other pharmacological effects, including anti-inflammatory, antioxidant, antidiabetic, and cytotoxic actions [28].

Alcoholic extract of *C. laevigatus* was reported to have antiinflammatory and antidiabetic activities, but phytochemical analyses were not determined except for phenolic constituents [28]. Moreover, little is known about the preliminary phytochemical analysis and biological activity of *C. laevigatus*, as well as allelopathic activity. To determine the antioxidant and antibacterial properties of a crude extract derived from *C. laevigatus*, which is used to cure a variety of ailments, the goal of this study was to screen for phytochemicals in the rhizome and leaves of *C. laevigatus* in Egypt.

2. Materials and Methods

2.1. Preparation of plant material

Cyperus laevigatus fresh plant components (rhizome, stem, and leaves) were collected during the flowering stage from sand flats in Egypt's northern Nile Delta (31°29'28.08"N, 31°23'46.90"E). According to Täckholm [31] and Boulos [32], the examined species were identified. The gathered plants were crushed into a fine powder and stored in a polypropylene container for later use after being dried for 21 days in the shade at room temperature.

After being washed, the samples were given time to air dry. 10 g of dried plant material was put into a conical flask that had a capacity of 250 mL and could hold 150 mL of methanol. The mixture was then placed in a water bath shaker (Memmert WB14, Schwabach, Germany), where it was continually stirred for two hours at room temperature. Whatman filter papers were used to filter the mixture (no. 1, 125 mm, Cat. No. 1001 125, Germany). The final plant extract concentrations were studied, and the extracts were kept at 4 °C for storage [33].

2.2. Phytochemical analysis

The active components were removed using a method like hot infusions used in conventional therapy. 20 grams of each dried plant part were combined with 200 mL of deionized water and agitated for 30 minutes in a water bath system that was heated to 70 °C. Filtration of the produced extract and storage of the filtrate at 4 °C. Quantitative estimates were made of the total amounts of flavonoid, tannin, and phenolic compounds in the aqueous extract of *C. laevigatus* aerial and underground parts.

2.2.1. Total Phenolic Contents

The total phenolic content was assessed using the Folin-Ciocalteu method developed by Wolfe *et al*. [34], using gallic acid as a reference. The measured total phenolic content in the aqueous extract of *C. laevigatus* was quantified as equivalents in milligrams of gallic acid/dried plant extract in grams using a standard curve ($y = 0.0074x$, $r^2 = 0.969$).

2.2.2. Total Flavonoid Contents

Zhishen *et al*. [35] used catechin as a reference and a colorimetric assay with aluminium chloride to

calculate the total quantity of flavonoids present. The value of the total flavonoid components was estimated as milligram equivalents of catechin per dried plant extract in grams using a standard curve (y = 0.0031x, r^2 = 0.991).

2.2.3. Total Tannin Contents

According to Burlingame [36] and Aberoumand [37], the vanillin-hydrochloride test was used to determine the total amount of tannins, and the comparable amounts of tannic acid in grams per dried plant per 100 g were used to express the values of the anticipated samples.

2.3. Antioxidant activities

2.3.1. DPPH radical scavenging capacity estimation

According to Miguel's assay [38], the radical scavenging capacity of *C. laevigatus* extract was assessed using the 2, 2-diphenyl-1-picryl-hydrazil (DPPH) radical. Simply put, 2 ml of plant extracts at concentrations ranging from 100 to 1000 mg/l were combined with 2 ml of 150 M DPPH and then left in the dark at 40 ºC for 30 minutes. All samples were examined in triplicate; the absorbance was at 520 nm using a Milton Roy Spectronic 21D UV-Visible Spectrophotometer (USA), and the IC50 values were calculated using an exponential curve.

$$\% \text{ Of DPPH scavenging} = [1 - (A_{sample} / A_{control})] \times 100$$

2.4. Antibacterial potential

2.4.1. Tested bacteria

The antimicrobial potential of *C. laevigatus* extract was estimated for eight pathogenic bacteria including 5 gram-negative bacteria (*Klebsiella pneumonia* (ATCC10031), *Listeria monocytoyenes* (ATCC19116), *Escherichia coli* (ATCC10536), *Salmonella typhi* (ATCC25566) and *Pseudomonas aeruginosa* (ATCC9027)) and 3 gram-positive bacteria (*Streptococcus epidermis* (EMCC1353^t), *Staphylococcus aureus* (ATCC6538) and *Bacillus subtilis* (DMS1088)).

2.4.2. Disc diffusion assay

Discs were loaded over the plates containing the tested strains after being submerged in the examined extracts for a period of 18 to 24 hours at 37 °C. The diameter of the filter paper discs (6 mm) was subtracted from the predicted zone of growth inhibition [39].

3. Results and Discussion

3.1. Phytochemical constituents

Herbal medicines' therapeutic advantages are based on the plant's chemistry. Understanding the chemical makeup of plants aids in understanding their potential medical uses. The primary metabolic pathways are used by the plant cell to produce a large number of secondary plant metabolites [40]. Among plant secondary metabolites, phenolic compounds were shown to have considerable antiinflammatory, antioxidant, antihyperglycemic, immunomodulatory, and anticancer activity [41-44]. The present study demonstrated that the parts of *C. laevigatus* extract are filled with phenolics (267.06, 79.48, and 96.46 mg gallic acid equivalent/g dry extract), flavonoids (90.62, 27.78, and 34.47 mg catechin equivalent/g dry extract), and tannins (32.83, 12.46, and 23.35 mg gallic acid equivalent/g dry extract) for the rhizome, stem, and leaves, respectively. These substantial variations may result from ecological variables, species, plant age, organ genetic variables, and the condition of secondary metabolism in various growth environments [45].

Our research on the antioxidant potentials and functions of flavonoids and phenolics has been published in recent works. In this respect, they both significantly stimulate and inhibit oxidative reactions [46]. Additionally, they can break radical chains, which have been demonstrated to have a potent antioxidant impact. In addition to flavonoids, tannins, and phenolics, there are widespread and substantial plant phytochemicals. The second-most prevalent polyphenol, tannins, primarily serve as defensive chemicals that shield plants from pests and other abiotic stresses like drought, heat, and intense UV radiation [47]. Moreover, tannins have strong antibacterial and antioxidant properties [41, 48]. Elshamy *et al*. [28] state that a phytochemical study of aboveground biomass revealed the presence of *C. laevigatus* phenolics as well as its anti-inflammatory and antidiabetic capabilities. Quinones, flavonoids, sesquiterpenes, steroids, and essential oils were among the secondary metabolites described from *Cyperus* sp. [17, 25, 29, 49].

Table 1. The phytochemical analysis of *Cyperus laevigatus* parts.

Samples	Phytochemical Analysis		
	Phenolics	Flavonoids	Tannins
Rhizome	267.06±3.65	90.62±3.41	32.83±1.08
Stem	79.48±2.87	27.78±1.86	12.46±0.93
Leaves	96.46±2.66	34.47±1.52	23.35±0.75

Phenolics Content "mg gallic acid/1 gm dry extract", Flavonoids Content "mg catechine/1 gm dry extract", Tannins Content "mg tannic acid/1 gm dry extract"

3.2. Biological characteristics of the plant extracts

3.2.1. Antioxidant activity - DPPH assay

In vitro assays, 2, 2 diphenyl-1-picrylhydrazyl radical scavenging assay was used to determine the antioxidant capacity of *Cyperus laevigatus* methanolic extract. Table 2 indicated an increasing trend in DPPH radical scavenging activity with an increase in the concentration of extract. The results are reported in Table 2 using half maximum inhibitory concentration (IC_{50}) values to express the scavenging activities of plant extracts and the standard on the DPPH radical. An increased ability to scavenge DPPH radicals is shown by a decreased IC_{50} value. It was further demonstrated that the extract from the rhizome, with an IC_{50} of 30.40 mg/L, has the greatest antioxidant scavenging activity when compared to ascorbic acid (IC_{50}= 14.16 mg/mL), followed by the stem and leaves (IC_{50} = 42.40 and 51.76 mg/mL, respectively) as shown in Table 2. Because of the sample's enhanced ability to trick free radicals in the solution due to the presence of phenolics, the results generally match those obtained from phytochemical analyses. According to El-Amier *et al.* [50], Elshamy *et al.* [28], Al-Rowaily *et al.* [51], and Abd-ElGawad *et al*. [52], the results of *Cyperus laevigatus* were in contract with the results of the present study.

Table 2. Radical scavenging activity (%), and IC_{50} values (mg/L) at various concentrations of the methanol extracted from *Cyperus laevigatus* and the standard ascorbic acid by DPPH assay.

Concentrations (mg/mL)	% of DPPH scavenging		
	Rhizome	Stem	Leaves
50	73.83±2.84	57.25±2.73	50.03±1.97
40	67.64±2.05	46.06±1.40	38.52±2.05
30	52.81±1.60	39.23±1.19	26.86±1.53
20	31.68±0.96	28.10±0.85	16.54±0.97
10	22.74±0.69	17.16±0.52	8.40±0.43
5	12.33±0.37	8.51±0.26	6.88±0.21
IC_{50} (mg/mL)	30.40	42.40	51.76
$LSD_{0.05}$		0.0004***	
		Ascorbic acid	
20		62.30±1.13	
15		53.56±0.97	
10		42.52±0.77	
5		35.53±0.27	
2.5		7.68±0.02	
1		1.89±0.02	
IC_{50} (mg/mL)		14.16	
$LSD_{0.05}$		1.82***	

Values are means ± standard error (n=3). IC_{50}: the antioxidant concentration capable of diminishing 50% of the used DPPH radical.

Alternatively, the standard curves, which were drawn as shown in Figure 1, represented the relationship between the sample concentration and the percentage of scavenging activity in all samples. All samples exhibiting proportional relationships showed an increase in the % activity when the sample concentration was increased [53].

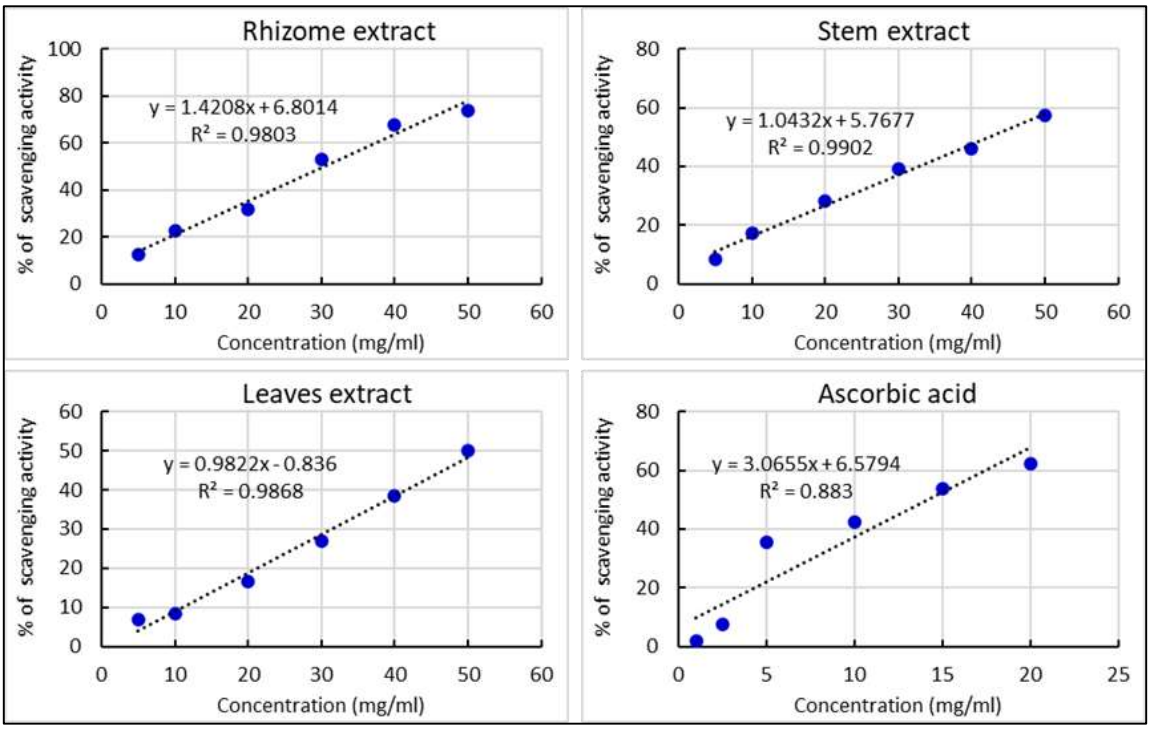

Fig. 1. The standard curves of % of scavenging activities versus sample concentrations.

On the other hand, the antioxidant strength of bioactive substances is often affected by how well reactive oxygen species like phenolics, fatty acids, terpenes, oxygenated hydrocarbons, or carbohydrates can get rid of or stabilize free radicals [54,55]. In terms of antioxidant activity in this investigation, *Cyperus laevigatus* extract surpassed other wild plant extracts from other nations. Many studies have shown that the ability of plants to act as antioxidants is directly related to the amount of bioactive chemicals they have, especially phenolic elements like flavonoids, phenolic acids, ascorbic acids, and carotenoids [56]. Our research indicates that this plant contains phenols, flavonoids, and tannins, among other non-volatile compounds.

3.2.2. Antibacterial Activity

In this study, the antibacterial effects of a methanolic extract of *Cyperus laevigatus* rhizome, stem, and leaf at a concentration of 10 mg/L against five Gram-negative and three Gram-positive bacterial strains were assessed using the previously discussed agar disc diffusion assay method [41]. The outcomes showed that a certain plant's methanolic extract successfully suppresses the growth of harmful bacteria with varied potencies (Table 3). Rhizome extracts demonstrated more antibacterial activity than stem and leaf extracts against *P. aeruginosa* and *E. coli* (25.8 and 22.2 mm, respectively), whereas all three extracts tested (rhizome, stem, and leaf) demonstrated equivalent activity against *K. pneumoniae* (Table 3). All the studied extracts did not affect *S. typhi* and *L. monocytogenes*, though. Against the Gram-positive strains (*S. aureus and B. subtilis*), however, rhizome extract showed higher antibacterial activity, while stem extract demonstrated higher antibacterial activity. Only the *Cyperus laevigatus* rhizome extract, however, demonstrated any antibacterial activity on *S. epidermis*; the other extracts lacked such activity. According to their level of activity, the examined extracts can be grouped as follows: rhizome > stem > leaf.

Different levels of activity were present in the common antibiotics, such as ampicillin, penicillin, gentamicin, and chloramphenicol. While *L. monocytoyenes* was completely resistant to ampicillin and chloramphenicol, as well as *K. pneumoniae*, *S. typhi*, *S. epidermis* and *B. subtilis* were totally resistant to ampicillin and penicillin, although they were both completely susceptible to the other (Table 3).

Table 3. Antibacterial activity of methanol extract from the aerial parts of *Cyperus laevigatus* and some selected reference antibiotics at a concentration of 10 mg/ml.

Tested microorganism	*Cyperus laevigatus* extracts (10 mg/ml)			Standard antibiotic (10 mg/ml)				$LSD_{0.05}$
	Rhizome	Stem	Leaf	AMP	PEN	GEN	CHL	
Gram-negative bacteria								
Klebsiella pneumoniae	13.8±0.4	12.8±0.2	11.9±0.3	17±0.2	ND	22±0.8	31±0.5	1.051***
Listeria monocytoyenes	11.7±0.2	ND	ND	ND	8±0.3	21±0.9	ND	0.461***
Escherichia coli	22.2±0.3	14.2±0.3	9.1±0.2	11±0.3	16±0.5	19±0.8	21±0.7	0.547***
Salmonella typhi	11.2±0.2	ND	ND	ND	12±0.7	22±0.1	20±0.2	0.165***
Pseudomonas aeruginosa	25.8±0.5	14.1±0.2	7.7±0.1	10±0.4	8±0.3	1±0.7	23±0.7	3.739***
Gram-positive bacteria								
Streptococcus epidermis	9.7±0.1	ND	ND	ND	ND	29±0.5	27±0.5	0.316***
Staphylococcus aureus	21.9±0.3	21.7±0.2	5.6±0.2	13±0.5	18±0.7	23±0.8	25±0.9	3.684***
Bacillus subtilis	20.3±0.3	10.8±0.1	6.7±0.2	ND	ND	9±0.4	16±0.7	1.765***

AMP: Ampicillin, PCN: Penicillin, GEN: Gentamicin, CHL: Chloramphenicol. value is the diameter of the inhibition zone (mm) as an average of three replications ± standard error. Significant variation at a probability level of 0.05 (Duncan's test). LSD: least significant difference. *** $P < 0.001$. ND is referred to as the not detected value "inactive antimicrobial agent".

A preliminary phytochemical study reveals that the alcoholic extract of the emerging plant *C. laevigatus* contains phenolics, tannins, flavonoids, and glycosides. Additionally, the plant alcohol extract's pharmacological effects, including its anti-inflammatory, antibacterial, antioxidant, antidiabetic, and cytotoxic properties, were briefly discussed [28]. According to our research, this plant contains non-volatile substances such as phenols, flavonoids, and tannins. Numerous prior studies on various plant components of various *Cyperus* species demonstrate their powerful antibacterial properties against both Gram-positive and negative bacteria [57–59]. However, they disagreed with Sultan *et al.* [46] on *Senecio glaucus* and Hafaz *et al*. [61] on *Rumex* spp. Abdel-Sattar *et al*. [60] discovered that the methanol extracts of *Plectranthus asirensis* and *Lavandula pubescens* were active against the same tested bacteria strain as well as Salama *et al*. [55] in *Rumex* spp. These outcomes were comparable to those of Joshi *et al.* [62] *investigation of Ocimum sanctum, Origanum majorana, Cinnamomum zeylanicum,* and *Xanthoxylum armatum*. These differences in the antibacterial latent potency may be related to environmental factors that affected the constituents of the extract, such as soil type and climate [63].

4. Conclusions.

In comparison to the standards, the results of this study showed that organ extracts from *C. laevigatus* showed promising biological activities, such as antioxidant and antibacterial agents. Particularly, when compared to other plant tissues, rhizome extract displayed the highest antioxidant activity. As opposed to reference standard antibiotics, the methanol extract of several *C. laevigatus* parts demonstrated significant antibacterial activity against Gram-negative species. The exceptional concentration of phenolics, flavonoids, and tannins in the *C. laevigatus* extracts, as well as the significant biological outcomes, suggested that additional research on this plant might be done to find novel medications made from natural sources.

5. Conflicts of interest

"There are no conflicts to declare".

6. Acknowledgments

"None"

7. References

[1] Cuttelod A, García N, Malak DA, Temple HJ and Katariya V. (2009). The Mediterranean: a biodiversity hotspot under threat. Wildlife in a Changing World–an analysis of the 2008 IUCN Red List of Threatened Species, 89.

[2] Zahran MA and El-Amier YA. (2013). Non-traditional fodders from the halophytic vegetation of the deltaic Mediterranean coastal desert, Egypt. Journal of Biological Science, 13(4), 226-233.

[3] El-Amier YA and Abdulkader OM. (2015). Vegetation and species diversity in the Northern sector of Eastern Desert, Egypt. West African Journal of Applied Ecology, 23(1), 75-95.

[4] El-Zeiny A, Elagami SA, Nour-Eldin H, El-Halawany ESF, Bonanomi G, Abd-ElGawad AM, Soufan W and El-Amier YA. (2022). Wild Plant Habitat Characterization in the Last Two Decades in the Nile Delta Coastal Region of Egypt. Agriculture, 12(1), p.108.

[5] El-Amier YA, El-Halawany EF and Abdullah TJ. (2014). Composition and diversity of plant communities in sand formations along the northern coast of the Nile Delta in Egypt. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 5(4), 826-847.

[6] Zahran MA and Willis AJ. (2009). The Vegetation of Egypt. 2nd ed. Springer. Netherlands.

[7] Abd-ElGawad AM, Elshamy AI, Al-Rowaily SL and El-Amier YA. (2019). Habitat affects the chemical profile, allelopathy, and antioxidant properties of essential oils and phenolic enriched extracts of the invasive plant *Heliotropium curassavicum*. Plants, 8(11), p.482.

[8] Razak F, Anand SS, Shannon H, Vuksan V, Davis B, Jacobs R, Teo KK, McQueen M and Yusuf S. (2007). Defining obesity cut points in a multiethnic population. Circulation, 115(16), p.2111-2118.

[9] Abd El-Gawad AM, El-Amier YA and Bonanomi G. (2018). Essential oil composition, antioxidant and allelopathic activities of *Cleome droserifolia* (Forssk.) Delile. Chemistry & biodiversity, 15(12), pe1800392.

[10] Sibanda T and Okoh AI. (2007). The challenges of overcoming antibiotic resistance: Plant extracts as potential sources of antimicrobial and resistance modifying agents. African Journal of Biotechnology, 6(25), 2886-2896.

[11] Lee TY and Tseng YH. (2020). The Potential of Phytochemicals in Oral Cancer Prevention and Therapy: A Review of the Evidence. Biomolecules, 10(8), 1150-1180.

[12] Muasya AM, Simpson DA, Chase MW, and Culham A. (1998). An assessment of the suprageneric phylogeny in Cyperaceae using rbcL DNA sequences. Plant Systematics and Evolution, 211, 257-271.

[13] Govaerts R, Simpson DA, Goetghebeur P, Wilson K, Egorova T, and Bruhl JJ. (2007) World checklist of Cyperaceae. The Board of Trusteeds of the Royal Botanic Gardens, Kew. Available at http://www.kew.org/wcsp/monocots/ , Accessed on 1 October 2007.

[14] Boulos L. (2005). Flora of Egypt, vol. 4, All Hadara Publishing, Cairo, Egypt.

[15] Farrag ARH, Abdallah HMI, Khattab AR, Elshamy AI, Gendy A, Mohamed TA, Farag MA, Efferth T and Hegazy MF. (2019). Antiulcer activity of Cyperus alternifolius in relation to its UPLC-MS metabolite fingerprint: A mechanistic study. Phytomedicine, 62, 152970.

[16] Boulos L. (1983). Medicinal Plants of North Africa. Reference Publication Algonac, Michigan.

[17] Vilhena KS, Guilhon GMSP, Zoghbi MDGB, Santos LS and Souza Filho APS. (2014). Chemical investigation of *Cyperus distans* L. and inhibitory activity of scabequinone in seed germination and seedling growth bioassays. Natural Product Research, 28(23), p.2128-2133.

[18] Thebtaranonth C, Thebtaranonth Y, Wanauppathamkul S and Yuthavong Y. (1995). Antimalarial sesquiterpenes from tubers of *Cyperus rotundus*: Structure of 10, 12-peroxycalamenene, a sesquiterpene endoperoxide. Phytochemistry, 40, 125–128.

[19] Kumar SS and Mishra S. (2005). Hepatoprotective activity of rhizomes of Cyperus rotundus Linn against carbon tetrachloride-induced hepatotoxicity. Indian Journal of Pharmaceutical Sciences, 67, 84–88.

[20] Raut NA and Gaikwad NJ. (2006). Antidiabetic activity of hydro-ethanolic extract of *Cyperus rotundus* in alloxan induced diabetes in rats. Fitoterapia, 77, 585–588.

[21] Kumar KH, Razack S, Nallamuthu I and Khanum F. (2014). Phytochemical analysis and biological properties of *Cyperus rotundus* L. Ind. Crops Prod, 52, 815–826.

[22] Sharma A, Verma R and Ramteke P. (2014). *Cyperus rotundus*: a potential novel source of

therapeutic compound against urinary tract pathogens. Journal of Herbal Medicine, 4, 74-82.

[23] Seabra RM, Silva AMS, Andrade PB and Manuela Moreira M. (1998). Methylaurones from *Cyperus capitatus*. Phytochemistry, 48, 1429–1432.

[24] Nassar MI, Abdel-Razik AF, El-Khrisy EEDA, Dawidar AAM, Bystrom A and Mabry TJ. (2002). A benzoquinone and flavonoids from *Cyperus alopecuroides*. Phytochemistry, 60, 385–387.

[25] Xu Y, Zhang HW, Yu CY, Lu Y, Chang Y and Zou ZM. (2008). Norcyperone, a novel skeleton norsesquiterpene from *Cyperus rotundus* L. Molecules, 13(10), p.2474-2481.

[26] Nassar MI, Yassine YM, Elshamy AI, El-Beih AA, El-Shazly M and Singab ANB. (2015). Essential oil and antimicrobial activity of aerial parts of *Cyperus leavigatus* L. (Family: Cyperaceae). Journal of Essential Oil Bearing Plants, 18, 416–422.

[27] Gamal M, Hani KM, Sameh ES and Sabrin IR. (2015). A review: Compounds isolated from Cyperus species (Part I): Phenolics and nitrogenous. Journal of Pharmacognosy and Phytochemistry, 7, 51–67.

[28] Elshamy AI, El-Shazly M, Yassine YM, El-Bana MA, Farrag AR, Nassar MI, Singab AN, Noji M, and Umeyama A. (2017). Phenolic constituents, anti-inflammatory and antidiabetic activities of *Cyperus laevigatus* L. Pharmacognosy Journal, 9, 828–833.

[29] Abdel-Razik AF, Nassar MI, El-Khrisy EDA, Dawidar AAM and Mabry TJ. (2005). New prenylflavans from Cyperus conglomeratus. Fitoterapia, 76, 762–764.

[30] Terry, P.J., 1976. Sedge Weeds of East Africa: I. Identification. East African Agricultural and Forestry Journal, 42(2), pp.231-249.

[31] Täckholm V. (1974). Students Flora of Egypt. 2nd ed. Cairo. Univ. Press, Egypt.

[32] Boulos L. (1999). Flora of Egypt. Vols. 2, All Hadara Publishing, Cairo, Egypt.

[33] Souza MM, Silva BD, Costa CS, Badiale-Furlong E. (2018). Free phenolic compounds extraction from Brazilian halophytes, soybean and rice bran by ultrasound-assisted and orbital shaker methods Anais da Academia Brasileira de Ciências, 90, 3363-3372.

[34] Wolfe K, Wu X, Liu RH. (2003). Antioxidant activity of apple peels Journal of agricultural and food chemistry, 51, 609-614.

[35] Zhishen J, Mengcheng T and Jianming W. (1999). The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals Food chemistry, 64, 555-559.

[36] Burlingame B. (2000). Wild nutrition Journal of Food Composition and Analysis, 13, 99-100.

[37] Aberoumand A. (2009). Nutritional evaluation of edible Portulaca oleracia as plant food Food Analytical Methods, 2, 204-207.

[38] Miguel MG. (2010). Antioxidant activity of medicinal and aromatic plants. A review, Flavour and Fragrance Journal, 25, 291–312.

[39] Cappuccino JG and Sherman N. (2008). Microbiology-A Laboratory Manual, 8th edn. 1301 Sansome St. San Francisco, CA. 94111.

[40] Thomford NE, Senthebane DA, Rowe A, Munro D, Seele P, Maroyi A and Dzobo K. (2018). Natural products for drug discovery in the 21st century: innovations for novel drug discovery. International journal of molecular sciences, 19, 1578.

[41] El-Amier YA, Soufan W, Almutairi KF, Zaghloul NS and Abd-ElGawad AM. (2021). Proximate composition, bioactive compounds, and antioxidant potential of wild halophytes grown in coastal salt marsh habitats. Molecules, 27, 28.

[42] Fu R, Zhang YT, Guo YR, Huang QL, Peng T, Xu Y, Tang L and Chen F. (2013). Antioxidant and anti-inflammatory activities of the phenolic extracts of *Sapium sebiferum* (L.) Roxb. leaves Journal of ethnopharmacology, 147, 517-524.

[43] Manickam M, Ramanathan M, Farboodniay Jahromi M, Chansouria J and Ray A. (1997). Antihyperglycemic activity of phenolics from Pterocarpus marsupium Journal of natural products, 60, 609-610.

[44] Liu X, Zhao M, Wu K, Chai X, Yu H, Tao Z, and Wang J. (2012). Immunomodulatory and anticancer activities of phenolics from emblica fruit (*Phyllanthus emblica* L.) Food Chemistry, 131, 685-690.

[45] Liu W, Yin D, Li N, Hou X, Wang D, Li D and Liu J. (2016). Influence of environmental factors on the active substance production and antioxidant activity in *Potentilla fruticosa* L.

and its quality assessment. Scientific reports, 6(1), p.1-18.

[46] Sultan MS, Elsayed A and El-Amier YA. (2022). In vitro effect of plant parts extract of *Senecio glaucus* L. On pathogenic bacteria. Biointerface Research in Applied Chemistry, 12, p.3800-3810.

[47] Suseela V. (2019). Potential roles of plant biochemistry in mediating ecosystem responses to warming and drought. In Ecosystem consequences of soil warming, Academic Press, p. 103-124.

[48] Scalbert A. (1991). Antimicrobial properties of tannins Phytochemistry, 30, 3875-3883.

[49] Elshamy AI, Farrag ARH, Ayoub IM, Mahdy KA, Taher RF, Gendy AENGE, Mohamed TA, Al-Rejaie SS, El-Amier YA, Abd-EIGawad AM and Farag MA, (2020). UPLC-qTOF-MS phytochemical profile and antiulcer potential of *Cyperus conglomeratus* Rottb. alcoholic extract. Molecules, 25(18), p.4234.

[50] El-Amier YA, Abdelghany AM and Abed Zaid A. (2014). Green synthesis and antimicrobial activity of *Senecio glaucus*-Mediated silver nanoparticles. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 5(5), p.631-642.

[51] Al-Rowaily SL, Abd-ElGawad AM, Alghanem SM, Al-Taisan WAA and El-Amier YA. (2019). Nutritional value, mineral composition, secondary metabolites, and antioxidant activity of some wild geophyte sedges and grasses. Plants, 8(12), p.569.

[52] Abd-ElGawad AM, El-Amier YA, Assaeed AM and Al-Rowaily SL. (2020). Interspecific variations in the habitats of *Reichardia tingitana* (L.) Roth leading to changes in its bioactive constituents and allelopathic activity. Saudi Journal of Biological Sciences, 27(1), p.489-499.

[53] Assimopoulou AN, Sinakos Z and Papageorgiou V. (2005). Radical scavenging activity of *Crocus sativus* L. extract and its bioactive constituents. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives, 19(11), p.997-1000.

[54] Al-Snafi AE. (2019). The medical benefit of Gnaphalium luteoalbum-A review IOSR Journal of pharmacy, 9, 40-44.

[55] Salama SA, Al-Faifi ZE, Masood MF and El-Amier YA. (2022). Investigation and Biological Assessment of *Rumex vesicarius* L. Extract: Characterization of the Chemical Components and Antioxidant, Antimicrobial, Cytotoxic, and Anti-Dengue Vector Activity. Molecules, 27(10), p.3177.

[56] Sytaová I, Orsavová J, Snopek L, Mlek J and Miurcová L. (2019). Impact of phenolic compounds and vitamins C and E on antioxidant activity of sea buckthorn (*Hippopha rhamnoides* L.) berries and leaves of diverse ripening times. Food Chemistry, 310, p. 125784.

[57] Prakash N and Ragavan B. (2009). Phytochemical observation and antibacterial activity of *Cyperus esculentus* L. Ancient Science of Life, 28(4), p.16.

[58] Karzan K, Shnawa B and Gorony S. (2017). Antimicrobial activity of *Cyperus rotundus* Linn. Extracts and phytochemical screening. Eurasian Journal of Science and Engineering, 312, p.82.

[59] El-Wakil EA, Morsi EA and Abel-Hady H. (2019). Phytochemical Screening, Antimicrobial Evaluation and Gc-Ms Analysis of *Cyperus Rotundus*. world journal pharmacy and pharmaceutical science, 8(9), p.129-139.

[60] Abdel-Sattar E, Harraz FM and El Gayed SH. (2008). Antimicrobial activity of extracts of some plants collected from the Kingdom of Saudi Arabia. Journal of King Abdulaziz University-Medical Sciences, 15(1), p.25-33.

[61] Hafaz MF, Soliman HM, Abbas MA, Gebreil AS and El-Amier YA. (2022). Potential Assessment of *Rumex* spp. as a source of bioactive compounds and biological activity. Biointerface Research in Applied Chemistry, 12, p.1824-1834.

[62] Joshi GV, Patel HA, Kevadiya BD and Bajaj HC. (2009). Montmorillonite intercalated with vitamin B1 as drug carrier. Applied Clay Science, 45(4), 248-253.

[63] Karahan F, Avsar C, Ozyigit II and Berber I. (2016). Antimicrobial and antioxidant activities of medicinal plant Glycyrrhiza glabra var. glandulifera from different habitats. Biotechnology & Biotechnological Equipment, 30(4), p.797-804.