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Phytochemical Screening on *Deverra tortuosa* (Desf.) DC. Collected from Different Habitats in Egypt

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DEVERRA tortuosa is a dominant woody perennial shrub (family Apiaceae). It spreads in arid regions characterized by strong climatic changes that affect production of bioactive natural products. In Egypt, it is widespread on the North-Western Coast and Western and Eastern deserts. It is used in folk medicine and as fuelwood by local inhabitants. In the present study, qualitative and quantitative tests were performed to investigate the main chemical constituents (primary and secondary metabolites) of *D. tortuosa* collected from 17 locations representing seven different habitats. The study also aims to clarify the effect of several environmental conditions on the main biochemical components of the plant. In the present study, *D. tortuosa* grew in adverse environments, particularly in summer, which improved the production and accumulation of some antioxidant compounds, including tannins, alkaloids, cardiac glycosides, flavonoids, saponins, phenols, carbohydrates, proteins, and lipids. *D. tortuosa* produced a high content of total carbohydrates (32.18% in salt marshes, which recorded the highest EC,0.54mS/cm), crude protein (19.88% in sand flats), total alkaloids (111.5mg/g on roadsides, which also recorded the lowest content of organic carbon, 0.16%), total tannins and flavonoids (17.76 and 73.56mg/g, respectively in fig fields, which were characterized by high soil pH, 7.8). Therefore, *D. tortuosa* shrubs preferred an arid environment and can be considered a new source of several different metabolites that can contribute to drug improvement. In addition, the study provides insight into unusual strategies to increase the efficiency of wild plants for accumulation of phytochemicals.

Keywords: Arid habitats, *Deverra tortuosa*, Primary and secondary metabolites.

Introduction

Secondary metabolites aid plants in adapting to their environments (Nugroho & Verpoorte, 2002). Environmental stresses, including water deficit, heat/cold, and mineral deficiencies, substantially affect the quantity and quality of secondary metabolite production and concentration in plants (Dixon, 2001; Amdoun et al., 2009).

Deserts have several benefits that meet the needs of local citizens and those in adjacent communities. These benefits include water, food, medicines, and industrial raw materials, but deserts are overlooked in most ecosystem assessment studies (El-Alfi et al., 2019).

Medicinal plants contain various chemical substances called secondary metabolites that are used totreat human diseases. Secondary metabolites may be alkaloids, flavonoids, sesquiterpenes, lactones, diterpenes, triterpenes, naphthoquinones, anthocyanin, coumarin, catechins, isocatechins, and others (Christaki et al., 2012; Chhetri et al., 2015).

Deverra tortuosa belongs to the family Apiaceae (Umbelliferae), one of the largest families of flowering plants, containing 300 - 450 genera and 3000 - 3700 species (Täckholm, 1974), some of which are used as a human food source and/or for medicinal purposes (Singh & Jain, 2007). Apiaceae's plants produce high

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amounts of secondary metabolites like flavonoids, essential oils, terpenes, and coumarins, and so they have economic and medicinal importance (Mohamed & Abdu, 2004). Monoterpenes, sesquiterpenes, and phenyl components and related resins are produced in different plant organs such as secrartory ducts, roots, stems, leaves, flowers, seeds, or fruits (Sodeifian & Ansari, 2011).

The genus *Deverra* is a wild-growing desert shrub, represented in Egypt by two species: *D. tortuosa* (Desf.) DC. Benth and Hook (*Pituranthos tortuosus*). (Desf.). DC. and *D. triradiatu*s (Hochst.) Asch. *D. tortuosa* is known in Arabic as " Shabat El-Gabal ". It spreads in almost all the phytogeographical regions of Egypt, mainly in desert wadis and sandy and stony plains (Täckholm, 1974; Boulos, 2002). It is a strong aromatic, glabrous shrub, with dichotomously branched stems, and striated caduceus leaves (Bolous, 2009). It is highly edible by livestock, especially camels, and is an important range plant during summer. The tender branches and leaves are also used as a condiment and to treat asthma and intestinal cramps (El-Seedi et al., 2013).

Traditionally, *D. tortuosa* was used in Egypt as a carminative, diuretic, and analgesic in the treatment of stomach pain and against intestinal parasites (Mahran et al., 1989). In Tunisia, it was used as an antiasthmatic and against scorpion stings (Boukef et al., 1982).

Many researchers such as Ahmed et al. (1969), Mahran et al. (1989), and ElMosallamy et al. (2020) have identified many important bioactive phytochemicals such as flavonoids, glycosides, essential oils, coumarins, and unsaturated sterols in different parts of *D. tortuosa*. Secondary metabolites such as terpenes, alkaloids, flavonoids, phenols, and tannins have a vital role in plant protection against herbivores and regulate the relationship between plants and other plants by allelopathic action (Kovačević, 2002).

Hence, the present study aimed to identify the main chemical constituents of *D. tortuosa* collected from 17 different locations representing seven different habitats in Egypt and to clarify the effect of environment on the main biochemical components of this species.

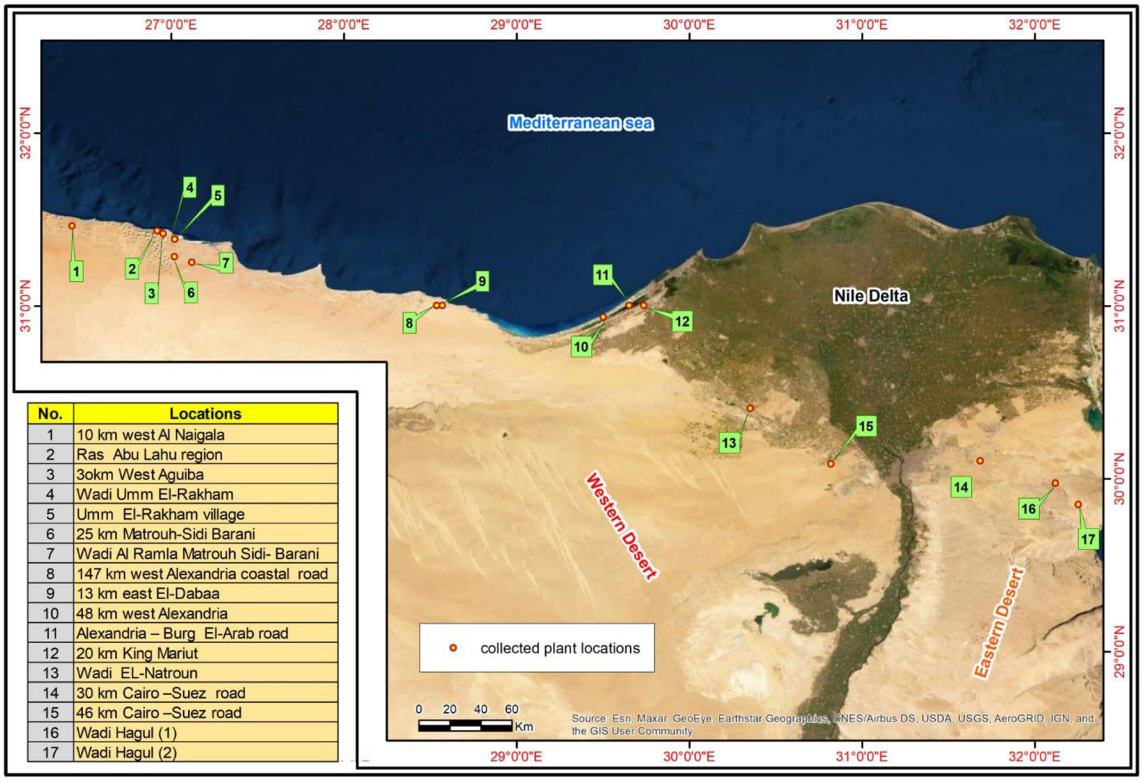
Materials and Methods

Soil analysis

Three merged soil samples were collected from profiles of 0–50cm from each studied location. Soil samples were mechanically analyzed to determine particle size using the sieves method (Jackson, 1967; Piper, 1950). Soil water extracts (1:5, *w/v*) were prepared, and soil salinity ($mScm^{-1}$) was determinede using an electrical conductivity meter (60 Sensor Operating Instruction Corning) according to Rowell (1994). Soil reaction was determined using a pH meter (Model 9107 BNORION type) according to Brower & Zar (1984). Soil moisture content was determined according to Rowell (1994) by putting 100 g of soil in a dry tin cup of known weight, weighting again, and then placing the cup and contents in an oven at 105^0C for 24h. The samples were left to cool and then weighted again. The nitrogen percentage was determined using the Kjeldahl method (James, 1995). The organic carbon percentage was determined using ferrous ammonium sulfate (Tinsley, 1950). The percentages of Na^+ and K^+ were determined using a flame photometer (PFP7, Genway) (Rowell, 1994). Simultaneously, Mg^{2+} and Ca^{2+} contents were determined using Inductivity Coupled Spectrometry Plasma (Ultima2-Jobin Yvon) according to Xiandeng & Bradley (2000). Phosphorous content was determined using a spectrophotometer (Metertek sP-850) according to Allen (1989). The percentages of chloride (Cl^-) and total carbonates (CO_3^{2-}) were determined according to Jackson (1967), and soluble bicarbonate (HCO_3^-) content was determined according to Rowell (1994). Sulfate content was determined using the turbidity method and spectrophotometry (Metertek sP - 850) according to Johnson & Nishita (1952).

Plant collection

D. tortuosa samples were collected during the flowering and fruiting stages in the spring of 2015 and 2016 from 17 different locations along the North-Western Coast and Western and Eastern deserts, representing seven different habitats (sand dunes, sand flats, salt marshes, wadi slope, wadi bed, roadsides, and cultivated lands) (Fig.1 and Table 1). The aerial parts were separated, cleaned, dried in the shade at room temperature, and then ground into a fine powder using an electric blender. The powdered samples were kept in well-sealed bags for subsequent chemical analyses.



No.	Locations
1	10 km west Al Naigala
2	Ras Abu Lahu region
3	3okm West Aguiba
4	Wadi Umm El-Rakham
5	Umm El-Rakham village
6	25 km Matrouh-Sidi Barani
7	Wadi Al Ramla Matrouh Sidi- Barani
8	147 km west Alexandria coastal road
9	13 km east El-Dabaa
10	48 km west Alexandria
11	Alexandria – Burg El-Arab road
12	20 km King Mariut
13	Wadi EL-Natroun
14	30 km Cairo –Suez road
15	46 km Cairo –Suez road
16	Wadi Hagul (1)
17	Wadi Hagul (2)

Fig. 1. Map showing locations of the collected plant.

TABLE 1. Localities, habitats and GPS data of collected *Deverra tortuosa* (Desf.) DC. in Egypt

No.	Locality	Habitat	GPS data
1	10km west Al Naigala Matrouh –Sallum road	Fig fields	N 31 27 449, E 26 25 323, Alt: 86m
2	Ras Abu Lahu region	Sand flats	N 31 26 346, E 26 55 649, Alt: 18m
3	Ras Abu Lahu, 3okm West Ageba	Fig fields	N 31 25755, E 2657 839, Alt: 37m
4	Wadi Umm El-Rakham	Wadi slopes	N 31 23 919, E 27 01 102, Alt:18m
5	Umm El-Rakham village	Olive fields	N 31 23 969, E 27 01910, Alt: 3m
6	25km Matrouh-Sidi Barani	Barley fields	N 31 17 300, E 27 01 571, Alt: 151m
7	*Wadi Al Ramla Matrouh Sidi-Barani*	Roadsides	N 31 15 972, E 27 07 893, Alt: 120m
8	147km west Alexandria coastal road	Fig fields	N 31 00 905, E 28 33 573, Alt: 12m
9	Alexandria-Matrouh coastal–road, 13km east El-Dabaa	Fig fields	N 31 00 895, E 28 34 707, Alt: 22m
10	48km west Alexandria	Sand dunes	N 30 56 543, E 29 30 113, Alt: 20m
11	Alexandria – Burg ElArab road	Salt marshes	N 31 00 631, E 29 39 200, Alt: 2m
12	20km King Mariut - Burg AlArab road	Salt marshes	N 31 00 725, E 29 44 947, Alt: 34m
13	Wadi EL-Natroun- Cairo-Alexandria desert road	Sand flats	N 30 24 231, E 30 21 872, Alt: 49m
14	30km Cairo –Suez road	Sand flats	N 30 06 538, E 31 41 118, Alt: 237m
15	46km Cairo –Suez road	Sand flats	N 30 05 773, E 31 49 896, Alt: 230m
16	Wadi Hagul (1)	Wadi bed	N 29 58 261, E 32 07 991, Alt: 325m
17	Wadi Hagul (2)	Wadi bed	N 29 51 285, E 32 15 379, Alt: 167m

Preliminary phytochemical screening

Qualitative chemical tests for the presence of alkaloids, saponins, phenols, tannins, flavonoids, and cardiac glycosides were performed on the aqueous and alcohol (ethanol or methanol) extracts of the powdered specimens of *D. tortuosa* according to the standard procedures described by Makkar et al. (1993).

Alkaloids were detected by mixing 0.5mL methanol extract with 8mL of 1% HCl heating gently, and filtering. Two milliliters of the filtrate was then treated independently with both reagents (Maeyers and Dragendorffs). The formation of turbidity and/or precipitate indicated the presence of alkaloids (Harborne, 1973).

Saponins were detected out according to Majab et al. (2002), by boiling 0.5g plant powder in 20mL distilled water, filtering and mixing 1mL filtrate with 5mL distilled water, and shaking vigorously until a stable, persistent froth formed. Samples were allowed to stand for 10-15min.

Phenols were detected by adding 2 ml ethanol extract to 1 ml potassium ferrocyanide (1%) and 1mL ferric chloride (1%). Samples turned blue when phenols were present (Harborne, 1984).

Tannins were detected by adding a few drops of 0.1% ferric chloride to an aqueous plant extract. The appearance of a brownish-green or blue-black color indicated the presence of tannins (Edeoga et al., 2005).

Flavonoids were detected according to Harborne (1973) and Sofowara (1993) by adding 5mL of diluted ammonia solution (10%) to 10mL ethanol extract and then adding a few drops of concentrated H_2SO_4. The appearance of yellow color indicated the presence of flavonoids.

Cardiac glycosides were detected by mixing 0.5mL of a concentrated solution of lead acetate with ethanol extract of the plant, adding sulphuric acid (10%) drop-wise until no further precipitate was formed, filtering, and then performing Keller-Killani's test according to Balbaa (1986).

Primary metabolite

Total carbohydrates

Total carbohydrates were determined according to Sadasivam & Manickam (1992) using the anthrone method.

Extraction: Plant powder (0.1g) was hydrolyzed with 5mL of 2.5N HCl in a boiling water bath for 3h. The mixture was then left to cool and neutralized with sodium carbonate (Na_2CO_3) until the effervescence was completed. Subsequently, sample volume was adjusted to 100mL with distilled water and then centrifuged.

Estimation of total carbohydrates: Of the plant extract, 0.1mL was put in a test tube, and then the volume was adjusted to 1mL with distilled water. The tubes were dipped in an ice bath, and then 4mL of cold anthrone reagent was added. The tubes were then placed in a boiling water bath for 8 min, and then cooled quickly, and the green color produced was measured at 630nm using a spectrophotometer (Metertek sP-850).

Soluble carbohydrates

Soluble carbohydrates were determined according to Deriaz (1961). Dry plant powder (5g) was extracted by adding 50mL distilled water, heating gently on a hot plate for 2h, adjusting the volume to 50mL with distilled water, cooling slightly, filtering, and adjusting to a final volume of 100mL with distilled water. Soluble carbohydrates were estimated by the anthrone assay (Sadasivam & Manickam, 1992).

Insoluble carbohydrates

Insoluble carbohydrates were determined by subtracting the soluble carbohydrates from total carbohydrates.

Crude protein

The percentage of crude protein was calculated using the following equation: Crude protein (%)= N (%) ×6.25, where N is the nitrogen content of the plant samples (James, 1995).

Total lipid analysis

The percentage of total lipids was determined as described by Christie (1982). Plant powder (10g) was extracted with petroleum ether (b.p. 40-60%): ether (1:1) for 24h using the soxhlet apparatus. A rotary evaporator was used to obtain the lipids by evaporating the solvent. The last traces of solvent were removed by heating the liquid sample in a vacuum oven at 50°C until constant weight was obtained. Lipid content was then calculated as follows:

Lipids content (%)= Weight of lipids/ Weight of plant sample (g) ×100

Secondary metabolites

Total alkaloids

Total alkaloids were determined according to Harborne (1973). Plant powder (1g) was extracted several times using 4:1 (v/v) 70% ethyl alcohol and glacial acetic acid. The mixture was left to stand for 6h, with intermittent shaking and then filtered. Alkaloids were precipitated by drop-wise in the collected supernatents by adding concentrated ammonia solution until precipitation was complete. The whole solution was left to settle, and the precipitated alkaloids were filtered using pre-weighed filter paper (Whatman 102), which had been previously moistened with diluted ammonia solution and dried. After filtration, alkaloids were dried in an oven at 60^0C until reaching a constant weight. Alkaloid content was calculated and expressed as mg/g dry weight of the plant sample.

Saponins

Saponin content was determined by the diosgenin standard solution using vanillin reagent according to Francis et al. (2002). Plant powder (0.1g) was extracted two times, each for 24h by 95% ethyl alcohol. The clear supernatants were collected and adjusted to a known volume. The extract (0.5mL) was then mixed with 5mL of 8% vanillin in ethyl alcohol, placed in an ice bath, mixed with 5mL of 72% H_2SO^4, heated to 60^0C in a water bath for 10min, and finally cooled in an ice bath. The color produced was measured at 544 nm using a spectrophotometer (Metertek sP-850).

Total phenolic compounds

Extraction was performed in triplicate mixing 0.1g dry powdered plant material with 5mL 95% ethyl alcohol and then filtering. The clear supernatants were combined and adjusted to 20mL with 95% ethyl alcohol. The extract (1mL) was then mixed with 1 ml folin ciocalteau reagent and 1 ml sodium carbonate solution (20% w/v), and the mixture was adjusted to a definid volume with distilled water. The tubes were then incubated in the dark for color appearance, and measured at 650nm using a spectrophotometer (Metertek sP-850) after exactly 30min (Jindal & Singh, 1975).

Tannins

Two samples were prepared by boiling 1g plant powder for 1h with 100mL acetone: water (1:1) and then filtering. The collected extracts were adjusted to a definid volume with distilled water and heated until boiling. Of 15% aqueous solution from copper acetate, 30mL was then added with shaking. The precipitate composed of copper tannate, was collected on ashless filter paper and washed with distilled water several times. The ashless filter paper containing the precipitate was then ignited in a pre-weighed porcelain crucible at 550^0C for 3h. A few drops of HNO_3 were added to the residue, and then the sample was reignited until a constant weight was obtained. The weight of the copper oxide was determined and tannin content was calculated by the following equation according to Ali (1991).

1g copper oxide= 1.305g tannins.

Flavonoids

Total flavonoids were investigated using the aluminum chloride colorimetric method described by Chang et al. (2002). Plant powder (0.1g) was extracted with 80% ethyl alcohol, and filtered. Of the extract, 0.5mL was then mixed with 1.5mL 95% ethyl alcohol, 0.1mL 10% aluminum chloride, 0.1mL 1M potassium acetate and 2.8mL of distilled water. The extract was then left at room temperature for 30min, after which the appearance of color was measured at 415nm using a spectrophotometer (Metertek sP-850).

Cardiac glycosides

Cardiac glycoside content was measured using Buljet‘s reagent as described by Solich et al. (1992). Plant powder (0.1g) was extracted using 80% ethyl alcohol and then filtered. The filtrate (0.5mL) was mixed with 10mL freshly prepared Baljet’s reagent (95mL of 1% picric acid+ 5mL of 10% NaOH). After an hour, the mixture was diluted with 20mL distilled water, and the produced color was measured at 495nm using a spectrophotometer (Metertek sP-850).

Statistical analysis

One-way analysis of variance (ANOVA-1) was used to determine the significant variation in concentration of the analyzed metabolites for the plant tissue collected from different locations and soil properties for each location using SPSS software. Duncan’s test was used to determine the internal significance between variables (SPSS, 2006).

Results

Soil analysis

All studied soil parameters except for K

content were significantly different (P≤ 0.001) between habitats (Table 2). All habitats had a high proportion of sand; the highest was in dunes (98.9%) and the lowest was in wadi beds (69.64%). Gravel was the second most predominant component except in wadi slopes, roadsides, and cultivated lands. The highest gravel percentage was in wadi beds (24.27%), while the lowest was in dunes (0.86%). In addition, silt and clay were most abundant in cultivated lands (9.11%) and lowest in dunes (0.72%).

Sand dunes had the highest bicarbonate values (8.6mg 100^{-1}) and the lowest pH (7.5), EC (0.2ms/cm), K^+ (0.01mg 100 g^{-1}), Mg^{2+} (2.5mg 100 g^{-1}), SO_4^{2-} (0.014mg $100g^{-1}$) and Cl^- (0.3mg 100 g^{-1}) values. Sand flats had the highest P^{3+} (0.22mg 100 g^{-1}) and SO_4^{2-} (0.05mg 100 g^{-1}) contents and low total carbonate (4.5mg 100 g^{-1}) content. Salt marshes had the highest EC (0.54ms/cm), and Mg^{2+} (5.5mg 100 g^{-1}), and lower pH (7.5) and moisture content (0.58%). Wadi slopes had the highest organic carbon percentage (0.6%) and total CO_3^{2-} (5.65mg 100 g^{-1}), but lower Ca^{2+} (1.8mg 100 g^{-1}) and SO_4^{2-} (0.014mg 100 g^{-1}) contents. Wadi beds had the highest moisture percentage (6.23%) and Ca^{2+} (3.3mg 100 g^{-1}) content, but lower N^{2+} (0.02 %), Na^+ (0.035mg 100 g^{-1}), P^{3+} (0.03mg $100g^{-1}$) and SO_4^{2-} (0.014mg 100 g^{-1}). Road sides had the highest N^{2+} (0.23%) and Cl^- (1.0mg 100 g^{-1}), but lower O.C (0.16%) and HCO_3^- (3.5mg 100 g^{-1}). Finally, cultivated lands had the highest pH (7.8), Na^+ (4.2mg 100 g^{-1}) and K^+ (0.21mg $100g^{-1}$) values (Table 2).

Preliminary phytochemical screening

Preliminary phytochemical screening of aerial parts from *D. tortuosa* showed the presence of alkaloids, saponins, phenolic compounds, tannins, flavonoids, cardiac glycosides, carbohydrates, lipids, and crude protein (Table 3).

Carbohydrates, proteins and lipid analysis

Total carbohydrates, soluble carbohydrates, insoluble carbohydrates**,** crude protein, and total lipid content of the aerial parts of *D. tortuosa* are shown in Table 4. All parameters had significant differences (P< 0.001) between different habitats.

The mean percentage of total carbohydrates in the aerial parts of *D. tortuosa* varied between 16.5 and 32.18% for samples collected from Wadi Hagul (2) (wadi bed) and Alexandria Burg ELArab Road (salt marsh), respectively. The mean percentage of soluble carbohydrates in the aerial parts varied between 3.32 and 13.08% in plant samples collected from Wadi Hagul (2) and the Ras Abu Lahu region, representing wadi bed and sand flat habitats, respectively. The mean percentage of insoluble carbohydrates varied between 11.33 and 28.75% in plant samples collected from 13 km east of El-Dabaa and Alexandria - Burg EL-Arab representing cultivated land and salt marsh habitats, respectively.

The mean percentage of crude protein varied between 3.12 and 19.88% for plant samples collected from Wadi Hagul (1) and the Ras Abu Lahu region, representing wadi bed and sand flat habitats, respectively. The mean percentage of total lipids varied between 5.64 and 11.12% for plant samples collected from Alexandria Burg EL-Arab Road and the Ras Abu Lahu region, representing salt marsh and sand flat habitats, respectively.

Quantitative investigation of secondary metabolites

The amount of alkaloids, saponins, phenolic compounds, tannins, flavonoids, and cardiac glycosides present in the aerial parts of *D. tortuosa* was determined quantitatively from samples collected from different habitats (Table 5). All parameters revealed significant differences (P< 0.001) at different locations.

Total alkaloids varied between 40.93 and 111.5mg/g for plant samples collected from Wadi Hagul (1) and Wadi AL-Ramla Matrouh–Sidi Barani representing wadi bed and roadside habitats, respectively. Total saponins varied between 6.09 and 64.08mg /g for plant samples collected from Wadi AL-Ramla Matrouh Sidi Barani and Wadi Hagul (2), representing roadside and wadi bed habitats, respectively.

Total phenolic concentration varied between 3.44 and 9.08mg /g for plant samples collected from Wadi Hagul (1) and Alexandria Burg EL-Arab Road representing wadi bed and sand flat habitats, respectively. Total tannins varied between 5.29 and 17.76mg/g for plant samples collected from 147km west of the Alexandria coastal road and 30km west of Agiba, respectively, both of which are cultivated habitats.

TABLE 2. Soil characteristics supporting growth of *Deverra tortuosa* (Desf.) DC. collected from different habitats in Egypt (Mean±SE)

Soil characters		Habitat							F- value
		Sand dunes	Sand flats	Salt marshes	Wadi slope	Wadi bed	Road sides	Cultivated lands	
Gravel		0.86 ± 0.10^{e}	5.44 ± 0.57^{c}	11.7 ± 0.81^{b}	4.11 ± 0.24^{d}	24.27 ± 0.69^{a}	5.93 ± 0.31^{c}	5.22±0.56^{c}	123.5
Sand		98.9 ± 0.75^{a}	90.1± 0.86^{b}	80.19 ± 0.5^{d}	89.92 ± 0.69^{c}	69.64 ± 0.56^{e}	90.63 ± 0.45^{b}	85.67 ±0.8^{c}	243.1
Silt+clay		0.72 ± 0.01^{f}	4.34 ± 0.37^{e}	8.1 ± 0.56^{c}	7.14 ± 0.28^{d}	7.59 ± 0.24^{c}	8.44 ± 0.69^{b}	9.11±0.44^{a}	12.3
Moisture	(%)	0.7 ± 0.012^{d}	2.6 ± 0.12^{b}	0.58 ± 0.06^{f}	0.9 ± 0.01^{c}	6.23 ± 0.07^{a}	0.63 ± 0.017^{e}	0.61 ± 0.05^{e}	898.3
N		0.27 ± 0.035^{c}	0.22 ± 0.02^{a}	0.2 ± 0.0034^{b}	0.03 ± 0.00028^{d}	0.02 ± 0.0023^{d}	0.23 ± 0.0086^{a}	0.11 ± 0.0057^{c}	209.1
O.C		0.31 ± 0.023^{d}	0.23 ± 0.0058^{e}	0.44 ± 0.01^{b}	0.6 ± 0.01^{a}	0.37 ± 0.02^{c}	0.16 ± 0.0080^{f}	0.33 ± 0.01^{d}	219.4
pH		7.5 ± 0.0028^{c}	7.64 ± 0.0092^{b}	7.5 ± 0.01^{c}	7.75 ± 0.0086^{a}	7.8 ± 0.0098^{a}	7.54 ± 0.02^{c}	7.8 ± 0.017^{a}	32.3
EC (mS/cm)		0.2 ± 0.00115^{f}	0.42 ± 0.0012^{b}	0.54 ± 0.00057^{a}	0.26 ± 0.000057^{e}	0.2 ± 0.00028^{f}	0.39 ± 0.000057^{c}	0.34 ± 0.00057^{d}	456.2
Na	mg/100g	0.21 ± 0.05^{c}	0.18 ± 0.0029^{cd}	0.39 ± 0.02^{b}	0.15 ± 0.0028^{d}	0.035 ± 0.0034^{e}	0.37 ± 0.0028^{b}	4.2 ± 0.0034^{a}	417.1
K		0.01 ± 0.028^{a}	0.1 ± 0.0029^{ab}	0.06 ± 0.0041^{ab}	0.08 ± 0.004^{b}	0.02±0.0023^{ab}	0.2 ± 0.0028^{ab}	0.21 ± 0.0034^{ab}	1.4
Mg		2.5 ± 0.028^{g}	5.4 ± 0.28^{b}	5.5 ± 0.34^{a}	3.8 ± 0.17^{d}	4.4±0.75^{c}	3.2 ± 0.43^{f}	3.4 ± 0.46^{e}	168.8
Ca		2.3 ± 0.17^{e}	2.8 ± 0.23^{c}	3.2 ± 0.28^{b}	1.8± 0.16 ^{f}	3.3±0.28^{a}	3.0 ± 0.28^{b}	2.5 ± 0.34^{d}	138.2
P		0.04 ±0.00046^{e}	0.22 ± 0.00029^{a}	0.09 ± 0.0023^{d}	0.07 ± 0.00057^{d}	0.03±0.0051^{e}	0.2 ± 0.004^{b}	0.13 ± 0.04^{c}	159.4
Cl		0.3 ± 0.04^{f}	0.7 ± 0.02^{c}	0.9 ± 0.017^{b}	0.6 ± 0.017^{d}	0.4±0.01^{e}	1.0 ± 0.023^{a}	0.7 ± 0.02^{c}	141.6
HCO_3		8.6 ± 0.051^{a}	7.6 ± 0.1^{b}	3.8 ± 0.046^{f}	5.6 ± 0.051^{d}	4.6±0.046^{e}	3.5 ± 0.05^{g}	7.5 ± 0.04^{c}	681.2
CO_3		5.6 ± 0.02^{b}	4.5 ± 0.51^{f}	5.1 ± 0.46^{e}	5.65 ± 0.023^{a}	5.5±0.23^{c}	5.46 ± 0.86^{d}	5.5 ± 0.04^{c}	289.1
SO_4		0.014 ± 0.00012^{e}	0.05 ± 0.000057^{a}	0.031± 0.00057^{b}	0.014 ± 0.00011^{e}	0.014±0.00057^{e}	0.023 ± 0.0011^{c}	0.016±0.00057^{d}	935.7

Maximum and minimum values are underlined.

E.C: Electrical conductivity, and O.C: Organic carbon.

All F-values are significant at P≤ 0.0001 except for K was not significant.

Means in the same line followed by different letters are significantly different at P<0.05 according to Duncan's multiple range test.

TABLE 3. Preliminary phytochemical screening of aerial parts for *Deverra tortuosa* (Desf.) collected from different seventeen localities

Locations	Flavonoids	Tannins	cardiac glycosides	Saponins	Alkaloids	phonlic compounds
10km west AL Naigala	+	+	+	+	+	+
Ras Abu Lahu region	+	+	+	+	+	+
	+	+	+	-	+	+
30km west Aguiba	+	+	+	+	+	+
	+	+	+	+	+	+
Wadi Umm EL-Rakham	+	+	+	+	+	+
	+	+	+	+	+	+
Umm EL-Rakham village	+	+	+	+	+	+
	+	+	+	-	+	+
25km Matrouh – Sidi Barani	+	+	+	+	+	+
	+	+	+	+	+	+
Wadi AL Ramla Matrouh –Sidi Barani	+	+	+	+	+	+
	+	+	+	-	+	+
147km west – Alex coastal road	+	+	+	+	+	+
	+	+	+	+	+	+
13km east El-Dabaa	+	+	+	+	+	+
	+	+	+	+	+	+
48km west Alex	+	+	+	+	+	+
	+	+	+	-	+	+
Alex–Burg EL- Arab road	+	+	+	+	+	+
	+	+	+	+	+	+
20km King Mereout Burg EL-Arab road	+	+	+	+	+	+
	+	+	+	-	+	+
Wadi EL-Natroun	+	+	+	+	+	+
	+	+	+	-	+	+
30km Cairo –Suez road	+	+	+	+	+	+
	+	+	+	-	+	+
46km Cairo –Suez road	+	+	+	+	+	+
	+	+	+	-	+	+
Wadi Hagul (1)	+	+	+	+	+	+
	+	+	+	-	+	+
Wadi Hagul (2)	+	+	+	+	+	+
	+	+	+	-	+	+

+= Presence, -= Absence.

Total flavonoids varied between 10.81 and 73.56mg /g for plant samples collected from Wadi EL-Natroun and 30km west of Ageba (Matrouh), representing sand flat and cultivated land habitats, respectively. Total cardiac glycosides varied between 37.77 and 72.00mg /g for plant samples collected from 25km from Matrouh–Sidi Brann and Alexandria Burg AL-Arab road, representing cultivated land and salt marsh habitats, respectively.

TABLE 4. Primary metabolites (g% dry weight) of aerial parts (Mean ±SD) for *Deverra tortuosa* (Desf.) collected from different locations

Locations	Total carbohydrate	Soluble carbohydrate	Insoluble carbohydrate	Crude protein	Total lipids
10km west ALNaigala	17.91.34±^{ab}	5.131.71±^{abcd}	12.770.59±^{ab}	7.080.09±^{a}	8.740.005±^{a}
Ras Abu Lahu region	26.13.87±^{def}	13.082.30±^{ef}	13.022.15±^{ab}	19.880.06±^{b}	11.120.007±^{b}
30km west Ageba	23.622.11±^{abcde}	3.621.3±^{ab}	20.003.25±^{c}	11.120.06±^{c}	9.360.003±^{c}
Wadi Umm ELRakham	24.333.69±^{bcde}	11.922.81±^{def}	12.420.93±^{ab}	4.180.06±^{ef}	7.650.003±^{d}
Umm ELRakham village	19.451.64±^{abcde}	7.5±0.84^{abcdef}	11.85±0.79^{ab}	3.850.006±^{efg}	7.680.03±^{d}
25km Matrouh – Sidi Barani	18.30.61±^{abc}	4.781.41±^{abc}	13.521.75±^{ab}	4.450.00±^{e}	6.990.003±^{e}
Wadi AL Ramla Matrouh –Sidi Barani	24.12.1±^{bcde}	7.231.99±^{abcde}	16.870.27±^{abc}	7.080.09±^{a}	6.250.01±^{f}
147km west –Alexandria coastal road	26.63.21±d^{ef}	10.41±0.02^{c}	16.19±4.31^{abc}	6.560.06±^{a}	7.590.01±^{g}
13km east El- Dabaa	19.451.64±^{abcd}	8.12±1.55^{abcd}	11.33±1.53^{a}	3.480.04±^{gh}	6.87±0.008^{h}
48km west Alexandria	21.672.68±^{abcde}	8.67±0.00^{abcde}	13.00±3.61^{ab}	3.750.63±^{ghf}	8.120.02±^{i}
Alexandria –Burg ELArab road	32.181.05±^{f}	3.431.31±a	28.750.28±^{d}	3.50.00±^{gh}	5.640.008±^{j}
20km King Mariut –Burg ELArab road	22.384.42±^{abcde}	10.25±2.94^{abcdef}	12.13±1.50^{ab}	4.20.006±^{ef}	7.520.01±^{k}
Wadi ELNatroun	27.82.56±^{ef}	10.132.46±^{abcdef}	17.670.11±^{bc}	3.440.06±^{gh}	7.530.003±^{k}
30km Cairo –Suez road	25.180.55±c^{def}	11.07±1.98^{cdef}	14.12±1.50^{abc}	3.440.06±^{gh}	8.020.01±^{i}
46km Cairo –Suezroad	22.50.00±^{abcde}	8.96±0.96^{abcde}	13.830.96±^{ab}	3.420.09±^{gh}	8.480.01±^{m}
Wadi Hagul (1)	25.80.00±^{def}	10.80±1.005^{cdef}	14.99±1.005^{abc}	3.120.62±^{h}	7.530.005±^{k}
Wadi Hagul (2)	16.52.71±^{a}	3.320.72±^{a}	13.182.09±^{ab}	5.520.06±^{a}	7.290.02±^{n}
F-Value	**8.357**	**14.725**	**13.973**	**1065.97**	**30209.74**

Different letters above mean numbers means significant differences at P< 0.05.

F-Value is mentioned.

* P: P≤0.0001, ns: Not significant

Means in the same line followed by different letters are significantly different at P<0.05 according to Duncan's multiple range test.

TABLE 5. Quantitative analysis of some phytochemical constituents (mg/g) of aerial parts of *Deverra tortusa* (Desf.) collected from different locations (Mean±SD) in Egypt

Locations	Total alkaloids	Total saponin	Total phenolic compouds	Total tannins	Total flavonoids	Total cardiac glycosides
10km west ALNaigala	79.3±0.2^{abc}	36.20±3.88^{abc}	7.21±1.09^{ab}	7.20±0.00^{c}	20.85±3.08^{abc}	39.93±0.35^{a}
Ras Abu Lahu region	90.97±0.06^{c}	47.00±7.27^{cd}	5.5±0.66^{bc}	7.46±26.03^{b}	24.98±6.27^{bc}	61.13±9.80^{ab}
30km west Ageba	87.45±0.25^{bc}	28.89±6.41^{abcef}	7.64±1.08^{ab}	17.76±33.34^{f}	73.56±2.31^{d}	52.7±0.46^{ab}
Wadi Umm ELRakham	87.7±0.00^{bc}	39.64±13.15^{bc}	6.66±0.61^{ab}	16.38±3.28^{cd}	18.06±4.80^{abc}	55.57±11.29^{ab}
Umm ELRakham village	58.43±1.67^{fgh}	17.21±1.87^{aefg}	4.94±1.65^{bc}	14.38±7.54^{e}	12.85±4.71^{ab}	49.86±0.58^{ab}
25km Matrouh – Sidi Barani	65.73±0.06^{fghe}	9.25±0.27^{fg}	6.75±1.75^{ab}	11.59±0.00^{de}	17.56±2.21^{abc}	37.77±17.43^{a}
Wadi AL Ramla Matrouh –Sidi Barani	111.5±0.00^{d}	6.09±2.06^{g}	6.54±0.63^{ab}	11.81±38.12^{cd}	22.27±1.59^{abc}	42.93±6.58^{ab}
147km west –Alexandria coastal road	71.5±0.17^{ae}	17.64±0.02aefg	5.22±0.63^{bc}	5.28±0.13^{a}	12.94±2.13^{ab}	71.00±0.00^{b}
13km east El- Dabaa	56.07±0.25^{h}	29.3±9.99^{abce}	5.39±1.10^{bc}	9.96±0.69^{c}	23.64±9.92^{abc}	39.37±6.09^{a}
48km west Alexandria	77.6±0.17^{aeb}	8.48±0.66^{g}	5.62±0.24^{bc}	16.82±19.8^{f1}	12.73±5.88^{ab}	66.87±6.21^{ab}
Alex –Burg EL Arab road	68.83±0.15^{aefg}	36.93±0.62^{abc}	9.08±0.71^{a}	7.20±0.00^{cd}	63.14±1.65^{d}	72.00±17.75^{b}
0km King Mariut –Burg EL Arab road	56.63±0.11^{gh}	45.72±5.98^{cd}	5.54±0.80^{bc}	11.87±20.02^{cd}	16.06±6.06^{abc}	54.3±0.5^{ab}
Wadi ELNatroun	71.73±0.25^{ae}	25.21±9.15^{abefg}	6.43±1.19^{ab}	11.65±7.65^{cd}	10.81±1.84^{a}	48.2±6.32^{ab}
30km Cairo –Suez road	56.23±0.25^{h}	8.63±0.33^{g}	6.81±0.81^{ab}	9.95±0.00^{cd}	15.14±0.07^{abc}	50.63±5.43^{ab}
46km Cairo –Suez road	69.2±0.5^{aef}	11.96±5.45^{efg}	5.96±0.29^{bc}	12.25±0.00^{cd}	19.27±1.54^{abc}	38.63±5.95^{a}
Wadi Hagul (1)	40.93±0.21^{i}	44.46±10.79^{cd}	3.44±0.12^{c}	11.49±0.42^{cd}	25.98±2.13^{c}	57.27±22.41^{ab}
Wadi Hagul (2)	59.2±0.17^{fgh}	64.08±1.09^{d}	6.42±0.62^{ab}	7.20±0.00^{cd}	24.93±3.56^{bc}	53.2±0.00^{ab}
F-Value	**50.271**	**20.425**	**4.617**	**11.337**	**49.773**	**3.857**

Different letters above the numbers means significant differences at P< 0.05

* P ≤0.0001, ns: Not significant

Means in the same line followed by different letters are significantly different at P<0.05 according to Duncan's multiple range test.

Discussion

In plant physiology, natural secondary metabolites have an important role in adaptation to habitat stresses and have the human benefit of medicinal, nutritive, and industrial purposes (Khattab et al., 2017). Many different herbal plants are used by the drug industry to extract pure and natural chemical compounds. One of the most important therapeutic uses is pain control (El-Alfi et al., 2019). Additionally, medicinal plants are extensively used to treat disease, and in developing countries, almost 80% of people are influenced by traditional therapies for their health maintenance and treatments. Plants act as natural sources for these therapies, and the medicinal extracts can easily be spread to industrialized regions (El-Alfi et al., 2019). Furthermore, Helal et al. (2019) show that secondary metabolites found in the aerial parts of *Pulicaria undulata*contain are useful for drug development as well as an alternative to harmful synthetic fungicides.

D. tortuosa is widespread in Egypt on the North-Western Coast and Western and Eastern deserts. It inhabits seven different habitats: sand dunes, sand flats, salt marshes, wadi slope, wadi bed, roadsides, and cultivated land (Slima et al., 2021). It is a traditional medicinal plant used in folk medicine, especially by local inhabitants of the Western Mediterranean Coast, and it is brought for sale to herbal shops in Matrouh and Salloum Cities (Shaltout & Ahmed, 2012). *D. tortuosa* is used in the treatment of different diseases as a carminative, diuretic, and antiasthmatic analgesic, and has been traditionally used to treat stomach pains and against intestinal parasites (Boukef et al., 1982; Mahran et al., 1989).

In the present study, primary and secondary metabolites, including carbohydrates, proteins, alkaloids, flavonoids, glycosides, tannins, phenols, and saponins were present in the aerial parts of *D. tortuosa* (Table 3). The secondary metabolites found are active constituents of many medicinal plants used as antifungals and antibacterials (Ahmed, 2014).

McChesney (1999) reported that the production of secondary metabolites is influenced by many environmental conditions such as water availability, soil pH, and available nutrients. Consistent with this previous study, variations in contents of secondary metabolite content among the aerial parts of *D. tortuosa* collected from different habitats were significant at $P \leq 0.0001$ (Table 5). In contrast, for primary metabolites, total carbohydrates were high in all samples collected from the different habitats. Possibly because the desert plants were increasing their osmotic pressure by accumulating high amounts of carbohydrates to increase water absorption power. Consistent with this hypothesis, the highest total carbohydrate percentage (32.18%) was measured in samples from salt marshes at Alexandria Burg El-Arab Road. This finding also coincides with that of Kafi et al. (2003), who reported that accumulation of soluble carbohydrates in leaves, roots, and maturing seeds of *Triticum aestivum* L. grown in a sand culture of different salinity levels might help in salinity tolerance. El-Absy et al. (2015) found that the total available carbohydrate content of the shoot of *Achillea fragrantissima* was significantly increased during the wet season compared to the arid one. This may be due to better seasonal conditions for metabolic processes, as evidenced by the formation of the greater bulk of photosynthetic tissue occurring during the wet season (Abd El-Rahman & Eissa, 1994). Different plant species especially halophytes use carbohydrates and other types of osmolytes to preserve osmotic balance (Parida & Das, 2005). Soluble carbohydrates play an important role in the mechanisms of adaptation to salt stress (Kerepesi & Galiba, 2000; Parida et al., 2002). Soluble carbohydrates, as sugars, and polyols are part of the solutes used in osmotic adjustment, and regulation and as osmoprotectants (Gil et al., 2011).

In the present study, the highest crude protein percentage (19.88%) was found in samples from the Ras Abu Lahu region representing sand plains habitat. This may be due to the higher nitrogen content (0.27%) and low moisture content (0.7%) in its soil. Crude protein is one of the most important criteria for forage quality estimation (Assefa & Ledin, 2001). Al-Noaim et al. (1991) showed that plants' crude protein contents generally decline as the plant matures, reaching its maximum value during the vegetative or flowering stage and minimum value during the senescent stage. Additionally, plant aerial biomass growth rate increases with dry matter nitrogen content and reaches its maximum rate with a critical nitrogen concentration level onwards. Haldemann & Brändle (1986), Scheible et al. (1997) and Sampoux et al. (2011) reported that

suitable nitrogen supply positively influences the metabolic pathways associated with nitrogen assimilation and synthesis of proteins for growth and storage. In addition, Pessarakali (1995) reported that quantitative and qualitative changes to protein synthesis results from water deficit. Vyas et al. (1996) also reported that water deficit causes a reduction in the rate of protein formation and affects the type of proteins produced, and Al-Jebory (2012) reported that the protein content in *Pisum sativum* declined as drought stress increased. Furthermore, Jiang & Huang (2002) found that changes in protein synthesis and degradation are vital metabolic processes that influence water stress tolerance. Moreover, Rocco et al. (2008) reported a significant increase in leaf proteins of tobacco plants that were involved in oxidative and environmental stress and defense against pathogens.

In the present study, the highest total lipid content (11.12%) was found in samples from the Ras Abu Lahu region, representing a sand plains habitat. This may be due to the low moisture content (0.7%) of the soil. The importance of lipids to plant metabolism is well known. Chapin et al. (1986) showed that lipids are an important energy source in some plants. Under water deficit, plant lipid content is reduced (Pham-Thi et al., 1985; Monteiro de Paula et al., 1990), because of the inhibition of lipid biosynthesis (Pham-Thi et al., 1987; Monteiro de Paula et al., 1993), leading to an increase in lipolytic and peroxidative activities (Ferrari-Iliou et al., 1994; Sahsah et al., 1998; Maarouf et al., 1999; Matos et al., 2001).

Haroon (2000) found that the maximum lipid content of an *Enteromorpha* sp. occurs in spring at the beginning of the growing season. As temperature increased, the lipid content decreased and eventually remained unchanged until the end of the growing season. El-Shesheny et al. (2014) showed that the percentage of total lipids in the aerial parts of *D. tortuosa,* collected from Sidi Barrani on the North-Western Coast of Egypt is 1.25%.

Alkaloids content was high in the aerial parts of *D. tortuosa*. The highest alkaloid content (111.5mg/g) was recorded for samples collected from roadsides at Wadi AlRamla, where soil was characterized by low pH (7.5) and high EC (0.39mS/cm). This result is in agreement with that of Yahyazadeh et al. (2018), who reported that alkaloid levels increased when the plant was under various stress conditions. The increase in alkaloid content could result from increased alkaloid biosynthesis, caused by a stress related increase in NADPH. El-Tayeb et al. (1997) and Schulz et al. (1999) reported that variation in alkaloid content of different plant parts is mainly due to environmental conditions and the growth stage of the plant organ.

Saponin accumulation was detected in plant samples collected from different habitats (Table 5). The highest saponin content (64.08 mg/g) was found in the wadi bed at Wadi Hagul (2). This finding agrees with Ammar et al. (2004), who reported that saponin formation in plant leaves might result from high metabolism rates. Saponins are defensive secondary metabolites that assist plants in adapting to environmental stresses such as water avalibilty, predators and difficult weather conditions (Harlev et al., 2012).

The organs of *D. tortuosa* contained different amounts of phenolic compounds. The highest phenolic compounds concentration (9.08mg/g) was recorded in the aerial parts of samples collected from Alex Burg El-Arab Road (salt marsh habitat). This may be a result of the stress caused by the high EC value (0.54mS/cm) and low moisture content (0.58%) of the soil in that habitat. Dixon & Pavia (1995) reported that phenolics are vital antioxidants, protecting plants from the oxidative harm caused by different environmental stresses. In addition, McCune & Jones (2007) reported that phenolic compounds protect the photosynthetic apparatus from Ultraviolet light.

In the present study, tannin concentration was high in the aerial parts of *D. tortuosa*. The highest value recorde (17.7mg/g) was in plants collected from fig fields 30km west of Ageba (cultivated lands). This concentration may result from the low soil moisture content (0.61%) and high EC and pH values (0.34 mS/cm and 7.8, respectively). Rhoades (1979) and Van Soest (1994) reported that high temperatures, water deficit, high light intensity and bad soil quality increase plants' tannin content. Many environmental conditions are also known to affect tannin formation, such as photoperiod, soil pH, water and nutrient availability, herbivory and atmospheric CO_2 (Herms & Mattson, 1992; Bussotti et al., 1998; Kraus et al., 2003; Cohen & Kennedy, 2010; Jaakola & Hohtola, 2010; Lindroth, 2010; Malisch et al., 2016).

Leaves contain chloroplasts that can biosynthesize flavonoids (Hernandez et al., 2009; Pollastri & Tattini, 2011). Manach et al. (1996) reported that sunlight stimulates flavonoid biosynthesis in plants until reaching a maximum. This finding agrees with the results of our study flavonoids. The highest flavonoid values (73.56 and 63.14mg/g) was found in the cultivated lands (fig fields 30km west of Ageba) and the salt marshes of Alexandria Burg El-Arab Road, respectively. This may be due to the low soil moisture contents (0.6 and 0.54%), respectively, and/or may be an adaptive response to high soil EC (0.34 and 0.54mS/cm, respectively,). Hernandez et al. (2009) showed that leaf flavonoid content increased in *Cistus clusii* during drought conditions, and Chutipaijit et al. (2009) showed that flavonoid concentration increases in *Oryza sativa* in response to high salinity. As such flavonoid accumulation in *D. tortuosa* may be an adaptation mechanism to water or salinity stress in its growth habitat.

Total cardiac glycosides concentration was the highest in plant samples (72mg/g) collected from the salt marshes of Alexandria Burg El-Arab Road. Cardiac glycosides can reduce plant tissue growth and are associated with a reduction in soil nutrient, mineral, and soil moisture content. The deficit in cardiac glycosides in *D. tortuosa* growing in salt marshes might be attributed to low moisture content (0.58%) and high EC value (0.54mS/cm). Soil moisture and nutrients may participate in the content of cardiac glycosides found in plant (Khattab et al., 2017). Cardiac glycoside also play a role in plant adaptation to different environmental conditions (Sahin et al., 2013), and the formation and accumulation of cardiac glycosides is influenced by different environmental conditions such as soil minerals, osmotic stresses (drought and salinity), and season (Waterman & Mole, 1989).

Conclusion

This study revealed remarkable qualitative and quantitative differences in *D. tortuosa* phytochemical constituents in different habitats. It also provided evidence that environmental conditions affect the content of secondary metabolites in *D. tortuosa.* It was concluded that salt marshes are the most favorable habitat for *D. tortuosa* growth relative to the other habitats studied. *D. tortuosa* grown in salt marshes was characterized by high production of secondary metabolites including alkaloids, phenolic compounds, flavonoids, and cardiac glycosides. *D. tortuosa* can be considered a new source of metabolites for drug discovery and/or improvement.

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مسح فيتوكيميائي على نبات شبت الجبل المجمع من بيئات مختلفة في مصر

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نبات شبت الجبل هو شجيرة معمرة وتتبع العائلة الخيمية. ينتشر في المناطق الجافة المعرضة لتغيرات مناخية قوية والتي تؤثر بدورها علي انتاجية المواد الفعالة بالنبات. ينتشر النبات في مصر في الساحل الشمالي الشرقي والصحراء الشرقية والغربية. للنبات استخدامات في الطب الشعبي و كمصدر للوقود الخشبي. في الدراسة الحالية تم عمل اختبارات نوعية وكمية لتعيين المركبات الكيميائية الأساسية (نواتج الأيض الاولية والثانوية) لنبات شبت الجبل والذي قد تم تجميعه من سبعة عشر موقعا مختلفا تمثل ست بيئات مختلفة. وتهدف الدراسة إلى توضيح تأثير الظروف البيئية المختلفة على المركبات الحيوية بالنبات.

في الدراسة الحالية وجد أن نبات شبت الجبل له القدرة على النمو في بيئات قاسية وخاصة في فصل الصيف مما يساعد في تحسين انتاج وتجميع بعض المركبات المضادة للأكسدة والتي تشمل التانينات – القلويدات – الجليكوسيدات – الفلافونيدات – المواد الصابونية والفينولية و كذلك المواد الكربوهيدراتية والبروتينية والدهنية المختلفة.

نبات شبت الجبل ينتج نسبة عالية من الكربوهيرات تصل إلى (32.18%) و خاصة في البيئات الملحية و التي تتميز تربتها بتوصيل كهربي يصل إلى (0.54 mS/cm) , و نسبة البروتين به تصل إلى (19.88%) في المسطحات الرملية وكمية القلويدات في النبات تصل إلى (111.5 mg/g) علي جانب الطريق و التي تتميز بأقل نسبة من الكربون العضوي (0.16%), ونسبة التانينات (17.76mg/g) و المواد الفلافونية (73.5 mg/g) في بيئات مستصلحة لزراعة التين و التي تتميز ب pH=7.8. وبالتالي يفضل نبات شبت الجبل البيئات الجافة المختلفة ويعتبر مصدرا لتلك المواد الفعالة المختلفة والتي تساهم في تطوير وتحسين الأدوية وتعتبر احدى الطرق الغير تقليدية لزيادة المواد الفعالة للنباتات البرية.