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Habitat, Phytochemical Profile and Biological Activity of *Datura innoxia* Mill. from Egypt

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AbstractWild medicinal plants have sparked interest due to their active metabolites with distinct therapeutic and pharmacological properties. Therefore, it is critical to highlight habitat conditions and quantify active phyocompounds to optimize their phytochmical constituents. *Datura innoxia* is an annual wild medicinal plant. This study addressed the physico-chemical features of soil where *Datura innoxia* is growing were addressed. In addition, secondary phytocompounds, antioxidant activity and antibacterial potential of methanol extract for aerial parts of *D. innoxia* were assessed. *D. innoxia* favored sandy soil with low salinity. In methanol extract of *D. innoxia*, phenols exhibited the highest level (652.1 mg gallic acid g^{-1} dry extract) followed by flavonoids, tannins, alkaloids and finally saponins (3.5 mg g^{-1} dry extract). *D. innoxia* showed a high antioxidant activity with IC50 value of 0.012 mg ml^{-1}. The extract exhibited better inhibition against gram +ve bacteria (*Staphylococcus aureus*) with inhibition zone of 19.45 mm than those of gram -ve isolates (*Escherchia coli* and *Salmonella typhi*). Our findings recommend that *D. innoxia* could provide a good source of antioxidant and antibacterial activities.

Keywords: Solanaceae, medicinal plants, antioxidant, phytochemistry.

1.Introduction

In the field of folk medicine and cancer approach, plants are still a promising source for a novel chemical compounds [1]. Plants and their derivative compounds have been widely used to treat pathogens like bacteria, fungi, and viruses.

Datura is one of the important genus in Solanaceae Family and includes about 20 species [2]. This genus is rich with phytochemical compounds including alkaloids, saponins, atropine, coumarins, carotenes and scopolamine. Therefore, it is widely used in folk medicine. It is used to treat several diseases, for example, gastric pain, skin infection, asthma, inflammation, etc. [3].

Datura innoxia, a member of Family Solanaceae, is used in medicine against a variety of diseases such as colds, skin eruptions nervous disorders, pain relief, pacifying, antispasmodic and various respiratory conditions [4]. The plant also contains phytochemicals known to have analgesic, anti-inflammatory, antibacterial, and antipyretic properties, such as tannins, phenols, flavonoids, glycosides, saponins and resins [5].

The objectives of the current study were to 1) address the physicochemical features of soil where *D. innoxia* is growing, 2) quantifying the secondary metabolites in aerial parts of *D. innoxia* and 3) assess the antioxidant and antibacterial activities of *D. innoxia*.

2. Materials and methods

2.1. Plant collection

Th fresh aerial parts of *D. innoxia* were collected in March 2022 from the garden of Mansoura University, Egypt. Voucher samples are kept in the herbarium of Faculty of Science, Mansoura University. The plant samples were cleaned by running water then by distilled water, left for air-dried at room temperature and finally powdered.

2.2. Soil- analysis

Three soil samples were collected at 50 cm depth and pooled as a composite. Physicochemical properties of soil were

estimated according to the Association of Official Agricultural Chemists (AOAC) [6]. Na^+, K^+, Ca^{++} and Mg^{++} were approached by a flame-photometer.

Fig. 1: Morphology and fruit (capsule) of Datura innoxia.

2.3. Preparation of plant extract

The methanol extract was obtained by putting 10 gram of dried powder of *D. innoxia* in conical flask (250 ml) and added 100 ml of methanol. The flask was kept in water bath-shaker for 4 hrs. The extract was filtered using Whatman filter paper and stored at 5°C.

2.4. Phytochemical analysis

Total phenols were estimated following the Folin-Ciocalteu assay [7]. The aluminum chloride colorimetric assay was considered to determine flavonoids [8]. The vanillin-hydrochloride was used to weigh the tannin concentration [9]. Using ammonium hydroxide, the alkaloid was calculated [10]. Saponin was determined by the assay of [11].

2.5. Biological activity

2.5.1. Antioxidant activity by DPPH

Using ascorbic acid as a reference, the DPPH colorimetric method was used to assess the plant sample' antioxidant capacity and expressed as IC_{50} [11]. The IC50 value showed how many antioxidants were required to lower the concentration of DPPH solution by 50%.

2.5.2. Antibacterial activity

The methanol extract of *D. innoxia* was evaluated against three pathogenic bacterial strains (*Escherichia coli*, *Salmonella typhi* and *Staphylococcus aureus*) using the agar well diffusion approach [12]. After incubation, diameter of inhibitory zone was measured (mm) and the average were obtained. Tetracycline antibiotic was used as a positive control while dist. water and DMSO were considered as negative control.

3. Results

3.1. Soil properties

The physical and chemical properties of soil samples where *D. innoxia* is growing are displayed in **Table 1**. *D. innoxia* favored sandy soil with mean values of sand, silt and clay of 96.6, 3.1 and 0.18%, respectively. In addition, other physical features of soil, include soil porosity and water holding capacity of 46.1 and 51.1%, respectively.

Soil calcium carbonates ranged from 1% to 11% with an average of 3.6%, while organic carbon varied from 1.3 to 1.5% with a mean value of 1.3%. The soil salinity is low. The mean values of total nitrogen and total dissolved phosphorous are 38.7 and 18.6 mg g^{-1} dry soil, respectively. The results of macroelements (Na^+, K^+, Ca^{++} and Mg^{++}) are displayed in **Table (1)**.

Table 1. Physical-chemical properties of soil samples collected from the habitat of *D. innoxia*

Soil factor	Minimum	Maximum	mean±SE
Sand (%)	94.5	99.1	96.6±1.0
Silt (%)	0.5	5.0	3.1±0.3
Clay (%)	0.0	0.5	0.18±0.0
Porosity (%)	42.3	49.6	46.1±1.1
WHC (%)	38.9	57.9	51.1±3.2
$CaCO_3$ (%)	1	11	3.6±1.9
OC (%)	1.3	1.5	1.3±0.0
pH	7.4	7.5	7.4±0.0
EC (mmhos cm^{-1})	0.10	0.3	0.13±0.0
Cl^- (%)	0.01	0.0	0.01±0.0
SO_4^{--} (%) **mg/100 g dry soil**	0.0	0.3	0.12±0.0
HCO_3^- (%)	0.0	0.1	0.07±0.0
TN	32.4	45.6	38.7±2.6
TDP	11.0	32.2	18.6±3.2
Na^+	3.4	11.5	5.8±1.5
K^+	0.6	1.6	1.0±0.1
Ca^{++}	3.0	8.6	5.8±0.9
Mg^{++}	2.8	9.1	5.1±1.1

WHC: water holding capacity, OC: organic carbon, EC: electric conductivity, TN: total nitrogen, TDP: total dissolved phosphorus, SE: standard error.

3.2. Phytochemical analysis of *D. innoxia*

The concentration of active phytocompounds in *D. innoxia* is showed in

Table 2. In methanol extract of *D. innoxia*, phenols exhibited the highest level (652.1 mg gallic acid g^{-1} dry extract) followed by flavonoids, tannins, alkaloids and finally saponins (3.5 mg g^{-1} dry extract).

Table (2): Phytochemical analysis of methanol extract of D. innoxia.

Secondary metabolites	Mean±SE
Phenols (mg gallic acid g^{-1})	652.1±3.2
Flavonoids (mg catechin g^{-1})	179.5±0.7
Tannins (mg tannic acid g^{-1})	135.8±1.2
Alkaloids (mg g^{-1} dry extract)	101.6±3.5
Saponins (mg g^{-1} dry extract)	3.5±0.6

3.3. Biological activity of *D. innoxia*

3.3.1. Antioxidant activity

The DPPH scavenging activity of methanol extract of *D. innoxia* is displayed in **Table (3)**. As compared with the natural antioxidant ascorbic acid (IC_{50}= 0.022 mg ml^{-1}), *D. innoxia* showed a high antioxidant activity with IC50 value of 0.012 mg ml^{-1}.

Table (3). Antioxidant activity (IC_{50}) and antibacterial activity of methanol extract of *D. innoxia*.

Antioxidant activity			
	IC_{50} (mg ml^{-1})		
Methanol	0.012		
Ascorbic acid	0.022		
Antibacterial potential			
Extract type	Escherichia coli	Salmonella typhi	Staphylococcus aureus
	Inhibition zone (mm)		
methanol	2.50	7.10	19.45
Tetracycline (Positive control)	30.15	28.10	29.45
Dist. Water (Negative control)	-	-	-
DMSO	-	-	-

3.3.2. Antibacterial potential of *D. innoxia*

The methanol extract of *D. innoxia* showed comparable inhibitory effects against the tested bacterial strains **(Table 3)**. The extract exhibited better inhibition against gram +ve bacteria (*S. aureus*) with inhibition zone of 19.45 mm than those of gram -ve isolates (*E. coli* and *S. typhi*).

4. Discussion

To optimize the yield of natural products from plants, it is important to address the soil features of their native habitats where they are naturally growing. Small amounts of biologically active ingredients are habitually present in plants. A successful extraction method is one that can generate a large quantity of the necessary extracts with little change to their functional properties [13]. An effective solvent stands out for its superior extraction and capacity to preserve the chemical structure's stability [10].

Previous studies reported that, the various quantity of phenols, flavonoids, tannins and alkaloids among different plant extracts or the same plant depends on several factors, such as, plant-part used, solvents, collection time, extraction methods and handling-instruments [4].

By scavenging free radicals or chelating trace elements and bolstering the antioxidant defenses, plant phenolics with antioxidant properties play a significant role in preventing oxidative stress, cytotoxicity, and cell death. The main factors of the antioxidant activity in most of medicinal plants are phenolics, flavonoids, and tannins [14].

As compared with *D. innoxia* collected from India [15], the antibacterial activity of Egyptian *D. innoxia* showed a close similarity against the same bacterial strains. On the other hand, the methanolic extract of *D. innoxia* showed higher inhibitory zone than those reported by [16] for the same isolates.

5. Conclusion

The current study addressed the habitat features (soil conditions) where *D. innoxia* is growing, as well as its phytochemical analysis and biological activity (antioxidant and antibacterial activities). After broaden studies, a future use of *D. innoxia* as source of natural product or as food additive with weighty antioxidant and antibacterial activities.

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