MANSOURA JOURNAL OF BIOLOGY
Official Journal of Faculty of Science, Mansoura University, Egypt
E-mail: scimag@mans.edu.eg ISSN: 2974-492X

Habitat features and metabolic profile of *Hyoscyamus muticus* L. in Egypt

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Received: 22/7/2024
Accepted: 5 /8 /2024

Abstract: Medicinal wild plants are regarded as a valuable source of secondary metabolites and thus bioactive compounds. This study was performed to explore the habitat features and phytochemical constituents of *Hyoscyamous muticus* L. which growing along the inland desert (Cairo Suez desert road) of Egypt. *H. muticus* preferred sandy alkaline soil with low water holding capacity and organic matter and high level of calcium carbonates. *H. muticus* attained the highest value of total phenols (211.6 mg GAE g^{-1} dry extract), followed by alkaloids (88.2 mg g^{-1} dry extract); flavonoids (50.46 mg CE g^{-1} dry extract), tannins (14.25 mg TAE g^{-1} dry extract) and saponins (10.16 mg g^{-1} dry extract). This study proposes using the aerial parts of *H. muticus* L. as a source of bioactive chemicals for use in the pharmaceutical, cosmetic and food sectors.

Keywords: Solanaceae, secondary metabolites, habitat, Egypt.

1.Introduction

Domesticated wild plants provide 90% of the world's food, fiber, medicine, and other essentials. Many of these plants, which have yet to be evaluated, are of interest to ecologists, genetic engineers, and agronomists since they produce novel crop kinds **[1].** Ecologists are therefore interested in addressing the current state of unevaluated wild plants, particularly highly adapted, medicinal, endemic, and endangered species in various environments. Concerning ecological aspects, it is critical to address the environmental circumstances that allow plants to grow and produce at their peak productivity with high amounts of active materials and high potential economic rates **[2]**.

Hyoscyamus muticus L. (Family Solanaceae), known as Egyptian henbane is a perennial herbaceous plant. *Hyoscyamus* species are known for their high alkaloid content.

The purpose of this study was to evaluate the ecological conditions and phytochemical content of *H. muticus* in Egypt's inland desert (along Cairo-Suez Desert Road).

2. Materials and methods

2.1. Study area

The current study area is Cairo-Suez road **(Figure 1)**. The Eastern-desert extends for 223,000 km^2 between the Nile Valley and the Gulf of Suez **[3]**. The climate in the inland desert is an arid-desert with low rainfall, and high-temperature. *H. muticus* was collected during Spring 2023 and identified according to **[4]**. Herbarium specimens were preserved in Mansoura University Herbarium.

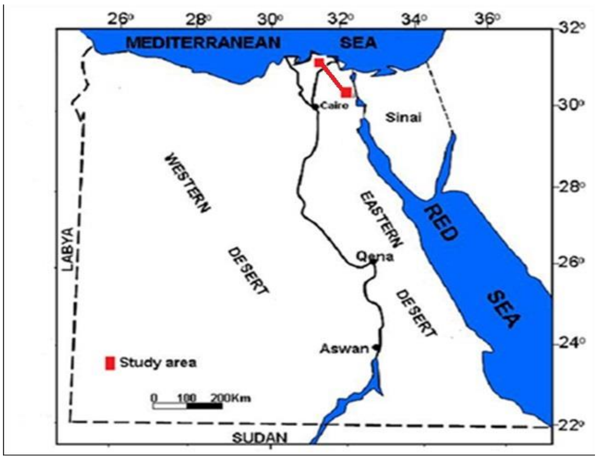

Fig (1): Map of Egypt shows the study area (red line).

2.2. Soil- analysis

Three soil samples were accumulated at 30 cm depth and pooled as a composite. All soil physical (texture, water holding capacity, porosity) and chemical properties (pH, EC, $CaCO_3$, organic-carbon, sulfates, bicarbonates, total nitrogen, total phosphorous, K, Na, Ca and Mg) were carried out according to AOAC **[5]**.

2.3. Phytochemical analysis

Total phenolic [6], flavonoid content [7], tannins [8], alkaloids [9], and saponins [10] were carried out in *H. muticus*.

2.4. Statistical analysis

The results were presented as means ± standard errors.

3. Results

3.1. Habitat features of *H. muticus*

As shown in Table (1), *H. muticus* preferred sandy alkaline soil with low water holding capacity and organic matter and high level of calcium carbonates. On the other hand, the value of soil Na, K, Ca and Mg were 23.74±1.05 mg/ 100g dry soil; 14.69±0.88 mg/ 100g dry soil; 5.47±0.49 mg/ 100g dry soil; and 7.11±1.04 mg/ 100g dry soil, respectively.

Table (1): Mean values± standard errors of soil of *H. muticus*

Soil variable	H. muticus soil
Sand (%)	85.50±0.33
Silt (%)	11.20±0.42
Clay (%)	3.30±0.09
Porosity (%)	37.10±1.87
WHC (%)	31.90±0.56
$CaCO_3$ (%)	15.68±2.19
OC (%)	0.18±0.00
pH	8.4±0.04
EC (mmhos cm^{-1})	188.05±3.75
Cl^- (%)	0.25±0.01
SO_4^{--} (%)	0.21±0.00
HCO_3^- (%)	0.15±0.00
TN (mg/ 100g)	10.18±1.24
TDP (mg/ 100g)	6.10±0.68
Na^+ (mg/ 100g)	23.74±1.05
K^+ (mg/ 100g)	14.69±0.88
Ca^{++} (mg/ 100g)	5.47±0.49
Mg^{++} (mg/ 100g)	7.11±1.04

WHC: water holding capacity, EC: electric conductivity, OC: organic carbon, TN: total nitrogen, TDP: total phosphorous.

3.2. Phytochemical composition

H. muticus attained the highest value of total phenols (211.6 mg GAE g^{-1} dry extract), followed by alkaloids (88.2 mg g^{-1} dry extract); flavonoids (50.46 mg CE g^{-1} dry extract), tannins (14.25 mg TAE g^{-1} dry extract) and saponins (10.16 mg g^{-1} dry extract) (Figure 2).

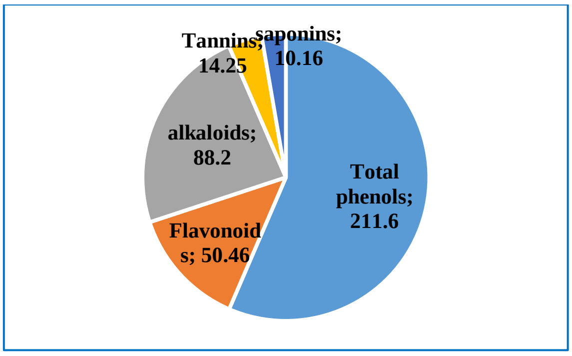

Fig. (2). Phytochemical analysis (mg/g dry extract) of *H. muticus*.

4. Discussion

To address global concerns like population growth, freshwater scarcity, and arable land reduction, scientists should look for alternatives to conventional crops. Wild plants, which can thrive on arable or non-arable, salt-degraded soil are one possibility. These plants can produce significant amounts of active compounds that serve as both defense systems and necessitate human nutrients and medicine **[11]**.

To increase the production and biomass of these alternatives for economic use, it is important to address the soil factors that encourage their growth and persistence. The soil analysis is a series of tests that look at the nutrient levels and availability for plant growth **[12]**. Soil is the most essential environmental variable for producing secondary metabolites because it regulates the flow and availability of water, air, and nutrients in plants **[13]**. In the current study, the desert soil supporting the *H. muticus* was characterised by its coarse sandy texture, alkaline range, low water holding capacity, low fertility (low organic matter, TN, TP, K, Ca, and Mg), and calcium carbonates. These results were consistent with earlier studies suggesting that the inland desert of Egypt includes a diversity of soil types with minimal organic matter, an acidic to alkaline pH range, and high salinity **[14]**.

In response to abiotic stimuli such as salt and drought, wild plants use chemo-defense mechanisms to produce secondary metabolites such as phenolics, tannins, alkaloids, terpenoids, and so on **[15]**. Furthermore, these metabolites are beneficial to humans since they act as antimicrobials, anticancer agents, and provide other biological activities. In general, secondary metabolite concentrations in wild plants varied significantly based on species, soil nutrients, age, environment and extraction solvents **[16]**. The total phenols of *H. muticus* from the current study showed higher phenols, alkaloids, flavonoids and tannins content than methanolic extracts of *A. macrostachyum*, *A. halimus*, and *T. nilotica* collected from Egypt **[2]**.

5. Conclusion

The findings of the current study showed that the methanolic extract of *H. muticus* might be potential sources of secondary metabolites. Therefore, further studies are required to investigate the phytochemical fractions and possible separations.

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