# PHYTOCHEMICAL SCREENING, POLYPHENOLS CONTENT AND ANTIOXIDANT ACTIVITIES OF SOME SELECTED MEDICINAL PLANTS GROWING IN ALGERIA

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# PHYTOCHEMICAL SCREENING, POLYPHENOLS CONTENT AND ANTIOXIDANT ACTIVITIES OF SOME SELECTED MEDICINAL PLANTS GROWING IN ALGERIA

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***Abstract***

*This study presents the first analysis of the phytochemical composition and antioxidant potential of Erodium medeens, Linum tenue subsp munbyanum, and Chrysanthemum multicaule. Phytochemical screening revealed the presence of flavonoids, terpenoids, tannins, and alkaloids, with varying levels across the species. The extraction yields were 4.25% for E. medeens, 2.1% for L. tenue subsp munbyanum, and 4.2% for C. multicaule. Total phenolic content (TPC) was highest in E. medeens (166.60 mg GAE/g extract), followed by L. tenue subsp munbyanum (151.01 mg GAE/g extract) and C. multicaule (83.79 mg GAE/g extract). Total flavonoid content (TFC) was also significant, with E. medeens showing 264.50 mg QE/g extract, L. tenue subsp munbyanum at 357.27 mg QE/g extract, and C. multicaule at 232.02 mg QE/g extract. Antioxidant activities were assessed using ABTS, DPPH, phenanthroline, and CUPRAC assays, with E. medeens exhibiting the lowest IC50 values of 24.85 µg/ml (ABTS) and 27.87 µg/ml (DPPH), indicating strong antioxidant potential. In comparison, standard antioxidants BHA and BHT demonstrated lower IC50 values, highlighting the efficacy of the plant extracts. These findings suggest that E. medeens, L. tenue subsp munbyanum, and C. multicaule are promising sources of natural antioxidants, warranting further investigation for their potential applications in food and pharmaceutical industries.*

**Key words:** phytochemical screening, antioxidant activity, *Erodium medeens*, flavonoids, natural products

## INTRODUCTION

The increasing interest in natural products as sources of bioactive compounds has driven extensive research into the phytochemical properties of various plant species. Plants synthesize a diverse range of secondary metabolites, including phenolic compounds, flavonoids, terpenoids, and alkaloids, which not only serve as defense mechanisms but also offer

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significant health benefits for humans, consisting of qualities such as antibacterial, anti-inflammatory and antioxidant. For centuries, plants have been indispensable to human health, serving as sources of medicinal substances to alleviate pain, heal wounds, and address nutritional needs (Rhattas et al., 2016; Gueye, 2007). This traditional knowledge, developed through observation and practice (Iserin, 2001), eventually culminated in the identification of bioactive compounds that contribute to the therapeutic effects.

Today, interest in these natural substances persists due to their diverse biological activities, even as modern pharmacology continues to advance. Medicinal plants remain widely used, particularly to evaluations conducted by the World Health Organization (WHO), between 65 and 80 percent of individuals in underdeveloped nations depend on traditional medicine for essential healthcare (Jiofack et al., 2009). Of approximately 500,000 plant species worldwide, about 80,000 are recognized for their medicinal properties (Gueye, 2007).

Algeria, with its rich biodiversity and geographic diversity, is home to approximately 3,164 vascular plant species. Among these, around 3,000 belong to various botanical families, including 408 species of the *Asteraceae* family (Bouzid et al., 2017; Quezel and Santa, 1963).

This biodiversity includes *Linum tenue subsp. munbyanum*, *Erodium medeense*, and *Chrysanthemum multicaule*, which were selected for this study due to their traditional medicinal uses and potential as sources of bioactive compounds. *Linum tenue subsp. munbyanum*, part of the genus *Linum* the largest in the Linaceae family includes around 230 species globally (McDill and Simpson, 2011; Kartal et al., 2004). Algeria is home to seven species, with studies highlighting their high flavonoid and terpenoid content and their therapeutic potential, such as the wound-healing properties of linseed oil (Beroual et al., 2017).

*Erodium medeense*, endemic to Algeria, is characterized by its unique morphology and adaptability to steppic zones. This species is rich in secondary metabolites like polyphenols and flavonoids, which contribute to its antioxidant and antimicrobial properties. *Chrysanthemum multicaule*, from the Asteraceae family, is widely appreciated for its ornamental and medicinal values. Phytochemically, it contains compounds like sesquiterpenes, flavonoids, and essential oils, which underline its pharmacological properties, including antioxidant and anti-inflammatory activities (Bellakhdar et al., 1991).

This study investigates the phytochemical profiles, total phenolic and flavonoid content, and antioxidant potential of ethanolic extracts from *Linum tenue subsp. munbyanum*, *Erodium medeense*, and *Chrysanthemum multicaule*. Using assays such as ABTS, DPPH, phenanthroline, and

CUPRAC, the antioxidant capacities of these extracts were assessed and compared with standard antioxidants like BHA and BHT. The findings aim to contribute to understanding the therapeutic potential of these species, highlighting their applications in food preservation and pharmaceutical formulations.

## MATERIAL AND METHOD

### Sampling and extraction

The aerial parts of *Linum tenue subsp. munbyanum* (Boiss. & Reut.) Batt (Fig. 1) were collected in May 2022 from Djebel Guezoul, located in the Tiaret province in northwestern Algeria. Similarly, the aerial parts of *Chrysanthemum multicaule* and *Erodium medeense* Batt (Fig. 1) were collected locally in the Guertoufa area in the month of April 2022 and also in Tiaret province.

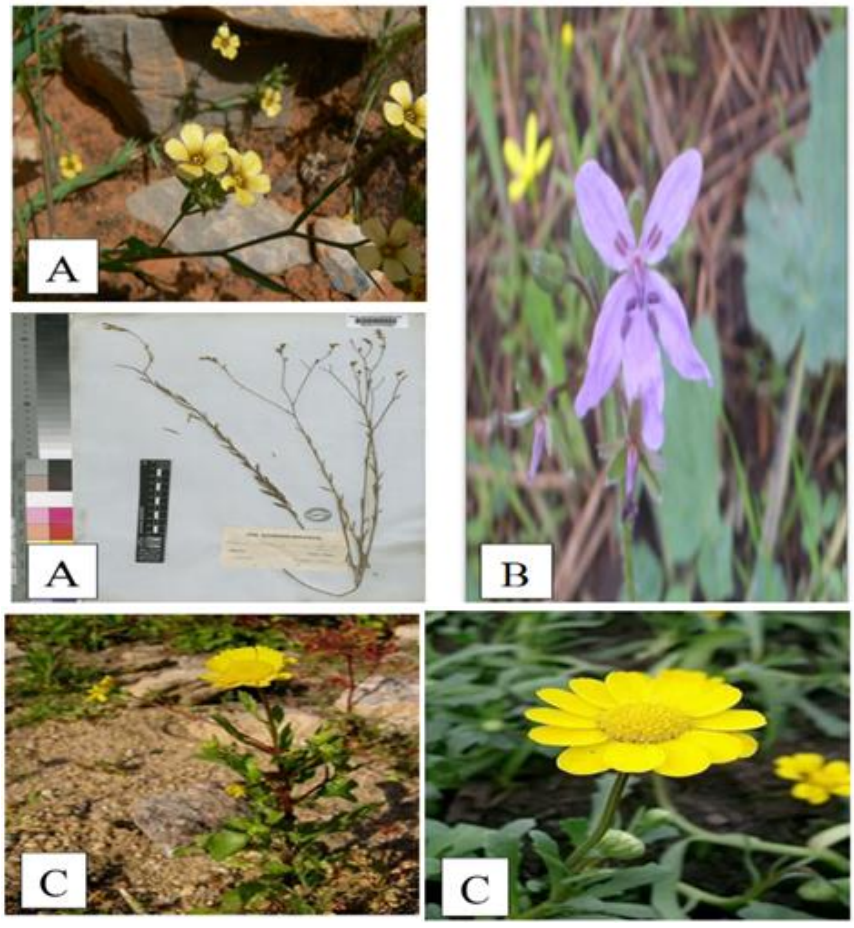


Fig. 1. Morphological aspect of the *species*: A. *Linum tenue subs munbyanum* B. *Erodium medeens;* C. *Chrysanthemum multicaule*

The plant species were identified by Professor Miara MDJ from the Department of Natural and Life Sciences, University of Tiaret, Algeria, and voucher specimens were deposited in the university's personal herbarium. Initially, the plant components were permitted to air-dry at ambient temperature. Subsequently, they were rinsed under running tap water to eliminate any particulate debris.

Ultimately, they were rinsed with distilled water to guarantee thorough cleanliness. Subsequent to the drying operation, the aerial components were meticulously chopped into diminutive segments, thoroughly dehydrated, and subsequently pulverized into a fine powder utilizing a mechanical grinder.

To maintain its integrity for subsequent analysis, the generated powder was stored in sealed containers. Twenty grams of each powdered plant sample were immersed in two hundred milliliters of ethanol and exposed to magnetic stirring for twenty-four hours during the extraction procedure. The extract was further filtered using Whatman filter paper, and the resultant filtrate was concentrated with a rotary evaporator at a temperature of forty degrees Celsius under decreased pressure. The concentrated extracts were stored at a temperature of 4 degrees Celsius for subsequent analysis.

**Phytochemical screening**

Utilizing the processes that are considered to be conventional, phytochemical analysis of the dried extracts was performed (Shaikh and Patil, 2020). Anthraquinones were identified by mixing the filtrate with 10% ammonia solution, resulting in a pink, violet, or red coloration (Chooranam, 2017). Terpenoids were detected by treating 0.5 g of the extract with chloroform and concentrated $H_2SO_4$, which formed a reddish-brown layer. Flavonoids were confirmed using three methods: adding dilute ammonia and sulfuric acid to the aqueous filtrate, aluminum solution to the extract, or ethyl acetate with dilute ammonia, each producing a yellow coloration. Saponins were indicated by the formation of stable froth and an emulsion when mixed with olive oil. Tannins were identified by a brownish-green or blue-black color upon the addition of ferric chloride. Alkaloids were detected using Mayer’s and Dragendorff’s reagents, which produced yellowish-white and orange-red precipitates, respectively.

**Total phenolic contents (TPC) determination**

The Total Phenolic Content (TPC) was quantified using the Folin-Ciocalteu reagent, as outlined by Singleton and Rossi, 1965, following the methodology provided by Muller et al., 2010. To prepare a reaction mixture, 0.5 milliliters of plant extract, 2.5 milliliters of Folin-Ciocalteu reagent, and 2 milliliters of sodium carbonate solution at a concentration of 75 grams per liter were amalgamated. The mixture was incubated for two hours at ambient

temperature and under darkness. Subsequently, the Total Phenolic Content (TPC) was quantified via a colorimetric approach, with absorbance assessed using a spectrophotometer at a wavelength of 765 nm. Gallic acid was utilized to generate a standard calibration curve at concentrations of 0, 50, 100, and 150 mg/mL. The derived equation is $y = 0.01x - 0.043$, with a coefficient of determination ($R^2$) of 0.99. The final results were expressed in milligrams per gram of extract as gallic acid equivalents.

**Total flavonoid contents (TFC) estimation**

The flavonoid content was determined using a modified version of the method outlined by Topcu et al., 2007. Quercetin was utilized as the reference standard to construct a calibration curve. To prepare the reaction mixture, 1 mL of the plant extract was combined with 0.3 mL of 5% sodium nitrate ($NaNO_3$), followed by the addition of 0.3 mL of 1% aluminum chloride ($AlCl_3$) after a five-minute interval. The mixture was then incubated at room temperature for 30 minutes, after which the absorbance was measured at 510 nm. A calibration curve for quercetin equivalents (QE) was generated using quercetin concentrations ranging from 0 to 70 mg/mL. The curve was described by the equation $y = 0.0008x + 0.0017$, with a correlation coefficient ($R^2$) of 0.98. The total flavonoid content (TFC) was expressed as quercetin equivalents per milligram of extract (QE/mg extract), along with the standard deviation.

**Free radical scavenging activity (DPPH assay)**

The DPPH assay, which was devised by Blois, 1958, was utilized in order to evaluate the extracts by determining their capacity to scavenge free radicals. In order to evaluate the effects of different doses of each extract, a 96-well microplate was utilized to combine 40 microliters of the sample with 160 microliters of a 0.1 millimolar DPPH ethanolic solution. For the purpose of the blank control, ethanol that contained DPPH was used. Following a thirty-minute period of incubation in the dark at 37 degrees Celsius, the absorbance of the mixture was determined by using a microplate reader to measure it at 515 nanometers. The reference standards that were utilized were butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA), and α-tocopherol. The scavenging activity was determined by employing the following formula:

$$(A515b - A515s) / A515b.$$

where A515b represents the absorbance of the blank and A515s represents the absorbance of the sample.

**Cupric reducing antioxidant capacity (CUPRAC assay)**

The Cupric Reducing Antioxidant Capacity (CUPRAC) assay was utilized to assess the Total Antioxidant Capacity (TAC) of hydrophilic and hydrophobic samples, adhering to the protocol established by Apak et al., 2004, with slight modifications. A series of sample concentrations (40 µL) was mixed with 50 µL of a 7.5 mM neocuproine solution, 60 µL of ammonium acetate ($AcNH_4$) solution, and 50 µL of a 10 mM $CuCl_2$ solution. A reagent-ethanol mixture served as the blank. Following a 60-minute reaction period, absorbance was assessed at 450 nm utilizing a 96-well microplate reader. The results were quantified as $A_{0.5}$ (µg/mL), indicating the concentration at which half the absorbance intensity was seen, and were compared to the standards butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT).

**ABTS Cation Radical Decolourisation assay**

The ABTS/PP assay relies on the interaction between an antioxidant and the ABTS•+ radical cation. The scavenging activity is assessed using the method established by Re et al., 1999, with slight changes. The ABTS stock solution reacted with 7 mM ABTS and 2.45 mM potassium persulfate in water, producing the ABTS•+ radical.

The reaction was subsequently followed by a 12–16-hour incubation period in darkness at ambient temperature. Forty microliters of plant extract dilutions were applied to a 96-well plate, followed by the addition of 160 microliters of ABTS•+ solution. Absorbance was measured at a wavelength of 734 nm, and the % inhibition was calculated relative to a blank, with ethanol acting as the control. The scavenging activity was quantified by determining the IC50 values (in micrograms per milliliter) using the formula:

(A734b - A734s) / A734b.

**Phenanthroline test**

This method is used to determine trace iron concentrations by reducing $Fe^{3+}$ to $Fe^{2+}$ using an antioxidant, with phenanthroline activity measured following Szydlowska-Czerniak et al., 2008, method, with minor modifications. BHT serves as the standard. The $Fe^{2+}$ ions react with ortho-phenanthroline to form an orange-red complex, which is quantified by absorbance at 510 nm.

To perform the assay, 10 µL of plant extract is added to a 110 µL volumetric flask, followed by 50 µL of $FeCl_3$ and 30 µL of 1,10-phenanthroline solution, then made up to volume with ethanol. After 20 minutes of incubation in darkness at room temperature, absorbance is measured, with ethanol as the blank.

**RESULTS AND DISCUSSION**

The phytochemical screening of the plants studied (*Linum tenue subsp. munbyanum*, *Erodium medeense* and *Chrysanthemum multicaule*) showed the presence of alkaloids, flavonoids, tannins, saponins, Terpenoids, anthraquinones, with varying intensities (Table 1).

*Table 1*

Preliminary Phytochemical screening of the three plants studied (*Linum tenue subsp. munbyanum*, *Erodium medeense* and *Chrysanthemum multicaule*)

| Test | *Linum tenue* subsp. *munbyanum* | *Erodium medeense* | *Chrysanthemum multicaule* |
|---|---|---|---|
| Anthraquinones | - | - | - |
| Terpenoids | ++++ | + | ++ |
| Flavonoids | ++ | ++++ | +++ |
| Saponins | +++ | + | +++ |
| Tannins | ++ | ++++ | +++ |
| Alkaloids | + | + | - |

The phytochemical screening of *Erodium medeens*, *Linum tenue* subsp. *munbyanum*, and *Chrysanthemum multicaule* revealed a rich diversity of secondary metabolites, underscoring their potential therapeutic applications. All three species demonstrated the presence of flavonoids, terpenoids, tannins, and alkaloids, with notable variability in their concentrations. *E. medeens* showed a high abundance of flavonoids and tannins, while *L. tenue* subsp. *munbyanum* exhibited a higher presence of terpenoids and saponins. Alkaloids, identified particularly in *E. medeens* and *L. tenue* subsp. *munbyanum*. This phytochemical diversity highlights the unique pharmacological profiles of each species and emphasizes their significance as sources of natural bioactive compounds for applications in herbal medicine, functional foods, and nutraceutical development. Further research into their biological activities and mechanisms of action could unlock novel therapeutic possibilities.

When compared to other genera, such as *Linum usitatissimum*, the phytochemical screening of *Linum tenue subsp. munbyanum* revealed pharmacological profiles that are different yet complementary to one another, both were characterized by the presence of key bioactive compounds such as flavonoids and tannins, which contribute to their antioxidant and therapeutic properties (Boukeria et al., 2020). Additionally, the analysis of the methanolic extract of flaxseed (*Linum usitatissimum*) demonstrated a profile rich in terpenoids, flavonoids, and phenols, with moderate amounts of tannins and glycosides, further supporting its strong antioxidant potential (Hanaa et al., 2017). However, were reported a similarity, identifying the presence of alkaloids and saponins, in the methanol extract of *Linum usitatissimum*. The

phytochemical screening of *Chrysanthemum indicum* L. and *Chrysanthemum multicaule* demonstrated shared bioactive compounds, including flavonoids and terpenoids, which contribute to their antioxidant potential. However, *C. multicaule* exhibited a more diverse phytochemical profile with the presence of tannins and alkaloids, absent in *C. indicum L.*, while steroids were uniquely detected in *C. indicum L. Chrysanthemum multicaule* phytochemical profiles in the studies by Aouzal et al., 2024 and Doan et al., 2024, emphasized the presence of phenolic acids, such as 3,5-dicaffeoylquinic acid and 4,5-dicaffeoylquinic acid, and flavonoids like luteolin and the absence of alkaloids which suggest a diverge from our results that could be attributed to differences in plant growth conditions, extraction protocols, or analytical techniques.

**Extractions yields, Total phenol and total flavonoid**

The results of the extraction yield, total phenol and total flavonoid of the three studied plants (*Linum tenue* subsp. *munbyanum*, *Erodium medeense* and *Chrysanthemum multicaule*) are shown in (Table 2).

*Table 2*

Extraction yield, TPC and TFC of the three plants (*Linum tenue* subsp. *munbyanum*, *Erodium medeense* and *Chrysanthemum multicaule*) methanolic extract

| Extracts | Yiled (%) | TPC (mg [a]GAE/g extract) | TFC (mg [b]QE/g extract) |
|---|---|---|---|
| ***Linum tenue subsp munbyanum*** | 2.1 | 151.01±3.98 | 357.27±2.13 |
| ***Erodium medeens*** | 4.25 | 166.60±0.17 | 264.50±4.52 |
| ***Chrysanthemum multicaule*** | 4.2 | 83.79±8.89 | 232.02±5.43 |

[a]GAE: Gallic acid equivalent; [b]QE: Quercetin equivalent; [c]Values were expressed as means ± SD of three parallel measurements.

The extraction yields varied between 2.1% and 4.25%, with the highest yield observed in the extract of *E. medeens* (4.25%), followed by *C. multicaule* (4.2%) and *L. tenue* subsp. *munbyanum* (2.1%). The total phenolic content (TPC) and total flavonoid content (TFC) were quantified relative to standard compounds, gallic acid and quercetin, respectively.

The phenolic content was expressed as gallic acid equivalents (mg GAE/g extract), while the flavonoid content was represented as quercetin equivalents (mg QE/mg extract), along with the standard deviation (SD). Total phenol and TFC varied significantly among species. The *E. medeens* has considerably high total phenol content with 166.60 ± 0.17mg GAEa/g

extract, followed by L. tenue *subsp* munbyanum with 151.01±3.98mg GAEa/g extract, while *C. multicaule* present the lowest total phenol content among species with 83.79±8.89c mg GAEa/g extract. The total flavonoid content in *L. tenue subsp munbyanum* extract was higher than the two others with extracts 357.27±2.13mg Qercetin equivalent/g of extract.

Our result show that *Linum tenue subsp munbyanum* with a yiled 2.1% was very low compare to Anwar and Przybylski, 2006, documented elevated quantities of antioxidative chemicals recovered from several plant materials, including *Moringa oleifera* leaves, utilizing a methanol/water mixture. In a study conducted by Sultana et al., 2009, aqueous methanol was determined to be the most efficacious solvent for the efficient extraction of antioxidants from the barks of various indigenous tree species. The current study shows a higher extract yield for *Erodium edens* (4.25%) compared to *Erodium arborescens* (2.66%) (Samet et al., 2022).

This implies that a number of variables, including species -even if the genus is the same- and the degree of polarity similarity between the solvent and the plant material that might be extracted can affect the yield of extracts (Sultana et al., 2009).

The results highlight the variability in phytochemical composition even within the same genus. Anwar and Przybylski, 2012, reported that *Linum usitatissimum* L extracted has a TPC range of 1360 to 3260 mg GAE/100 g and a TFC of 480 mg CE/100 g using various solvent mixtures, the present study reveals lower significant differences fond in *Linum tenue subsp munbyanum* with a TPC of 151.01 ± 3.98 mg GAE/100 g and a TFC of 357.27 ± 2.13 mg CE/100 g. The higher TPC and TFC observed in our study in comparison to Samet et al., 2022, emphasizing the importance of standardizing extraction conditions to ensure reliable comparisons of bioactive content.

**Antioxidant activity**

In the present study, the antioxidant activity ethanolic extract of the three plants was evaluated using five tests used for the characterization of plant extracts: ABTS and DPPH (IC 50 µg/mL), ABTS phenanthroline and CUPRAC (A 0.5 µg/mL), The results of these samples were listed in Table 3.

The antioxidant activities of three plant extracts, L. tenue subsp. *mumbyanum, C. multicaule, and E. medees*, were assessed through four complementary assays (ABTS, DPPH, Phenanthroline, and CUPRAC), and their performance was benchmarked against the synthetic antioxidants BHA and BHT. Among the plant extracts, E. medees demonstrated the most potent antioxidant activity, as evidenced by its low $IC_{50}$ values in the ABTS (24.85 ± 0.15 µg/mL) and DPPH (27.87 ± 3.24 µg/mL) assays and its strong

reducing power in the Phenanthroline (71.05 ± 3.85) and CUPRAC (40.91 ± 1.49 µg/mL) assays.

*Table 3*

Antioxidant activities of *Linum tenue* subsp. *munbyanum*, *Erodium medeense* and *Chrysanthemum multicaule*

| | IC 50 (µg/ml) | | A 0.5 (µg/ml) | |
|---|---|---|---|---|
| | **ABTS** | **DPPH** | **Phenanthroline** | **CUPRAC** |
| *L. tenue* subsp *munbyanum* | 60.68±5.37 | 179.23±8.48 | 176.27±7.8 | 54.13±1.79 |
| *C. multicaule* | 24.03±0.58 | 46.78±0.58 | 81.20±5.42 | 28.07±4 |
| *E. medeens* | 24.85±0.15 | 27.87±3.24 | 71.05±3.85 | 40.91±1.49 |
| BHA (standard) | 5.98±0.1 | 5.73±0.41 | 0.93±0.07 | 3.94±0.19 |
| BHT (standard) | 1.68±0.3 | 1.94±0.41 | 2.24±0.17 | 1.75±0.01 |

Similarly, *C. multicaule* exhibited comparable antioxidant efficacy, while L. *tenue subsp. mumbyanum* displayed significantly weaker activity in all assays. The synthetic standards, BHA and BHT, outperformed all plant extracts across all methods, with markedly lower $IC_{50}$ values.

The plant extracts demonstrated substantial ABTS+ radical scavenging action, essential for alleviating radical-associated pathological damage, especially at elevated doses (Wang et al., 1998).

The results of the current test further confirm those obtained from the previous assay. According to Dugas et al., 2000, flavonoids contain two key functional groups: a hydroxyl (-OH) group, which is crucial for their high antioxidant capacity, and a methoxy (-OMe) group, which enhances their antioxidant potential. Both of these groups are present in the flavonoid, contributing to its overall antioxidant activity.

This work utilized the CUPRAC test, classified as an electron transfer assay (Apak et al., 2007). This technique quantifies the conversion of the stable neocuproine-copper (II) complex (blue hue) to the neocuproine-copper (I) complex (orange hue) in the presence of an antioxidant. The phenanthroline assay entails the reduction of $Fe^{3+}$ to $Fe^{2+}$ ions by an antioxidant, resulting in the formation of a stable orange-red complex with phenanthroline, which displays maximum absorbance at 510 nm.

The antioxidant activity of *L. tenue* subsp. *munbyanum* and flaxseed extracts shows notable differences in DPPH scavenging potential. *Linum tenue* demonstrated a DPPH IC50 of 179.23 ± 8.48 µg/mL, indicating moderate scavenging activity, while flaxseed extracts, at a fixed concentration of 25 µg/mL, achieved scavenging rates between 42.2% and 87.5%, with the highest activities (>80%) obtained using 80% aqueous ethanol, 80% aqueous methanol, or pure methanol, suggesting higher antioxidant efficiency under optimal conditions. The ABTS IC50 for *Linum*

*tenue* was 60.68 ± 5.37 µg/mL, reflecting stronger activity against ABTS radicals compared to DPPH (Anwar, Przybylski, 2012).

In contrast, the control antioxidant BHT used in the flaxseed study exhibited significantly higher activity (94% at 25 µg/mL), surpassing both *Linum tenue* and flaxseed extracts. For DPPH scavenging activity, our results reported an IC50 value of 46.78 µg/mL for *C. multicaule* Doan et al., 2024, observed stronger DPPH activity in related Chrysanthemum species, with $IC_{50}$ values ranging from 28.45 µg/mL to 41.23 µg/mL, which suggests a better hydrogen-donating capacity in their extracts.

*C. multicaule* exhibited strong ABTS radical scavenging activity with an IC50 value of 24.03 µg/mL, demonstrating its high electron transfer capability. This result highlights the effectiveness of the plant in scavenging radicals in both hydrophilic and lipophilic environments. In contrast, Doan et al., 2024, reported ABTS $IC_{50}$ values for related Chrysanthemum species between 34.67 µg/mL and 52.14 µg/mL, depending on the cultivar. According to Hsu et al., 2006, the reducing capacity of a molecule may be regarded as a significant indication of the antioxidant activity of the chemical.

**CONCLUSIONS**

The study successfully demonstrated the phytochemical diversity and antioxidant potential of *Erodium medeens*, *Linum tenue subsp munbyanum*, and *Chrysanthemum multicaule*. As a result of the phytochemical screening, the presence of numerous important bioactive chemicals was discovered.

These compounds include flavonoids, terpenoids, tannins, and alkaloids, all of which are well-known for the various health-promoting aspects that they possess. Notably, *E. medeens* exhibited the highest total phenolic content, correlating with its superior antioxidant activity as evidenced by lower IC50 values in the antioxidant assays.

These findings suggest that *E. medeens*, in particular, may serve as a potent natural source of antioxidants, potentially offering protective effects against oxidative stress-related diseases. The variability in phytochemical composition among the species indicates that each plant may possess unique therapeutic properties, warranting further investigation into their specific health benefits and applications.

Overall, this research underscores the significance of these plants in natural product research and their potential use in developing functional foods and nutraceuticals aimed at promoting health and preventing disease. As the first data of its kind, it lays the groundwork for future studies exploring the pharmacological potential of these species.

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