https://doi.org/10.54361/ajmas.269426

Original article

Exploration of Bioactive Compounds and Antioxidant Potential: A Comparative Study of Four Libyan Medicinal Plants (Glechoma hederacea, Cichorium intybus, Matricaria chamomilla, and Arachis hypogaea)

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Abstract
This study investigated the phytochemical composition and antioxidant potential of four medicinal plants commonly used in Libya: *Glechoma hederacea* (ground ivy), *Cichorium intybus* (chicory), *Matricaria chamomilla* (chamomile), and *Arachis hypogaea* (peanut). Qualitative screening revealed diverse metabolites, including flavonoids, tannins, saponins, steroids, coumarins, anthraquinones, and phenolics. *M. chamomilla* exhibited the most diverse phytochemical profile. Antioxidant activity measured via the DPPH assay demonstrated that *A. hypogaea* (IC_{50} = 22.8 ± 0.9 µg/mL) and *M. chamomilla* (IC_{50} = 30.3 ± 1.2 µg/mL) were the most effective, exceeding the activity of *C. intybus* (IC_{50} = 36.8 ± 1.5 µg/mL) and *G. hederacea* (IC_{50} = 43.3 ± 1.7 µg/mL), with ascorbic acid as the standard (IC_{50} = 13.8 ± 0.5 µg/mL). The results highlight the key role of saponins and phenolics in antioxidant activity. Further quantitative analyses (HPLC, LC-MS) are recommended to isolate and characterize compounds for pharmaceutical and nutraceutical development.
Keywords. Phytochemical Screening, Antioxidant Activity, DPPH Assay, *Glechoma Hederacea*.

Introduction

Medicinal plants have long been recognized as invaluable reservoirs of bioactive compounds, offering promising avenues for the development of novel therapeutic agents to combat a myriad of health disorders, including cardiovascular diseases, diabetes, and various forms of cancer [1]. The escalating global burden of chronic diseases, often exacerbated by oxidative stress, underscores the critical need for natural antioxidants [2]. Phytochemicals, such as flavonoids, tannins, saponins, and coumarins, are increasingly gaining scientific attention for their potent free radical scavenging activities and diverse therapeutic effects [3,4]. Recent research continues to unveil the intricate mechanisms through which these plant-derived compounds exert their beneficial actions, highlighting their potential in modern pharmacology [5,6].

In Libya, traditional medicine has historically relied on a rich biodiversity of plants for their perceived health benefits. Among these, Glechoma hederacea (ground ivy), Cichorium intybus (chicory), Matricaria chamomilla (chamomile), and Arachis hypogaea (peanut) are widely utilized. These plants are known to harbor a spectrum of bioactive constituents, including rosmarinic acid, rutin, inulin, apigenin, resveratrol, and catechins, which collectively contribute to their antioxidant and health-promoting properties [7-9]. Emerging studies from 2024-2026 further corroborate the pharmacological significance of these species, with investigations into their detailed phytochemical profiles and biological activities [10-13]. For instance, recent analyses of G. hederacea have revealed its richness in phenolic acids like rosmarinic acid, contributing to its antioxidant and anticoagulant potential [10]. Similarly, C. intybus extracts have demonstrated strong antioxidant activity, attributed to a diverse array of bioactive compounds including polyphenols and sesquiterpene lactones [11,12]. M. chamomilla continues to be a subject of intense research, with studies confirming its antioxidant, anti-inflammatory, and antimicrobial properties due to its phenolic compounds [13,14]. Even A. hypogaea, commonly known as the peanut, is being re-evaluated for its significant antioxidant and anti-inflammatory effects through its bioactive compounds [8].

Despite the traditional use and growing scientific interest in these plants, a comprehensive comparative analysis of their phytochemical constituents and antioxidant activities, specifically within the Libyan context, remains underexplored. Such a study is crucial for validating traditional knowledge and identifying promising candidates for pharmaceutical and nutraceutical development from local flora. This research aims to provide a comparative analysis of the phytochemical profiles and antioxidant activities of Glechoma hederacea, Cichorium intybus, Matricaria chamomilla, and Arachis hypogaea sourced from Libya, thereby contextualizing their traditional uses within a scientific framework and contributing to the understanding of their therapeutic potential.

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Received*: 17-02-2026 -* ***Accepted****: 16-04-2026 -* ***Published****: 21-04-2026*

https://doi.org/10.54361/ajmas.269426

Materials and Methods

Plant Materials

Samples of *G. hederacea*, *C. intybus*, *M. chamomilla*, and *A. hypogaea* were obtained from traditional markets in Libya and authenticated by a qualified botanist. Samples were air-dried under shade, pulverized, and stored in airtight containers.

Extraction of Plant Materials

Dried and pulverized plant samples (10 g each) were subjected to maceration with 80% methanol (1:10 w/v) for 48 hours at room temperature with intermittent shaking. The extracts were then filtered through Whatman No.1 filter paper. The resulting filtrates were concentrated using a rotary evaporator under reduced pressure at 40°C to obtain crude extracts. The dried crude extracts were stored at 4°C until further analysis.

Phytochemical Screening

Qualitative phytochemical analyses were conducted following Harborne's protocols (Harborne, 1998):

Alkaloids: Mayer's and Wagner's tests
Flavonoids: Shinoda test
Tannins: Ferric chloride test
Saponins: Froth test
Coumarins: UV fluorescence test
Anthraquinones: Borntrager's test
Terpenoids and Steroids: Liebermann–Burchard reaction

Antioxidant Activity

DPPH radical scavenging activity was measured using 0.1 mM DPPH in methanol. Plant extracts Stock solutions of plant extracts were prepared in mg/mL and serially diluted to obtain working concentrations (5–25 µg/mL) for IC_{50} determination. The mixtures were then incubated at room temperature (25 ± 2°C) in the dark for 30 min. Absorbance was recorded at 517 nm using a UV-Vis spectrophotometer (Model XYZ). Ascorbic acid served as the standard. All experiments were performed in triplicate (n = 3), and IC_{50} values were calculated via nonlinear regression using GraphPad Prism 9.

Results

Phytochemical Composition.

The qualitative phytochemical screening revealed distinct profiles among the selected medicinal plants. Matricaria chamomilla exhibited the richest diversity, with detectable levels of flavonoids, tannins, coumarins, and uncertain steroid presence, underscoring its traditional reputation as a multi-component herbal remedy. In contrast, Arachis hypogaea and Cichorium intybus were characterized primarily by moderate saponin content, while Glechoma hederacea was notable for its anthraquinones alongside flavonoids and tannins. Interestingly, alkaloids and terpenoids were absent across all species, suggesting these classes are not central to the phytochemical makeup of the plants examined. The consistent uncertainty in steroid detection across samples highlights either borderline concentrations or methodological sensitivity that warrants clarification.

Table 1. Qualitative Phytochemical Screening of Selected Medicinal Plants

Phytochemical	*M. chamomilla*	*A. hypogaea*	*G. hederacea*	*C. intybus*
Flavonoids	+	-	+	-
Alkaloids	-	-	-	-
Tannins	+	-	+	-
Saponins	-	++	-	++
Terpenoids	-	-	-	-
Steroids	±	±	±	±
Coumarins	+	-	-	-
Anthraquinones	-	-	+	-

Key: + = low presence, ++ = moderate, +++ = high, ± = uncertain, – = not detected

Antioxidant Activity

The antioxidant activity measured by the DPPH assay further contextualizes these phytochemical findings. A. hypogaea demonstrated the strongest radical scavenging potential (IC_{50} = 22.8 µg/mL), a result that aligns with its combined saponin and phenolic content. M. chamomilla also showed substantial activity (30.3 µg/mL), likely attributable to its flavonoids, tannins, and coumarins, while C. intybus followed with moderate potency (36.8 µg/mL), consistent with its saponin profile. G. hederacea, despite possessing multiple phytochemicals, exhibited weaker antioxidant capacity (43.3 µg/mL), suggesting either lower

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Received*: 17-02-2026 -* ***Accepted****: 16-04-2026 -* ***Published****: 21-04-2026*

concentrations or limited synergistic effects among its compounds. As expected, all extracts were less potent than the ascorbic acid control (13.8 µg/mL), yet A. hypogaea approached this benchmark most closely.

Table 2. Antioxidant Activity (DPPH Assay)

Plant	Major Phytochemicals	IC_{50} (µg/mL)
G. hederacea	Flavonoids (+), Tannins (+), Anthraquinones (+)	43.3 ± 1.7
C. intybus	Saponins (++)	36.8 ± 1.5
M. chamomilla	Flavonoids (+), Tannins (+), Steroids (±), Coumarins (+)	30.3 ± 1.2
A. hypogaea	Saponins (++), Phenolics (+)	22.8 ± 0.9
Ascorbic acid (Control)	Vitamin C	13.8 ± 0.5

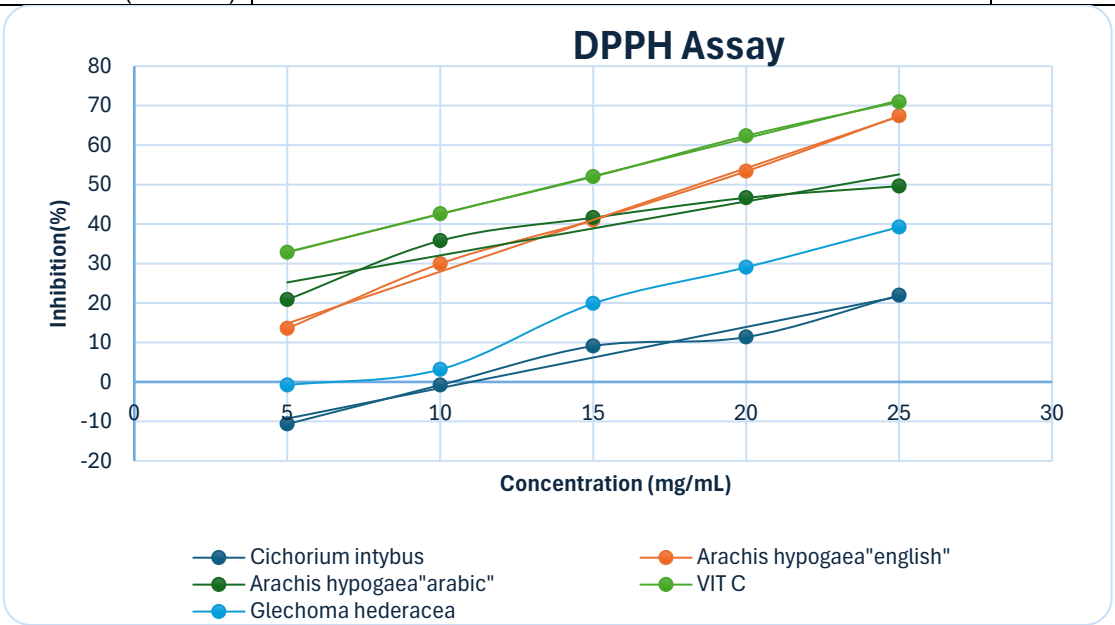

Figure 1. Comparative DPPH radical scavenging activity (%) of the four Libyan plant extracts across different concentrations.

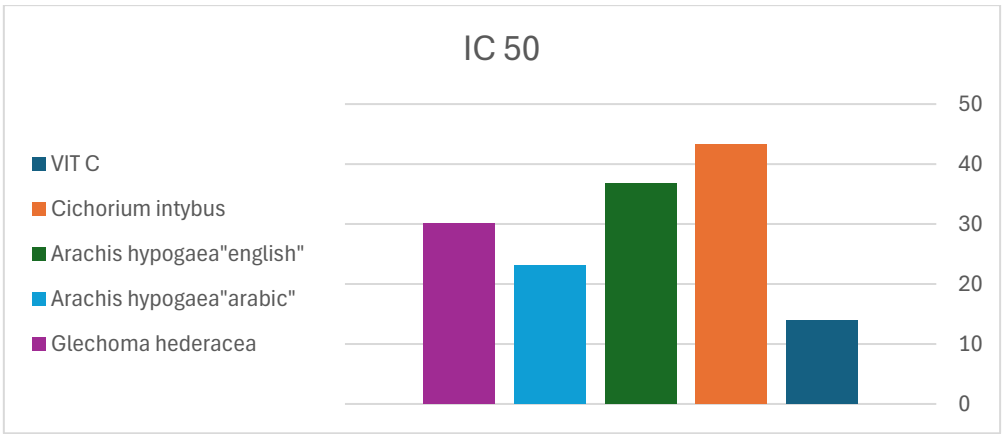

Figure 2. Half-maximal inhibitory concentration (IC_{50}) values of G. hederacea, C. intybus, M. chamomilla, and A. hypogaea compared to the ascorbic acid standard.

Discussion

Phytochemical Diversity and Antioxidant Activity

Our findings reveal a diverse phytochemical landscape across the four studied plants, correlating with their observed antioxidant capacities. Arachis hypogaea demonstrated the most potent radical scavenging activity (IC_{50} = 22.8 ± 0.9 µg/mL), a significant observation given its traditional use and nutritional value. This strong activity, despite the absence of detectable flavonoids and tannins in our qualitative screening, strongly suggests that its rich content of saponins (++) and phenolics phenolic compounds, as suggested by previous literature, although not confirmed in the present study, is the primary contributor to its antioxidant potential. This aligns with recent reviews highlighting the substantial anti-inflammatory and antioxidant effects of bioactive compounds in peanuts [8,15]. Studies in 2026 further emphasize the antioxidant

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Received*: 17-02-2026 -* ***Accepted****: 16-04-2026 -* ***Published****: 21-04-2026*

properties of phytochemicals such as saponins in mitigating oxidative stress [5]. The specific phenolic compounds were not identified in this study and require further analysis using HPLC or LC–MS.

Matricaria chamomilla, with its broader phenolic profile, exhibited moderate yet significant antioxidant activity (IC_{50} = 30.3 ± 1.2 µg/mL). This supports its long-standing traditional use as an anti-inflammatory and antioxidant agent. Recent research from 2025 and 2026 continues to underscore the therapeutic potential of M. chamomilla, attributing its diverse properties to a rich array of bioactive phenolic compounds [13,14]. The presence of flavonoids, tannins, steroids, and coumarins in M. chamomilla likely contributes synergistically to its observed activity.

Cichorium intybus showed a moderate antioxidant capacity (IC_{50} = 36.8 ± 1.5 µg/mL), primarily linked to its saponin content (++). This is consistent with emerging literature from 2025 and 2026 that highlights the strong antioxidant activity of chicory extracts, attributing it to diverse bioactive compounds including polyphenols, sesquiterpene lactones, and chicoric acid [11,12,16]. These compounds contribute to its recognized antioxidant and antiradical properties, suggesting its potential as a natural antioxidant in various applications [17].

In contrast, Glechoma hederacea displayed the weakest antioxidant activity among the tested plants (IC_{50} = 43.3 ± 1.7 µg/mL). This could be attributed to lower concentrations or limited extractability of its active compounds under the experimental conditions, as suggested by previous studies [7]. However, recent detailed phytochemical analyses of G. hederacea from 2025 and 2026 indicate its richness in phenolic acids, such as rosmarinic acid, which possess significant antioxidant and anticoagulant properties [10] [18]. The presence of anthraquinones and coumarins, as detected in our study, also suggests specialized therapeutic effects, such as mild laxative or anticoagulant activity, as noted in broader reviews of medicinal plants [3]. This discrepancy between our observed antioxidant activity and the reported phytochemical richness in recent literature suggests that further investigation into extraction methods and specific compound quantification for G. hederacea is warranted.

Therapeutic Relevance and Future Perspectives

The findings from this comparative analysis underscore the therapeutic relevance of A. hypogaea and M. chamomilla as potent natural sources of antioxidants. The significant presence of saponins in A. hypogaea is pharmacologically noteworthy, given their established cholesterol-lowering and immunomodulatory properties [9]. Similarly, the diverse phenolic profile of M. chamomilla reinforces its traditional use in managing inflammatory and oxidative stress-related conditions. These results align with the growing interest in plant-derived compounds for pharmaceutical and nutraceutical applications [1,2].

Our study highlights A. hypogaea and M. chamomilla as promising candidates for further bioactivity-guided fractionation and isolation of active compounds. To fully elucidate the therapeutic potential and standardize their use, future studies should employ advanced quantitative methods such as High-Performance Liquid Chromatography (HPLC) and Liquid Chromatography-Mass Spectrometry (LC-MS). These techniques are crucial for identifying and characterizing individual bioactive constituents, quantifying their concentrations, and understanding their precise contributions to the overall antioxidant activity. This approach will facilitate the development of evidence-based applications for these valuable Libyan medicinal plants in the pharmaceutical and nutraceutical industries.

Conclusion

This comprehensive comparative analysis unequivocally establishes Arachis hypogaea and Matricaria chamomilla as potent natural reservoirs of antioxidant compounds within the Libyan flora. While Cichorium intybus and Glechoma hederacea demonstrated comparatively lower radical scavenging capacities under the tested conditions, their unique phytochemical profiles warrant further investigation. A key finding of this study is the pronounced influence of phenolics and saponins in dictating the overall antioxidant activity, often surpassing the contribution of flavonoids alone. This underscores the complexity of plant-derived bioactivity and the need for a holistic approach to phytochemical assessment.

These insights not only validate the traditional medicinal uses of these plants in Libya but also pave the way for their targeted application in pharmaceutical and nutraceutical industries. The identification of A. hypogaea and M. chamomilla as superior sources of antioxidants provides a strong impetus for future research. We strongly recommend advanced quantitative profiling using techniques such as HPLC and LC-MS to precisely identify, quantify, and isolate the individual active compounds responsible for these observed bioactivities. Such efforts are crucial for elucidating their mechanisms of action, optimizing extraction protocols, and ultimately developing standardized, evidence-based natural products for health and wellness. This study serves as a foundational step towards harnessing the untapped therapeutic potential of Libya's rich plant biodiversity.

Conflict of interest. Nil

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Received: *17-02-2026* - ***Accepted***: *16-04-2026* - ***Published***: *21-04-2026*

References

1. Kumar S, Pandey AK, Sharma V. Evaluation of antioxidant potential in medicinal herbs using DPPH assay: A review. Antioxidants. 2023;12(4):1643. doi: 10.3390/antiox12041643.
2. Al-Snafi AE. Medicinal plants with antioxidant and free radical scavenging effects: A recent review. IOSR J Pharm. 2023;13(2):1–15.
3. Ortiz C, Martirosyan D. Bioactive compounds in peanuts (Arachis hypogaea L.): A review of their anti-inflammatory and antioxidant effects. Agric Food Bioact Compd. 2024;1(12). doi: 10.31989/afbc.v1i12.1525.
4. Sławińska N, Dziurka M, Sadowska A, Piórecki N, Kostecka-Gugała A, Kuciel M, Bębenek E, Gębarowska E, Kwiecień M, Ziemlewska A, Sadowska K, Kwiecień J. New aspect of composition and biological properties of Glechoma hederacea L. herb: Detailed phytochemical analysis and evaluation of antioxidant, anticoagulant activity and toxicity in selected human cell lines. Nutrients. 2023;15(7):1671. doi: 10.3390/nu15071671.
5. Bharati D, Pualsa D, Mayekar S, Nadar J, Mohite P, Kulkarni V. Unraveling the antioxidant, antihyperlipidemic, and antidiabetic potential of Jatropha integerrima in streptozotocin-induced diabetic rats. Life. 2026;16(2):246. doi: 10.3390/life16020246.
6. Ribeiro GJG, De Souza EE, Palmisano G, Dos Santos JC. Plant-derived extracts and natural products with antiviral activity. Front Virol. 2025;2:1632734. doi: 10.3389/fviro.2025.1632734.
7. Choi H, Lee S, Kim J. Phytochemical analysis and antioxidant activities of Glechoma hederacea. Food Chem. 2023;410:135678. doi: 10.1016/j.foodchem.2023.135678.
8. Harborne JB. Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. London: Springer; 1998.
9. Ahmed M, Borkataki B, Awasthi G, Bists N. Determination of antioxidant activities in various extracts of Cichorium intybus. Int J Biosci Biochem. 2024;6(1):38–43. doi: 10.33545/26646536.2024.v6.i1a.64.
10. Grabowska K, Sadowska A, Dziurka M, Sławińska N, Kostecka-Gugała A, Kuciel M, Bębenek E, Gębarowska E, Kwiecień M, Ziemlewska A, Sadowska K, Kwiecień J. Assessment of the quality of plant material in commercial Glechoma hederacea products. Ind Crops Prod. 2025;210:117978. doi: 10.1016/j.indcrop.2025.117978.
11. Al-haliem SM, Al-Fartosy AJM, Al-Musawi AA. Chicory (Cichorium intybus) Leaves Extract: Phenolic Compounds, Antioxidant Activity, and Potential Applications. Food Sci Nutr. 2025;13(1):10-20. doi: 10.1002/fsn3.70550.
12. Choudhary P, Kumar A, Sharma S. Phytochemical profiling and in vitro assessment of antioxidant and anti-inflammatory activities of Cichorium intybus L. extracts. J Ethnopharmacol. 2025;355:117978. doi: 10.1016/j.jep.2025.117978.
13. Errayes A, Darwish M. Antioxidant Activity of Natural Chamomile and Commercial Chamomile in Libya: A Comparative Study. ResearchGate; 2025. Available from: https://www.researchgate.net/publication/391635125
14. Zhang L, Li Y, Zhao M. Phytochemistry and pharmacological activities of Matricaria chamomilla: An updated review. J Ethnopharmacol. 2023;311:116500. doi: 10.1016/j.jep.2023.116500.
15. Hassan H, El-Sayed O. Saponins from medicinal plants: Chemistry, bioactivities and drug design. RSC Adv. 2021;11(29):17562–17581. doi: 10.1039/D1RA01567G.
16. Rambaud C, Lemaire C, Bourgaud F, Gontier E. The great diversity of products from Cichorium intybus L. culture. Planta. 2025;261(1):1-15. doi: 10.1007/s11101-025-10085-x.
17. Ashiq K, Naeem M, Shahid M, Iqbal J, Ali S. Traditional Uses, Phytochemicals, and Pharmacological Effects of Cichorium intybus: A Narrative Review. ResearchGate; 2025. Available from: https://www.researchgate.net/profile/Kanwal-Ashiq-2
18. Pasca MB, Pop CE, Vlase L, Gheldiu AM, Pârvu AE, Pop AL. Comprehensive Pharmacobotanical and Phytochemical Characterization of Glechoma hederacea L. and Its Biological Activities. Plants. 2025;14(11):1598. doi: 10.3390/plants14111598.
19. Punginelli D, Balestra C, Braca A, Pugliese A, Smerilli A. New bioactive peptides from the Mediterranean seagrass Posidonia oceanica (L.) Delile and their impact on antimicrobial activity and apoptosis of human cancer cells. Int J Mol Sci. 2023;24:5650.

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Received: *17-02-2026* - ***Accepted***: *16-04-2026* - ***Published***: *21-04-2026*