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Original article

Estimating Minerals, Antioxidant Activity, Total Phenols, and Carbohydrates in *Salvia fruticosa Mill., Urtica urens L.,* and *Urtica pilulifera L.* Plants

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ABSTRACT

In this, the mineral (Sodium, potassium, and Calcium) contents, antioxidant activity, total phenols, and Carbohydrate concentrations were estimated in the leaves and stems of *Salvia fruticosa. Mill. Gard Dict. ed, Urtica urens L.Sp.Pl.* and *Urticapilulifera* L. Sp.Pl. plants. The plant samples were collected from the Al-Gabal Al-Akhder region, around Al-Quba and Derna areas. Some of the instruments used in this study included a Flame photometer for evaluating the mineral contents and a Spectrophotometer for determining the concentrations of Carbohydrate, anti-oxidant, and Total phenols. The results of this study stated that the potassium showed higher values compared with sodium and calcium minerals, where their values were fluctuated in the ranges of (5.56 –36.56) and (32.76 -84.36 ppm) in leaves and stems, respectively. In contrast, the contents of sodium and calcium did not show wide variations and ranged as follows: (0.48- 0.88) and (0.291–1.041 ppm) for calcium in leaves and stems, respectively. While for sodium, the contents fluctuated in the ranges of (1.125 – 2.95 ppm) in leaves and from 7.28 ppm to 20.08 in stems. Also the results showed that there are higher values of total phenols in the selected plants in this study, their contents were ranged as follows (182.88 - 275.939 ppm)in leaves and from (298.148 - 323.501 ppm) in stems, while the Anti-oxidant activity values were ranged between (7.476 to 9.996 ppm) in leaves and between (9.707-10.117 ppm) in stems, on the other side the contents of Carbohydrate were fluctuated in the ranges between(0.029 – 0.114ppm) in leaves and between (0.177 to 0.177 ppm) in stems, respectively.

Introduction

Medicinal plants are commonly used in many developing and non-industrialized societies due to their accessibility and relatively low cost compared to modern pharmaceutical drugs. In many nations, traditional medicine is not yet fully governed by clear regulatory frameworks. Nevertheless, the World Health Organization (WHO) has developed programs and international collaborations to promote its safe, appropriate, and scientifically supported use. Despite their popularity, the herbal medicine industry has been criticized for regulatory gaps and the commercialization of products that may rely on pseudoscientific claims or placebo effects without strong scientific validation of their therapeutic efficacy [1].Medicinal plant resources are currently facing several challenges, including excessive harvesting driven by increasing commercial demand, in addition to broader environmental pressures, including biodiversity loss driven by habitat damage and climate variability [2].

Historically, plants have been utilized for therapeutic purposes for thousands of years, and many species that are now commonly used as herbs and spices were originally valued for their medicinal properties, although their effectiveness has not always been consistently proven. Spices, in particular, have played an important role in food preservation, especially in warm climates and in meat-based dishes that are more susceptible to microbial spoilage. Furthermore, most plant-derived medicinal compounds have traditionally been obtained from angiosperms, which are flowering plants and represent the primary source of herbal pharmacological agents [3].

Weeds, including nettle, dandelion, and chickweed, are employed as herbal remedies frequently around human settlements [4&5]. Herbs have been used by creatures other than humans, including sheep, monarch butterflies, and non-human primates. Paleolithic people ate vegetation, according to samples

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taken from ancient burial sites. For example, pollen from eight plant species was found at "Shanidar IV" in northern Iraq, a 60,000-year-old Neanderthal burial site. The presence of Ephedra remains dating back approximately 15,000 years, discovered in a burial site at Taforalt Cave in Morocco, indicates that this plant may have been involved in ancient funerary rituals [6]. Consequently, numerous investigations have been carried out to identify and quantify a wide range of phytochemical compounds [7–38], as well as to determine the concentrations of various metals and mineral elements in plant samples through different analytical methodologies [38–90]. The present study is designed to evaluate selected biochemical constituents, including carbohydrates, total phenolic compounds, and antioxidant content, in specific plant species. Phytochemical analyses were performed on both leaves and stems. In addition, the study aims to assess the mineral composition, particularly sodium (Na), potassium (K), and calcium (Ca), in the leaves and stems of *Salvia fruticosa Mill.*, *Urtica urens L.*, and *Urtica pilulifera L.* collected from different regions of Libya

Methods

Sampling

In the present investigation, the leaves and stems of Salvia fruticosa Mill., Urtica urens L., and Urtica pilulifera L. were chosen for analysis. Plant materials were systematically collected from diverse geographical regions across Libya, namely Wadi Derna Valley, Karsah in the western region, Al-Dhahr Al-Ahmar in southern Libya, and selected sites along the Mediterranean coastal belt. The study area is located on the second terrace of Al-Jabal Al-Akhdar and extends longitudinally along Wadi Derna in northeastern Libya. This valley geographically separates the city of Derna into two sections and lies approximately between latitudes 32°30′–33°00′ N and longitudes 22°30′–22°45′ E .The altitude within the Wadi varies from about 40 m to 300 m above sea level. Climatically, the area shares similar environmental conditions with the Al-Jabal Al-Akhdar region, characterized by a moderate climate with an average annual temperature of around 20 °C and mean annual rainfall ranging from 200 to 300 mm (Figure 1).

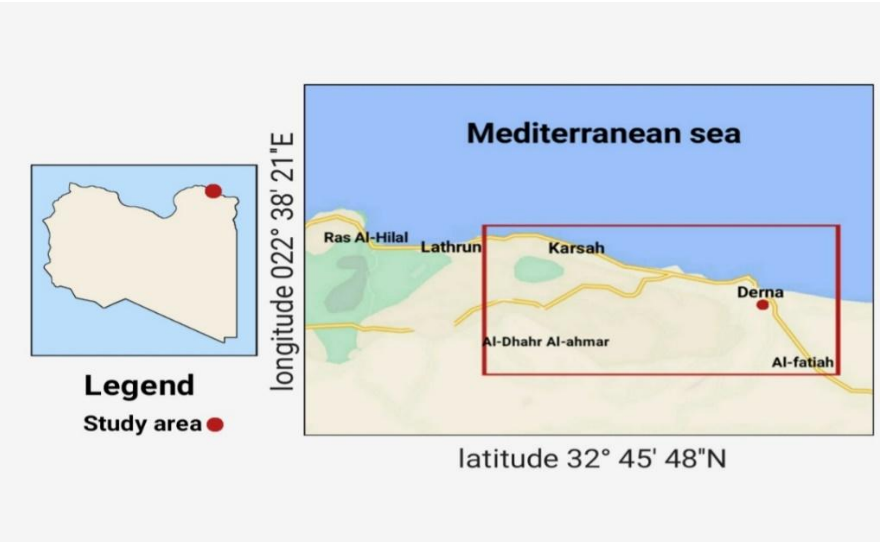

Figure 1. The selected study site

Sample extraction

For each sample, nearly 10 g of the air-dried plant material was carefully measured and introduced into 100 mL of distilled water to initiate the extraction procedure. The suspension was vigorously agitated to enhance the release of soluble constituents. Thermal extraction was subsequently conducted using an evaporation apparatus maintained at 75 °C. After allowing the process to proceed for two hours, the mixture was subjected to filtration, and the clarified extract obtained was reserved for phytochemical screening tests [12].

Determination of Total Phenolic Compounds (Folin–Ciocalteu Method)

The phenolic constituents present in the plant extracts were assessed using the Folin–Ciocalteu spectrophotometric technique, based on the methodology reported by Slinkard and Singleton (10). A calibration curve was generated using gallic acid as the reference compound. To ensure reproducibility, each extract was examined in duplicate, and measured portions were placed into spectrophotometric

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cuvettes. Thereafter, 1.0 mL of Folin–Ciocalteu reagent was introduced, followed by the addition of 0.8 mL of 7.5% (w/v) sodium carbonate solution to facilitate the chromogenic reaction.

Determination of Antioxidant Capacity (Prussian Blue Method)

One gram of finely ground plant material was first treated with petroleum ether to eliminate lipophilic compounds. After removal of the solvent, the remaining plant matrix underwent successive extraction using methanol (10 mL, two cycles with agitation), followed by treatment with 10 mL of a methanolic solution containing 1% hydrochloric acid (v/v). All obtained fractions were pooled, and the solvent was removed under reduced pressure with a rotary vacuum system. The resulting residue was reconstituted in 10 mL of methanol to prepare the final extract solution. For evaluation of antioxidant capacity, an aliquot of 0.5 mL from this solution was mixed with 3 mL of distilled water. The reaction system was prepared by adding 3 mL of 0.008 M potassium ferricyanide, 3 mL of 0.1 M hydrochloric acid, and 1 mL of 1% ferric chloride in sequence. After allowing the mixture to stand for five minutes to permit development of the characteristic blue coloration, absorbance was measured at 720 nm using a UV–visible spectrophotometer. All experimental procedures were conducted at the Central Laboratory, Faculty of Science, Omar Al-Mukhtar University.

Determination of Total Carbohydrates

Total carbohydrate concentration was determined through a phenol–sulfuric acid spectrophotometric technique adapted from earlier published protocols [9–15]. About 0.2 g of oven-dried plant material was carefully weighed and ground into a fine, uniform powder. The sample was digested with 5 mL of concentrated sulfuric acid to achieve complete breakdown of the matrix. After the reaction was completed, the mixture was allowed to cool to room temperature. Barium carbonate was then introduced to neutralize residual acidity, and mild heating was applied to facilitate full reaction progress. Once cooled, the mixture was clarified by filtration. A 1 mL portion of the clear solution was transferred into a test tube and treated with 1 mL of 5% phenol reagent to initiate color development. The absorbance of the resulting solution was recorded at 490 nm using a spectrophotometer, and the carbohydrate content was subsequently calculated from the measured values.

Determination of Mineral Content

The mineral elements, specifically sodium (Na), potassium (K), and calcium (Ca), were determined using a JENWAY flame photometer based on standard analytical procedures reported in the literature [60–70]. All mineral determinations were carried out at the Central Laboratory, Faculty of Science, Omar Al-Mukhtar University, under controlled laboratory conditions to ensure accuracy and reproducibility.

Results

Total phenols, Anti–Oxidantand Carbohydrate Contents

The obtained results revealed that the total phenolic content ranged from 182.88 to 275.939 ppm in the leaves and from 298.148 to 323.501 ppm in the stems of the investigated plants. The measured antioxidant activity varied between 7.476 and 9.996 ppm in leaf samples and between 9.707 and 10.117 ppm in stem samples. In contrast, the carbohydrate content showed relatively low and fluctuating values, ranging from 0.029 to 0.114 ppm in the leaves and remaining nearly constant at approximately 0.177 ppm in the stems. Among the analyzed species, the leaves of Urtica urens L. exhibited the highest concentration of total phenolic compounds compared with the other leaf samples. Conversely, the stems of Urtica pilulifera L. recorded the greatest phenolic content among the examined stem samples. Overall, only minor differences were observed in antioxidant activity and carbohydrate levels among the studied plants in both leaves and stems, as illustrated in (Table 1 and Figures 2–4).

Table1.Thecontents(ppm) of Phenols, Anti-oxidant, and Carbohydrate in the studied samples

Scientific name	Total Phenols		Anti-Oxidant		Carbohydrate	
Compounds	Leaves	Stems	Leaves	Stems	Leaves	Stems
Salviafruticosa. Mill.Gard Dict.ed	197.30	298.148	9.996	9.707	0.029	0.163
Urtica urens L. Sp. Pl.	275.939	319.47	7.476	10.02	0.107	0.123
Urticapilulifera L. Sp. Pl.	182.88	323.501	9.793	10.117	0.114	0.177

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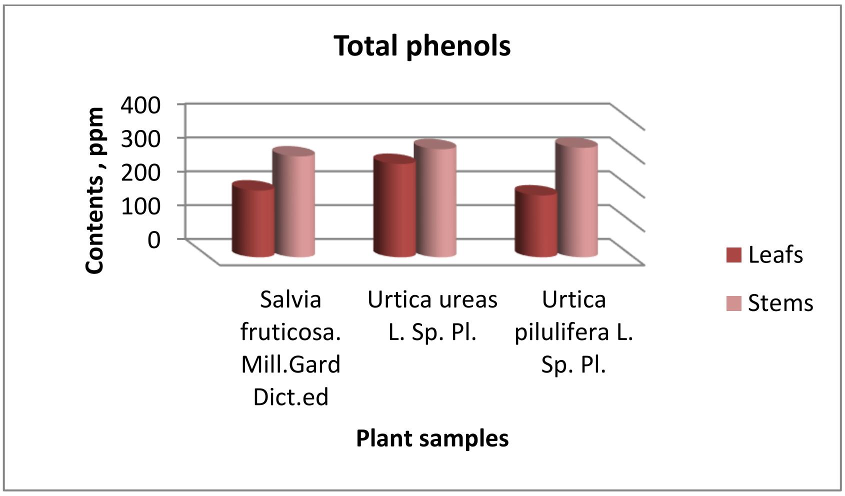

Figure 2. The number of total phenols expressed in ppm within the tested samples

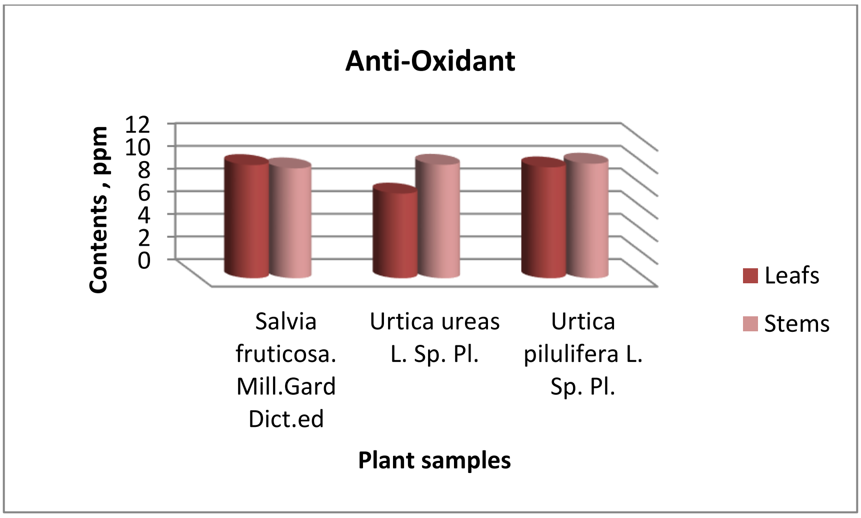

Figure 3. The Contents (ppm) of Anti-Oxidant in the studied samples

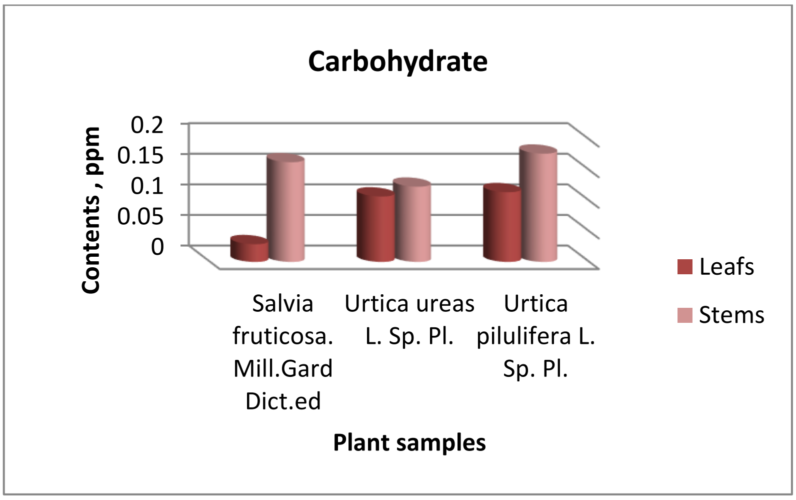

Figure 4. Carbohydrate amounts (ppm) detected in the collected samples

Minerals

The contents of potassium recorded higher values compared with calcium and sodium, where their values were ranged between (5.56 –36.56) and (32.76 -84.36 ppm) in leaves and stems, respectively. There are small values of Calcium observed in both leaves and stems, and their contents were ranged as follows: (0.48- 0.88) and (0.291 – 1.041 ppm) in leaves and stems, respectively. On the other side, the contents of sodium were fluctuated in the ranges of (1.125 – 2.95 ppm) in leaves and from 7.28 ppm to 20.08 in

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stems, (Table 3 and Figures 5,6 and 7).

Table3.Concentrations of selected minerals—Na, K, and Ca—expressed in ppm for the tested samples

Scientific name	**Sodium**		**potassium**		**Calcium**	
Compounds	Leaves	Stems	Leaves	Stems	Leaves	Stems
Salviafruticosa. Mill.Gard Dict.ed	1.125	7.28	5.56	32.76	0.48	0.791
Urtica urens L. Sp. Pl.	2.95	12.08	36.56	84.20	0.88	0.291
Urticapilulifera L. Sp. Pl.	2.291	20.08	23.56	84.36	0.68	1.041

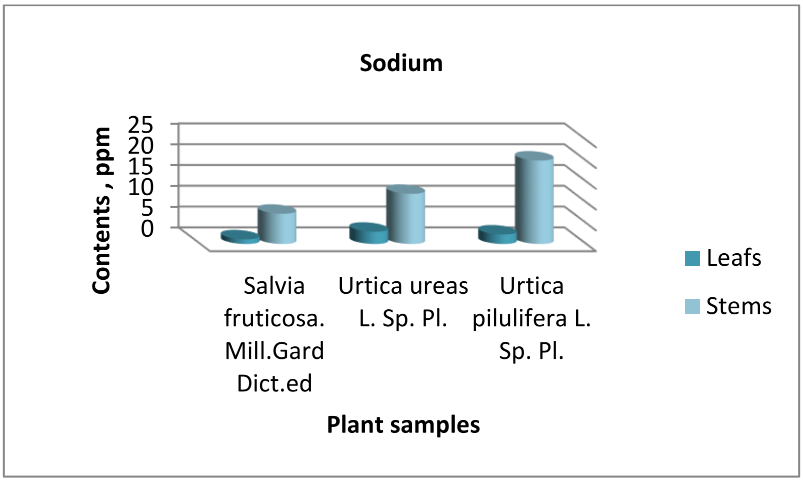

Figure 5. The Contents (ppm) of sodium in the studied samples

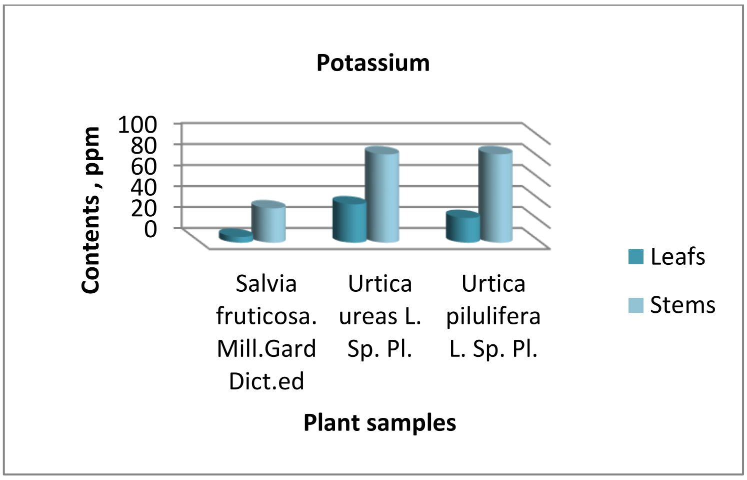

Figure 6. The Contents (ppm) of potassium in the studied samples

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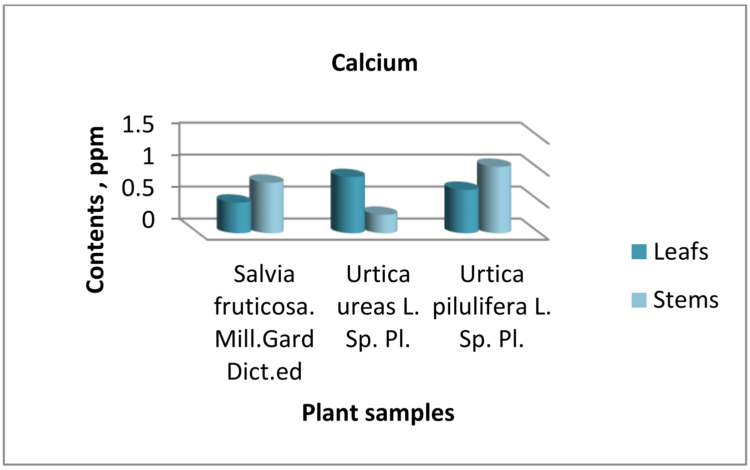

Figure 7. The Contents (ppm) of Calcium in the studied samples

Discussion

The results of the present study indicate that the investigated plant species contain relatively low concentrations of carbohydrates, total phenolic compounds, and antioxidant constituents. Antioxidant capacity in medicinal plants is largely attributed to the presence of bioactive substances such as phenolic compounds, flavonoids, and other secondary metabolites. In general, medicinal plants are rich in diverse natural products that contribute to their biological activities, particularly their antioxidant potential. The detection of phenolic compounds in the analyzed samples further supports their role in enhancing antioxidant activity.

The accurate characterization and quantification of distinct phenolic and flavonoid molecules rely heavily on advanced instrumental approaches, particularly gas chromatography combined with mass spectrometric detection (GC–MS) and high-resolution liquid chromatographic systems (HPLC).The occurrence of carbohydrates in the plant samples suggests their involvement in the biosynthesis of various secondary metabolites, including phenolic acids, tannins, terpenoids, and other organic constituents. Minor variations in the levels of these compounds between samples may be associated with physiological differences among plant tissues and their metabolic functions [30–35].

The analysis also confirmed the presence of essential minerals, namely sodium (Na), potassium (K), and calcium (Ca), in both leaves and stems. The slight differences observed in mineral concentrations between plant parts can be explained by structural and functional variations in the tissues. Furthermore, environmental factors at the sampling sites, such as soil composition, water availability, and geochemical characteristics of the habitat, play a significant role in influencing mineral accumulation in plants [73–85]. In addition, the analytical technique employed can affect the measured concentrations of metals and minerals. Various instrumental methods, including atomic absorption spectroscopy, spectrophotometry, flame photometry, inductively coupled plasma (ICP), and X-ray fluorescence (XRF), are commonly used to determine elemental contents in environmental and biological samples such as soil, water, and plant materials [86–95]. In some studies, metal elements have also been investigated for their antimicrobial properties and other biological applications [96–114].

Medicinal plants continue to be extensively utilized worldwide for therapeutic purposes. In many developing regions, particularly rural areas, traditional herbal medicine often represents the primary source of healthcare. Conversely, in developed countries, alternative medicine and dietary supplements are widely marketed, frequently based on traditional medicinal claims. However, by 2015, a large proportion of plant-derived medicinal products had not been rigorously evaluated for safety and efficacy, and their quality varied considerably, with some preparations containing potentially harmful substances [115]. Traditional medicine encompasses the use of numerous plant species along with diverse preparation methods and materials. As an illustration, a comprehensive ethnobotanical assessment carried out by researchers associated with the Royal Botanic Gardens, Kew, catalogued 104 plant species traditionally applied in diabetes management throughout Central America.

Notably, seven of these taxa were recurrently mentioned across at least three independent reports [116]. In a similar vein, the Yanomami communities residing in the Brazilian Amazon have compiled records of more than one hundred plant species incorporated into their indigenous therapeutic systems, with documentation facilitated through collaboration with ethnobotanical scholars.Moreover, several plant-derived compounds, such as opioids, cocaine, and cannabis, possess both medicinal and recreational

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applications, and their legal status and usage have varied across countries over time due to concerns related to psychoactive effects and public health risks [117].

Conclusion
The study's findings indicate that the chosen plants had varying concentrations of total phenols, antioxidants, and carbohydrates in their leaves and stems. In comparison to potassium and sodium, trace levels of calcium were found.

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Conflict of interest
The authors state that there is no inconsistency between the findings of this study and those of other research.

References
1. Ahn K. The worldwide trend of using botanical drugs and strategies for developing global drugs. BMB Rep. 2017;50(3):111-6.
2. Collins M. Medieval Herbals: The Illustrative Traditions. University of Toronto Press; 2000.
3. Tapsell LC, Hemphill I, Cobiac L. Health benefits of herbs and spices: the past, the present, the future. Med J Aust. 2006;185(4):4-24.
4. Sherman PW, Hash GA. Why vegetable recipes are not very spicy. Evol Hum Behav. 2011;22(3):147-63.
5. Stepp JR. The role of weeds as sources of pharmaceuticals. J Ethnopharmacol. 2004;92(2-3):163-6.
6. Morales J, Carrión M, Yolanda C, Joanne H. Late Pleistocene exploitation of Ephedra in a funerary context in Morocco. Sci Rep. 2024;14(1):26443.
7. Al-Awjali K, Abdulsalam S, El-Mokasabi F, Akrim Z, Hasan H. Estimate the antioxidant capacity, total phenol contents mineral concentrations, total carbohydrate of Capparis spinosa L. (Kabbar), Ceratonia siliqua L (Kharuwb) and Juniperus phoenicea L (Arar) plants. Attahadi Med J. 2025;2(4):376-84.
8. Aljamal MA, Hasan HM, Al Sonosy HA. Antibacterial activity investigation and anti-biotic sensitive's for different solvents (ethanol, propanol, DMSO and diethyl ether) extracts of seeds, leaves and stems of (Laurus azorica and Avena sterilis) plants. Int J Curr Microbiol App Sci. 2024;13(11):175-90.
9. Hamade MH, Abdelraziq SA, Gebreel AA. Extraction and determination of beta carotene content in carrots and tomato samples collected from some markets at ElBeida City, Libya. EPH Int J Appl Sci. 2019;1(1):105-10.
10. Hasan HM, Ibrahim H, Gonaid MA, Mojahidul I. Comparative phytochemical and antimicrobial investigation of some plants growing in Al Jabal Al-Akhdar. J Nat Prod Plant Resour. 2011;1(1):15-23.
11. Hasan H, Jadallah S, Zuhir A, Ali F, Saber M. Anti-cancer, anti-inflammatory, antibacterial, antifungal, anti-oxidant and phytochemical investigation of flowers and stems of Anacyclus clavatus plant extracts. AlQalam J Med Appl Sci. 2025;8(3):415-27.
12. Hasan H, Zuhir A, Shuib F, Abdraba D. Phytochemical investigation and exploring Citrullus colocynthis extracts as antibacterial agents against some gram and negative bacteria species. AlQalam J Med Appl Sci. 2025;8(3):392-400.
13. Md Zeyaullah R, Naseem A, Badrul I, Hamad MI, Azza SA, Faheem AB, et al. Catechol biodegradation by Pseudomonas strain: a critical analysis. Int J Chem Sci. 2009;7(3):2211-21.
14. Abdull-Jalliel H, B Arous N, Alhoreir M, Hasan H. Using extracts of (Dodder) plant and concentrations of some metals as inhibitors for growth, (Pseudomonas) bacteria isolated from some hospital rooms in Derna and Al bayda. AlQalam J Med Appl Sci. 2025;8(3):1600-11.
15. Abdull-Jalliel H, Sulayman A, Alhoreir M, Hasan H. Antimicrobial effect of some metal concentration on growth of staphylococcus and klebsiella bacteria species. AlQalam J Med Appl Sci. 2025;8(3):1646-56.
16. Hamad MH, Noura AAM, Salem AM. Phytochemical screening, total phenolic, anti-oxidant, metal and mineral contents in some parts of Plantago albicans grown in Libya. World J Pharm Res. 2024;13(3):1-17.
17. Anees AS, Hamad MIH, Hasan H, Mojahidul I. Antifungal potential of 1,2-4 triazole derivatives and therapeutic efficacy of Tinea corporis in albino rats. Der Pharm Lett. 2011;3(1):228-36.
18. Hamad Hasan, Marwa Mohammed, Amal Haroon. Determining contents of antioxidants, total phenols, carbohydrate, total protein, and some elements in Eucalyptus gomphocephala and Ricinus communis plant samples. Libyan Med J. 2015;1(1):222-31.
19. Hamad Hasan, Zuhir Akrim, Farag Shuib, Dala Abdraba. Efficiency of Cynara cornigera fruits on antibacterial, antifungal and its phytochemical, anti-oxidant screening. Libyan Med J. 2025;3(1):120-8.
20. Hamad Hasan, Ashour Sulayman, Ahmed Alehrir. Estimation of amino acid composition, total carbohydrate, and total protein content in Ballota pseudodictamnus plant extracts from Al Jabal Al Akhdar Region, Libya. Libyan Med J. 2025;3(1):266-71.
21. Al-Awjali K, Abdulathim A, El-Mokasabi F, Akrim Z, Hasan H. Antioxidant activity, total phenols and carbohydrate and mineral concentrations of Pistacia lentiscus L. Sp. Pl., Portulaca oleracea L. Sp. Pl. and Rubus sanctus Schreber. Khalij-Libya J Dent Med Res. 2026;48-55.

Received*: 04-02-2026 -* ***Accepted****: 02-04-2026 -* ***Published****: 09-04-2026*

22. Ben Arous NA, Naser ME, Hamad MAH. Phytochemical screening, anti-bacterial and anti-fungi activities of leaves, stems and roots of C. parviflorus Lam and C. salviifolius L plants. Int J Curr Microbiol App Sci. 2014;13(11):262-80.
23. Anas FAE, Hamad MAH, Salim AM, Azza MH. Phytochemical screening, total phenolics, antioxidant activity and minerals composition of Helichrysum stoechas grown in Libya. Afr J Biol Sci. 2024;3(6):2349-60.
24. Naseer RE, Najat MAB, Salma AA, Hamad MAH. Evaluation of metal and mineral contents of leaves, stems and roots of C. parviflorus Lam and C. salviifolius L plants growing at Al Ghabal Al-Khder (Libya). Int J Adv Multidiscip Res Stud. 2024;4(5):191-4.
25. Hamad MAH, Salem AM. Total carbohydrate, total protein, minerals and amino acid contents in fruits, pulps and seeds of some cultivars of muskmelon and watermelon fruit samples collected from Algabal Alkhder region. Sch J Appl Med Sci. 2024;12(1):1-7.
26. Gonaid MI, Ibrahim H, Al-Arefy HM. Comparative chemical and biological studies of Salvia fruticosa, Ocimum basillicum and Pelergonium graveolans cultivated in Al-Jabal Al-Akhdar. J Nat Prod Plant Resour. 2012;6(2):705-10.
27. Rinya FMA, Hamad MAH, Ahlam KA, Hammida MEH. Phytochemical screening of some herbal plants (Men, Origanum and Salvia) growing at Al-Gabal Al-akhder Region-Libya. Afr J Basic Appl Sci. 2017;9(3):161-4.
28. Anas FAA, Hamad MAH, Salim AA, Azza MH. Phytochemical screening, total phenolics, antioxidant activity and minerals composition of Helichrysum stoechas grown in Libya. Afr J Biol Sci. 2024;3(6):2349-60.
29. Haroon A, Hasan H, Wafa AAS, Baset ESM. A comparative study of morphological, physiological and chemical properties of leaves and steam samples of (E. gomphocephala) (Tuart) plant growing at coastal (Derna city) and …. J Res Environ Earth Sci. 2024;9(12):10-8.
30. Hamad MAS, Ali AR. Separation and identification speciation of phenolic compounds in fruits and leaves of some medicinal plants (Juniperus phoenicea and Quercus coccifera) growing at Algabal Al Akhder region, Libya. Indian J Pharm Educ Res. 2016;51(3):299-303.
31. Aisha Ali, Adel Abdulathim, Zuhir Akrim, Nevein Abdel-Hady, Hamad Hasan. Applying different analytical methods (GC-Mass, spectrophotometer, atomic absorption, and flame photometry) for estimation some chemical constituents in leaves and stems of the …. AlQalam J Med Appl Sci. 2026;234-41.
32. Hamad MIH, Safa RM Mousa. Synthesis and (IR and TEM) characterization of leaves and stem nanoparticles of Artemisia plant: comparative study for evaluation of anti-bacterial efficiency. Int J Adv Multidiscip Res Stud. 2024;4(5):195-9.
33. Al-Awjali K, Mohammed E, El-Mokasabi F, Ikraim Z, Hasan H. Using flame photometer and spectrophotometric methods to estimate the minerals, anti-oxidant capacity, total phenol, and total carbohydrate of Nicotiana glauca RC Graham …. Libyan Med J. 2026;1-8.
34. Alaila AK, El Salhin HE, Ali RF, Hasan HM. Phytochemical screening of some herbal plants (Men, Origanum and Salvia) growing at Al-Gabal Al-Akhder region-Libya. Int J Pharm Life Sci. 2017;8(4):5500-3.
35. Hasan H, Mariea FFE, Eman KS. Contents of some chemical compounds of leaves and stems of some herbal plants (Thymy, rosemary, Salvia, marjoram and hybrid tea rose) at Al-Gabal Al-Akhder region. EPH Int J Appl Sci. 2014;6(3):1-8.
36. Ehdoud Abdulhadi, Salma Abdulsalam, Asraa Bunuwarah, Asma Altarkawi, Zuhir Ikrim, Hamad Hasan. Spectrophotometric analysis of carbohydrates, proteins, amino acids, and metals in leaf and stem extracts of Cistaceae. Libyan Med J. 2025;432-41.
37. Hamad MIH, Aaza IY, Safaa SHN, Mabrouk MS. Biological study of transition metal complexes with adenine ligand. Proceedings. 2019;41(1):77.
38. Hasan JA, Hasan HMA. Potential human health risks assessment through determination of heavy metals contents in regularly consumed yogurta in Libya. World J Pharm Pharm Sci. 2024;13(12):100-12.
39. Mamdouh SM, Wagdi ME, Ahmed MA, Alaa EA, Essam AM, Hamad MIH. Rice husk and activated carbon for waste water treatment of El-Mex Bay, Alexandria Coast, Egypt. Arab J Chem. 2016;9(S2):S1590-6.
40. Mamdouh SM, Wagdi ME, Ahmed MA, Alaa EA, Hamad IH. Heavy metals accumulation in sediments of Alexandria coastal areas. Bull Fac Sci. 2012;47(1-2):12-28.
41. Mamdouh SM, Wagdi ME, Ahmed MA, Hamad MIH. Chemical studies on Alexandria coast sediment. Egypt Sci Mag. 2005;2(4):93-102.
42. Mamdouh SM, Wagdi ME, Ahmed MA, Alaa EA, Hamad MIH. Distribution of different metals in coastal waters of Alexandria, Egypt. Egypt Sci Mag. 2010;7(1):1-19.
43. Shanzaq Mohammed, Asmaa Altarkawi, Hamad Hasan. Investigation of the effect of two different solvents (aqueous and alcoholic) on phytochemical screening and antimicrobial activities for the Globularia repens plant. Libyan Med J. 2025;356-65.
44. Mohamed AE, Afnan SA, Hamad MA, Mohammed AA, Mamdouh SM, Alaa RE, et al. Usage of natural wastes from animal and plant origins as adsorbents for removal of some toxic industrial dyes and heavy metals in aqueous media. J Water Process Eng. 2023;55:104192.
45. Mohamed HB, Mohammed AZ, Ahmed MD, Hamad MAH, Doaa AE. The heavy metal pollution and associated toxicity risk assessment in Ajdabiya and Zueitina, Libya. Sci J Damietta Fac Sci. 2024;14(1):16-27.
46. Nabil B, Hamad H, Ahmed E. Determination of Cu, Co and Pb in selected frozen fish tissues collected from Benghazi markets in Libya. Chem Methodol. 2018;2:56-63.
47. Wesam FAM, Hamad MAH. Detection of heavy metals and radioactivity in some bones of frozen chicken samples collected from Libyan markets. Int J Adv Multidiscip Res Stud. 2023;3(3):761-4.

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48. Wesam FAM, Hamad MAH. Study accumulation of minerals and heavy metals in Ulva algae, Cladophora, Polysiphonia and Laurencia algae samples at eastern north region of Libya coast. GSC Biol Pharm Sci. 2023;23(3):147-52.
49. Citrine E, Hamad H, Hajer Af. Contents of metal oxides in marine sediment and rock samples from eastern Libyan coast, utilizing X-ray method. AlQalam J Med Appl Sci. 2015;1(1):1316-21.
50. Hanan MA, Hamida E, Hamad MAH. Nitrogen, phosphorus and minerals (sodium, potassium and calcium) contents of some algae's species (Anabaena and Spirulina platensis). Int J Curr Microbiol App Sci. 2016;5(11):836-41.
51. Mardhiyah F, Hamad H. Assessment of the contamination by heavy metals in Al-Fatayeh Region, Derna, Libya. AlQalam J Med Appl Sci. 2025;8(3):1081-91.
52. Abdelrazeg A, Khalifa A, Mohammed H, Miftah H, Hamad H. Using melon and watermelon peels for removal of some heavy metals from aqueous solutions. AlQalam J Med Appl Sci. 2025;8(3):787-96.
53. Abdul Razaq A, Hamad H. Estimate contents and types of water well salts by Palmer Roger model affecting corrosion of Al-Bayda city (Libya) network pipes. AlQalam J Med Appl Sci. 2025;8(3):744-53.
54. Abdulsayid FA, Hamad MAH, Huda AE. IR spectroscopic investigation, X-ray fluorescence scanning, and flame photometer analysis for sediments and rock samples of Al-Gabal Al-Akhder coast region (Libya). IOSR J Appl Chem. 2021;14(4):20-30.
55. ALambarki M, Hasan HMA. Assessment of heavy metal contents in air samples collected from area extended between Albayda and Alquba cities (Libya). AlQalam J Med Appl Sci. 2025;8(3):695-707.
56. Al-Nayyan N, Mohammed B, Hamad H. Estimate of concentrations of heavy metals in the and some plant samples collected from (near and far away) of main road between Al-Bayda city and Wadi Al-Kouf region. AlQalam J Med Appl Sci. 2025;8(3):816-26.
57. Hasan HMI. Studies on physicochemical parameters and water treatment for some localities along coast of Alexandria [dissertation]. Alexandria (Egypt): Alexandria University; 2006.
58. Hamad MAH, Hager AA, Mohammed EY. Chemical studies of water samples collected from area extended between Ras Al-Halal and El Haniea, Libya. Asian J Appl Chem Res. 2022;12(3):33-46.
59. Hamad M, Mohammed AA, Hamad MAH. Adsorption and kinetic study for removal some heavy metals by use in activated carbon of sea grasses. Int J Adv Multidiscip Res Stud. 2024;4(6):677-85.
60. Hamad MAH, Hamad NI, Mohammed MYA, Hajir OAA, Al-Hendawi RA. Using bottom marine sediments as environmental indicator state of (Tolmaitha – Toukra) region at eastern north coast of Libya. Sch J Eng Tech. 2024;2(14):118-32.
61. Hamad MIH. Heavy metals distribution at coastal water of Derna city (Libya). Egypt J Aquat Res. 2008;34(4):35-52.
62. Hamad MIH, Mojahid ul Islam. Concentrations of some heavy metals of Al-Gabal Al-Akhdar coast sediment. Arch Appl Sci Res. 2010;2(6):59-67.
63. Hamad MAH, Amira AKA. Estimate concentrations of some heavy metals in some shoes polish samples. EPH Int J Appl Sci. 2016;2(2):24-7.
64. Hamad MAH, Hussien SSM, Basit EEM. Accumulation of some heavy metals in green algae as bio indicators of environmental pollution at Al-Haniea region: Libya coastline. Int J Adv Multidiscip Res Stud. 2024;4(5):188-90.
65. Hamad MIH, Ahmed MA. Major cations levels studies in surface coastal waters of Derna city, Libya. Egypt J Aquat Res. 2009;35(1):13-20.
66. Hamad MIH, Masoud MS. Thermal analysis (TGA), differential thermal analysis (DTA), infrared and X-rays analysis for sediment samples of Toubrouk city (Libya) coast. Int J Chem Sci. 2014;12(1):11-22.
67. Hamad R, Ikraiam FA, Hasan H. Estimation of heavy metals in bones of selected commercial fish from eastern Libyan coast. J Rad Nucl Appl. 2024;9(1):47-51.
68. Hasan HAH. Estimate lead and cadmium contents of some archeological samples collected from ancient cities location (Cyrene and Abolonia) at Al-Gabal Al-Akhder Region, Libya. Univ J Chem Appl. 2021;12(21):902-7.
69. Hasan H, El-maleh C. Evaluation of some heavy metal levels in tissue of fish collected from coasts of Susa region, Libya. Attahadi Med J. 2025;1(1):118-22.
70. Balal A, Obid M, Khatab H, Hasan H. Determination of lead and cadmium marine water and crabs (Pachygrapsus marmoratus) from Tolmitha coast, Libya. AlQalam J Med Appl Sci. 2025;8(3):1670-7.
71. Hamad IH, Nuesry MS. Poly cyclic hydrocarbons levels in some fishes tissues collected from Derna City (Libya) coast. In: International conference on chemical, agricultural and medical sciences; 2014 Dec 4-5; Antalya, Turkey. 2014. p. 52-6.
72. Hamad MAH, Mounera AAE, Baseet ESM, Eman E, Al-Badri M. Identification and detection aromatic and aliphatic hydrocarbons in Epinephelus marginatus fish samples collected from Benghazi coast. Int J Adv Multidiscip Res Stud. 2023;6(3):107-13.
73. Mohammed A, Hamad MAH, Mounera AAE, Eman IHE. Extraction and identification of aliphatic hydrocarbons in marine sediment samples at Benghazi city and Dyriana town coasts (Libya). J Res Humanit Soc Sci. 2023;11(10):168-74.
74. Hasan MAH, Muftah HS, Abdelghani KA, Saad SI. Poly aromatic hydrocarbon concentrations in some shell samples at some Tobrouk city coast regions: could oil industry be significantly affecting environment. Ukr J Ecol. 2022;12(3):21-8.
75. Habel AMA, Mohamed NIH, Mohammed MA, Hamad MAH. Levels and sources of aliphatic and polycyclic aromatic hydrocarbons in blue runner fish from Benghazi coast, Libya. Afr J Biol Sci. 2024;6(3):1-10.

Received: *04-02-2026* - ***Accepted***: *02-04-2026* - ***Published***: *09-04-2026*

76. Hasan HMI, Mohamad ASA. A study of aliphatic hydrocarbons levels of some waters and sediments at Al-Gabal Al-Akhder coast regions. Int J Chem Sci. 2013;11(2):833-49.
77. Salem GM, Aljidaemi FF, Hwisa SA, Hamad MIH, Zaid AA, Amer IO. Occupational exposure to benzene and changes in hematological parameters in East Tripoli, Libya. Nanotechnol Percept. 2024;20(S5):358-64.
78. Habil Z, Ben arous N, Masoud N, Hasan H. Using GC-mass method for determination hydrocarbon compounds in some vegetable samples at Derna city, Libya. Libyan Med J. 2025;17(3):374-83.
79. Hasan H, Habil Z, Ben arous N. Estimate types and contents of phenolic acid in C. parviflorus Lam and C. salviifolius L plants growing at Al-Gabal Al-Hder regions. AlQalam J Med Appl Sci. 2025;8(3):1646-56.
80. Zeyadah MA, Bahnasawy MH, Deedah AM, El-Emam DA, Hasan MA. Evaluation of the contents of aliphatic and aromatic hydrocarbons in sediment from Zueitina harbor coast (Libya), as indicator of petroleum pollution. Egypt J Aquat Biol Fish. 2023;27(6).
81. Hamad R, Ikraiam F, Hasan H. Determination of specific natural radionuclides in bones of some local fish commonly consumed from eastern Libyan coast. J Rad Nucl Appl. 2023;8(3):283-9.
82. Sroor AT, Walley El-Dine N, El-Bahi SM, Hasan HMA, Ali JM. Determination of radionuclides levels and absorbed dose for the rock, plant and water in Gondola-Libya. IOSR J Appl Phys. 2018;10(4):40-9.
83. Hasan H, Ammhmmid R, Khatab H, Ali J, Al kaseh A. Using gamma ray radiation to estimate types and contents of radioactive nuclides in some ported sugar samples, Libya. AlQalam J Med Appl Sci. 2025;8(3):1795-803.
84. Hasan H, Abdelgader I, Emrayed H, Abdel-Gany K. Removal of medical dye safranin from aqueous solutions by sea grasses activated carbon: a kinetic study. AlQalam J Med Appl Sci. 2025;8(3):428-34.
85. Hasan HMA, Alhamdy MA. Adsorption and kinetic study for removal some heavy metals by using activated carbon of sea grasses. Int J Adv Multidiscip Res Stud. 2024;4(6):677-85.
86. Almadani EA, Hamad MAH, Kwakab FS. Kinetic study of adsorption of removal of bromo cresol purple from aqueous solutions. Int J Res Granthaalayah. 2019;7(12):1-10.
87. Alfutisi H, Hasan H. Removing of thymol blue from aqueous solutions by pomegranate peel. EPH Int J Appl Sci. 2019;1(1):111-9.
88. Ahmed ONH, Hamad MAH, Fatin ME. Chemical and biological study of some transition metal complexes with guanine as ligand. Int J New Chem. 2023;10(3):172-83.
89. Hamad MAH, Enas UE, Hanan AK, Hana FS, Somia MAE. Synthesis, characterization and antibacterial applications of compounds produced by reaction between barbital with threonine, glycine, lysine, and alanine. Afr J Biol Sci. 2024;6(4):1-10.
90. Hasan S, Abduljalil O, Mohamed F, Hasan H. Detection of residual pesticides (imidacloprid, aldicarb, metalaxyl, cypermethrin, chlorpyrifos, DDA, and endrin) in peach samples collected from Jabal al Akhder farms, Libya. AlQalam J Med Appl Sci. 2025;8(4):2099-106.
91. Mohamed FH, Salah MIH, Omuthum A, Hasan Hamad. Sensitive and rapid method to estimate residual pesticides in some local and imported apple cultivars collected from eastern north side of Libya. Int J Adv Multidiscip Res Stud. 2023;3(6):100.
92. Hamad MIH, Aaza IY, Safaa SHN, Mabrouk MS. Biological study of transition metal complexes with adenine ligand. In: The 23rd International Electronic Conference on Synthetic Organic Chemistry. Proceedings. 2019;41(1):77.
93. Habib IH, Idres AMA, Hasan HMI. Synthesis, infrared (IR), thermal gravimetric analysis (TGA) characterization and antibacterial activity of some amino acids complexes. Chem Sci Rev Lett. 2014;3(12):1303-16.
94. Hasan HMA, Khalid HAA, Abdulsayid F. Infrared (IR) characterizations and physicochemical properties of Schiff base compound obtained by the reaction between 4-hydroxy-3-methoxy benzaldehyde and 2-amino-3-methylbutanoic acid. J Res Pharm Sci. 2021;7:8-12.
95. Zawia A Asia, Najar AM, Abdusalam AAA, Aeyad T. Synthesis, characterization, biological screening and molecular docking of new Schiff base and its mononuclear complexes with Pb2+, Cd2+, Zn2+ and Cu2+. J Pharm Appl Chem. 2023;8(1):1-9.
96. Hasan HMA, Elmagbari F, Othman A, Hammouda AN. Chemical and biological study of some transition metal complexes with guanine as ligand. Int J New Chem. 2023;10(3):172-83.
97. Hasan HMA, Al-Warad Y. Synthesis, physical properties, infrared (IR) analysis and anti-fungi activity of some valine and metal ion complexes. Int J Multidiscip Sci Adv Technol. 2021;Spec Iss 1:246-54.
98. Hasan H, Abdulathim A, Bunuwarah A. Using atomic absorption spectrometry (AAS) for the determination of aluminum and zinc in wrapped chocolate and chips samples. Attahadi Med J. 2026;32-8.
99. Hasan H, Mohamed E, Abdulathim A. Detection of types and contents of natural radionuclides and hazard indexes in vegetable and soil samples at some Al-Marj City locations. Razi Med J. 2026;46-57.
100. Hasan H, Mohamed E, Mohamed R. Evaluation of the contents of manganese and lead and their hazard indices in some coffee brands. AlQalam J Med Appl Sci. 2026;197-204.
101. Hasan H, Abdulalah A, Khalifa M, Saleh M. Assessment of natural radioactivity and health risk indices in commercial tea samples from Libyan markets using gamma-ray spectrometry. AlQalam J Med Appl Sci. 2025;2330-40.
102. Hasan H, Abdulalah A, Khalifa M, Abduinabi H. Assessment of natural radioactive elements and health risk values in imported cocoa samples at some Libyan markets. Libyan Med J. 2025;383-92.
103. Hasan H, Bader H, Ali H, Othman H. Detection of radioactive element contents and their hazard indices in composite soil and rock samples from the southern Al Jabal al Akhdar region (between Aslunta and Al ...). Libyan Med J. 2025;366-37.

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Attahadi Medical Journal
2026;3(2):127-137
https://doi.org/10.69667/amj.26203

104. Hasan H, Khalifa M, Saleh M. Using inductively coupled plasma (ICP) for estimating some heavy metals and elements in some tea samples and calculating their health risk assessment. AlQalam J Med Appl Sci. 2025;2190-201.
105. Hasan H, Ali H, Bader H, Yousef M. The detection of the types and contents of metal oxides and ores in the southern regions of Al-Gabal Alkhder (Libya) areas. AlQalam J Med Appl Sci. 2025;2181-9.
106. Altarkawi A, Mohammed S, Hasan H. Microbial applications of leaves and stems of Matricaria chamomilla plant growing at Al-Gabal Al-Khder region. AlQalam J Med Appl Sci. 2025;2088-9.
107. Hasan H, Alfurjani H, Idres N. Physicochemical characteristics and heavy metal concentrations in marine waters between Tolmitha and Tukra, Libya. Libyan Med J. 2025;502-13.
108. Hasan H, Ali A, Abdel-Hady N. Analysis of fatty acids, phenolic compounds, antimicrobial activity, paper chromatography, and metal and mineral content of the Arbutus pavarii plant. AlQalam J Med Appl Sci. 2025;2021-32.
109. Hasan H, Amhmmid R, Habil Z, Khatab H, Masoud N. Assessment of selected properties and heavy metal concentrations in soil and vegetable samples from regions surrounding Derna city, Libya. Libyan Med J. 2025;463-73.
110. Habil Z, Ben Arous N, Masoud N, Hasan H. Using GC-mass method for determination the hydrocarbon compounds in some vegetable samples at Derna city, Libya. Libyan Med J. 2025;374-83.
111. Hasan H, Al Jamal M, Mahmoud A, Al Daik G. Estimation of residual organic matter and heavy metals in some hookah (waterpipe, argileh) samples. AlQalam J Med Appl Sci. 2025;1051-5.
112. Hasan H, Mohammed M, Al Hadad E. Metal pollution and hazard indexes of heavy metal contents for some fish tissues collected from some Libyan coasts. Attahadi Med J. 2025;127-38.
113. Chan M. WHO Director-General addresses traditional medicine forum. Geneva: World Health Organization; 2015.
114. Giovannini P, Melanie-Jayne R, Edwards SE. Medicinal plants used in the traditional management of diabetes and its sequelae in Central America: a review. J Ethnopharmacol. 2016;184:58-71.
115. Milliken W. Medicinal knowledge in the Amazon. London: Kew Gardens; 2017.

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