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Original article

Antibacterial Investigation and Mineral Contents of Stems and Leaves of Latus Tetrgonolobus plant extracts

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A B S T R A C T

In this study, mineral contents (Sodium, potassium, calcium, phosphorus, and Nitrogen) were estimated using flame photometry and Spectrophotometry methods. An antibacterial investigation of leaves and stems of the Latus Tetragonolobus plant was also conducted. The results of minerals recorded that the contents fluctuated in the ranges of potassium of (1419 and 1233 ppm) in leaves and Fruits, respectively, followed by Nitrogen (652.25 and 262.20 ppm) in leaves and fruits, respectively. In contrast, phosphorus, sodium, and calcium fluctuated as follows: 85.09, 30.36, and 10.76 ppm in leaves and 85.04, 22.36, and 8.76 ppm in fruits. Higher contents were recorded for potassium and nitrogen compared with the other minerals; there is a relative increase in the mineral levels in leaves compared with stem extracts. For the antibacterial activity against the selected species of Staphylococcus aureus, Bacillus cereus, and Pseudomonas aeruginosa, the results showed a relative increase in the inhibition zone of leaves compared with stem extracts (5-11 g/ml) against Escherichia coli compared with the values of 3-5 mg/l. Also, all concentrations showed inhibition zones that fluctuated between 12 -16 mg/l of leaves compared with the fruit extract (6-12 mg/l)

Introduction

Phytochemicals are naturally occurring chemicals present in or extracted from plants [1-2]. Some phytochemicals are nutrients for the plant, while others are metabolites produced to enhance plant survivability and reproduction[3]. The fields of extracting phytochemicals for manufactured products or applying scientific methods to study phytochemical properties are called *phytochemistry* [3]. An individual who uses phytochemicals in food chemistry manufacturing or research is a *phytochemist*. The term phytochemical does not generally imply that there is any biological activity or health benefit following its consumption [2]. Once phytochemicals in a food enter the digestion process, the fate of individual phytochemicals in the body is unknown due to extensive metabolism of the food in the gastrointestinal tract, producing phytochemical metabolites with different biological properties from those of the parent compound that may have been tested in vitro [4]. Further, the bioavailability of many phytochemical metabolites appears to be low, as they are rapidly excreted from the body within minutes [4]. Other than for dietary fiber, no non-nutrient phytochemicals have sufficient scientific evidence for providing a health benefit. Some ingested phytochemicals may be toxic, and some may be used in cosmetics, drug discovery, or traditional medicine.[3].

Several studies have taken place in Libya to estimate chemical and biological properties [5-39]. Most of these studies showed the presence of different compounds in the studied plants. In Libya, there are continues growth in the environmental constituents (Plants, Soil, water, and Chemical constituents during the Last twenty years [40- 110]. Also, several instruments such as (Atomic absorption, flame photometer, Spectrophotometer, GC-Mass, and other methods) were used in these studies. This study aims to estimate the Minerals (Sodium, potassium, Calcium, nitrogen, and phosphorus contents) and biological investigation of Latus *Tetrgonolobus* plant extracts.

Methods

Sampling

In this study, the leaves and stems of Latus Tetrgonolobus plants were selected, and the samples were collected from different locations around Al-Marj farms. The study area is located on the second terrace of El- Jabal El- Akhdar mountain. The climate of the study area is comparable to that of El-Jabal El-Akhdar, with a mean temperature of about 15 oC in winter and 24 in summer. The average rainfall ranges between 200 and 300 mm.

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Sample extraction

10 grams of each dried sample were taken and transferred to a beaker containing 100 ml of distilled water; the mixture was mixed. Then the extraction was carried out by an evaporator system at 75 ^{0}C. After two hours, the mixture was filtered; the filtrate was used to determine the phytochemical screening [6-10].

Determination of Minerals

The sodium, potassium, and calcium contents were measured by a Flame Photometer (JENWAY Flame Photometer) according to the method described by some studies [60-70]. In the central lab of the Faculty of Science, Omar Al-Mukhtar University.

Results

Minerals

The contents of sodium, potassium, calcium, phosphorus, and Nitrogen in leaves and fruits of the studied plant showed wide variations, where the highest concentrations were recorded for potassium of (1419 and 1233 ppm) in leaves and Fruits, respectively, followed by Nitrogen (652.25 and 262.20 ppm) in leaves and fruits, respectively. On the other hand, the contents of phosphorus, sodium, and calcium fluctuated as follows: 85.09,30.36, and 10.76 ppm in leaves and 85.04, 22.36, and 8.76 ppm in fruits. Generally, there is a relative increase in the mineral contents in leaves compared with their values in the fruits of the studied plant, except for nitrogen (Table 1).

Table 1. The contents (ppm) of minerals (Na, K, Ca, N and P) in fruits and Leaves of the studied samples

Minerals / Plant	Sodium		potassium		Calcium		Phosphorus		Nitrogen	
	Leafs	Fruits	Leafs	Fruits	Leafs	Fruits	Leafs	Fruits	Leafs	Fruits
Latus Tetrgonolobus	30.36	22.36	1419	1233	10.76	8.76	85.09	85.04	652.25	262.2

Antibacterial activity

The results of antibacterial activity of extracts of fruits and leaves showed antibacterial activity against different bacteria species, including Gram-positive bacteria (*Staphylococcus aureus*) and (*Bacillus cereus*), beside gram negative bacteria (*Pseudomonas aeruginosa*) and (*Escherichia coli*) species, the results of antibacterial activities are illustrated in the tables of (2-5). Higher concentrations of 0.9 g/ml showed higher inhibition zones for Bacillus Cereus; there is a relative increase in the effect of leaf extracts compared with fruits. For the effect of the studied abstracts the results showed the leaves extracts showed higher values of inhibition zones (5-11g/ml) against Escherichia coli compared with the values of 3-5 mg/l. Also, all concentrations showed that inhibition zones fluctuated between (12 -16 mg/l) of leaves compared with the fruit extract (6-12 mg/l).

Table 2. Antibacterial activity of different concentrations of leaves and fruits of plant extracts against Staphylococcus aureus

Concentrations	Leaves	Fruits
0.9 g/ml	R	R
0.6 g /ml	R	R
0.4 g /ml	R	R
0.2 g/ml	R	R

Table 3. Antibacterial activity of different concentrations of leaves and fruits of plant extracts against Bacillus Cereus

Concentrations	Leaves	Fruits
0.9 g/ml	15	12
0.6 g /ml	12	11
0.4 g /ml	11	10
0.2 g/ml	10	R

Table 4. Antibacterial activity of different concentrations of leaves and fruits of plant extracts against Pseudomonas aeruginosa

Concentrations	Leaves	Fruits
0.9 g/ml	16	12
0.6 g /ml	14	10

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0.4 g /ml	13	9
0.2 g/ml	12	6

Table 5. Antibacterial activity of different concentrations of leaves and fruits of plant extracts against Escherichia coli

Concentrations	Leaves	Fruits
0.9 g/ml	11	5
0.6 g /ml	7	3
0.4 g /ml	6	R
0.2 g/ml	5	R

Discussion

A number of studies have indicated that extracts obtained from medicinal plants possess various biological properties, including antibacterial, anti-inflammatory, and antioxidant properties. While some of those active substances remain ineffective as independent antibiotics or antimicrobial agents, they may assist in combatting antibiotic resistance when used as an antimicrobial cocktail [111]. Various plant extracts have antibiotic properties that show inhibitory effects against specific bacterial communities.

Since plant extracts contain various active compounds that exhibit synergetic effects against a wide range of pathogens [112], herbal plants are a reservoir for a wide range of chemical compounds with antimicrobial properties. With a plethora of compounds possessing antimicrobial activities, it is a humongous challenge to include all medicinal plants and the associated compounds with antibacterial properties. Nonetheless, in this review, we have highlighted a few highly intriguing compounds as discussed below [113]. Also, the variations in the minerals may be attributed to different factors, such as soil and water types, according to their mineral content, mainly the leaves containing minerals higher than the other plant tissues, such as stems, fruits, and Flowers.

Conclusion

The results of this study showed the presence of minerals including sodium, potassium, calcium, nitrogen, and phosphorus in the studied plant. Also, the extracts showed antibacterial activities against the selected species (Staphylococcus aureus) and (Bacillus cereus), besides Gram-negative bacteria (Pseudomonas aeruginosa) and (Escherichia coli) species in this study

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Conflict of interest. Nil

References

1. Frank J, Fukagawa NK, Bilia AR. Terms and nomenclature used for plant-derived components in nutrition and related research: efforts toward harmonization. Nutr Rev. 2000;78(6):451-458.
2. Hassan SA, Tripathi R, Sreejith K. Plant Metabolites: Methods for Isolation, Purification, and Characterization. In: Sukumaran ST, et al., editors. Plant Metabolites: Methods, Applications and Prospects. Singapore: Springer; 2020.
3. Harborne JB, Baxter H, Moss GP, editors. General Introduction. In: Phytochemical Dictionary: A Handbook of Bioactive Compounds from Plants. 2nd ed. London: Taylor & Francis; 1999. p. vii.
4. Molyneux RJ, Lee ST, Gardner DR. Phytochemicals: the good, the bad and the ugly? Phytochemistry. 2007;68(22-24):2973-2985.
5. 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):376-384.
6. 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, leafs and stems of (Laurus azorica and Avena sterilis) plants. Int J Curr Microbiol App Sci. 2024;13(11):175-190.
7. 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):105-110.
8. 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.
9. 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):415-427.

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10. 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.
11. 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):2211-2221.
12. 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):1600-1611.
13. 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):1646-1656.
14. 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.
15. 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):228-236.
16. 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):222-231.
17. 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):120-128.
18. 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):266-271.
19. 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.
20. Ben Arous NA, Naser ME, Hamad MAH. Phytochemical screening, anti-bacterial and anti-fungi activities of leafs, stems and roots of C. parviflorus Lam and C. salviifolius L plants. Int J Curr Microbiol App Sci. 2014;13(11):262-280.
21. 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):2349-2360.
22. Naseer RE, Najat MAB, Salma AA, Hamad MAH. Evaluation of metal and mineral contents of leafs, 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):191-194.
23. 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.
24. 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):705-710.
25. 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):161-164.
26. 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):2349-2360.
27. Haroon A, Hasan H, Wafa AAS, Baset ESM. A comparative study of morphological, physiological and chemical properties of leafs and steam samples of (E. gomphocephala) (Tuart) plant growing at coastal (Derna city) and .... J Res Environ Earth Sci. 2024;9(12):10-18.
28. Hamad MAS, Ali AR. Separation and identification speciation of phenolic compounds in fruits and leafs 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.
29. 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. 2026:234-241.
30. Hamad MIH, Safa RM Mousa. Synthesis and (IR and TEM) characterization of leafs and stem nanoparticles of Artemisia plant: comparative study for evaluation of anti-bacterial efficiency. Int J Adv Multidiscip Res Stud. 2024;4(5):195-199.
31. 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.
32. 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):5500-5503.
33. Hasan H, Mariea FFE, Eman KS. Contents of some chemical compounds of leafs 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.
34. 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. 2025:432-441.
35. 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. 2025:2181-2189.

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36. Altarkawi A, Mohammed S, Hasan H. Microbial applications of leaves and stems of Matricaria chamomile plant growing at Al-Gabal Al-Khder region. AlQalam J Med Appl Sci. 2025:2088-2089.
37. 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. 2025:2021-2032.
38. 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. 2025:463-473.
39. 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. 2025:374-383.
40. 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.
41. 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. 2025:356-365.
42. 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.
43. 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.
44. 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.
45. 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):761-764.
46. 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):147-152.
47. 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):1316-1321.
48. 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):836-841.
49. 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):1081-1091.
50. 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):787-796.
51. 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):744-753.
52. 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.
53. 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.
54. 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):816-826.
55. Hasan HMI. Studies on physicochemical parameters and water treatment for some localities along coast of Alexandria [dissertation]. Alexandria (Egypt): Alexandria University; 2006.
56. 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.
57. 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):677-685.
58. 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):118-132.
59. Hamad MIH. Heavy metals distribution at coastal water of Derna city (Libya). Egypt J Aquat Res. 2008;34(4):35-52.
60. 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.
61. Hamad MAH, Amira AKA. Estimate concentrations of some heavy metals in some shoes polish samples. EPH Int J Appl Sci. 2016;2(2):24-27.
62. 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):188-190.
63. 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.
64. 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.
65. 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.

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66. 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):902-907.
67. 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):118-122.
68. 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):1670-1677.
69. 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. 52-56.
70. 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):107-113.
71. 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):168-174.
72. 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):21-28.
73. 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.
74. 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):833-849.
75. 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):358-364.
76. 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):374-383.
77. 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):1646-1656.
78. 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).
79. 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):283-289.
80. 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):40-49.
81. 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):1795-1803.
82. 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):428-434.
83. 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):677-685.
84. 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.
85. Alfutisi H, Hasan H. Removing of thymol blue from aqueous solutions by pomegranate peel. EPH Int J Appl Sci. 2019;1(1):111-119.
86. 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):172-183.
87. 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.
88. 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):2099-2106.
89. 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.
90. 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.
91. 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):1303-1316.
92. 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.
93. 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.
94. 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):172-183.

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95. 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 1:246-254.
96. 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. 2026:32-38.
97. 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.
98. 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.
99. 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. 2025:2330-2340.
100. 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. 2025:383-392.
101. 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. 2025:366-337.
102. 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. 2025:2190-2201.
103. Hamad MIH, Aaza IY, Safaa SHN, Mabrouk MS. Biological study of transition metal complexes with adenine ligand. Proceedings. 2019;41(1):77.
104. 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):100-112.
105. 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-S1596.
106. 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.
107. Mamdouh SM, Wagdi ME, Ahmed MA, Hamad MIH. Chemical studies on Alexandria coast sediment. Egypt Sci Mag. 2005;2(4):93-102.
108. Hasan H, Alfurjani H, Idres N. Physicochemical characteristics and heavy metal concentrations in marine waters between Tolmitha and Tukra, Libya. Libyan Med J. 2025:502-513.
109. 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. 2025:1051-1055.
110. 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. 2025:127-138.
111. Cowan MM. Plant products as antimicrobial agents. Clin Microbiol Rev. 1999;12(4):564-582.
112. Ondua M, Njoya EM, Abdalla MA, McGaw LJ. Anti-inflammatory and antioxidant properties of leaf extracts of eleven South African medicinal plants used traditionally to treat inflammation. J Ethnopharmacol. 2019;234:27-35.
113. de Boer HJ, Kool A, Broberg A, Mziray WR, Hedberg I, Levenfors JJ. Anti-fungal and anti-bacterial activity of some herbal remedies from Tanzania. J Ethnopharmacol. 2005;96(3):461-469.

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