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Original article

Antioxidant Activity, Total Phenols and Carbohydrate and Mineral Concentrations of *Pistacia lentiscus L. Sp. Pl. Portulaca oleracea L. Sp. Pl.* and *Rubus sanctus Schreber. L Consp. Descr. Pl* plants

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Abstract
This study presents a comparative chemical evaluation of leaf and stem tissues from Pistacia lentiscus L. Sp. Pl., Portulaca oleracea L. Sp. Pl., and Rubus sanctus Schreber. L con. Descr. Pl., collected from multiple sites between the Al-Quba and Derna regions.The investigation focused on assessing antioxidant *activity, total phenolic content, total carbohydrate levels, and the concentrations of selected mineral elements, namely sodium, potassium, and calcium. A combination of spectrophotometric techniques was employed to quantify antioxidant capacity, total phenols, and carbohydrates, while mineral analysis was performed using flame photometry. The results demonstrated that total phenolic content varied notably among samples, with concentrations ranging from 197.05 to 351.72 ppm. Antioxidant activity exhibited limited variation across the studied tissues, with values between 9.2 and 9.6 ppm in leaves and between 9.99 and 10.74 ppm in stems. Carbohydrate levels were consistently low in both leaves and stems across all investigated species, indicating that secondary metabolites rather than primary energy storage compounds dominate the chemical composition of these plants. Mineral analysis revealed that calcium was present at lower concentrations compared to sodium and potassium. Potassium content showed marked variability, ranging from 6.36 to 77.16 ppm in leaves and from 52.36 to 84.36 ppm in stems, reflecting tissue-specific accumulation patterns and potential environmental influences. Overall, the findings highlight distinct differences in phytochemical and mineral profiles between plant organs and among species, underscoring the importance of tissue type and geographical origin in determining the chemical characteristics of medicinal plants.*
Keywords. *Minerals, Anti-Oxidant, Total phenols, plants, Libya.*

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Introduction

Medicinal plants, commonly known as medicinal herbs, have been utilized in traditional therapeutic practices since ancient civilizations. Plants biosynthesize a wide array of chemical compounds that serve multiple biological functions, most notably defense mechanisms against herbivorous animals, insects, fungi, pathogenic microorganisms, and parasites. In addition to protective roles, these secondary metabolites contribute to physiological regulation and ecological interactions within plant systems.

Historical evidence indicates that the earliest documented use of medicinal plants dates back to the Sumerian civilization, where clay tablets from approximately 3000 B.C. listed hundreds of herbal remedies, including opium. Similarly, the Ebers Papyrus from ancient Egypt (circa 1550 B.C.) describes more than 850 plant-based treatments, forming the foundation of pharmacopoeias that influenced medical practice for nearly 1500 years. In modern drug discovery, ethnobotanical knowledge is frequently applied to identify biologically active compounds with therapeutic potential. This strategy has led to the development of numerous clinically significant drugs, such as opium, digoxin, aspirin, and quinine. The majority of phytochemicals identified in plants belong to four major biochemical classes: alkaloids, glycosides, polyphenols, and terpenes. Despite their abundance and diversity, only a limited number of these compounds have been scientifically validated for medicinal use or incorporated into conventional pharmaceutical applications [3]. Consequently, extensive research efforts have been conducted to isolate, characterize, and quantify various plant-derived compounds [4–38]. In parallel, the elemental composition of medicinal plants, particularly essential minerals and trace metals, has been investigated using diverse analytical techniques to evaluate their nutritional and therapeutic relevance [38–75].

The present study aims to estimate selected chemical constituents—namely carbohydrates, total phenolic compounds, and antioxidant activity—in specific medicinal plants through phytochemical analysis of their leaves and stems. Additionally, the concentrations of essential minerals, including sodium (Na), potassium (K), and calcium (Ca), were determined in the leaves and stems of *Pistacia lentiscus* L. Sp. Pl., *Portulaca*

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oleracea L. Sp. Pl., and *Rubus sanctus* Schreber. L consp. Descr. Pl. These plant species were collected from various locations in Libya, where environmental and geographical factors may influence their phytochemical and mineral profiles

Methods

Sampling

In this study the leafs and stems of *Pistacia lentiscus L. Sp. Pl.* *Portulaca oleracea L. Sp. Pl.* and *Rubus sanctus Schreber. L Consp. Descr. Pl* plants were selected, where the samples were gathered from diverse areas included Al-Dhahr Al- Ahmar in the South, valley known as Wadi Derna, Karsah in the west, and the coast of the Mediterranean in the north are all located in the region. Located in the Derna region of northeastern Libya, the research area located on the second terrace of El-Jabal El-Akhdar Mountain within the country of Libya. The Wadi cuts the city in half at longitudes 33°00' and 32°30' north and 22°30' and 22°45' east, dividing it into two halves. The Wadi is situated between 40 and 300 meters above sea level. The climate of the research region is comparable to that of El-Jabal El-Akhdar, with average temperatures of about 20 degrees Celsius. Figure 1 illustrates that the average rainfall ranges from 200 to 300 mm.

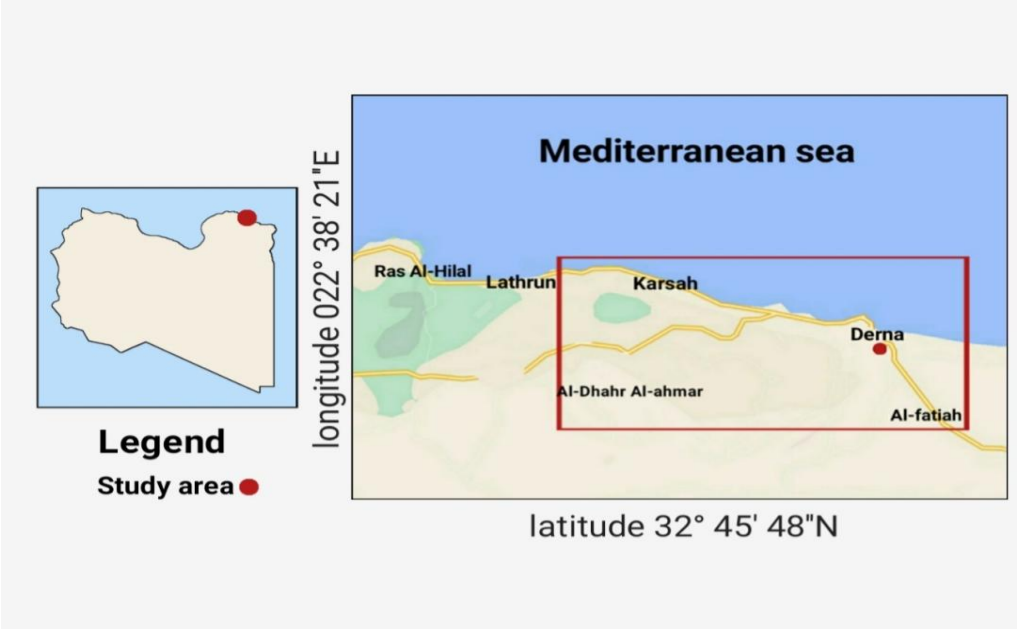

Figure 1. The studied area

Preparation and Aqueous Extraction of Plant Samples

Plant samples were prepared for analysis through an aqueous extraction procedure optimized for polar phytochemicals. Precisely 10 g of each sample were weighed and immersed in 100 mL of distilled water in clean glass beakers. The suspensions were mechanically stirred to promote solvent penetration and enhance mass transfer between plant tissues and the extraction medium. Extraction was Conducted using a temperature-Controlled evaporator system set at 75 °C, a Condition selected to improve extraction efficiency while minimizing thermal degradation of heat-sensitive Constituents. The process was maintained for two hours, after which the mixtures were cooled and subjected to filtration to separate solid residues. The clarified aqueous extracts were collected and used directly for subsequent phytochemical analyses following established procedures [6–10].

Quantification of Total Phenolic Content

The total phenolic Concentration of the obtained extracts was evaluated using a modified Folin–Ciocalteu colorimetric assay, based on the method reported by Slinkard and Singleton [10]. Gallic acid was employed as the reference compound for calibration and quantification. Duplicate aliquots of each extract were transferred into optical cuvettes, after which 1.0 mL of Folin–Ciocalteu reagent was added. The reaction was initiated by the addition of 0.8 mL of sodium carbonate solution (7.5%), which adjusted the alkaline Conditions required for phenolic oxidation. The mixtures were incubated at 30 °C for 90 minutes to allow complete development of the blue-colored complex resulting from electron transfer reactions between phenolic compounds and the reagent. Absorbance readings were recorded at 765 nm using a Shimadzu UV–Vis spectrophotometer. Total phenolic Content was calculated from the gallic acid standard curve and expressed in parts per million (ppm) relative to fresh sample weight.

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Evaluation of Antioxidant Capacity by the Prussian Blue Method

Antioxidant potential was assessed using the Prussian blue assay, which is based on the reduction of ferric ions to ferrous ions by antioxidant molecules. Prior to extraction, one gram of dried and powdered plant material was defatted using petroleum ether to remove lipophilic components that could interfere with redox reactions. The defatted residue underwent two sequential extractions with 10 mL of methanol under Continuous agitation. To ensure recovery of acid-soluble antioxidant compounds, an additional extraction was performed using 10 mL of methanol acidified with 1% hydrochloric acid (v/v). The combined extracts were Concentrated under reduced pressure via vacuum evaporation. The resulting residue was dissolved in 10 mL of methanol to obtain a homogeneous analytical solution. For the colorimetric reaction, 0.5 mL of the prepared extract was mixed with 3 mL of distilled water, followed by the addition of 3 mL of potassium ferricyanide solution (0.008 M), 3 mL of hydrochloric acid (0.1 M), and 1 mL of ferric chloride solution (1%). The mixture was allowed to stand for five minutes to permit the formation of the Prussian blue complex. Absorbance was measured at 720 nm in the central laboratory of the Faculty of Science, Omar Al-Mukhtar University, and the absorbance intensity was used as an indicator of antioxidant activity.

Determination of Total Carbohydrate Content

Total carbohydrate levels were determined using an acid hydrolysis followed by phenol–sulfuric acid colorimetric detection. Approximately 0.2 g of dried, finely powdered plant material was treated with 5 mL of Concentrated sulfuric acid to hydrolyze complex carbohydrates into simple sugars. Upon complete dissolution, the reaction mixture was allowed to cool to ambient temperature. Neutralization of excess acid was achieved by the gradual addition of barium carbonate ($BaCO_3$), after which the mixture was reheated to complete the reaction. Following cooling, the solution was filtered to remove precipitated salts and insoluble residues. One milliliter of the filtrate was combined with 1 mL of 5% phenol solution, and the resulting chromogenic reaction was allowed to develop. Absorbance was measured at 490 nm using a UV–Vis spectrophotometer. Total carbohydrate Concentration was calculated using established procedures reported in earlier studies [8–10].

Determination of Mineral Elements

The elemental composition of the plant samples was evaluated through flame photometric analysis. Sodium (Na), potassium (K), and calcium (Ca) Concentrations were measured using a JENWAY Flame Photometer at the central laboratory of the Faculty of Science, Omar Al-Mukhtar University. Instrument calibration was performed using standard solutions of known Concentrations for each element. Quantitative results were obtained by comparing sample emission intensities with calibration curves, following analytical protocols documented in previous research [60–70].

Results

Total phenols, Anti – Oxidant and Carbohydrate Contents

According to the study's findings, total phenol concentrations were higher in the plants' stems than in their leaves. The Pistacia lentiscus L. Sp. Pl. plant's leaves showed a lower Concentration (197.06 ppm) and a greater Content (339.43 ppm). According to Table 3, the total phenol Concentrations ranged from 197.06 to 300.11 ppm for leaves and from 313.40 to 351.772 ppm for stems. The anti-oxidant levels in the leaves and stems, respectively, ranged from 9.240 to 9.677 ppm and 9.99 to 10.74 ppm. However, the carbohydrate Contents of the plants under study did not exhibit high values or significant differences between the leaves and stems. The range of their readings was 0.004 to 0.144 ppm for leaves and 0.133 to 0.172 ppm for stems. (Table 1).

Table 1. The Consptents (ppm) of Phenols, Anti-oxidant, and Carbohydrate in the studied samples

Scientific name	**Total Phenols**		**Anti-Oxidant**		**Carbohydrate**	
Compounds	Leafs	Stems	Leafs	Stems	Leafs	Stems
Pistacia lentiscus L. Sp. Pl.	197.06	313.40	9.240	10.74	0.134	0.172
Portulaca oleracea L. Sp. Pl.	300.11	339.43	9.480	10.08	0.144	0.133
Rubus sanctus Schreber. LConsp. Descr. Pl	226.22	351.72	9.677	9.99	0.004	0.165

Minerals

The results of the research revealed the presence of sodium, potassium, and calcium in the leaves and stems of the plants under investigation. The sodium Contents ranged from 0.375 to 1.291 ppm in the

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leaves and from 3.68 to 41.48 ppm in the stems, respectively. The findings showed that Portulaca oleracea L. Sp. Pl. had higher sodium Contents (41.48 ppm) than the other plants under investigation. Additionally, the potassium concentrations were higher in the stems when compared to the other plants under investigation. When compared to samples of leaves, the results revealed higher potassium Contents in stems. In general, potassium Contents varied between 6.36 and 77.16 ppm in leaves and between 52.36 and 84.36 ppm in stems. The results also revealed trace quantities of calcium, which varied from 0.625 to 0.875 ppm in stems and from 0.08 to 0.28 ppm in leaves (Table 2).

Table 2. The Contents (ppm) of minerals (Na ,K and Ca) in the studied samples

Scientific name	**Sodium**		**Potassium**		**Calcium**	
Compounds	Leafs	Stems	Leafs	Stems	Leafs	Stems
Pistacia lentiscus L. Sp. Pl.	0.375	6.48	17.16	52.36	0.12	0.708
Portulaca oleracea L. Sp. Pl.	1.291	41.48	77.16	84.36	0.28	0.875
Rubus sanctus Schreber. LConsp. Descr. Pl	0.708	3.68	6.36	59.56	0.08	0.625

Discussion

The quantitative analysis of the investigated plant samples revealed the presence of appreciable levels of total phenolic compounds and antioxidant activity, while carbohydrate concentrations were comparatively low. This compositional pattern is characteristic of many medicinal plants, where biological activity is primarily associated with secondary metabolites rather than energy-storage compounds. The antioxidant capacity observed in the extracts can be directly linked to the abundance and diversity of naturally occurring phytochemicals capable of participating in electron transfer and free-radical neutralization reactions.

Phenolic compounds are widely recognized as major Contributors to antioxidant behavior due to their redox properties and structural ability to stabilize reactive oxygen species. In the present study, variations in total phenolic Content and antioxidant activity among plant parts can be explained by differences in tissue-specific metabolic activity. Leaves, which are metabolically active and directly exposed to environmental stressors, typically accumulate higher concentrations of protective secondary metabolites compared to stems. These findings are Consistent with previous reports indicating that phenolic acids, tannins, terpenes, and related compounds dominate the phytochemical profiles of medicinal plants, with their relative abundance governed by physiological function and tissue differentiation [30–35].

Although carbohydrates were detected in limited quantities, their presence remains significant, as carbohydrate-derived structures often serve as precursors or Conjugated components of secondary metabolites such as glycosides. The modest variability in carbohydrate levels observed between leaves and stems may therefore reflect differences in biosynthetic pathways and structural roles rather than nutritional storage alone. In addition to organic Constituents, elemental analysis demonstrated that sodium (Na), potassium (K), and calcium (Ca) were Consistently present in both leaves and stems of the studied species. These elements are essential for numerous physiological processes, including enzyme activation, osmotic regulation, membrane stability, and signal transduction. The relatively small but measurable differences in mineral concentrations between plant organs can be attributed to variations in tissue anatomy, ion transport mechanisms, and storage capacity within cellular compartments.

Environmental Conditions were found to play a decisive role in shaping the mineral composition of the analyzed samples. Factors such as soil mineralogy, water quality, and the geochemical characteristics of the plant growth environment strongly influence elemental uptake and accumulation. Consequently, plants collected from different locations may exhibit distinct mineral profiles even when belonging to the same species. This observation aligns with previous studies emphasizing the combined influence of biological and environmental factors on mineral distribution in medicinal plants [73–85]. The results of the present study reinforce the broader understanding that the chemical composition of medicinal plants is inherently variable and Context-dependent. Such variability has important implications for the standardization, safety, and efficacy of plant-derived products. Despite their widespread use, a substantial proportion of medicinal plant products remains insufficiently evaluated, and inconsistencies in preparation and quality Control have been reported, particularly in traditional and informal healthcare settings [101].

Ethnobotanical research Continues to highlight the extensive reliance on plant-based therapies across cultures. For example, surveys Conducted by Kew Gardens documented 104 plant species used in the treatment of diabetes in Central America, although only a small subset demonstrated Consistent use across multiple independent studies [102]. Similarly, documentation of traditional medical practices among the Yanomami people of the Brazilian Amazon revealed the medicinal application of over 100 plant

species, underscoring both the richness of indigenous knowledge and the need for systematic scientific validation.

Certain plant-derived compounds, including opiates, cocaine, and cannabis, further illustrate the complex relationship between medicinal value and potential risk. These substances possess well-established pharmacological effects but also raise Concerns related to toxicity, dependency, and psych-activity. As a result, regulatory frameworks governing their use have varied widely across regions and time periods, reflecting differing evaluations of therapeutic benefit versus societal risk [103].

Conclusion

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

Acknowledgment

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Conflict of Interest

The authors declare that there are no financial, personal, or professional relationships that could be perceived as influencing the results or interpretations presented in this work. Furthermore, the findings reported herein do not Conflict with those of previously published studies.

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