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# Detect Polyphenol and Fatty Acid Content of Two Wild Plants Collected in Mazne Sub-district, Kurdistan Region of Iraq

**SAMIAA J. ABDULWAHID-KURDI**

Department of General Sciences, Faculty of Education, Soran University, Kawa street, Soran, Erbil, Kurdistan Region of Iraq street, Soran, Erbil, Kurdistan Region, Iraq.

**Abstract**

*Celtis tournefortii* Lam and *Prosopis farcta* plant's antioxidant and polyphenolic characteristics have been attributed to the various phytochemicals, including phenolic and fatty acids, present in the crude extract in the leaves, fruits, pods, and seeds. This study's aim is to determine the entire phytochemical compositions of the leaf and fruit reflect *Celtis tournefortii* Lam, while pod and seed represent *Prosopis farcta* from Mazne sub-district, including proximate analysis, total antioxidant capacity, total organic acids, ascorbic acids, polyphenols, and fatty acids following established procedures. Pods have higher levels of fiber (41±0.05 mg/100 g), protein (20.3±0.05%), and vitamin C (26.47±0.03 mg/100 g) from *Prosopis farcta*, although fruit has higher levels of total antioxidants (89.54± 0.28%) and organic acid (1576±0.57 mg/kg) from *Celtis tournefortii* Lam. Gallic acid (10.56±0.03 mg/kg) had the highest concentration of polyphenols, whereas the pod contained the highest concentrations of quercetin (11.27±0.14 mg/kg), rutin (13.0±0.57 mg/kg), coumaric acid (2140.57 mg/kg), and chlorogenic acid (659.0±0.57 mg/kg). Oleic acid 32.60±0.24%, Cis-11-Eicosenoic 3.20±0.11%, and Cis-4,7,10,13,16,19-Docosahexaenoic 2.10±0.05% were the most prevalent unsaturated fatty acids in the seed, whereas palmitic 17.40±0.05% and tricosanoic 6.40±0.05% were the most prevalent saturated fatty acids in the leaves. Overall, seeds had the highest concentration of unsaturated fatty acids (74.44%), while leaves had the highest concentration of saturated fatty acids (44.42%). This study identifies two untamed plants, *Celtis tournefortii* Lam and *Prosopis farcta*, as potential new sources of natural oil and beneficial natural ingredients.

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**CONTACT** Samiaa J. Abdulwahid-Kurdi samiaa.abdulwahid@gmail.com Department of General Sciences, Faculty of Education, Soran University, Kawa street, Soran, Erbil, Kurdistan Region of Iraq street, Soran, Erbil, Kurdistan Region, Iraq.



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## Introduction

Approximately 70-80% of the world's population, primarily in developing countries, still relies primarily on medicinal plants as their major source of healthcare since they are more commonly accepted culturally.[1] Phytochemicals are organic substances that are present in various plant sections.[2] Crude extracts and dry powder samples from medicinal plants and their species have recently attracted interest in the development and production of alternative traditional medicine.[3] Linoleic and alpha-linolenic acid cannot be produced by the human body; they must be consumed through diet.[4] Since ancient times, the oils found in the seeds of these plants have been used to strengthen the body. They have also traditionally been used as a diuretic.[5] Fruits also contain oleic acid, which is widely known for its ability to strengthen the immune system and lower the risk of diseases brought on by reactive oxygen species.[6] Fruit growth is accompanied by the simultaneous accumulation of sugars and organic acids, albeit at different developmental stages. Both concentration and metabolic processes differ substantially between species. Accordingly, it has been discovered that as sweet fruits such as apples, litchi, melons, peaches, and strawberries ripen, sucrose, glucose, and fructose accumulate in them.[7] The search for herbal medicinal plants with possible medicinal properties is crucial due to their ethno-medical usage, as well as their isolation, characterization, and conservation.[8] Traditional plants from the Mazne region that were the focus of ethnobotanical studies, like the *Celtis tournefortii* Lam and *Prosopis farcta* are discussed in this manuscript.

Mazne Subdistrict is located 135 kilometers from the center of Erbil Kurdistan region of Iraq. It has a vast range of plant species. Mazne region experiences a Mediterranean climate with cold winters and hot summers, and the center district receives more than one meter of snow each year. It has long been suggested that some tree species could be used as animal feed in arid regions. Because of this, edible wild plants offer a significant nutritional value for humans. For example, they include vitamins, antioxidants, carbs, lipids, and proteins.[9] From wild edible plants, several medicines and therapies have been created over the years.[10] Traditional treatments for a variety of conditions, including arthritis, eczema, cancer, diarrhea, diabetes, hypertension, cardiovascular issues, renal disorders, and joint pain, use the *Celtis tournefortii* Lam species.[11]

A deciduous tree, *Celtis tournefortii* Lam, which belongs to the family Cannabaceae can reach a height of 6 meters in plains and dry woods in hot climates. According to Yldrm *et al.*[12] numerous nations, including Kurdistan in Iraq, Turkey, Iran, Ukraine, Croatia, Greece, and Azerbaijan, are fond of this tree's edible fruits. It is called Hackberry in English and Tawk in Kurdish. Perennial shrub *Prosopis farcta*, which belongs to the family Fabaceae (Leguminosae) grows to a height of 30 to 100 cm and is a common plant in the Middle East, where it dominates the entire belt of Mediterranean-style alluvial soils used for agriculture. It is called Syrian mesquite in English and Khrnuk in kurdish. It can be found in Iraq in a range of environments, from the North to the South.[13] Kurdish people utilized *Prosopis farcta* leaves or beans as a traditional medicine to treat conditions like colds, diarrhea, inflammation, measles, diabetes, skin problems, prostate abnormalities, wound healing, gastrointestinal problem, stomach ache and chest pain.[14] The phytochemical and antioxidant properties of *Celtis tournefortii* Lam and *Prosopis farcta* have not been thoroughly investigated and reported in the Mazne sub-district of Kurdistan region. However, various studies conducted in the past have demonstrated that both *Celtis tournefortii* Lam and *Prosopis farcta* plants have therapeutic uses in both Iranian and Turkish. *Celtis tournefortii* Lam leaves and fruits, *Prosopis farcta* pods and seeds were grown in their native habitats in Mazne subdistrict, and this study was therefore designed to evaluate the chemical components, polyphenols and fatty acids content of these wild plants.

## Material and Methods

### Description of the Study Area

The Mergasor district is divided into five subdistricts (Sherwan Mazne, Barzan, Goretu, Piran, Mazne) as shown in (Figure 1). Mazne subdistrict is made up of 31 villages and 25 kilometers away from Mergasor District's. The global position system (GPS) coordinates for these locations were 36°47'28.5"N latitude and 44°25'24.5"E longitude. *Celtis tournefortii* Lam (voucher species: (ESUH7901) and *Prosopis farcta* (voucher species: ESUH7913) were collected in November 2021 from the Mazne sub-district (Figure 2). Plants identified by a National Herbarium of Kurdistan expert, coded, and kept at the Salahaddin University Herbarium Education College's herbarium (ESUH7901 and ESUH7913).

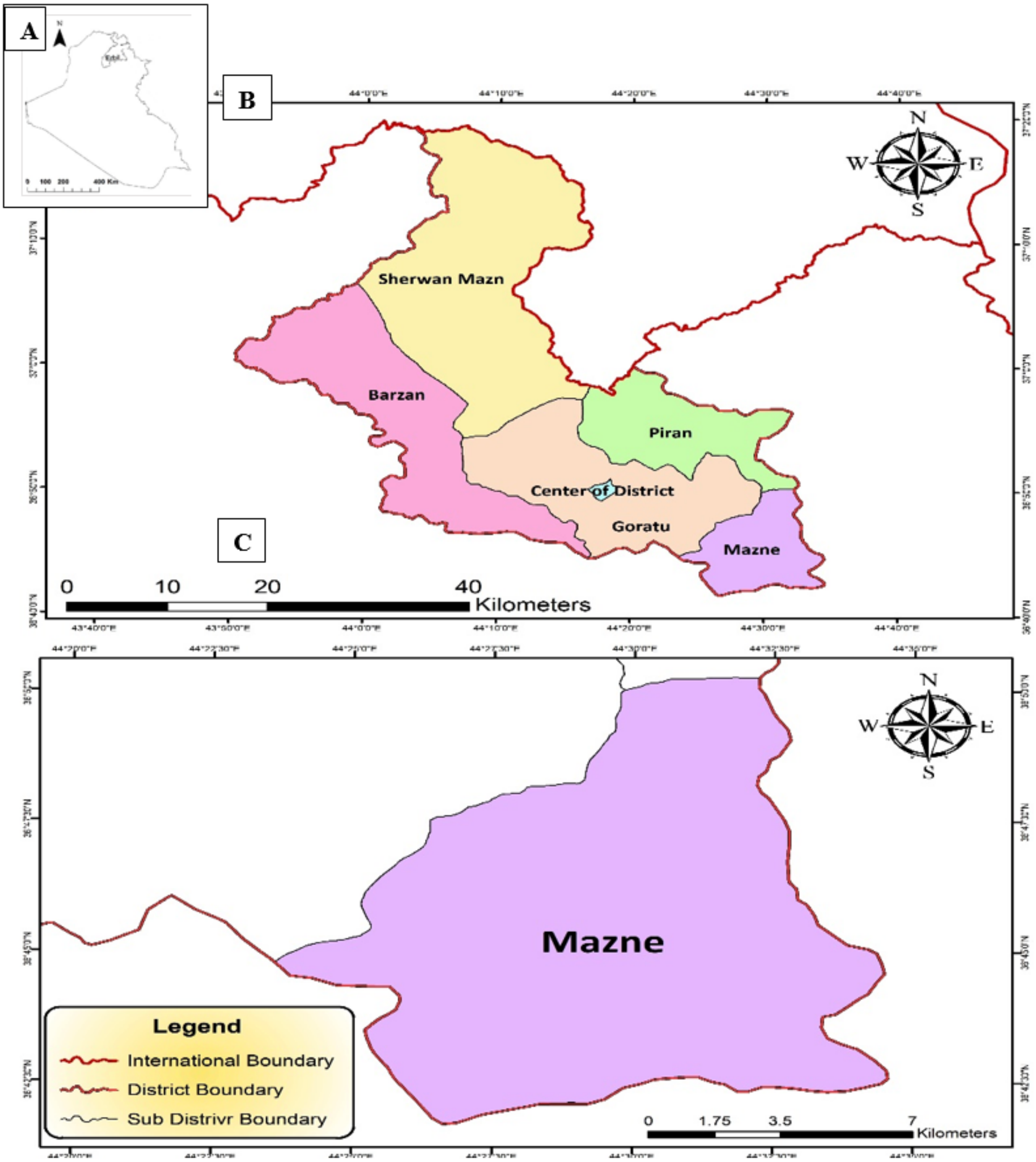


**Fig. 1: Maps showing the location of the research area. A. Iraqi map B. Mergasur district C. Mazne sub-district.**

A. *Celtis Tournefortii* Lam

*B. Prosopis farcta*

**Fig. 2: Trees of the study area.**

**Collect Plant Samples**

Leaves, ripe fruits, pods and seeds wild trees were used as sources for the randomly selected plant samples. Each tree in the plant specimen had three copies. Wild plant samples were dried in the shade (Figure 3). Before the leaves, fruits, pods and seeds were mashed then stored as a homogenous powder at -80 °C until extraction.

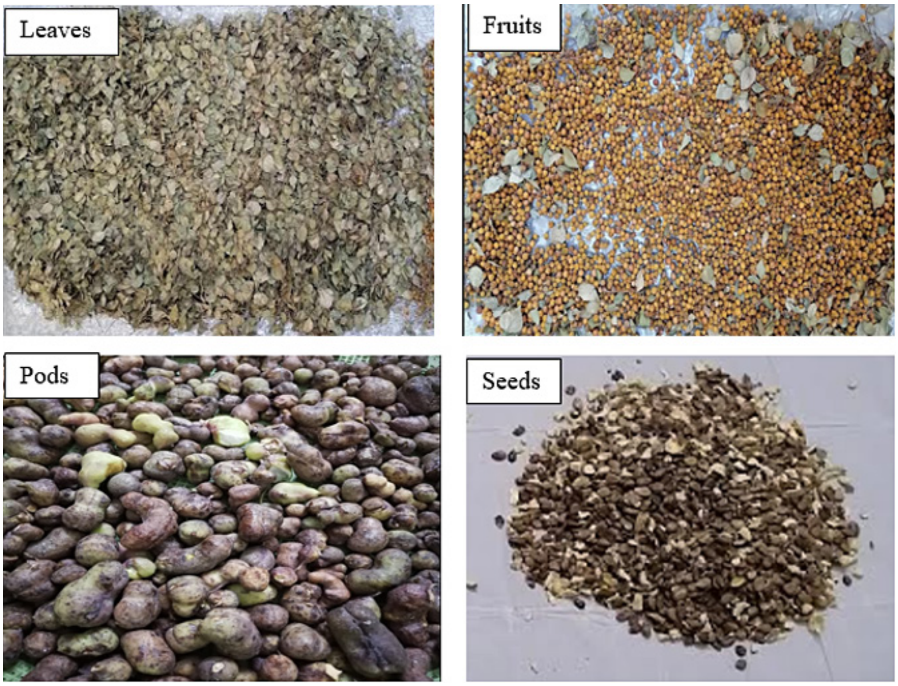


**Fig. 3: leaves, fruits Celtis tournefortii Lam, and pods, seeds of Prosopis farctal.**

**Proximate Analysis**

According to the official analysis procedures from the Association of Official Analytical Chemists,[15] proximate analyses were used to determine the amounts of ash, moisture, protein, fat, and carbohydrates in the samples.

**Total Antioxidant**

The total antioxidant was evaluated using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) DPPH standard, following the procedure employed by Brand-Williams *et al.*[16]

**Vitamin C**

Utilizing the titration method and 1, 2-dichlorophenol indophenol (DCIP) solution vitamin C was measured as described by Mokhtarpour *et al.*[17]

**Total Sugar**

One milliliter of standard solution or properly diluted sample was combined with 0.5 milliliters of 0.1N HCl. The mixture was boiled in a 100°C water bath for 15 minutes before being immersed in cold water to cool it. Half milliliter of 0.1N NaOH was added while mixing after cooling. Nelson's decreasing sugar test was used to measure the obtained sample solution's total sugar concentration.[18]

**Polyphenol Extraction**

Two gram of the powdered samples were taken out in order to extract the polyphenols. Four milliliter of a methanol solution having 1% acetic acid was added. Ultrasonic waves were then used to conduct the solvent extraction for 20 minutes. The phenolic acids were isolated, recognized, and quantified using the high-performance liquid chromatography (HPLC) apparatus model 1100 series (Agilent USA). It was set up with a 20 microliter injection loop, four solvent gradient pumps, a degassing system, a column oven (set at 25°C), and a diode array detector with settings for 250, 272, and 310 nm, respectively.[21]

### Total Phenolic Content

According to Iqbal et al,[19] the total phenolic content of the plant sample was ascertained using the modified Folin-Ciocalteu technique. The amount of phenolic in extracts was then quantified as mg GAE/g extract (gallic acid equivalents).

### Total Flavonoids Content

The aluminium chloride colorimetric method established by Yusri *et al.*[20] was used to quantify the total flavonoid concentration (TFC) in extracts. TFC was expressed as rutin equivalents in milligrams per gram of extract for extracts (mg RU/g extract).

### Fatty Acid Analysis

A 500 ml of hexane was placed in a flask with a round bottom and 100 g of plant powder was combined with a soxhlet chamber, which was then set up to extract the mixture for 6 hours at 50°C. The distillation procedure was started after the extracts were heated to a gentle extraction temperature of 50°C to prevent thermal degradation of the bioactive components. The solvent and extractor were placed in a water bath after the extraction procedure was finished to allow the solvent to evaporate. Soxhlet extraction was used to obtain seed oil. Vortex was used to properly homogenize the oil samples and each sample was carefully weighed at 100 mg. Then, 5 mL of methanolic sulfuric acid (12% v/v) and 3 mL of soap methanolic potassium hydroxide (2M) were added to the fat to convert it to methyl ester. One milliliter of regular heptane was used to extract the fatty acid methyl ester, and 1μL of regular heptane phase was added to gas chromatography mass spectro-photometer (GC-MS) (Agilent HP 6890 Series combined with Agilent HP 5973 Mass Selective Detector), to assess the fatty acid profile. By comparing the inhibition times, each fatty acid was identified using the standard fatty acid solution produced by Sigma Company.[21]

### Statistical Analysis

The PROC UNIVARIATE technique of SAS software was used in the current study to verify that all of the data was in accordance with normality before statistical analysis. The means (SEM) and standard error of the means are displayed for each result in the tables. Tukey's post hoc comparison test was used to explain the analysis of variance ANOVA in one way or statistically relevant variations between group means. Statistical operations were carried out with a 95% degree of confidence. The graph was also made using the program Graph Pad Prism.

## Results and Discussion

The antioxidant properties of two plant species, particularly those that are less often used in food and medicine, are currently the subject of a paucity of research data. In light of this, assessing these characteristics is still fascinating and helpful, especially when trying to find new sources of natural polyphenols, food supplements, and health products.[22] To support their activities, all humans needed a variety of complex chemical and inorganic components in their diets. Natural phytochemicals, such as fatty acids, flavonoids, and phenolic compounds, are significant bioactive compounds that have been demonstrated to have a variety of biological effects and to be protective against a number of diseases.

Carbohydrates, lipids, proteins, vitamins, minerals, and water are crucial nutritional components. Table 1 displays the primary nutrient composition of the *Celtis tournefortii* Lam leaves and fruit, *Prosopis farcta* pod and seed. The ash contents of the two plant species have similar values, but they differ statistically. The ash content of *Celtis tournefortii*-fruits Lam's and leaves 93±0.04% and 3.65±0.08% respectively, is significantly higher than that of the pod and seeds. The higher ash content of the fruits demonstrated their increased mineral richness.[23] Analyses of carbohydrates showed that seeds (48.5±0.28%) had much more carbohydrates than pods (25.8±0.1%), leaves (36.3±0.33%), and fruits. According to Shibata *et al.*[24] the reserve content of *Agave angustifolia* seeds was primarily made up of starch, with smaller amounts of proteins and lipids. In comparison to seeds (11.80±0.05%), leaves (16.6±0.11%), and fruit (15.4±0.06%), protein levels in pods (20.3±0.05%) were significantly greater. Due to moisture and protein contents often slightly decreasing with maturation and concurrent increases in total carbohydrates and fat, the amount of protein is smaller than the amount of carbohydrates.[25] These alterations imply that proteins are being broken down into peptides and amino acids, which can then be employed to create new tissue or contribute to the respiratory cycle of events. According to Shibata *et al.*[24] maturations often resulted in a minor decrease in moisture and protein contents and an increase in total carbs and fat.[25] According to Dasari *et al.*[26] environmental factors (such as the year and growing place) have an impact on how much crude protein plants produce as they grow.[27]

The pod's (41±0.05 mg/100g) crude fiber content was substantially higher than that of the leaf (36.3±0.11 mg/100g), fruit (32.1±0.02 mg/100g), and seed (28.9±0.05 mg/100g). Since non-starchy vegetables are the main sources of dietary fiber utilized in the treatment of conditions like obesity, diabetes, cancer, and gastrointestinal illnesses, traditional medicine practitioners in the Mazne area of Kurdistan region used pods for treating the gastrointestinal tract.[3]

**Table 1: Proximate analysis, total phenol and flavonoid content from leaf, fruit *Celtis tournefortii* Lam and pod, seed of Prosopis farcta.**

| | ***Celtis Tournefortii* Lam** | | ***Prosopis farcta*** | | |
|---|---|---|---|---|---|
| **Parameters** | **Leaf** | **Fruit** | **Pod** | **Seed** | **P-value** |
| Ash (%) | 3.65 ± 0.08$^b$ | 3.93 ± 0.04$^a$ | 3.59 ± 0.05$^c$ | 3.54 ± 0.05$^c$ | 0.003 |
| Carbohydrate (%) | 36.3 ± 0.33$^c$ | 42.1 ± 0.1$^b$ | 25.8 ± 0.1$^d$ | 48.5 ± 0.28$^a$ | 0.001 |
| Fiber (mg/100 g) | 36.3 ±0.11$^b$ | 32.1 ± 0.02$^c$ | 41 ± 0.05$^a$ | 28.9 ± 0.05$^d$ | 0.0001 |
| Protein (%) | 16.6 ±0.11$^b$ | 15.4 ± 0.06$^c$ | 20.3 ±0.05$^a$ | 11.80 ± 0.05$^d$ | 0.0001 |
| Vitamin C (mg/100g) | 25.34 ± 0.0$^b$ | 24.01 ± 0.05$^c$ | 26.47± 0.03$^a$ | 26.43 ± 0.01$^a$ | 0.0001 |
| Total sugar (mg/100g) | 44.0 ± 0.57$^a$ | 41.00 ± 0.57$^b$ | 34.00 ± 0.57$^d$ | 38.0 ± 0.57$^c$ | 0.0001 |
| Total organic acid (mg/kg) | 1543± 1.15$^b$ | 1576 ± 0.57$^a$ | 1243 ± 0.57$^d$ | 1376 ± 0.57$^c$ | <.0001 |
| Total phenol content (mg GAE/100g) | 49.03± 0.01$^b$ | 52 ± 0.57$^a$ | 45.98± 0.01$^c$ | 37.90± 0.52$^d$ | <.0001 |
| Total flavonoid content (mg RU/100g) | 3.52 ±0.02b | 4.39± 0.03a | 2.31± 0.05c | 2.34 ± 0.01c | <.0001 |
| Total oxidant capacity % | 82.50±0.59b | 89.54±0.28a | 65.00±0.57c | 67.80±0.86c | <.0001 |

The data are expressed as mean ± SEM. Means with different letters were significantly different at the level of P<0.05. SEM, standard error of mean; GAE, gallic acid equivalent; RU, rutin equivalent.

Consuming more dietary fiber was associated with a higher body mass index and a reduced risk of cardiovascular system.[28] The 30% of the pulp is made up of dietary fiber, most of which is insoluble. The fiber fraction contains neutral polysaccharides, which make up more than half of it.[29] Vitamin C is relatively similar, but statistically, the amount in seeds and pods (25.34±0.0 and 24.01±0.05 mg/100g respectively) was significantly higher than that in leaves and fruits. The ascorbic acid content gradually decreased over time and finally reached its lowest level at the end of the preservation period. Other essential nutrients include carbohydrates, lipids, proteins, and water.[30] Whenever the storage conditions is over, chitosan-treated pepper fruits and plant essential oils reportedly had the greatest vitamin C concentration among treatments and controls. Chitosan can lower $O_2$ emissions, which can prolong fruit ripening, better preserve vitamin C content, and postpone the aging of sweet peppers since a drop in ascorbic acid content can be closely associated to $O_2$ content.[17]

In the most recent analysis of total sugar, *Celtis tournefortii* Lam leaves (44.0±0.57 mg/100g) were statistically greater than fruit (41.00±0.57 mg/100g), pod (34.0±0.57 mg/100g), and seed (38.0±0.57 mg/100g). The amount of phenol, the wavelength, and the instrument used all affected the absorbance indices for the sugars with the highest concentration in *Celtis tournefortii* Lam leaves.[31] These findings were in line with those made by Mona[32] who discovered that spraying rocket (*Eruca* *vesicaria* subsp. *sativa*) with aqueous extracts of Moringa oleifera leaves and twigs at 2% enhanced total sugars and ascorbic acid. Similar to the current study, Deore Sonali[30] revealed that during the summer, total sugar accumulated to high levels in leaves, and that the percentage of total sugar was shown to increase with the number of seeds. It was discovered that the order of the seeds, leaves, stems, and roots corresponded to the concentration of starch. Humans can metabolize some carbs, making them a substantial source of energy.[33]

The significance of organic acid analysis has increased as a result of their function in plant physiological activities.[34] The outcome demonstrated that total organic acid in fruit (1576±0.57 mg/kg), which was statistically substantially greater than leaf (1543±1.15 mg/kg), pod (1243±0.57 mg/kg), and seed (1376±0.57 mg/kg), was present in larger amounts. According to Pereira *et al.*[35] the *Sambucus nigra* extract had the highest content of total organic acids (159 mg/g), with the largest contributor being citric acid (97 mg/g), that is in line with observations from Austrian flowers and fruits of this species. Fruit growth occurs simultaneously with the accumulation of sugars and organic acids, but at different developmental stages. In *Fagopyrum. esculentum* and *Hydrangea,* the importance of organic acids in the xylem transport, tissue detoxification, and protection of the root apex from stress have been demonstrated.[36] Citric acids is in high demand globally due to its minimal toxicity and broad use as an acidulant in the food and health care sectors.[37]

Plants produce a variety of phytochemicals called phenolic compounds, which are secondary metabolites produced from the amino acids phenylalanine and tyrosine.[38] Fruit had a considerably greater total phenolic compound value (52±0.57 mg GAE/100g), compared to the pod (45.98±0.01 mg GAE/100g) and seed (37.90±0.52 mg GAE/100g). In a similar vein, Doshi *et al.*[39] showed that Zanthoxylum armatum fruit methanol extract had a total phenolic compound value of 366.3 mg GAE/g, which was higher than the value of the seeds. Their bark extracts may also significantly contribute to the antioxidant properties, with a presence of 4.39±0.03% and the ability to eliminate free radicals. The domesticated and wild fruits, seeds and bark extracts had varying amounts of total phenolic content. Variations in agronomic techniques, environmental conditions, and genetic origins could also contribute to these disparities.[39]

Fruits had considerably more total flavonoids (4.39±0.04 mg RU/100g)) than pods (2.31±0.05 mg RU/100g) and seeds (2.34±0.01 mg RU/100g). Similar to that study, Negi *et al.*[40] reported that ethanolic extract *Zanthoxylum armatum* fruit had 22.8±1.33 mg/kg of total flavonoids, whilst extracts of bark contained 18.33±1.22 mg/g, the amount of flavonoids being considerably less than that of phenol. The polarity of the extraction solvents has an impact on the level of phenols and flavonoids as well. There is a significant relationship between phenolic acid, polyphenols and flavonoids.[41] Flavonoids are recognized to suppress cell development and serve as anticancer agents, and the majority of them are widely accepted as therapeutic medicines.[42]

Due to their redox-active nature, the great majority of these phytochemicals are regarded as antioxidants. Antioxidant capacities can reduce the consequences of free radicals, reactive oxygen and nitrogen species, which are the primary causes of the majority of chronic diseases. According to the current study, the fruit has a much greater total antioxidant capacity (89.54±0.28%) than leaves (82.50±0.59%), pods (65.00±0.57%), and seeds (67.80±0.86%). According to Tukun *et al.*[43] has the widest variation of total phenol concentration and antioxidant capability. As a result, the nutraceutical food and pharmaceutical industries may greatly benefit from using these plants' parts that are edible as an amazing source of natural antioxidants. The antioxidant content of the food sample that was consumed does not necessarily correlate with the antioxidant activity that occurs in the target cell. Although Yildrm *et al.*[12] stated that *Celtis Tournefortii* Lam had a total antioxidant capacity of 7.09±0.00 mg of fresh fruit, the total antioxidant capacity in fruit in the current investigation was (89.54±0.28%). How bioavailable phytochemical antioxidants are affected by the dietary composition, absorption, and metabolism.[44] The concentration of antioxidants in any dietary component may differ for a variety of reasons, such as the growing environment, seasonal fluctuations genetically diverse cultivars, storage conditions, and variations in the production and processing procedures.[45] Similar investigations, however, have proven that the phenolic content of extracts and antioxidant activity are strongly linked.[39] An alcoholic extract is prepared from of the fruits, leaves, pods, and seeds of *Celtis Tournefortii* Lam and *Prosopis farcta*. Through the use of high-performance liquid chromatography (HPLC), nine polyphenolic substances were identified, including gallic acid, caffeic acid, rutin, coumaric acid, rosmaric acid, cinamic acid, and apigenin as shown in (Table 2). The highest quantity of gallic acid makes up a significant portion of phenolic acids (10.56±0.03 mg/kg). Two catechins, epicatechin gallate and epigallocatechin gallate, are responsible for the high levels of gallic acid released by tannase from green tea preparations.[46] There are numerous industrial uses for gallic acid and its derivatives, such as supplements or food additives.[47] Fruit and seeds contained the highest level of caffeine at 12.33±0.16 mg/kg and 12.30 ± 0.10 mg/kg, respectively. Thyme and rosemary contain significant levels of the acids ferulic acid and caffeic acid, claim Wojdyo *et al.*[48] Although consumers and food manufacturers are familiar with these medicinal plants, there are other, more well-known plants whose extracts can be used as food additives due to their high concentration of numerous pro-health compounds. There isn't much information in the literature about the amount of chlorogenic acid present in meals and beverages, with the exception is one of the best sources. However, while comparing the chemical makeup of different plants, it is important to take into account elements like climate, seasons, soil, and farming techniques.[49] Numerous biological characteristics of rutin have been demonstrated, including cytoprotective, antioxidant, and anticancer effects.[50] According to a certain study, temperature stress can affect the production of bioactive compounds, which are frequently the basis for the medicinal activity of plants. The primary phenolic components in parsley according to Shan *et al.* [51] were apigenin, caffeic acid, p-coumaric acid, and ferulic acid, however, they were unable to find kaempferol. The extraction solvent's type, polarity and processing have a considerable impact on the composition of the extract and its total phenolic content.[52] Pod of *Prosopis farcta* contained a significant amount of quercetin with 11.27±0.14 mg/kg than seed 0.43±0.03mg/kg and fruit 0.36± 0.03 mg/kg. Some research has suggested that quercetin may be beneficial for both men and women chronic prostatitis with interstitial cystitis respectively, as a result of its ability to serve as a mast cell inhibitor.[53] Quercetin may be effective in treating or preventing respiratory conditions like bronchitis and asthma as well as conditions like cancer, prostatitis, heart disease, cataracts, and allergies/inflammations.[52] These compounds have been proven to have antioxidant activity.[54] Yıldırım

**Table 2: Phenolic compound identified by HPLC from leaf, fruit Celtis tournefortii Lam and pod, seed of Prosopis farcta.**

| Parameters (mg/kg) | Celtis Tournefortii Lam | | Prosopis farcta | | |
|---|---|---|---|---|---|
| | Leaf | Fruit | Pod | Seed | P-value |
| Gallic acid | 10.56±0.03$^{a}$ | 6.26±0.08$^{b}$ | 6.17±0.03$^{b}$ | 6.33±0.03$^{b}$ | <.0001 |
| Caffeic acid | 5.90 ±0.05$^{b}$ | 12.33± 0.16$^{a}$ | 2.10±0.05$^{c}$ | 12.30±0.10$^{a}$ | <.0001 |
| Chlorogenic acid | 12.20 ± 0.11$^{c}$ | 54.0±1.15$^{b}$ | 659.0 ±0.57$^{a}$ | 54.0±1.15$^{b}$ | <.0001 |
| Rutin | 5.0±0.28$^{b}$ | 1.26 ± 0.17$^{c}$ | 13.0 ± 0.57$^{a}$ | 1.30 ±0.05$^{c}$ | <.0001 |
| Coumaric acid | 21.56 ±0.23$^{b}$ | 17.33± 0.06$^{c}$ | 214±0.57$^{a}$ | 17.30±0.15$^{c}$ | <.0001 |
| Rosmaric acid | 0.77 ± 0.08$^{c}$ | 3.97± 0.18$^{a}$ | 1.40 ±0.11$^{b}$ | 3.97 ±0.26$^{a}$ | <.0001 |
| Quercetin | 3.50±0.28$^{b}$ | 0.36± 0.03$^{c}$ | 11.27±0.14$^{a}$ | 0.43±0.03$^{c}$ | 0.001 |
| Cinamic acid | 1.80±0.11$^{a}$ | 0.0 ±0.0$^{b}$ | 0.0 ±0.0$^{b}$ | 1.50±0.28$^{a}$ | <.0001 |
| Apigenin | 2.26±0.14$^{a}$ | 0.0±0.0$^{c}$ | 0.26±0.03$^{c}$ | 1.57±0,18$^{b}$ | <.0001 |

Values were expressed as mean ± SEM (n=6). a,b,c Means within a row with different superscript letters are significantly different ($p < 0.05$) between groups by Tukey's test.

**Table 3: percentage of fatty acids profile from leaf, fruit *Celtis tournefortii Lam* and pod, seed of *Prosopis farcta*.**

| | Fatty acids | Types | ***Celtis Tournefortii-lam*** | | ***Prosopis farcta*** | | |
|---|---|---|---|---|---|---|---|
| | | | **Leaf %** | **Fruit %** | **Pod %** | **Seed %** | **P-value** |
| 1 | Capric acid methyl ester (C10:0) | Saturated | 0.60±0.057$^{b}$ | 1.54±0.11$^{a}$ | 1.65 ±0.03$^{a}$ | 0.40±0.05$^{b}$ | <.0001 |
| 2 | Undecanoic acid methyl ester (C11:0) | Saturated | 1.34±0.02$^{a}$ | 0.63±0.01$^{c}$ | 0.66±0.08$^{c}$ | 0.90±0.02$^{b}$ | <.0001 |
| 3 | Palmitic acid methyl ester (C16:0) | Saturated | 17.40±0.05$^{a}$ | 16.40±0.20$^{b}$ | 14.87±0.06$^{c}$ | 4.70±0.15$^{d}$ | <.0001 |
| 4 | Stearic acid methyl ester (C18:0) | Saturated | 4.20±0.01$^{b}$ | 4.50±0.11$^{b}$ | 2.40±0.05$^{c}$ | 6.90±0.05$^{a}$ | <.0001 |
| 5 | trans-9-octadecenoic methyl ester (C18:1n9t) | Unsaturated | 2.30±0.10$^{a}$, | 1.54±0.18$^{b}$ | 1.46±0.0b | 2.24±0.03$^{a}$ | 0.0007 |
| 6 | Oleic acid methyl ester (C18:1n9c) | Unsaturated | 18.67±0.21$^{d}$ | 23.7±0.15$^{c}$ | 24.80±0.40$^{b}$ | 32.60±0.24$^{a}$ | <.0001 |
| 7 | Linoleic acid methyl ester (C18:2n6c) | Unsaturated | 31.66±0.24$^{b}$ | 28.98±0.02$^{c}$ | 34.70±0.43$^{a}$ | 34.10±0.15$^{a}$ | <.0001 |
| 8 | Alpha-Linolenic acid methyl ester (C18:3n3) | Unsaturated | 0.760±0.02$^{c}$ | 9.60±0.15$^{a}$ | 6.40±0.05$^{b}$ | 0.20±0.05$^{d}$ | <.0001 |
| 9 | Arachidic acid methyl ester (C20:0) | Saturated | 6.70±0.17$^{b}$ | 7.50±0.04$^{a}$ | 4.60±0.20$^{d}$ | 5.80±0.09$^{c}$ | <.0001 |
| 10 | Cis-11-Eicosenoic acid, methyl ester (20:1) | Unsaturated | 0.43±0.01$^{c}$ | 0.70±0.02$^{b}$ | 0.60±0.05$^{bc}$ | 3.20±0.11$^{a}$ | <.0001 |
| 11 | Behenic acid methyl ester (C22:0) | Saturated | 3.70±0.15$^{a}$ | 1.22±0.03$^{b}$ | 0.40±0.0$^{c}$ | 3.50±0.28$^{a}$ | <.0001 |
| 12 | Tricosanoic acid methyl ester (C23:0) | Saturated | 6.40±0.05$^{a}$ | 1.40±0.5$^{c}$ | 4.70±0.07$^{b}$ | 1.40±0.03.$^{c}$ | <.0001 |
| 13 | Lignoceric acid methyl ester (C24:0) | Saturated | 3.90±0.07$^{a}$ | 0.89±0.05$^{c}$ | 1.80±0.05$^{b}$ | 0.70±0.05$^{d}$ | <.0001 |
| 14 | Cis- 4,7,10,13,16,19-Docosahexaenoic acid methyl ester (C22:6n3) | Unsaturated | 1.32±0.01$^{b}$ | 0.60±0.05$^{c}$ | 0.54±0.01$^{c}$ | 2.10±0.05$^{a}$ | <.0001 |
| | Total saturated fatty acids % | | 44.24 | 34.08 | 31.08 | 24.3 | |
| | *Total unsaturated fatty acids* % | | 55.14 | 65.12 | 68.5 | 74.44 | |

Values were expressed as mean ± SEM (N=3). $^{a,b,c}$ Means within a row with different superscript letters are significantly different ($p < 0.05$) between groups by Tukey's test.

and his colleagues[12] reported that the antioxidant and polyphenol content of *Celtis Tournefortii* Lam, which differed from our observations, may be attributed to heredity and environmental factors.

Leaf, fruit, pod and seed statistical study for fatty acids gas chromatography (GC) were used to identify 15 fatty acids in the *Celtis tournefortii* and *Prosopis farcta* showning in (Table 3). According to Lajnef *et al.*[55] six fatty acids were found in the seeds of *Prosopis farcta* such as palmitic acid, stearic acid, oleic acid, linoleic acid gadoleic acid and lignoceric acids. The *Prosopis farcta* pods (1.65±0.03%) and *Celtis tournefortii* fruit (1.54±0.11%) both contain considerably more caprylic acid methyl ester than seeds (0.40±0.05%) and leaves (0.60±0.057%). According to Thakur *et al.*[56] study Acacia catechu contains methyl ester forms of caprylic acid (19.77%), lauric acid (27.42%), 2-ethyl-3-methyl-1-butene (42.09%), myristic acid (10.72%), and other acids. Consuming caprylic acid as a dietary supplement, according to some research, can help people lose weight by helping their bodies burn extra calories. A ketogenic diet that includes caprylic acid is also used to treat children with uncontrollable epilepsy.[57] According to Lazzara and their colleagues[58] the amount of palmitic acid (13.11%) and stearic acid (1.73%) in Ricinus communis leaf extract was measured by gas chromography. However, *Prosopis farcta* seed had the highest stearic acid content (6.90±0.05%), and Brassica tournefortii leaf and fruit had the highest levels of palmitic acid (17.40±0.05%). Alpha-linolenic acid levels are much greater in fruit (9.60±0.15%) and pods (6.40±0.05%) compared to seeds (0.20±0.05%) and leaves (0.760±0.02%). The usage of flaxseed has been recommended to prevent cardio vascular illness because of its high alpha-linolenic acid content, as demonstrated by Rodriguez-Leyva *et al.*[59] Alpha-linolenic acid and omega-3 fatty acid is particularly abundant in flaxseed. Fruit (7.50±0.04%) and leaves (6.70±0.17%) had considerably greater arachidic acid methyl ester levels than pod and seed. Total fatty acids are mainly composed of linoleic acid and arachidic acid, according to Straccia *et al.*[60] who also noted that cherry seed oil contains substantial percentages of both of these acids. The amount of eicosenoic acid in seeds (3.20±0.11%) is statistically larger than that in fruit and leaves. Similar to this, Asadi-Samani *et al.*[61] demonstrated that gamma–linolenic acid, which is consumed as a dietary or food nutritional supplement, is abundant in the plant that produces borage seed oil (26%–38%). There are numerous fatty acids included in it besides seed oil, including linoleic acid (35–38%), oleic acid )16–20%), palmitic acid (10–11%), straric acid (3–4.5%), eicosenoic acid (3–5.5%) and erucic acid (1–3.5%). Multiple sclerosis, diabetes, heart disease, arthritis, and eczema are just a few of the illnesses it is used to treat. Similar to Zayed *et al.*[62] who discovered that a maximum of 26 compounds were detected, with n-hexadecanoic acid (44.88%), hexadecanoic acid ethyl ester (17.96%), and octadecanoic acid ethyl ester (11.71%), serving as the principal chemical ingredients of seed and leaf had higher octadecanoic acid ethyl ester levels. The findings led to the conclusion that *Neolamarckia cadamba,* leaves contain a variety of powerful bioactive chemicals. Similarly, alpha-linolenic acid and docosahexaenoic acid of the walnut extract showed considerable protection against cell death and calcium dysregulation, while linoleic acid and eicosapentaenoic acid did not work as well to protect hippocampus cells from these harms, according to research by Carey *et al.*[63] seed (2.10±0.05%) had significantly higher docosahexaenoic than leaves (1.32±0.0%). The capacity of walnut extract and fatty acids content to shield hippocampus cells from harmful oxidative stress and inflammation's negative effects.

According to Alvarez and Rodriguez[64] the palmitic, oleic, and linoleic acid composition of the research plants has a remarkable resemblance to industrial lipids utilized in medicinal and cosmetic preparations as well as soybean varieties.[65] The table showed that saturated fatty acids were greater in the leaf than in the fruit, pod, or seed, but unsaturated fatty acids were higher in the seed than in the pod, fruit, or leaf. Oleic, Cis-11-Eicosenoic, and Cis-4, 7, 10, 13, 16, and 19-Docosahexaenoic were the most common unsaturated fatty acids in the seed, while the two most prevalent saturated fatty acids in the leaf were palmitic and tricosanoic. These outcomes supported the findings of earlier investigations showing the majority of the fatty acids in *Prosopis farcta* seed oils were unsaturated.[55]

According to several studies,[66, 67, 68, 69, 70, 71] flavonoids are substances that are found in various plant matrices. According to studies,[72] a cardio protective effect with a 150 mg daily dose,[73] and a robust improvement of dyslipidemia (reduction of triglycerides, total cholesterol, and low-density lipoprotein cholesterol), are flavonoids in bergamot albedo and juice.[74] Bergamot juice and hazy juice contain the highest representative flavonoids.[66] For bergamot juice, the Femminello cv was found to contain the highest total amount of flavonoids (520 mg/L), followed by Fantastico (460 mg/L) and Castagnaro (362 mg/L). In our study, total flavonoids in fruits (4.39±0.04 mg RU/100g) is more than in pods (2.31±0.05 mg RU/100g) and in seeds (2.34±0.01 mg RU/100g). Flavonoids are good suppressing agents against cancer cells in humans.

according to[66] study, epigallocatechin (EGC), epicatechin gallate (ECG), and epigallocatechin gallate (EGCG) were the main tea catechins discovered in dried tea leaves. In addition to those, ready-to-drink products also contained gallocatechin (GC). EGCG accounts for around 40% of the total catechin content and is generally acknowledged as the primary antioxidant component of green tea.[75]

Two Brazilian brands of green tea and a brand of "ban-chá" were previously reported to contain lower amounts of quercetin, ranging from 0.7 to 1.0 mg. 200 $mL^{-1}$, with very little kaempferol (0.3 to 0.6) and myricetin present (0.2 to 0.5 mg.200 $mL^{-1}$). The Bancha preparation had the lowest catechin concentrations overall, which seems to be consistent with its lowest antioxidant capacity. The greatest amount of total flavonoid was 197 mg. 200 $mL^{-1}$ of the Feel Good green tea that is ready to drink, then 145 mg. A Leo tea bag was used to create 200 $mL^{-1}$ of the infusion. These findings are significant since catechins, a type of antioxidant found in green tea, are largely responsible for the beverage's positive health effects. It is crucial to let customers know that these levels may differ from one product to another.

The analysis of the fatty acid profile of bergamot seed oil revealed that oleic acid was present in amounts ranging from 30.15% (Castagnaro) to 34.36% (Fantastico), which is comparable to other edible vegetable oils like sesame (36.82–41.75%) and low oleic sunflower (32.47%) or less than other edible vegetable oils like peanut seed oil (44.61%–50.9).[75] Other citrus seed oils were also found to include oleic acid, which was shown to be present in cold-pressed grapefruit seeds at 20.78% and enzyme-treated grapefruit seeds at 20.74%,[76] and cold-pressed and solvent-extracted lemon seeds at 30.86% and 30.27%, respectively[77] Linolenic/linolenic acid ratios for Castagnaro, Fantastico, and Femminello were 2.60, 2.15, and 2.97, respectively, whereas linoleic acid levels ranged from 27.01% (Fantastico) to 29.82% (Femminello).

Other authors' findings on linoleic acid included 39.9% for Citrus sinensis, 42.1% for Citrus nobilis, 26.8% for Citrus limon, var. Interdonato, 44.5% for Citrus limon, var. kütdiken, and 19.5% for Citrus paradise.[70] Overall, it can be seen that bergamot seed oil has a low total saturated fatty acid content, ranging from 25.85 to 28.78%, while the total unsaturated fatty acid content ranged from 74.15% (Fantastico) to 71.22% (Castagnaro), in amounts that are very similar to those found in tomato seed oil, another vegetable whose seeds could be viewed as a byproduct and not a waste.[68] Fantastico had the greatest oleic/linoleic acid and oleic/palmitic acid ratios, 1.27 and 1.63, respectively. In Castagnaro, Fantastico, and Femminello, respectively, the sum of 18 carbonchain fatty acids accounted for 72.60, 76.13, and 78.13% of the total, whereas polyunsaturated fatty acids (EFAs) made up roughly 40% of each cultivar.

## Conclusion

The region of Kurdistan is rich in many plant species and wild vegetables. These plants give the local community both food and medicine. This study is the first to identify various phenolic compounds and fatty acids discovered in two medicinal plants from the Mazne subdistrict in Iraq's Kurdistan region. A pod has more fiber, protein, and vitamin C, whereas fruit has more organic acid and overall antioxidants. The highest concentration of polyphenols, gallic acid, was identified in the leaf, whereas the highest concentrations of chlorogenic acid, rutin, coumaric, and quercetin were detected in the pod. Oleic, Cis-11-Eicosenoic, and Cis-4, 7, 10, 13, 16, and 19-Docosahexaenoic were the most common unsaturated fatty acids in the seed, while palmitic and tricosanoic were the most prevalent saturated fatty acids in the leaf of *Celtis Tournefortii* Lam. Despite the fact that *Prosopis farcta*'s seeds contain saturated fatty acids and its pods contain polyphenols. Therefore, this plant might be more important in preventing a number of serious human ailments. The overall phenolic and flavonoid content is related to this antioxidant activity. Including these plants in daily meals would increase the nutritional value of food while also adding flavor and scent. Future research should focus on isolating and identifying more antioxidants from the plant under study, as well as on their biological activities and associated mechanisms of action.

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**Conflict of Interest**

Author states that they have no competing interests.

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