Phytochemical Screening and Spectrophotometric Determination of the Nutritional Value of Eruca-Sativa

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Abstract

Eruca sativa, or rocket, is one of the most valuable members of the Brassicaceae family, which mostly originated in different parts of Middle East and Mediterranean countries. It has been used as a powerful source of many active compounds that might be used for therapeutic purposes. The aim of this study is to assess some essential minerals available in Eruca sativa leaves. Phytochemical screening was performed to investigate the nutrition values in Eruca sativa leaves in addition to investigating the level of potassium, iron, and calcium in ethanolic extract of rocket (Eruca sativa) leaves using flame atomic emission photometry for potassium and atomic absorption spectroscopy for iron and calcium. The phytochemical study reveals the absence of alkaloids and carbohydrates in ethanolic extract of Eruca sativa leaves, while all components show positive tests with methanol and ethanol. The analytical data showed a linearity range of (0.5 to 10), (0.5-50), and (10-50) ppm for iron, calcium, and potassium respectively. The used spectrophotometric method offers rapid, efficient and direct determination of Fe, Ca and K.

Keywords: Eruca sativa, phytochemical, nutritional minerals, flame photometry, atomic absorption spectrophotometry

1. Introduction

Eruca sativa, or rocket, is one of the most valuable members of the Brassicaceae family, which mostly originated in different parts of Middle East and Mediterranean countries [1] see Figure 1. It has been used as a powerful source of many active compounds that might be used for therapeutic purposes. It can be used as a diuretic [2], digestive, facial tonic, stimulant, aphrodisiac, antiscorbutic, and stomachic in addition to being as vegetable and spice [3].

Also, Eruca sativa has been reported to have a high level of protein glucosinolate, oil contents, carbohydrates, and minerals nutrients [4]. It is notable that using an adjusted regimen is most important to keep the body healthy, which should be achieved by taking into consideration the levels of the nutritional minerals intake such as calcium which can be helpful for central nervous system, sodium and potassium for electrolyte balance, iron for formation of hemoglobin and myoglobin in addition to it's a vital role in oxidation-reduction processes throughout the body, and magnesium for muscle relaxing [5].

Figure 1 Eruca sativa

Estimation of nutrient minerals in plants and food has acquired a great interest by researchers to evaluate the concentration of the effective minerals in foodstuffs and study the advantages of these elements on the human body.

Trace amounts of nutrient minerals such as iron, potassium, and sodium were determined in lactuca sativa using precise, accurate, and reproducible flame photometric and atomic absorption spectrophotometric methods6. It was found that lactuca sativa is a good source of potassium as it contains 32.67 ppm while it contains 7.03, and 9.61 ppm for iron and sodium respectively [6].

Recently, a new study has been proposed to determine potassium, iron, and lead by flame photometry and atomic absorption spectroscopy in three types of Iraqi date fruits [7]. It has been found that the nutrition values of (potassium and iron) for a one date fruit of zahdi, burhi, and tabrizi is (2.5%, 0.7%), (2.7%, 1.2%), and (2.4%, 1.5%) respectively. Also, it has been concluded that washing date fruits before eating may keep the lead level within a safe limit [7].

Determination of nutrients minerals in Eruca sativa has been addressed in limited studies. One of the most interested studies was done by Borlas et.al. [8[. They performed a comprehensive study to estimate the mineral content in Eruca sativa cultivated in Turkey. They illustrated the nutritional value of its leaves as a powerful source of many minerals such as, zinc, manganese, iron, copper, magnesium, calcium, and potassium [8].

Potassium and sodium were estimated in aqueous

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extract of Withania someniferum roots by flame atomic emission spectroscopy [9]. The results showed that 115 and 65 ppm of potassium and sodium respectively were found in 20 gm of Withania someniferum while calcium was not detected [9]. Also, the content of potassium, sodium, and calcium were directly determined in fermented milk products by Kravic et.al [10]. They used two methods to prepare the studied samples, one with distilled water and the other one with acidic treatment. It could be confirmed that the first procedure is the more suitable according to green chemistry demands, in addition to having a confident level of 95% that makes this proposed procedure is recommended for fast estimation of metals in milk [10].

A cheap, rapid and an accurate method for estimation of potassium and sodium in Brazilian dietary sweeteners was proposed by Oliveira et.al [11]. The results showed acceptable statistical data with the viability of detection of K and Na at low concentrations (less than 100 ppm).

Banerjee and Prasad [12] have recently proposed an efficient photometric method to assay potassium and sodium in some kinds of water sources. They found that the content of both K and Na were acceptable for human consumption in some areas. Regarding iron content in plants, it plays a vital role as it is considered to be one of the most essential micronutrients in living organisms. Hailu et.al [13] proposed a colorimetric method to determine Fe in different types of vegetables available in Ethiopian local markets. This method was based on using a dry ashing method followed by subsequent uv-vis spectrophotometric determination of Iron [13].

A simple, accurate, and cheap colorimetric method was proposed by Gitz et.al [14] to determine Fe in tobacco leaves. This method is based on formation of a Prussian blue solution as a result of addition of known amount of Potassium ferrocyanide to 0.5 ml of acidified sample of Iron to obtain the Prussian blue solution which can be measured at λmax = 715 nm [14]. Iron and some nutritional elements in Iraqi beta vulgaris roots have recently been assessed by Al-Hachami et.al [15]. They have measured the level of Fe in beta vulgaris root juice which is prepared in four different procedures. It has been found that the beta vulgaris root juice prepared with deionized water at low temperature has a higher level of Fe than other procedures [15].

Therefore, the main aim of the current study is to investigate the level of potassium, sodium, and calcium in different organic extracts of rocket (Eruca sativa) leaves using atomic absorption spectroscopy and flame photometry.

2. Experimental Section

Materials

Deionized distal water DDW, concentrated nitric acid, perchloric acid, hydrogen peroxide, ethanol, methanol, ferric chloride, iodine, potassium iodide, sulphuric acid, and potassium hydroxide. The plant material (aerial part) of Eruca sativa were collected from the Iraqi market, washed with water, and cut into small pieces, dried at room temperature, and the dried leaves were powdered. Two equal amounts (10 g) of powdered leaves were extracted in soxhlet apparatus successively with ethanol and methanol for 72 and 48 hours respectively. The extracts were then concentrated using a rotary evaporator.

Instrumentation

Nov AA 350 Germany Atomic absorption spectrophotometer (AAS) with iron EDL lamp (248 nm), Acetylene as a fuel gas, and air as a support gas. JENWAY PFP7 Flame Photometer (FP) designed and manufactured by Bibby Scientific Ltd, it was equipped with butane as a fuel and air as an oxidant.

Procedure: Phytochemical Analysis

Carbohydrides (Molisch's test)

Few drops of an ethanolic solution of α-naphthol were added to the analyte followed by addition of a few drops of concentrated H2SO4 (sulphuric acid) to produce a purple or a purplish-red ring as an indication to the presence of carbohydrates [16].

Saponins

A methanolic extract of the leaves (1mL) was mixed with distilled water (5mL) in a test tube and then shaken vigorously until persistent foam observed [17].

Tannins

A 0.25g of plant extract was dissolve in (10mL) of distilled water and filtered.1% aqueous ferric chloride (FeCl3) solution was added to the filtrate, the appearance of dark green, dark blue or black color indicates the presence of tannins [17].

Glycosides

A 25mL of dilute sulphuric acid was added to 5mL extract in a test tube and boiled for 15 minutes, cooled and neutralized with 10%NaOH, then 5mL of Fehling solution added. Glycosides are indicated by a brick red precipitate [17].

Alkaloids

Alcoholic extract (3.0 mL) then added a few drops of Wagner's reagent (that is prepared by dissolving Iodine in Potassium Iodide) were added. The appearance of reddish -brown precipitate indicates the presence of alkaloid [17].

Wagner's Test

Filtrates were treated with Wagner's reagent (Iodine in Potassium Iodide). Formation of brown/reddish precipitate indicates the presence of alkaloids [17].

Dragendroff's Test

Filtrates were treated with Dragendroff's reagent (solution of Potassium Bismuth Iodide). Formation of red precipitate indicates the presence of alkaloids.

Flavonoids

Ethanolic KOH 2% (2ml) was added to (1ml) of ethanolic extract of plant leaves. The formation of

yellow color indicates the presence of flavonoids [17].

Terpenoids

Four ml of extract was treated with 0.5 ml of acetic anhydride and 0.5 ml of chloroform. Then concentrated solution of sulphuric acid was added slowly and red violet color was observed for terpenoid [17].

Coumarins

A 5 mL of extract was added to 0.5 mL 10% NH4OH, put two spots on filter paper and examined under UV light. Intense fluorescence indicates the presence of coumarins [17].

Sterols and Steroids

Ten mL of extract was evaporated, the residue was dissolved in 0.5 mL of hot acetic anhydride; 0.5 ml of the filtrate was added, treated with the reagent of Libermann Burchardt. The appearance at the interphase, a ring of blue green, showed a positive reaction [17].

3. Results and Discussion

The phytochemical analysis was carried out qualitatively using different standard methods in order to establish the secondary metabolites present in the sample. Table 1 showed the Qualitative Phytochemical analysis of the extracts of Eruca sativa leaf by two solvents (methanol and ethanol), all components show positive test with using methanol while Alkaloid (dragendroff) and Carbohydrate (Molisch) shows negative test with using ethanol.

Table 1: Qualitative Phytochemical Analysis of the Extracts of Eruca sativa leaf by two solvent.

Chemical constituent	Methanol	Ethanol
Alkaloid	+	-
Carbohydrate	Weak +	-
Terpenes	+	+
Flavonoid	+	+
Lead acetate	Weak +	Very clear +
Saponin	+	Very strong +
Tannin	If + very weak (hydrolysable tannin)	Condensed +

Figure 2 shows the standard calibration curve of iron by using atomic absorption spectrophotometry with (0.5–10 ppm). Table 2 shows the concentration and absorption of unknown sample.

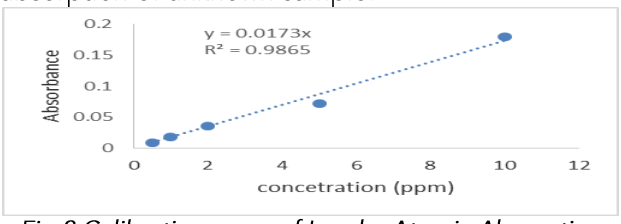

Fig.2 Calibration curve of Iron by Atomic Absorption spectrometry

Table (2): The Concentration data for Determination of Iron by Atomic Absorption Spectrometry

No.	Mean unit	Conc.(ppm)	Abs.
1	Eruca sativa Fe	6.13	0.106

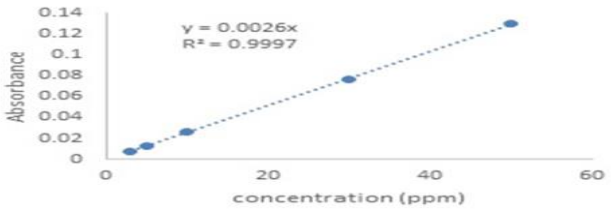

Figure 3 shows the standard calibration curve of Calcium by using atomic absorption spectrophotometry with (0.5–50 ppm), table 3 shows the concentration and absorption of unknown.

Figure 3 Calibration curve of Calcium by Atomic Absorption spectrometry

Table (3): The Concentration data for Determination of Calcium by Atomic Absorption Spectrometry.

No.	Mean unit	Conc.(ppm)	Abs.
1	Eruca sativa Ca	39.47	0.102

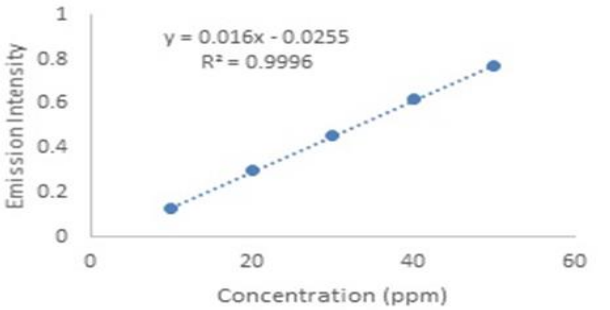

Figure 4 shows the standard calibration curve of potassium by using flame atomic emission photometry with (10 – 50 ppm).

Figure 4 Calibration curve of potassium by Flame Atomic Emission Photometry

Table 4 shows the concentration, standard deviation and relative standard deviation for potassium by Flame Atomic Emission Photometry.

Table (4): The Analytical data for Determination of potassium by Flame Atomic Emission Photometry.

No.	Mean unit Eruca sativa Ca (ppm)	Standard deviation (n=5)	Relative standard deviation
1	50	0.000548	0.4549
2	40	0.000548	0.5670
3	30	0.000447	0.6143

Table 5 shows the Emission intensity, Conc.mg/L, Relative Error E_{rel}. % And Recovery % obtained for potassium by Flame Atomic Emission Photometry. The suggested method offers rapid and efficient

preparation of samples for direct determination of Fe, Ca and K.

Table 5: Analytical data for Determination of potassium by Flame Atomic Emission Photometry.

No.	Mean unit Eruca sativa K	Conc. (ppm)	E_{rel} %	Recovery %	Abs.
1	30	28.40	5.333	94.666	0.073
2	40	37.98	5.050	94.950	0.097
3	50	49.16	1.680	98.320	0.120

4. Conclusion

The current study showed that the phytochemical screening of both the ethanoic and methanoic extracts of Eruca-Sativa leaves indicated the presence of terpenes, flavonoids, saponin and tannin. Alkaloids and carbohydrates were not found in ethanolic extract of Eruca-Sativa leaves while they gave a positive indication in methanolic extract. Also, Eruca-Sativa extracts showed significant amounts of iron, calcium, and potassium which form an essential nutritional element for human health.

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Conflict Of Interest

Declared none

Author Contributions

All the authors have contributed equally.

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