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Determination of the Total Antioxidant Activity of Methanolic Extract of *Falcaria Vulgaris*

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ABSTRACT

Introduction: A growing tendency to the administration of medicinal plants is observed because of their amazing influence on human health. Pharmaceutical and food industries recommend the use of medicinal plants due to their antioxidant properties. Hence, this study was conducted to examine the antioxidant activity of the methanolic extract of *Falcaria vulgaris*.

Methods: Aerial parts of *F. vulgaris* were dried and ground. Then, plant samples were prepared using homogenizing plant powders in a methanol solution. Finally, the total antioxidant capacity of the plants was assessed by ferric reducing antioxidant power (FRAP) assay.

Results: Our findings demonstrated that the total antioxidant capacity was obtained as 2.86 mmol Fe2+/L for the methanolic extract of *F. vulgaris*.

Conclusion: According to the findings, *F. vulgaris* had a strong antioxidant capacity. It could be concluded that administration of *F. vulgaris* in food and pharmaceutical industries could possibly affect positively human health.

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Intorduction

The use of medicinal plants is one of mankind's oldest methods of treating diseases. Recently, in most countries of the world, people's approach to the use of herbal medicines has increased Bhardwaj et al., 2018; Jamshidi-Kia et al., 2018). Medicinal plants appear to have fewer side effects than chemical drugs and this is the main reason that consumption patterns have changed in favor of herbal medicines (Bagheri et al., 2019; Akbari).The use of synthetic chemicals drugs can cause harmful metabolic reactions and often producing free radicals and peroxides (Aloud et al., 2017). Free radicals are molecules that are able to damage tissues et al., 2022and cells and creates condition called oxidative stress. Oxidative stress indicates an imbalance between the production of free radicals and the ability of the biological system to detoxify their destructive effects (Tungmunnithum et al., 2018). Although the body naturally produces antioxidants to deal with these free radicals, using sources of antioxidants can

decrease oxidative stress. Antioxidants are deemed as important and valuable chemical compounds in medicinal plants (Gulcin et al., 2020). Several reports have documented that flavonoids found in plants can diminish oxidative stress by increasing antioxidant enzyme activity including glutathione peroxidase, catalase and superoxide dismutase and decreasing lipid peroxidation (Rana et al., 2022). Plant secondary metabolites such asphenolic compounds especially flavonoids exert numerous beneficial biological properties including antibacterial, anticancer, anti-inflammatory and particularly antioxidants effects (Jafari et al., 2022). Today, changes in lifestyle and increased stress have induced oxidative factors in the body. The use of antioxidants in food is one of the most effective ways to inhibit lipid oxidation and protect human cellular components from the dangers of free radicals (Khazaei et al., 2021). The discovery that phenolic compounds in medicinal plants prevent lipid oxidation has led to the use of these compounds as therapeutic agents (Hosseini et al., 2022).

Falcaria vulgaris is a plant of Apiaceae (Umbelliferae) family, which is foundin its natural habitat in west of Asia, Europe and America particularly inwestern and south□western Iran.The edible and medicinal use of this plant has a long history (Dokhani et al., 2022). *F. vulgaris* is known in traditional medicine for its skin wound healing effects and treating renal, stomach and liver disease (Boy et al., 2022). Phytochemical findings have revealed the presence of numerous chemical compounds with different biological properties including tannin, saponin, vitamins, phytosterol, spathulenol, carvacrol, alpha- pinene, 1, 8- cineole and limonene (Hashim et al., 2020). The major active ingredients of *F. vulgaris* have shown a potent antioxidant activity and free radical scavenging effect (Boy et al., 2022). Hence, the present study was performed to investigate the antioxidant activity of methanolic extract of *F. vulgaris*

Materials and Methods

Plant Materials

Collection of *F. vulgaris* (aerial parts) was carried out from Ilam County of Ilam Province, Southwest of Iran, in May 2022 (Figure 1).

Figure 1. Location of collection area, Ilam, in Iran Map.

F. vulgaris was identified according to the morphological features of Ilam Province Plant Flora at the Biotechnology and Medicinal Plants Research Center, Ilam University of Medical Sciences, Ilam, Iran. Then, *F. vulgaris* was air dried in the shade and then ground and used for antioxidant assessment. The characteristics of *F. vulgaris* has been shown in Table 1.

Plant Sample Preparation

After drying the plant, 1 g of the dry powder of the studied plants was homogenized using 100 ml of methanol solution and was shaken in the same solution for 6 hours. The resulting solution was then poured into a plastic falcon and centrifuged at 6000 rpm for 10 minutes. The resulting solution was used as a sample.

Determination of Antioxidant Activity

The total antioxidant capacity of the plants was assessed by ferric reducing antioxidant power (FRAP) assay.

Stock Solution Preparation

2.2 mL of R2b solution was added to the parent bottle R2a and vortexed until complete dissolution and R2 solution was obtained. Then, the R2 solution was mixed in a ratio of 1: 1 and after vortexing, 5 times its volume was added to R1 solution. The resulting solution is the stock solution of an antioxidant kit.

Standard Solution Preparation

Standard solution at 0, 0.2, 0.4, 0.6, 0.8 and 1 µL was also prepared. The linear equation obtained from the different concentrations of the standard solution is illustrated in Figure 2.

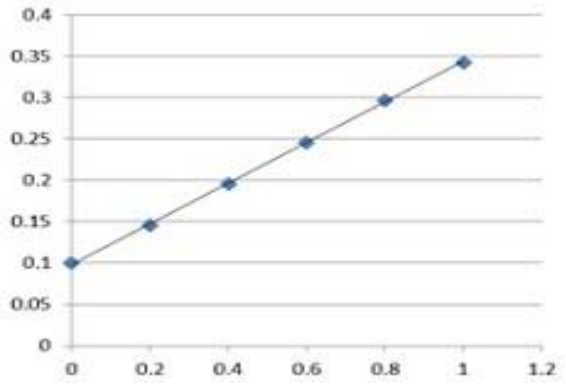

Figure 2. Linear equation obtained from different concentrations of standard solution ($Y= 0.2447_X + 0.0988$, $R^2=0.9997$).

Procedure

First, 5 µL of the prepared plant solution was added to each well and then 250 µL of the prepared working solution was added to each well containing the plant solution. The microplate was then incubated at 35-50 °C for 30 minutes and finally read at 570 nm with the ELISA reader (Monfared et al., 2012).

Table 1. The characteristics of the *Falcaria vulgaris*.

Scientific name	Persian name	Family	Collection area	Geographic coordinate	Plant
Falcaria vulgaris	Qazyaghi (Paghazeh)	Apiaceae	Ilam	33° 37' 60" North, 46° 25' 60" East	

Results

As shown in Table 2, the results of evaluation of antioxidant activity of *F. vulgaris* exhibited that the total antioxidant capacity was obtained as 2.86 mmol Fe^{2+}/L. Based on the number obtained from the kit, the antioxidant standard limit is 1 mmol Fe^{2+}/L. The results of this study showed that the methanolic extract of *F. vulgaris* plant is 2.86 times the kit standard.

Discussion

Medicinal plants are valuable natural resources that are considered by the advanced countries of the world as raw materials to become safe medicines for human diseases (Bose et al., 2020; Bhattacharya et al., 2020). The present study was designed to assess the antioxidant effect of methanolic extract of *F. vulgaris*. In our study, the findings of assessment of antioxidant capacity of *F. vulgaris* showed that the total antioxidant activity was obtained as 2.86 mmol Fe^{2+}/L. Since in recent years, the abundance of antioxidants such as food polyphenols have been included in the human diet due to their amazing properties, finding medicinal plants that have this property has attracted the attention of researchers (Goorani et al., 2019). It has been found that the antioxidant effect of medicinal plants is mostly attributed to the presence of secondary metabolites including phenolic compounds such as flavonoids and phenolic acid, ascorbic acid, vitamin E and various carotenoids, which prevent oxidative damage to cells (Salahshoor et al., 2019). In a similar study, Soleimani Shadvar M. and Moradkhani S. demonstrated strong antioxidant capacity of *F. vulgaris* in line with our findings. They indicated that methanolic extract of aerial parts of *F. vulgaris* had a significant reducing power through FRAP test. They found that the result of FRAP test for extract of aerial parts of *F. vulgaris* was obtained as 41.11 ± 7.39 mM Fe^{2+}/g and 17.62 ± 4.01 mM Fe^{2+}/g for seeds of *F. vulgaris*. Furthermore, their results displayed that the presence of antioxidant compounds in *F. vulgaris* is responsible for its antioxidant activity (Zangeneh et al., 2019). Similar to our study, Ebrahimi Monfared K. and colleagues examined phenolic content and antioxidant activity of different extracts of *F. vulgaris*. The results of their study demonstrated that extracts of *F. vulgaris* had high reducing power and total antioxidant capacity (200.118±0.14 µg/mL and 281.901±0.12µg/mL, respectively). From the phenolic contents point of view, this study showed high levels of phenolic compounds in *F. vulgaris*. They concluded that high total antioxidant capacity was positively related to its phenolic compounds (Zangeneh et al., 2019). The results of the above investigation confirmed the antioxidant effects of this plant in line with our results. Recent investigations have shown that the essential oil of *F. vulgaris* is rich in various phytochemicals with antioxidant properties such as spatholenol, carvacrol, alpha-pinene and limonene (Dokhani et al., 2022). In another study by Delfan Z. et al., the results demonstrated that aqueous extract of *F. vulgaris* and its synthetized silver nanoparticle showed a good antioxidant effect. They found that the high antioxidant effect of their silver nanoparticle is due to the presence of phenolic compounds in *F. vulgaris* (Hekmati etal., 2020). As the results of our study and the study of Delfan Z. and colleagues showed, high antioxidant activity is one of the characteristics of *F. vulgaris*. Previously researchers showed strong antioxidant capacity of *F. vulgaris*. For instance, Goorani s. and her team revealed that aqueous extract of *F. vulgaris* exerted great antioxidant activity in comparison with standardpositive control means butylated hydroxy toluene (BHT) (Goorani et al., 2019). The alignment of our study with the above study was remarkable in showing the antioxidant effect of *F. vulgaris*. The beneficial role of administration of hydroalcoholic extract of *F. vulgaris* in reducing oxidative damage in caused by diabetes in rat has been proven in the study of Salahshooe MR. and his team. In this regard, their results showed that *F. vulgaris* can reverse damage due to oxidative stress in living organism (Salahshoor et al., 2019). Several studies have proposed that various parts of *F. vulgaris* possess antioxidant property. The presence of phytochemicals with high antioxidant potential increases antioxidant capacity of this medicinal plant (Salahshoor et al., 2019).

Conclusions

Taking together, it may be concluded from the results that *F. vulgaris* could exhibit a capable antioxidant capacity. The findings of our experiment showed that *F. vulgaris* is a potent plant for application in the pharmaceutical industry and therapeutic purposes. According to the above findings, it can be suggested that administration of *F. vulgaris* could possibly possess useful health effects.

Conflict of interest
There is no conflict of interest among the authors.

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Consent for publications
The authors approved the manuscript for publication.

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This study was carried out with personal funds from the authors.

Authors' contributions
SSH conceived the research idea and SKM designed the work. SSH carried out the experiment, SS and DJS wrote the first draft of the manuscript, SKM carried out the literature search, SSH carried out the statistical analysis, and SKM supervised the study. All authors read and approved the final manuscript for publication.

Ethical considerations
Ethical issues (including plagiarism, misconduct, data fabrication, falsification, double publication or submission, redundancy) have been completely observed by the author.

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