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Investigating the Effect of Total Antioxidant Capacity of Medicinal Plants *Salsola rigida* and *Triticum aestivum*

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Abstract

Objective: Plants are an excellent source of phenolic compounds, which are among the most important antioxidant substances. The antioxidant properties of medicinal plants have prompted researchers to use them in the food, health, and pharmaceutical industries.

Methods: The purpose of the present study is to investigate the antioxidant properties of the methanol extract of the medicinal plants of *Salsola rigida (Salsola orientalis)* and wheat. The aerial parts of these plants were dried and ground. Then plant samples were prepared using homogenized methanol. Finally, the total antioxidant capacity of the mentioned plants was evaluated using ferric iron reducing antioxidant power (FRAP).

Results: The results showed that the total antioxidant capacity for *Salsola rigida* -wheat was 0.77 and 2.20 Fe^{2+} mmol L^{-1}, respectively. Based on our findings, wheat showed strong antioxidant activity and *S.rigida* showed little antioxidant capacity.

Conclusion: It is recommended to use the medicinal plants of *S.rigida* and wheat due to -antioxidant effects against free radicals. Antioxidant medicines or supplements can be produced from the mentioned plants.

Introduction

Oxidative stress occurs when an oxygen molecule is split into individual atoms with unbonded electrons called free radicals. The body is under a constant attack of oxidative stress [1].

Free radicals are linked to human disease including cancer, atherosclerosis, Alzheimer's disease, Parkinson's and many others. They may also be related to aging, which is

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known as the gradual accumulation of free radical damage [2]. Free radicals play a dual role in our body. These substances are produced by the body itself to destroy viruses and bacteria. But due to the instability and high activity of free radicals, its excess reacts with healthy cells to achieve stability and causes damage to them. These compounds can have destructive effects on DNA and cause diseases such as cancer [3]. The role of antioxidants is to neutralize these free radicals. In addition to the amount of free radicals that the body naturally produces, sunlight, electromagnetic waves, air pollution, tobacco, some chemicals can increase the amount of free radicals in the body.

In general, these molecules can be classified into two categories: natural and synthetic antioxidants [4, 5[. Antioxidants are natural substances whose task is to remove free radicals. Well known antioxidants are beta-carotene and other carotenoids, lutein, resveratrol, vitamin C, vitamin E, lycopene and other [6-8]. Natural antioxidants are widely found in food and medicinal plants. These natural antioxidants, especially polyphenols and carotenoids, show a wide range of biological effects, including anti-inflammatory, anti-aging and anti-cancer. Also, plant foods are rich sources of natural antioxidants. They are found in abundance in fruits and vegetables as well as other foods including nuts, whole grains and some meats, poultry and fish. Good sources of specific antioxidants include leeks, onions, and garlic [9-12]. Antioxidants are compounds that effectively prevent the oxidation of oils and fats and increase their shelf life. However, due to the possibility of toxicity and carcinogenicity of synthetic antioxidants, today much attention has been paid to the use of natural antioxidants [10-12]. Free radicals play an important role in causing various diseases and antioxidant compounds can be useful in preventing and treating these diseases. Today, natural antioxidants are healthier and safer than artificial ones [12].

Salsola rigida from the Chenopodioideae family is a species of flowering plant that grows in low rainfall and non-saline areas. This plant is native to Central Asia, North Africa and low-rain Mediterranean regions. *S.rigida* is a very hardy shrub that has evolved to live in low rainfall and dry areas. This plant grows well in the northwest and south of Iran [13]. From the morphological point of view, this plant is an annual shrub, with juicy and fleshy stems and leaves, with wide branches on salty lands and is seen in a heap.

A stationary plant, with a height of 15 to 150 cm, which is propagated by seeds. Its stem is branched from the bottom to the top and looks like a shrub. Its branches are narrow and firm and hairless. The leaves of this medicinal plant are short, juicy and fleshy, yellow-green flowers and colorful fruits that can be seen in the fall season [14]. This plant is used in traditional medicine to treat some diseases.

Improvement of urinary infections, prevention of heart and brain stroke, prevention and treatment of kidney and bladder stones, regulation of blood pressure, regulation of menstruation, treatment of stomach and intestinal parasites, treatment of constipation and diuretic are amongst main indications [15]. Wheat is an annual monocotyledonous plant, which is known as the most important grain in the whole world [16]. According to traditional medicine, the temperament of wheat is warm and moderate. Undried fresh wheat is warm and moist. It helps to treat menopause, children's asthma, weight loss, anti-rheumatism, anti-gallstones, constipation, and colon cancer [17].

Materials and methods

Plant preparation

In April 2022, medicinal plants of S.rigida and wheat were prepared from the southern area of Ilam province located in the west of Iran. The plant was identified and confirmed as a species using the morphological keys of the book of Flora of Ilam Province (Waliullah Mozaffarian) at the Biotechnology and Medicinal Plants Research Center of Ilam University of Medical Sciences. The collected plants were cleaned and dried in the open air in the shade. The dried plant was powdered by a plant mixer and used for antioxidant testing.

The characteristics of the medicinal plants used in this study are specified in Table1.

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Table 1. *Details of medicinal plants of Alafe shour and wheat*

The name of the plant	Scientific name	Plant family	Collection area	Geographical coordinates
Alafe shour	*Salsola rigida*	Amaranthaceae	Dehlran	32° 41' 28" North, 47° 15' 58" East
Wheat	*Triticum aestivum*	Poaceae	Dehlran	32° 41' 28" North, 47° 15' 58" East

Materials and Methods

Determination of antioxidant activity of methanolic extract

Preparation of plant sample

From the dried plant, we homogenized 1 gr of the dry powder of the desired plant using 100 ml of methanol solution and allowed it to shake for 6 hours. Then the obtained solution was poured into a plastic falcon and centrifuged at 6000 rpm for 10 minutes. The centrifuged solution was used as a sample [18]. Preparation of working solution 2.2 ml of the R2b solution was added to the R2a parent bottle and vortexed until complete dissolution, and the R2 solution was obtained. Then the R2 solution was mixed at a ratio of 1:1 and after vortexing, 5 times its volume was added to the R1 solution.

The obtained solution is the working solution of the antioxidant kit [18].

Preparation of standard solution

The standard solution was prepared with concentrations of 0, 0.2, 0.4, 0.6, 0.8 and 1 ML. Then, the linear equation resulting from the concentrations of 0, 0.2, 0.4, 0.6, 0.8 and 1 ML of the standard solution is shown in fig. 1 (18).

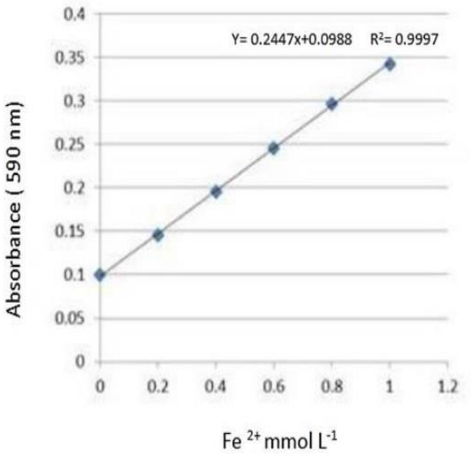

Fig. 1. *Linear equation resulting from different concentrations of the standard solution*

Method

First, 5 microliters of the prepared herbal solution was added to each well, and then 250 ML of the prepared working solution was added to each well containing the herbal solution. Then the microplate was incubated for 30 minutes at a temperature of 35 to 50 °C and finally it was read at a wavelength of 570 nm with an Elizar reader (18).

Results

FRAP assay is a direct method to measure total antioxidant activity. The principle of this test is based on the reduction of iron ion Fe^{3+} to iron Fe^{2+}. The results of total antioxidant capacity for methanolic extracts of *S.rigida* and wheat are shown in Table 2.

Table 2. *Total antioxidant capacity of methanolic extract of Alaf shour and wheat*

Plant	Total antioxidant capacity

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Alaf shour	0.77 Fe+2 mmol L-1
Wheat	2.2 Fe+2 mmol L-1

As can be seen from the results of Table 2, the antioxidant effect of methanolic extract of wheat is much stronger than the antioxidant effect of methanolic extract of *S. rigida*.

Discussion

One of the prominent effects of free radical activity in the body is damage to biological and vital molecules such as nucleic acids, proteins and lipoproteins. Therefore, free radicals, especially reactive oxygen species, play an important role in medical problems. Using compounds that neutralize free radicals, i.e. antioxidants, is a good choice to minimize the damage caused by their production. Plants are known as rich sources of antioxidants and consumption of these plants can be effective for human health [19]. The use of medicinal plants and herbal medicines has been highly considered due to their health-giving effect on humans. Antioxidant properties of medicinal plants have prompted researchers to use this valuable medicinal source in the pharmaceutical, food and health industries [19].

Ebrahimi et al., (2022) shown that the total antioxidant capacity of the medicinal plants *Mentha longifolia, Pistacia khinjuk* and *Eucalyptus globulus* was evaluated using ferric iron reducing antioxidant power (FRAP).

The results of that study showed that the total antioxidant capacity for extracts of medicinal plants *Mentha longifolia, Pistacia khinjuk* and *Eucalyptus globulus* was 2.21, 0.78 and 7 Fe^{+2} mmol L^{-1} respectively. Based on the findings of this research, medicinal plants showed strong antioxidant activity [20]. The results of our study are similar to the aforementioned study.

Changaee et al. (2023) showed that the total antioxidant capacity of Anthemis Susiana, *Alyssum campestre* and *Gundelia tournefortii* is 4.29, 1.01, and 1.25 Fe^{+2} mmol L^{-1}, respectively [21]. Bayas-Morejón et al. (2020) revealed that had a greater effect on the antioxidant activity of Bl flower extract at the rate of 60 mg/ml with 47.25 % [22]. Afttakhari et al. (2022) demonstrated that the methanol extract of the bitter and sweet variety of *Ferula assa-foetida* and *Bunium persicum* plant extracts can significantly increase the antioxidant effect compared to two different species of *F. assa- foetida* ($P<0.05$).

While the antioxidant capacity between bitter and sweet species of F. assa-foetida was not statistically significant [23].

Altememy et al. (2022) showed that the total antioxidant capacity for *Cynara scolymus, Echinacea purpurea* and *Portulaca oleracea* was 3.45, 1.16 and 1.68 Fe^{+2} mmol L^{-1}, respectively [24]. In another study by Altememy et al. (2022), it was found that the antioxidant capacity of whole oak, thyme, and watermelon was 4.1, 2.35, and 0.46 (Fe^{+2} mmol L^{-1}), respectively [25]. Shaheswari et al. (2022) showed that the total antioxidant capacity for the methanolic extract of *Falcaria vulgaris* was 2.86 Fe^{+2} mmol L^{-1} [26]. In another study by Shaheswari et al. (2022), the results of evaluating the antioxidant activity of *Nasturtium officinale* showed that the total antioxidant capacity was 2.83 Fe^{+2} mmol L^{-1} [27]. The results of evaluating the antioxidant activity of *Allium ampeloprasum*-revealed that the total antioxidant capacity of the methanolic extract of this plant is 3.06 Fe^{+2} mmol L^{-1} [28]. Alrekaby et al. (2023) demonstrated that the antioxidant potential of the methanolic extract of *Ziziphus spina-christi* was 7 Fe^{+2} mmol L^{-1}, rosemary 1.93 Fe^{+2} mmol L^{-1}, and *Satureja Khuzestani* 12.99 Fe^{+2} mmol L^{-1} [29]. In terms of antioxidant properties, the results are similar to the results of our study. The presence of phytochemicals and bioactive compounds with high antioxidant potential increases the antioxidant capacity of medicinal plants [30].

Conclusion

According to the findings, the investigated medicinal plants have antioxidant capacity. It can be concluded that using medicinal plants in pharmaceutical, food and health industries can have a positive effect on human health. Alaf shour and wheat have antioxidant properties due to their effective and bioactive chemical compounds, and they can be used for medicinal and therapeutic purposes, reducing free radicals and controlling diseases caused by oxidative stress.

Authors' contribution

All authors contributed equally to the manuscript.

Conflicts of interest

The authors declared no competing interests.

Ethical considerations

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Ethical issues (including plagiarism, data fabrication, double publication and etc.) have been completely observed by author.

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