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Evaluation of the Total Antioxidant Effect of Methanolic Extract of *Nasturtium Officinale*

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ABSTRACT

Introduction: Scientists have shown a growing interest in the use of herbs due to their valuable effect on human health. The antioxidant activity of medicinal plants is a powerful reason to use them in the food and pharmaceutical industries. Hence, the aim of this study was to evaluate the antioxidant properties of *Nasturtium officinale*.

Methods: Aerial parts of *N. officinale* 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 ability of plasma (FRAP) assay.

Results: The results of the evaluation of the antioxidant activity of *N. officinale* exhibited that the total antioxidant capacity was obtained as 2.83 mmol Fe^{2+}/L.

Conclusion: Our findings showed a potent antioxidant activity for *N. officinale*. It is recommended that the administration of *N. officinale* for therapeutic purposes could possibly possess beneficial health effects.

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Intorduction

Today, researchers have a great tendency to use antioxidant compounds to deal with complications caused by a wide range of diseases (Salehi et al., 2020). Antioxidant compounds improve many diseases caused by the increase of free radicals by overcoming oxidative stress (Akbari et al., 2022). Indeed, the accumulation of free radicals particularly reactive oxygen species (ROS) can lead to the induction of oxidative stress. ROS attacks all biological molecules including lipids, proteins, and nucleic acids. In fact, disruption of cellular redox interaction due to the increase of ROS and disruption of antioxidant defense leads to changes in the oxidation of the above molecules (Juan et al., 2021). Inside the cells, there are enzymatic and non-enzymatic systems to prevent oxidative stress. In physiological conditions, the level of ROS formation is in balance with the antioxidant capacity of the cell (Kapoor et al., 2019). During the last few decades, extensive studies have been conducted in the field of association of diseases with the reduction of antioxidants and the increase of oxidative damage to protein, DNA and lipids (Lorenzon dos Santos et al., 2020; Chen et al., 2020). It has been well known that plant

derived antioxidants can overcome oxidative stress by improving the amount of endogenous antioxidants such as glutathione (GSH) and increasing the activity of antioxidant enzymes including superoxide dismutase (SOD), glutathione peroxidase (Gpx) and catalase (CAT) (Pisoschi et al., 2021). Medicinal plants are reliable sources of antioxidant compounds that have long been used to treat diseases caused by oxidative stress (Tungmunnithum et al., 2018).

Nasturtium officinale is a medicinal plant in Brassicaceae family. Watercress is common name of this plant. It is a perennial herb which grows in Western Asia, Europe, India, and Africa. *N. officinale*is an edible plant which consumed with various food (Sadeghi et al., 2014). The hypoglycemic, stomachic, depurative, diuretic, expectorant, odontalgic, and stimulant effects of this plant are well known in traditional medicine (Chaudhary et al., 2018).Several diseases including asthma, bronchitis, tuberculosis, jaundice, urinary tract infection, calculi and scurvy could treat following administration of different parts of *N. officinale* (Klimek-Szczykutowicz et al., 2018). Indeed, the biological properties mentioned in several studies such as antioxidant, antihyperlipidemic, antidiabetic, antibacterial, anti-inflammatory, antihypertensive, hepatoprotective, antiulcer, anticancer, antifungal, nephroprotective and immunomodulatory effects have led to various therapeutic applications of this plant (Klimek-Szczykutowicz et al., 2020).Furthermore, the abundance of phytochemicals such as carotenoids, polyphenols, tannins, flavonoids, terpenoids, vitamins and minerals including lutein and zeaxanthincauses the healing properties mentioned in *N. officinale* (Chaudhary et al., 2018). Hence, the purpose of the current study was to investigate the antioxidant effect of methanolic extract of *N. officinale***.**

Materials and Methods

Plant Materials

Collection of *N. officinale* (Aerial parts) was carried out from Ilam County of Ilam Province, Southwest of Iran, in May 2022 (Figure 1). *N. officinale* 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, *N. officinale* was air dried in the shade and then ground and used for antioxidant assessment. The characteristics of *N. officinale* has been shown in Table 1.

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

Plant Sample Preparation

After drying the plant, 1 gram 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

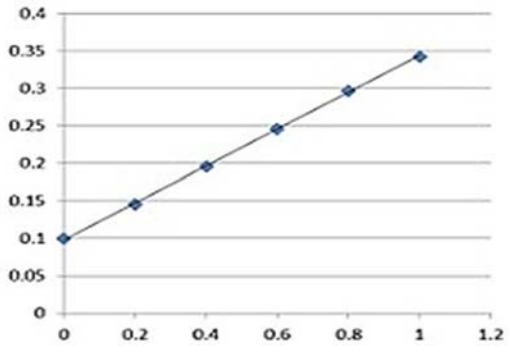
The total antioxidant capacity of the plants was assessed by ferric iron reducing antioxidant power (FRAP) assay.

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.



$Y = 0.2447_X + 0.0988$ & $R^2 = 0.9997$

Figure 2. Linear equation obtained from different concentrations of standard solution.

Procedure

First, 5µL 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.

Table 1. The characteristics of the *Nasturtium officinale*.

Scientific name	Persian name	Family	Collection area	Geographic coordinate
Nasturtium officinale	Kaleh sheng	Apiaceae	Ilam County	33° 37' 60" North, 46° 25' 60" East

Results

As shown in Table 2, the results of evaluation of antioxidant activity of *N. officinale* exhibited that the total antioxidant capacity was obtained as 2.83mmol Fe^{2+}/L. According to the instructions of the kit, the antioxidant standard limit is 1mmol Fe^{2+}/L. The results of the present study showed that the methanolic extract of *N.officinale* has antioxidant properties equal to 2.83 mmol Fe^{2+}/L, which is 2.83 times stronger than the standard kit. *N. officinale* is a plant with strong antioxidant properties.

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; Mandal et al., 2020; Banerjee et al., 2019; Roy et al., 2020; Mandal et al., 2019). Medicinal plants have attracted a lot of attention due to their low cost, availability, long history of use, preference of consumers and less side effects.Medicinal plants are known as rich sources of antioxidant compounds. Polyphenols are a group of these antioxidant compounds that play a role in preventing many diseases, including cancer (Chaachouay et al., 2022). Hence, the aim of the present study was to determine the antioxidant property of methanolic extract of *N. officinale*. Plant of *N. officinale*is recognized as an amazing herb with various therapeutic role. It has been indicated that phytochemical constituents with antioxidant activity are responsible for development of these biological properties (Klimek-Szczykutowicz et al., 2018). In the present study, our results for the evaluation of antioxidant activity of *N. officinale* demonstrated that the total antioxidant capacity was obtained as 2.83 mmol Fe^{2+}/L. In a similar study conducted by S. Bahramikia and R. Yazdanparast, the findings displayed that the aqueous ethanol extract of aerial parts of *N. officinale* exerteda potent antioxidant activity through scavenging of free radicals and its reducing power. Indeed, the FRAP value was obtained as 55.1 µM for concentration of 100 µg/mL compared to 91.9 µM for trolox as standard. The results of above study in agreement with the results of our study confirmed strong antioxidant effects of this plant. Differences in preparation of extracts could affect the obtained values of FRAP assay in these studies. Another part of the above study showed that the mentioned extract of *N.officinale* had ability to inhibit lipid peroxidation in rat liver homogenate (Bahramikia et al., 2010). Boligonet al.in an experimental study showed that various extracts of *N. officinale* had a significant antioxidant property through DPPH assay. This study also reported a high content of total phenolic and flavonoid for the extracts of this herb. Furthermore, the reducing effect of the extracts of *N. officinale* for lipid peroxidation had been proven in rat brains. The authors of this study proposed that the presence of phenolic acids, flavonoids and even the liposolublebetacarotene is responsible for the antioxidant effect of *N. officinale* (Boligon et al., 2013). Mazandarani M. and her team were also evaluated the antioxidant activities of *Nasturtium officinale*. The results of their study highlighted that methanolic extract of the aerial parts of *N. officinale* had a high antioxidant activity that could deal with free radicals. They proposed that the presence of high phenolic and flavonoid content of the extract of *N. officinale* could be attribute to the antioxidant effect of this plant. Indeed, the results of this study were in line with the results of our study (Mazandarani et al., 2013). In another similar study, the strong antioxidant activity of methanolic extract of *N. officinale* has proven. This study proposed that the potent antioxidant property of this herb could be due to its high flavonoids, glycosides and triterpenoidcontens (Haro et al., 2018). Zeb A. in an investigation showed significant antioxidant activity of methanolic extract of *N. officinale*. Moreover, this study exhibited that there were fourteen phenolic compounds in this plant. Coumaric acid, sinapic acid, caftaric acid and quercetin were the most abundant phytochemical constituents in the extract of *N. officinale*. In line with our result, this study demonstrated that methanolic extract has a better antioxidant activity and phenolic content than other types of extracts (Zeb et al., 2015)

Conclusions

In conclusion, our findings demonstrated that the methanolic extract of *N. officinale* exert a remarkable antioxidant capacity through FRAP assay. It can be understand from these results that *N. officinale* has a valuable antioxidant effect. Taking together, *N. officinale* as a medicinal herb could choose for therapeutic purposes in pharmaceutical industries.

Declarations

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 SM wrote the first draft of the manuscript, PG 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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