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Research Article

Comparative assessment of antioxidant activity in red apricot (*Prunus armeniaca* L.) and Fig fruits (*Ficus carica* L.) cultivated in Nakhchivan AR, Azerbaijan

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Abstract: Red apricot (*Prunus* spp.) and Black Fig (*Ficus carica* L.) are two of the most commonly grown summer fruits in the Nakhchivan region. In this preliminary study, ethanol fruit extracts were compared based on their total phenolic content (TPC) and antioxidant properties. According to the Folin-Ciocalteu method, the TPC was found to be 176.20 mg GAE/100 g in red apricot and 45.30 mg GAE/100 g in fig. Their antioxidant capacities were assessed using 2,2-Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity. The scavenging activity, identified as the concentration of ethanol extract needed to scavenge half of the radicals (SC50), was determined to be 3.52 mg/mL for red apricot and 6.46 mg/mL for fig. Based on these two biological activity assays, red apricot exhibited higher phenolic composition and radical scavenging activity. However, further studies are required to understand whether these differences are attributed to secondary metabolites in these fruits.

1. INTRODUCTION

Nutrition plays a crucial role not only in promoting natural, high-quality, and balanced diets but also in preventing or treating certain diseases. Foods contain varying proportions of proteins, fats, carbohydrates, minerals, and vitamins, along with one or more antioxidants. Food antioxidants are defined as substances that can mitigate the adverse effects of reactive oxygen species (ROS) or reactive nitrogen species (RNS) produced under physiological conditions in humans. Maintaining a balance between oxidants and antioxidants is essential for health. The term "antioxidant" is broad and varies in content and bioavailability depending on factors such as the type of food product, harvest time and methods, climate, temperature, humidity, storage conditions, and food preparation methods, influencing individuals' and communities' product choices and consumption habits (Akin *et al*., 2008; Kasnak & Palamutoğlu, 2015; Malkoç *et al*., 2019).

Apricot, considered a valuable natural gift, is rich in essential nutrients such as vitamins A, B, C, and P, along with significant amounts of iron. Additionally, apricots are abundant with calcium, phosphorus, sulfur, chromium, and magnesium. The high potassium content further underscores its nutritional benefits for human health. Apricots are noted for their nourishing

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and appetizing effects, and their substantial iron content aids in combating anemia. They contribute to detoxification processes in the body and possess protective properties against various types of cancer. Apricots enhance overall body resistance, particularly supporting the physiological development of adolescents. Furthermore, they promote nerve calming and facilitate sleep induction (Caliskan *et al*., 2012). Research indicates that apricot seeds are purported to aid in the treatment of several conditions including bronchitis, bronchial asthma, laryngitis, tracheitis, and upper respiratory tract infections. However, it is cautioned against consuming apricots on an empty stomach or following meals containing meat and rice, as these combinations can hinder the digestion process and weaken metabolism. Consumption of apricots during gastritis may elevate stomach acidity. Moreover, individuals with liver and pancreas diseases are advised to limit apricot intake (Campbell *et al*., 2011; Fratianni *et al*., 2018). Apricots aid in digestion, enhance hemoglobin levels, and support cardiovascular and nervous system health. The fruit's pectin content accelerates metabolism and lowers cholesterol. Apricot kernels are recommended for treating anemia, while apricot oil, rich in linolenic acid, is used in medicinal preparations. In traditional medicine, apricots are employed for respiratory ailments (Calıskan *et al*., 2012; Fan *et al*., 2018; Göttingerová *et al*., 2021).

The fig tree (*Ficus carica* L.) thrives in diverse soil types and is resilient to frost damage in the Autonomous Republic of Azerbaijan. Female flowers form in newly developed pods after above-ground frost, whereas one-year branches with preserved bushes produce both female and male flowers, ensuring effective pollination and high yield. Figs are cultivated extensively throughout Azerbaijan, and historical Azerbaijani texts document their medicinal benefits extensively. According to Muhammad Momin, figs are effective against high fever, chills, thirst, and diarrhea, while also possessing choleretic and liver-strengthening properties (Mawa *et al*., 2013). They are recommended for conditions like urinary retention, heart palpitations, asthma, cough, lung pain, and wheezing. Consumption guidelines suggest up to 300 grams of fresh figs or 120 grams of dried figs, preferably accompanied by cumin and other spices to aid digestion. Ibn Sina notes that fig milk has diuretic effects and aids in kidney stone removal. Figs are considered beneficial for kidney and bladder health. According to Muhammad Huseyn Khan, combining figs with almonds prevents thinness, and consuming figs before meals aids in weight gain and soothes the stomach (Rahimova, 2023).

In folk medicine, fig leaves are also utilized for therapeutic purposes. Leaf decoctions and extracts are administered for cough, bronchial asthma, kidney ailments, and applied topically to boils. Young branch leaf decoctions are used against scurvy. Fig milk serves as a pain reliever for injuries, rheumatism, and gout. Fresh figs contain 23% sugar (glucose, fructose), pectin, dietary fiber, organic acids, vitamins C, B1, B2, B6, PP, carotene (provitamin A), pantothenic acid, folic acid, potassium, phosphorus, calcium, magnesium, and iron. Dried figs, with up to 71% sugar content, are calorically dense. Modern medicine recognizes figs as beneficial in treating cardiovascular disease and reducing blood clotting, particularly when prepared with milk for upper respiratory conditions (Guliyev *et al*., 2023). These two fruits are used variously fresh, dried or as pulp, especially as a bowel mobility enhancer (Erdem *et al*., 2024).

2. MATERIAL and METHODS

2.1. Chemicals

2,2-diphenyl-1-picrylhydrazyl (DPPH), Folin-Ciocalteu reagent, methanol and ethanol were purchased from Sigma Chemical Co. St Louis, MO, USA.

2.2. Plant Samples and Extraction

The antioxidant activities of Red Nakhchivan apricot (*Prunus armeniaca* L.) and Black Nakhchivan fig (*Ficus carica*) varieties cultivated in the city of Nakhchivan were investigated in this study. Fresh fruits were harvested from the experimental area and subsequently dried in shaded conditions. Upon collection, the fresh fruits underwent initial washing with distilled water followed by drying with paper towels. They were then finely chopped and mixed with methanol using a blender. Specifically, 100 chopped fruits were combined with 250 mL of 60% ethanol and stirred for 24 hours to facilitate extraction of antioxidant compounds. Following the extraction period, the mixture was filtered sequentially through Whatman No. 4 filter paper and then through Whatman No. 1 filter paper to obtain a clear extract. The resultant extract was then stored in a deep freezer at -18°C until further analysis (Bayrak *et al*., 2023; Kolayli *et al*., 2024).

2.3. Determination of Total Phenolic Content (TPC)

Total phenolic content was determined using the Folin-Ciocalteu assay, following the method described by Singleton *et al*. (1999). Initially, 680 µL of distilled water was combined with 400 µL of 0.2 N Folin reagent in a test tube. Subsequently, 20 µL of the ethanolic fruit extract was added to the mixture, followed by the addition of 400 µL of 10% Na2CO3 solution. The resulting solution was thoroughly mixed and then incubated in darkness for 2 hours to allow color development (Singleton *et al*.,1999).

After incubation, the absorbance of the reaction mixture was measured at 760 nm using a spectrophotometer. The total phenolic content of the extracts was quantified based on a calibration curve prepared using gallic acid standards at concentrations ranging from 0.50 to 0.0156 mg/mL. The results were expressed as milligrams of gallic acid equivalents (GAE) per gram of fresh fruit (mg GAE/g fresh fruit).

This analytical approach ensured accurate determination of the phenolic compounds present in Red Nakhchivan apricot and Black Nakhchivan fig extracts, providing valuable insights into their antioxidant potential and health-promoting properties.

2.4. Determination of Total Antioxidant Capacity

The radical scavenging activity of the samples was assessed using a 100 µM methanolic solution of 2,2-Diphenyl-1-picrylhydrazyl (DPPH). Initially, 3.94 mg of DPPH was accurately weighed and dissolved in methanol to achieve a final volume of 100 mL, ensuring a standardized concentration of DPPH radicals in the solution. To measure the DPPH radical scavenging activity of the sample components, various dilutions of the sample extracts were prepared. Each sample solution was mixed in equal parts with the constant concentration of DPPH radical solution. The reaction mixtures were then allowed to incubate for a specified time in darkness to facilitate the reaction between the antioxidants in the samples and the DPPH radicals. Subsequently, the absorbance of the reaction mixtures was measured spectrophotometrically at a wavelength of 517 nm.

The results were plotted on an exponential graph to determine the radical scavenging power of the antioxidant substances present in the samples. This methodological approach ensured precise evaluation of the antioxidant capacity of the ethanolic frutis extracts, providing valuable insights into their free radical scavenging abilities and potential health benefits (Kolaylı *et al*., 2016; Kolaylı *et al*., 2024).

To determine the SC50 value, which represents the concentration of the sample extract required to scavenge 50% of DPPH radicals, solutions were prepared at least in six different concentrations. A 100 µM methanolic solution of 2,2-Diphenyl-1-picrylhydrazyl (DPPH) was used as the radical source. Initially, 3.94 mg of DPPH was dissolved in methanol to a final volume of 100 mL, ensuring a consistent concentration of DPPH radicals. The sample solutions were prepared by serial dilution to achieve varying concentrations. Each sample concentration was then mixed in equal volume with the DPPH radical solution. These mixtures were incubated in darkness for a specific time to allow the reaction between the antioxidants in the samples and the DPPH radicals. Following incubation, the absorbance of each mixture was measured spectrophotometrically at a wavelength of 517 nm. A dose-response curve was plotted using the percentage inhibition values against the logarithm of the concentrations of the sample extracts. From this curve, the SC50 value, representing the concentration of the sample required to scavenge 50% of the DPPH radicals, was determined.

3. RESULTS AND DISCUSSION

In Nakhchivan Autonomous Republic, apricot varieties are categorized into two main groups based on their flowering times: (i) early blooming and (ii) late blooming types. The apricot tree, belonging to the Rosaceae family, typically reaches heights of 5-7 meters, with round or oval-shaped canopies. The fruits, which are whitish-yellow in color and weigh between 65-75 grams, are predominantly single-seeded. The common apricot (A. vulgaris Lam.) blooms in March-April with white or light pink flowers that appear before the leaves. Fruits ripen from June to August, varying in weight from 3-18 grams and exhibiting different shapes, ranging from white to yellow and red-orange hues.

The Red Nakhchivan apricot variety studied has pyramidal trees reaching heights of 6-7 meters, characterized by reddish-brown trunks and branches. On the other hand, black figs are mainly propagated through root cuttings. Apricots are consumed fresh and are also processed into compote, juice, jam, jelly, and dried apricots used widely in culinary applications. Additionally, apricot bark can be used for activated charcoal production, and resin from its branches can yield clay.

Wild apricot species are valued for breeding cultural varieties and are notable for their large kernels containing non-drying fats, proteins, and carbohydrates. Apricots thrive in temperate climates, blooming briefly in spring and showing resilience to cold weather conditions (Akin *et al*., 2008; Campbell *et al*., 2011; Bayrak *et al*., 2023; Dinç *et al*., 2024).

Based on the research conducted by Guliyev *et al*., wild figs are often found in the territory of Nakhchivan AR (Guliyev *et al*., 2023). In addition, figs are very common on the Mediterranean coast and especially in Greece. Many varieties are grown in Azerbaijan. Large-fruited varieties with white and black fruits are mainly grown in backyards in the plains of Nakhchivan AR. Brown figs can also be found wild in Sharur, Ordubad, and Julfa regions. According to scientific studies, it can be said that among the subtropical fruit plants that are distributed and cultivated in the world, there is no other fruit plant that is as nutritious, fragrant and sweet as figs. White, black, yellow, brown and Ordubad fig varieties are cultivated in the autonomous republic.

The amounts of total phenolic substances were summarised in Table 1. Fig fruits had an average of 45 mg GAE/100 g, while red apricot had 176,20 mg GAE/100 g. It was found that the amount of polyphenol substance in apricot was about 3 times higher. When we compare these values with the values in the literature, it is possible to say that these fruits have similar values. In a study conducted in Turkey, it was reported that the amount of TPC in 3 different fig fruits varied between 35 and 47 mg GAE/100g (Bayrak *et al*., 2023). In another study conducted on apricots collected from different regions, it was reported that the amount of TPC varied between 74 and 274 mg GAE/g (Göttingerová *et al*., 2021). According to Dinç *et al*. (2024), red apricot fruit exhibits a higher total phenolic content compared to flower fruit. However, its phenolic content was found to be lower than that of grapes, as reported by Kavgacı *et al*. (Kavgacı *et al*., 2023). Total phenolic content serves as a significant indicator of antioxidant potential and health benefits in fruits, influencing their nutritional value and potential applications in food and pharmaceutical industries.

Plants with unlimited synthesis capacity have the ability to synthesize many secondary metabolites they need. Polyphenols are the secondary metabolites of plants with the widest membership and serve both themselves and humanity with their biologically active properties. Due to their biological activities such as antioxidant, antimicrobial, antiviral and anti-inflammatory, herbal products are used more and more frequently in diet programs. They are recommended to be taken regularly because they strengthen the immune system (Akyüz & Ersus, 2022; Özen & Yılmaz, 2023).

Plant-derived foods rich in phenolic phytochemicals are known for their potent antioxidant properties, crucial in defending the body against oxidative damage. These compounds act as effective scavengers of free radicals and metal chelators, thereby positively influencing metabolic processes (Can *et al*., 2015; Kolayli *et al*., 2016; Degirmenci *et al*., 2020; Akyüz & Ersus, 2022; Özen & Yılmaz, 2023). In the study, ethanol extracts of Red Nakhchivan apricot and black fig varieties exhibited significant antioxidant activity as measured by their ability to scavenge the DPPH radical. The SC50 values, representing the concentration of extract required to scavenge 50% of DPPH radicals, were 3.12 ± 0.043 mg/mL for Red Nakhchivan apricot and 6.46 ± 0.092 mg/mL for black fig (Table 1).

Table 1. Total phenolic content (TPC) and DPPH radical scavenging activities.

	TPC (mg GAE/100 g)	DPPH (SC_{50} mg/mL)
Fig fruits (n=5)	45.30 ± 2.30 mg /100 g	6.46 ± 0.092
Apricot fruits (n=5)	176.20 ± 5.66 mg /100 g	3.12 ± 0.043

In the study, it was found that extracts of fig and red apricot fruits possess the ability to scavenge the DPPH radical, with apricot fruit exhibiting a stronger antioxidant capacity. Research conducted on apricot and fig samples from different regions outside of Nakhchivan has consistently demonstrated these fruits to be rich sources of polyphenols, natural compounds known for their antioxidant properties. However, their antioxidant capacities vary depending on geographical regions and species (Ihns *et al*., 2011; Yiğit *et al*., 2009).

This preliminary study focused solely on total phenolic content analysis, while other studies have shown that apricots typically contain significant antioxidants such as chlorogenic acid, neochlorogenic acid, caffeic acid, and quercetin, which contribute to their health-promoting properties (Göttingerova *et al*., 2021). Studies have indicated that fig fruits, similar to apricots, are rich in chlorogenic acid. Additionally, they have been reported to contain high levels of flavonoids such as luteolin, apigenin, and rutin (Bayrak *et al*., 2023).

4. CONCLUSION

In this preliminary study conducted for the first time in the Nakhchivan region, apricots and figs, two fruit types known for promoting bowel movement and alleviating constipation, were compared in terms of their phenolic content and antioxidant properties. It was found that both fruits exhibited high levels of phenolic compounds, with the phenolic content in Red apricots being three times higher than in figs. Apricots were also determined to have a higher antioxidant value correlated with their phenolic component levels. Consequently, both fruits possess beneficial secondary metabolites for human health; however, further studies are needed to elucidate the specific nature of these metabolites.

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Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. This research study complies with research and publishing ethics. The scientific and legal responsibility for manuscripts published in IJSM belongs to the authors. **Ethics Committee Number**: Nakhchivan State University, 001/2024.

Authorship Contribution Statement

Elsevar Asadov: Research, investigation, analysis, systematization, visualization, editing. **Sura Rahimova:** Methodology, monitoring and evaluation, research, software, formal analysis. **Aziza Huseynova:** Collection of samples, research, editing

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