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Chemical Characterization and Antioxidant Activity of *Rosa canina L.* from Çekerek Region of Yozgat, Türkiye

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Abstract

Rosehip, popular for its bioactive richness, including phenolic acids, flavonoids, carotenoids, and ascorbic acid, exhibits significant antioxidant and health-promoting potential. This study investigated the physicochemical, mineral, and phytochemical characteristics of rosehips sourced from Çekerek region of Yozgat, Türkiye, to evaluate their suitability as a functional food. The rosehips exhibited high dry matter content and low water activity, suggesting excellent stability for storage and processing. Furthermore, the rosehips contained substantial mineral content, including potassium, calcium, magnesium, iron, and zinc, which enhances their nutritional value. Phytochemical analysis revealed a significant phenolic content, potent antioxidant activity, and exceptional vitamin C levels, positioning Çekerek rosehips as a superior natural antioxidant source. These findings underscore the influence of Çekerek's unique environmental conditions on rosehip composition and highlight their potential applications in the functional food, nutraceutical, and pharmaceutical sectors, addressing the increasing demand for natural antioxidants. This research contributes to the understanding of regional variations in *Rosa canina* and provides a basis for further investigation into the bioavailability, clinical applications, and development of value-added products from Çekerek rosehips.

Keywords: *Rosa canina* L., Rosehip, Phenolic compounds, Antioxidant activity

1. INTRODUCTION

Rosehips are popular for their abundance of bioactive compounds, including phenolic acids, flavonoids, carotenoids, and antioxidants, which collectively contribute to their significant health benefits [1]. Traditionally, rosehips have been utilized in herbal medicine for their anti-inflammatory, antioxidant, and antimicrobial properties, highlighting their role in promoting human health [2]. Rosehips are also an excellent source of vitamins, particularly vitamin C, as well as tocopherols, making them a valuable ingredient in functional foods and nutraceuticals [3] [4].

The Anatolia region of Türkiye is known for its diverse genetic pool of Rosa species, and the rosehips from this region exhibit varied phytochemical profiles [5]. Previous research has demonstrated significant variability in the chemical composition and antioxidant potentials of rosehips from different regions of Türkiye, emphasizing the influence of environmental factors such as climate and soil characteristics [1, 6]. Among these regions, Çekerek area of Yozgat stands out due to its unique climatic and edaphic conditions, which may contribute to the distinct phytochemical properties of its rosehip plants.

The phenolic content and antioxidant activity of rosehips have garnered considerable attention in health research due to their potential to mitigate oxidative stress [7]. Oxidative stress, a key contributor to the pathogenesis of chronic diseases such as cardiovascular diseases, cancer, and neurodegenerative disorders, can be alleviated by antioxidants that scavenge free radicals and reduce cellular damage [8, 9]. This makes the investigation of rosehip's antioxidant properties particularly relevant.

In this study, rosehip samples were collected from Çekerek region of Yozgat during the harvest season. The primary objectives were to analyze their total phenolic and flavonoid contents, evaluate their antioxidant activities using the DPPH radical scavenging method, and compare the findings with data from other regions of Türkiye. This investigation aims to highlight the unique phytochemical profile and

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nutritional potential of Çekerek rosehips, offering insights into their potential health benefits and applications in functional food products.

2. MATERIAL AND METHODS

2.1 Sample Collection and Preparation

The rosehip samples were collected from Çekerek region of Yozgat during the harvest season. The collected plant material was thoroughly washed with distilled water to remove any surface impurities. The samples were then dried in a hot air oven at 40°C until a constant weight was achieved. The dried rosehips were ground into a fine powder using a laboratory mill and stored in airtight containers at 4°C until further analysis [10].

2.2 Physical and Chemical Properties

The dry matter content of the rosehip was determined using gravimetric method. 5 g sample was weighed, placed in a pre-tared drying dish, and then dried in an oven at 105°C until a constant weight was reached. The dry matter percentage was subsequently calculated as the difference between the initial and final weights and expressed as grams per 100 grams of the sample [11].

The water activity of the rosehip samples was evaluated using a Novasina LabMaster-aw water activity meter. 10 g portion of the sample was placed in the device's chamber, and the water activity was determined at ambient temperature [12].

The ash content was determined by incinerating 5 g sample of dried rosehip in a muffle furnace at 550°C for 6 hours until it reached a constant weight. The resulting ash was then weighed and expressed as a percentage of the initial sample weight [6].

The pH of the rosehip extract was measured using a Mettler Toledo pH meter. To create the extract, 10 g of dried rosehip powder was dissolved in 100 mL of distilled water and agitated for 30 minutes. The pH of the resulting solution was then recorded [13].

2.3 Mineral Composition

The mineral composition of the rosehip, including the concentrations of potassium, calcium, magnesium, iron, and zinc, was analyzed using Inductively Coupled Plasma Optical Emission Spectrometry (Thermo Fisher iCAP 6000 Series ICP-OES). 0.5 g sample of the dried rosehip powder was treated in concentrated nitric acid and then diluted with deionized water. The mineral contents were quantified by referencing standard calibration curves and reported in milligrams per 100 grams of the dry sample [14].

2.4 Phytochemical Composition

The total phenolic content of the rosehip was quantified utilizing the Folin-Ciocalteu assay. 1 g sample was extracted with 80% methanol, and the resulting extract was combined with Folin-Ciocalteu reagent and sodium carbonate. The absorbance of the solution was measured at 765 nm, and the phenolic concentration was expressed as gallic acid equivalents per 100 g of dry weight [15].

The flavonoid content was quantified using aluminum chloride spectrophotometric method. 1 g sample of the dried rosehip material was extracted with 80% methanol, and the resulting extract was then combined with sodium nitrite, aluminum chloride, and sodium hydroxide. The absorbance of the mixture was measured at 510 nm, and the flavonoid concentration was reported as quercetin equivalents per 100 g of the dry rosehip sample [16].

The carotenoid content was quantified through spectrophotometric analysis. 1 g sample of the dried rosehip powder was extracted with hexane, and the absorbance of the extract was measured at 450 nm using a spectrophotometer. The carotenoid concentration was then calculated based on the standard absorption coefficient [17].

The vitamin C content was evaluated using the DCPIP (2,6-dichlorophenolindophenol) titration method. 1 g sample of the dried rosehip powder was extracted with 5 mL of 3% metaphosphoric acid solution. The extract was then titrated with a standardized DCPIP solution until the color remained stable for 30 seconds. The vitamin C concentration was subsequently calculated based on the volume of DCPIP used during the titration process [18].

2.5 Antioxidant Activity

The antioxidant activity of the rosehip samples was determined using the DPPH radical scavenging method. Dried rosehip powder (1 g) was extracted with 80% methanol and then combined with 0.1 mM DPPH solution. After 30 minutes of incubation, the absorbance was measured at 517 nm. The antioxidant activity was expressed as Trolox equivalents per 100 g of dry weight, based on a standard calibration curve [19].

3. RESULTS AND DISCUSSION

3.1 Dry Matter

The rosehip samples exhibited a high dry matter content of 91.37 g/100 g. This is advantageous for storage and processing, as it minimizes microbial deterioration and enzymatic activity, which are often depended on higher moisture content. Such a high dry matter value is particularly desirable for fruits intended for powder or dried product formulations, enhancing their stability and shelf life. Comparable dry matter values have been reported for *R. canina* in other regions, confirming the robustness of this characteristic across different environments [6]. The high dry matter content also suggests a concentration of bioactive compounds, enhancing their functionality in nutraceutical applications.

3.2 Water Activity (aw)

Measured water activity is found to be 0.387 which is a critical factor in determining the microbial stability of the samples. This low aw value limits the availability of free water, effectively restricting microbial growth and reducing enzymatic activity, thereby extending the storage period. In comparison, other dried fruits and functional food ingredients exhibit similar aw values, underlining the suitability of these rosehips for incorporation into shelf-stable products. The combination of low water activity and high dry matter content suggests a product well-suited for global distribution and long-term storage [20].

3.3 Ash Content

The ash content, reflecting the total mineral content, was measured at 4.63 g/100 g. This is consistent with values reported for other Rosa species and related fruits, such as hawthorn and cranberry. The significant mineral content enhances the nutritional profile of the rosehips, making them valuable for dietary supplementation. Future studies comparing the mineral profiles of rosehips from different regions could provide insights into the influence of soil and climate on ash content [21].

3.4 pH

pH measured as 3.8 is typical for rosehips and is largely attributed to the presence of organic acids such as citric acid and ascorbic acid. This acidic environment contributes to sour characteristic of rosehips and plays a role in their preservative properties by inhibiting microbial growth [22]. This pH is within the optimal range for natural food products and functional beverages, supporting their use in formulations aimed at maintaining both flavor and stability [14].

3.5 Mineral Composition

Potassium was the most abundant mineral in the rosehip samples, with a concentration of 818 mg/100 g. As a key nutrient, potassium plays an essential role in maintaining electrolyte balance, nerve function, and blood pressure regulation [23]. The value aligns closely with previous reports for Turkish rosehips and other functional fruits, confirming the nutritional value of *R. canina*.

Calcium (193 mg/100 g) and magnesium (90 mg/100 g) were present in significant amounts. Calcium is critical for bone health and cellular signaling, while magnesium supports muscle function and enzymatic processes [24]. These values highlight the potential of rosehips as a natural source of essential minerals for dietary supplementation, particularly in populations at risk of deficiencies.

The concentrations of iron (2.3 mg/100 g) and zinc (0.75 mg/100 g) were relatively lower but remain nutritionally significant. Iron supports oxygen transport and enzymatic activity, while zinc is vital for immune function and wound healing. These levels are consistent with reports for other *R. canina* varieties, suggesting their general adequacy as a source of trace minerals [3].

3.6 Vitamin C Content

The vitamin C content found as 1052 mg/100 g is exceptionally high, reaffirming rosehips as one of the richest natural sources of ascorbic acid. Vitamin C is not only a powerful antioxidant but also crucial for collagen synthesis, immune function, and wound healing [25]. This concentration exceeds the values reported for most other fruits and highlights the potential of Çekerek rosehips as a natural alternative to synthetic vitamin C supplements.

3.7 Flavonoid Content

The flavonoid content found as 244 mg/100 g further enhances the antioxidant profile of the rosehips. Flavonoids contribute to various health benefits, including anti-inflammatory and cardioprotective effects [26]. These levels are consistent with or exceed those reported for *R. canina* in other regions, reflecting the favorable growing conditions of Çekerek region.

3.8 Carotenoid Content

The carotenoid content of 4.84 mg/100 g, though moderate, adds to the overall antioxidant and nutritional value of the samples. Carotenoids are known for their pro-vitamin A activity and protective role against oxidative stress [27]. While slightly lower than values observed in regions with greater sun exposure, this level is adequate for contributing to eye health and skin protection.

3.9 Total Phenolic Content

The high total phenolic content of 1678 mg GAE/100 g (Gallic acid equivalent) confirms the rosehips as a rich source of bioactive compounds. Phenolics are well-documented for their potent antioxidant properties, which contribute to the mitigation of oxidative stress and prevention of chronic diseases such as cardiovascular conditions and cancer [7]. This value surpasses some previously reported ranges for *R. canina* from other regions [1], suggesting that Çekerek region's unique climatic and soil conditions may enhance phenolic biosynthesis.

3.10 Total Antioxidant Activity

The antioxidant activity of 517.04 mg TE/100 g (Trolox equivalent), measured via the DPPH assay, underscores the strong free radical scavenging potential of the samples. The observed antioxidant capacity aligns with the high phenolic content, confirming the central role of these compounds in neutralizing oxidative damage. These findings position Çekerek rosehips as a potent functional ingredient for health-promoting products, comparable to other antioxidant-rich fruits like blueberries and cranberries [28].

4. CONCLUSION

The rosehips from Çekerek region exhibit an exceptional combination of nutritional, phytochemical, and antioxidant properties, establishing them as a valuable natural resource with promising potential for health-promoting applications. Their substantial phenolic content, coupled with potent antioxidant activity, underscores their capacity to mitigate oxidative stress and the associated risks of chronic diseases, including cardiovascular disorders and certain cancers. Furthermore, the remarkable levels of vitamin C observed in these rosehips position them among the most abundant natural sources of this vital nutrient, offering a compelling alternative to synthetic supplements.

The notable mineral composition, featuring appreciable quantities of potassium, calcium, magnesium, iron, and zinc, further contributes to the nutritional value of these rosehips. These essential minerals play indispensable roles in maintaining human health, from regulating electrolyte balance and supporting bone health to bolstering immune function. The presence of flavonoids and carotenoids complements the robust antioxidant profile, further contributing to the prevention of oxidative damage and the promotion of overall well-being.

The findings of this study highlight the profound influence of regional environmental factors, such as the distinctive soil composition and climatic conditions of Çekerek region, on the biosynthesis of bioactive compounds and the overall nutritional profile of *R. canina* fruits. These results underscore the importance of investigating local variations in plant composition to fully realize their potential for utilization in functional foods, nutraceuticals, and potentially even pharmaceuticals.

Beyond the scientific implications, these findings hold significant promise for regional development by stimulating the cultivation, processing, and commercialization of Çekerek rosehips. Their superior quality presents novel opportunities within domestic and international markets, fostering sustainable agricultural practices and contributing to economic growth.

Future research endeavors should prioritize a deeper understanding of the genetic factors and specific environmental drivers that influence the composition of Çekerek rosehips. Investigations into optimizing cultivation and post-harvest processing techniques could further enhance their quality and extend their shelf life, ensuring greater applicability in health-related contexts. Expanding the scope of analysis to encompass bioavailability studies and clinical trials will be crucial for validating the health benefits of these rosehips and solidifying their position as a cornerstone in the functional food and nutraceutical industries.

AUTHOR'S CONTRIBUTIONS

The authors contributed equally.

CONFLICTS OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

RESEARCH AND PUBLICATION ETHICS

The author declares that this study complies with Research and Publication Ethics.

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