



TƏBİƏT ELMLƏRİ

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Research on the Phytochemical Composition of *Prangos Acaulis* and *Prangos Ferulacea* Species of the Apiaceae Family

Ziyaddin Mammadov^{1*} , Fatima Rashidova 

Abstract. The Apiaceae family comprises around 3,800 species, classified into four subfamilies and 29 tribes. Within this family, the genus *Prangos* includes approximately 30 species and is primarily distributed across Western Asia and the eastern Mediterranean. Several species of *Prangos* are widely utilized in traditional medicine and exhibit a range of pharmacological properties, including emollient, carminative, antifungal, antioxidant, antibacterial, cytokine secretion inhibitory, nutritive, anti-HIV, tonic, anti-meteorism, and anthelmintic effects. The objective of this study was to analyze the phytochemical composition of *Prangos acaulis* and *Prangos ferulacea* through qualitative chemical reactions. It is worth noting that *Prangos ferulacea* has been partially examined in previous phytochemical research. To achieve this goal, plant material from both species was subjected to phytochemical screening using various qualitative assays. The findings revealed that both *Prangos acaulis* and *Prangos ferulacea* are abundant in biologically active compounds. The analyses confirmed the presence of diverse phytochemical constituents. These results highlight the pharmacological significance of these species and suggest that their bioactive compounds hold promise for future medical and biological investigations. In conclusion, this research contributes valuable insights into the phytochemical profiles of *Prangos* species and provides a scientific foundation for subsequent pharmacological and biological studies.

Keywords: *Prangos acaulis* (DC.) Bornm., *Prangos ferulacea* (L.) Lindl., Apiaceae, phytochemical composition, qualitative reactions

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Apiaceae ailəsinin *Prangos acaulis* və *Prangos ferulacea* növlərinin fitokimyəvi tərkibinin tədqiqi

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Xülasə. *Apiaceae* ailəsi təxminən 3800 növü əhatə edir və dörd alt ailə ilə 29 tayfaya bölünür. Bu ailəyə daxil olan *Prangos* cinsi təxminən 30 növdən ibarətdir və əsasən Qərbi Asiya və Şərqi Aralıq dənizi bölgəsində yayılmışdır. *Prangos* növlərinin bir çoxu ənənəvi tibbdə geniş istifadə olunur və yumşaldıcı, qazqovucu (karminativ), antifunqal, antioksidant, antibakterial, sitokin ifrazını tormozlayıcı, qidalandırıcı, anti-HIV, tonik, meteorizmə qarşı və antihelmintik təsirlər kimi müxtəlif farmakoloji xüsusiyyətlər göstərir. Bu tədqiqatın məqsədi *Prangos acaulis* və *Prangos ferulacea* növlərinin fitokimyəvi tərkibini keyfiyyət reaksiyaları vasitəsilə təhlil etmək olmuşdur. Qeyd etmək lazımdır ki, *Prangos ferulacea* əvvəlki fitokimyəvi araşdırmalarda qismən öyrənilmişdir. Bu məqsədlə hər iki növdən əldə olunan bitki materialları müxtəlif keyfiyyət analizləri ilə fitokimyəvi skrininqdən keçirilmişdir. Nəticələr göstərmişdir ki, həm *Prangos acaulis*, həm də *Prangos ferulacea* bioloji cəhətdən aktiv birləşmələrlə zəngindir. Aparılan analizlər müxtəlif fitokimyəvi komponentlərin mövcudluğunu təsdiqləmişdir. Bu nəticələr həmin növlərin farmakoloji əhəmiyyətini vurğulayır və onların bioaktiv maddələrinin gələcək tibbi və bioloji tədqiqatlar üçün perspektivli olduğunu göstərir. Nəticə olaraq, bu araşdırma *Prangos* növlərinin fitokimyəvi profilləri haqqında dəyərli məlumatlar təqdim edir və gələcək farmakoloji və bioloji tədqiqatlar üçün elmi əsas yaradır.

Açar sözlər: *Prangos acaulis* (DC.) Bornm., *Prangos ferulacea* (L.) Lindl., *Apiaceae*, fitokimyəvi tərkib, keyfiyyət reaksiyaları

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Introduction

Members of the *Apiaceae* family are widely recognized as valuable vegetable, culinary, and medicinal plants. Phytochemicals, which are chemical compounds naturally occurring in plants, are responsible for their color and organoleptic properties (Yadav et al., 2017). Plants belonging to this family are notably rich in numerous chemical compounds exhibiting diverse biological activities, including coumarins, flavonoids, saponins, and other secondary metabolites. Saponins, which are classified among secondary metabolites with biological activity, demonstrate various pharmacological effects, and their influence on the cardiovascular system, immune system, and central nervous system, as well as their antidiabetic and antitumor properties, have been well documented (Yuan et al., 2010). Essential oils are composed of various biologically active compounds and possess antioxidant, anti-inflammatory, antimicrobial, antiviral, and antitumor effects, and owing to these properties, they are regarded as promising natural compounds in the fields of pharmacology and medicine (De Sousa et al., 2023). The most frequent application of *Prangos* species in traditional medicine is the alleviation of gastrointestinal symptoms, although numerous other uses have also been documented (Zengin et al., 2022).

The primary biological activities detected in representatives of the *Apiaceae* family include induction of apoptosis, antibacterial effects, hepatoprotective properties, vasodilatory (vasorelaxant) activity,

cyclooxygenase inhibition, and antitumor effects (Amiri & Joharchi, 2016). Prangos is one of the genera belonging to the Apiaceae family. Approximately 45 species within this genus have been recorded, and many of them possess economic and medicinal importance (Salihu et al., 2024). Prangos acaulis is a perennial herbaceous plant covered with dense, short, gray hairs and reaches a height of 15-40 cm. The flowering period of this plant occurs in April-May, while the fruits ripen in May-June. Its fruits are elongated and measure 12-18 mm in length. This species is xerophytic and is primarily distributed in plains and low mountainous areas, on gypsum and clay soils, as well as in dry valleys (Rashidova et al., 2026). Prangos ferulacea (L.) (called "Jashir" in Persian and "Oppoponax" in French) is one of the valuable medicinal plants utilized in traditional medicine for the treatment of various diseases. These plants are widely distributed in Iran, Türkiye, Lebanon, and parts of Europe, typically growing in rocky and mountainous regions and exhibiting remarkable adaptability to harsh environmental conditions. Phytochemical investigations have demonstrated that Prangos ferulacea contains numerous bioactive compounds, including coumarins, flavonoids, and terpenoids. Its essential oil is particularly abundant in monoterpenes and sesquiterpenes, which contribute to its antimicrobial and antioxidant properties. Furthermore, this plant has been traditionally employed to treat digestive disorders, diabetes, and inflammatory conditions, and contemporary studies have validated several of these therapeutic applications. According to various laboratory investigations, this plant has been demonstrated to possess therapeutic properties (Kafash-Farkhad et al., 2013). Prangos ferulacea is an orophilous species distributed throughout mountainous regions of the Eastern Mediterranean and Western Asia, with its occurrence recorded in Italy, Sicily, the Balkans, Syria, the Caucasus, and Iran (Marrelli et al., 2023). In contrast, Prangos acaulis is widely distributed across Central Asia and the Caucasus, including Iran (Rashidova et al., 2026). Research findings have established that the phytochemical composition of both plants is notably rich in essential oils (Badalamenti et al., 2022; Meshkatalasadat et al., 2010). Additional studies indicate that the young shoots and leaves of Prangos acaulis contain 60 mg/% ascorbic acid, 15.03-16.95 mg/% monosaccharides, 2.94-4.01 mg/% sucrose, 14-22.02 mg/% cellulose, various protein compounds, and 0.7-5.02 mg/% fatty oils (Qasimov et al., 2018).

Numerous methodological approaches are employed in the investigation of plant phytochemical composition. One such approach involves the examination of phytochemical constituents through qualitative reactions. Qualitative analysis holds considerable significance for identifying the phytochemical components present in medicinal plants (Mumtaz et al., 2014). Through the application of qualitative reactions, it becomes possible to detect biologically active substances such as flavonoids, saponins, coumarins, phenolic compounds, and tannins in plant extracts (Santhi & Sengottuvel, 2016). Although the existing literature provides sufficient information regarding the chemical composition of Prangos ferulacea, the available data concerning Prangos acaulis remains quite limited. In light of this circumstance, the objective of the present study is to investigate the phytochemical composition of both species through the application of qualitative reactions.

Research

Plant material. Specimens of roots and leaves from Prangos acaulis were collected during May 2025 from the vicinity of Diyagchay River, situated near Soyugdagh in the Ordubad district of the Nakhchivan Autonomous Republic, at an elevation of 2020 meters above sea level, corresponding to coordinates 38°98'72.1" N latitude and 46°06'55.3" E longitude. Root and leaf samples of Prangos ferulacea were obtained during May 2025 from the Kalbajar district.

Preparation of plant extract. The collected plant materials were subjected to complete drying in open air under conditions sheltered from direct sunlight exposure. Subsequently, until the preparation of extracts, they were preserved in dark-colored glass containers maintained in a cool environment protected from light. For the purpose of obtaining extracts from the leaf and root portions of both

plant species, accurately weighed quantities of 5 g of plant material were boiled in 100 ml of distilled water for a duration of 5 minutes. Following the cooling process, the solid plant particles were separated by filtration through filter paper.

Determination of saponins by qualitative reactions. For the purpose of phytochemical analysis, several tests were conducted including the foam test, reaction with concentrated sulfuric acid, the Rafon reaction, the Salkowski reaction, and reactions utilizing the Marquis reagent. For each individual test, 2 ml of plant extract was employed.

Determination of coumarins by qualitative reactions. For the identification of coumarins, observations were carried out under ultraviolet (UV) light at a wavelength of 365 nm within an alkaline medium. Additionally, paper chromatography treated with ammonia vapor followed by UV irradiation was utilized for this purpose. *Determination of flavonoids by qualitative reactions.* For the identification of flavonoids, various reagents were employed including $AlCl_3$, alkaline solution, and lead acetate. *Determination of anthracene derivatives by qualitative reactions.* For the identification of anthracene derivatives, dilute HCl, chloroform, and ammonia solutions were applied during the analytical procedure.

Determination of tannin derivatives by qualitative reactions. For the determination of tannin derivatives, $FeCl_3$ (iron (III) chloride) solution was utilized as the testing reagent. During the analysis of saponins through the foam test, persistent foam measuring approximately 1 cm in height, which remained stable and did not dissipate after 10 minutes of agitation, was observed in the root and leaf extracts of *Prangos ferulacea*, as well as in the root extract of *Prangos acaulis*. In contrast, the leaf extract of *Prangos acaulis* exhibited only minimal foam formation. Upon performing the reaction with concentrated sulfuric acid, a reddish coloration developed in all four samples examined. The application of the Rafon reaction yielded a blue-green coloration across all extracts. In the Salkowski reaction, although an orange color formation was anticipated for all four samples, only a pale-yellow coloration was observed instead. Regarding the reaction conducted with the Marquis reagent, a dark brown coloration developed rather than the expected raspberry color.

Table 1

Determination of saponins by qualitative reactions

	Foam test	Reaction with concentrated H_2SO_4	Rafon reaction	Salkowski reaction	Reaction with Marquis reagent
<i>Prangos ferulacea</i> (leaf)	+	+	+	+	-
<i>Prangos ferulacea</i> (root)	+	+	+	+	-
<i>Prangos acaulis</i> (leaf)	-	+	+	+	-
<i>Prangos acaulis</i> (root)	+	+	+	+	-

For the determination of tannin derivatives, upon the addition of FeCl₃ solution, a yellowish coloration was observed in the root extract of *Prangos acaulis*, whereas a bluish-black coloration, indicative of gallic acid, was observed in the leaf extract. In the root and leaf extracts of *Prangos ferulacea*, an olive-green coloration, characteristic of catechin, was formed.

Table 2

Determination of tannins by qualitative reactions

	Gallic acid (bluish-black color)	Catechin (olive-green color)
<i>Prangos ferulacea</i> (leaf)	-	+
<i>Prangos ferulacea</i> (root)	-	+
<i>Prangos acaulis</i> (leaf)	+	-
<i>Prangos acaulis</i> (root)	-	-

During the determination of flavonoids, in the reaction conducted with the AlCl₃ reagent, all samples exhibited yellow fluorescence when examined under UV light. In the alkaline test, a bright yellow coloration was observed across all samples, and it was noted that this color diminished following the addition of dilute HCl. In the reaction performed with lead acetate, a yellowish precipitate formed in all samples. In the reaction carried out with dilute HCl and Zn powder, which was employed for the identification of flavonoids, although the development of pink, orange, or purple coloration was anticipated, a brown color was observed in all samples instead.

Table 3

Determination of flavonoids by qualitative reactions

	Reaction with AlCl₃	Reaction with alkali	Reaction with lead acetate	Reaction with dilute HCl and Zn powder
<i>Prangos ferulacea</i> (leaf)	+	+	+	-
<i>Prangos ferulacea</i> (root)	+	+	+	-
<i>Prangos acaulis</i> (leaf)	+	+	+	-
<i>Prangos acaulis</i> (root)	+	+	+	-

For the determination of coumarins, when the extracts were treated with alkali and examined under UV light, blue-green fluorescence was recorded in all samples. In an additional test, spots of the extracts were applied onto paper chromatography; following the drying process, they were exposed to ammonia vapor and subsequently examined under UV light, where blue fluorescence was observed.

Table 4

Determination of coumarins by qualitative reactions

	Alkali + UV light	Paper chromatography + ammonia vapor + UV light
<i>Prangos ferulacea</i> (leaf)	+	+
<i>Prangos ferulacea</i> (root)	+	+
<i>Prangos acaulis</i> (leaf)	+	+
<i>Prangos acaulis</i> (root)	+	+

For the determination of anthracene derivatives, dilute HCl was added to the extracts and the mixture was heated in a water bath; subsequently, chloroform was introduced. Following the separation of the chloroform layer, ammonia solution was added. Although the development of pink, red, or cherry coloration was anticipated, none of these colors were observed in any of the samples.

As a consequence of the conducted investigation, the phytochemical composition of the extracts obtained from the plant was analyzed, and the presence of biologically active substances including coumarins, flavonoids, saponins, and tannins within their composition was established. These compounds represent widely distributed phytochemical constituents in plants and demonstrate various biological and pharmacological properties. Several qualitative reactions were employed for the detection of flavonoids. For this purpose, $AlCl_3$ solution, alkaline solution, and lead acetate reagents were utilized. The color changes and precipitate formation observed as a result of these reactions indicated the presence of flavonoids in the extract. The obtained findings demonstrate that the studied plant samples are abundant in various bioactive compounds. Research indicates that flavonoids exhibit antioxidant, anti-inflammatory, wound-healing, anti-aging, and immunomodulatory effects. Furthermore, it has been determined that flavonoids improve the progression of cardiovascular diseases, reduce the severity of upper respiratory tract infections, support cognitive health, and contribute to body weight reduction. Owing to their high biological activity and favorable safety profile, flavonoids are regarded as promising natural compounds for the development of novel pharmaceutical preparations (Taldaev et al., 2022). For the determination of coumarins, observations were conducted under ultraviolet (UV) radiation at a wavelength of 365 nm within an alkaline medium. Additionally, paper chromatography treated with ammonia vapor was employed for the detection of coumarins, and the chromatograms were examined under ultraviolet radiation.

The obtained results confirmed the presence of coumarins in the extract. Coumarins belong to a class of compounds that attract considerable scientific interest owing to their biological activity. Their physiological, bacteriostatic, and antitumor effects render further investigation and structural modification of these substances promising for their utilization as novel therapeutic agents (Jain & Joshi, 2012). For the determination of saponins, within the framework of phytochemical analysis, the foam test, reaction with concentrated sulfuric acid, Rafon reaction, Salkowski reaction, and reactions with the Marquis reagent were conducted, and the obtained results indicated the presence of saponins in the extract. For each reaction, 2 ml of plant extract was employed. The determination of tannin derivatives through qualitative reactions was performed using $FeCl_3$ (iron (III) chloride) solution, and the results of the reaction confirmed the presence of tannins in the extract. During our investigation, the presence of anthracene derivatives was not detected. Nevertheless, this outcome may be contingent upon various factors, including the pH of the medium, temperature, the extraction method utilized, and the properties of the obtained extract. For this reason, it is not possible to definitively assert that anthracene derivatives are entirely absent in the studied plant sample, and additional studies are considered appropriate for their more precise determination. The conducted investigations demonstrate that while certain information exists regarding the presence of these bioactive substances in *Prangos ferulacea* (Bruno et al., 2019), there is insufficient information in the literature concerning

the phytochemical composition of *Prangos acaulis*. The findings of the present study indicate that *Prangos acaulis* may be rich in bioactive substances such as flavonoids, coumarins, saponins, and tannins, and that the presence of these compounds is plausible. In this regard, a more comprehensive investigation of the phytochemical composition of this species is considered necessary, and the topic remains relevant.

Conclusion

As a result of the conducted phytochemical analyses, the presence of various biologically active substances in the root and leaf extracts of *Prangos acaulis* and *Prangos ferulacea* species was established. During the investigation, the presence of saponins, flavonoids, coumarins, and tannin derivatives was detected through qualitative reactions. In particular, the presence of saponins was confirmed by the foam test, while positive results were obtained in the determination of flavonoids using $AlCl_3$ and alkaline tests. Reactions carried out with $FeCl_3$ solution indicated the presence of tannin derivatives. During the determination of coumarins, characteristic fluorescence was observed under UV light. Additionally, as a result of the analyses performed, the presence of anthracene derivatives was not detected. The obtained findings demonstrate that the studied species are rich in various biologically active substances, and it can be concluded that they represent pharmacologically important plants.

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