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ARAŞTIRMA MAKALESI / RESEARCH ARTICLE

A COMPARATIVE STUDY OF PHENOLIC AND ANTIOXIDANT PROPERTIES OF PROPOLIS AND SUMAC (*RHUS CORIARIA* L.)

Propolis ve Sumak'ın (*Rhus coriaria* L.) Fenolik ve Antioksidan Özelliklerinin Karşılaştırmalı Bir Çalışması

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ABSTRACT

Sumac (*Rhus coriaria* L.) is a sour spice widely used in Türkiye and especially in the Southeastern Anatolia region to give a distinctive color and sharp taste to dishes. Propolis is a resinous natural product collected from beehives, and due to its wide range of biologically active properties, it is an important dietary supplement. In this study, the phenolic and antioxidant properties of sumac and propolis from Malatya region were examined and compared. Ethanolic extracts of sumac and propolis were analyzed for their phenolic properties, including total phenolic content (TPC), total flavonoid content (TFC), and phenolic composition. The phenolic profile was determined using HPLC-PDA based on 26 phenolic standards. Antioxidant activities were evaluated using the ferric reducing/antioxidant power (FRAP) assay and ABTS radical scavenging activity. The total phenolic content was measured at 49.12 mg GAE/g in sumac and 159.30 mg GAE/g in propolis. Sumac was found to be particularly rich in phenolic acids, including gallic acid, protocatechuic acid, and syringic acid. In contrast, propolis exhibited a higher content of flavonoids such as pinocembrin, hesperetin, caffeic acid, and CAPE. Chrysin was identified as a common flavonoid present in both natural products. The findings indicate that sumac contains a significant concentration of biologically active compounds, similar to propolis, and therefore has the potential to be utilized not only as a spice but also as a dietary supplement.

Keywords: Sumac, Propolis, Phenolics, Antioxidant activity

ÖZ

Sumak (*Rhus coriaria* L.), Türkiye'de ve özellikle Güneydoğu Anadolu Bölgesi'nde yemeklere belirgin bir renk ve keskin bir tat vermek için yaygın olarak kullanılan ekşi bir baharattır. Propolis, arı kovanlarından toplanan reçineli bir doğal üründür ve çok çeşitli biyolojik olarak aktif özellikleri nedeniyle önemli bir besin takviyesidir. Bu çalışmada, Malatya bölgesinden elde edilen sumak ve propolisin fenolik ve antioksidan özellikleri incelenmiş ve karşılaştırılmıştır. Sumak ve propolisin etanol ekstraktları, toplam fenolik içerik (TPC), toplam flavonoid içerik (TFC) ve fenolik bileşim dahil olmak üzere fenolik özellikleri açısından analiz edilmiştir. Fenolik profil, 26 fenolik standarda dayalı HPLC-PDA kullanılarak belirlenmiştir. Antioksidan aktiviteler, ferrik indirgeyici/antioksidan güç (FRAP) testi ve ABTS· radikal süpürücü aktivitesi kullanılarak değerlendirilmiştir. Toplam fenolik içerik, sumağın içinde 49,12 mg GAE/g ve propolisin içinde 159,30 mg GAE/g olarak ölçülmüştür. Sumak, gallik asit, protokatekuik asit ve şiringik asit dahil olmak üzere fenolik asitler açısından özellikle zengin bulundu. Buna karşılık, propolis, pinocembrin, hesperetin, kafeik asit ve CAPE gibi daha yüksek bir flavonoid içeriği sergiledi. Krisin, her iki doğal üründe de bulunan yaygın bir flavonoid olarak

tanımlandı. Bulgular, sumağın propolise benzer şekilde önemli miktarda biyolojik olarak aktif bileşik içerdiğini ve bu nedenle yalnızca bir baharat olarak değil aynı zamanda bir diyet takviyesi olarak da kullanılma potansiyeline sahip olduğunu göstermektedir.

Anahtar kelimeler: Sumak, Propolis, Fenolik, Antioksidan aktivite

GENİŞLETİLMİŞ ÖZET

Amaç: Sumak (*Rhus coriaria* L.), Türkiye'de ve özellikle Güneydoğu Anadolu Bölgesi'nde yemeklere kendine özgü bir renk ve keskin bir tat vermek amacıyla yaygın olarak kullanılan ekşi bir baharattır. Propolis ise arı kovanlarından toplanan reçinemsi bir doğal ürün olup, geniş biyolojik aktif özellikleri sayesinde önemli bir besin takviyesidir. Sumak ve propolis her ikisi de koyu renkli doğal ürünlerden olup, yüksek fenolik madde miktarlarına sahip doğal bitkisel karışımlardır. Bu çalışmanın amacı Malatya bölgesinde üretilen sumak ve propolisin örneklerinin fenolik ve antioksidan özelliklerinin incelenmesi ve karşılaştırılmasıdır.

Gereç-Yöntem: Malatya Doğanşehir'den toplanan Sumak ve propolis örneklerinden elde edilen etanolik özütlerin fenolik madde miktarları toplam fenolik madde miktarı (TFM), toplam flavonoid madde miktarı (TFM) cinsinden ölçüldü. Fenolik kompozisyonları ise 26 fenolik bileşene göre valide edilmiş HPLC-PDA ile analiz edildi Antioksidan özellikleri ise, demir-III-indirgeme /antioksidan test (FRAP) ve ABTS radikali temizleme aktivitesine göre belirlendi.

Bulgular: Etanolik örneklerin toplam fenolik madde miktarları, sumakta 49,12 mg GAE/g, propoliste ise 159,30 mg GAE/g olarak ölçüldü. Sumak bitkisinin, gallik asit, protokatekuik asit ve şiringik asit fenolik asitlerce zengin açısından zengin bulundu. Buna karşılık, propolisin flavonoidlerce zengin içerikli pinosembrin, hesperetin, kafeik asit ve CAPE (kafeik asit fenetil esteri) bulundu. Her iki doğal ürünün krisince zengin olması dikkat çekti.

Sonuç: Bu bulgular, sumak ve propolisin her ikisinin de biyolojik olarak aktif bileşenler açısından zengin olduğunu ve sumak bitkisinin sadece bir baharat olarak değil, aynı zamanda bir besin takviyesi olarak da değerlendirilebileceğini ortaya koymaktadır. Her ikisinin birlikte oluşturacağı karışımların, sinerjik olarak etkin potansiyel oluşturması düşünülmektedir. Bunun için daha ileri çalışmalara ihtiyaç vardır.

INTRODUCTION

Sumac (*Rhus coriaria* L.), a member of the Anacardiaceae family, is native to the Mediterranean region and typically grows as a shrub reaching heights of 1 to 3 meters. During the summer, it produces small, greenish flowers, followed by reddish-brown fruits in the autumn (Alsamri et al., 2021). Sumac is a popular spice in culinary applications and is widely used in Middle Eastern, Mediterranean and Turkish cuisines. It is often sprinkled on salads, meat dishes, and marinades to enhance flavor. Additionally, it is used in sauces, yogurt-based dips, and even some beverages to impart a tangy taste. Sumac serves as both a natural source of acidity and a rich reservoir of antioxidants, making it a valuable ingredient in the kitchen (Alsamri et al., 2021; Shabbir, 2012). Sumac fruits are rich in tannins, giving them a characteristic sour taste. They are known for their antioxidants, antimicrobial, and anti-inflammatory properties. Traditionally, sumac has been used in herbal medicine to treat digestive disorders and as an anti-inflammatory agent. Additionally, its fruits are widely used as a spice, especially in Middle Eastern and Mediterranean cuisines (Alsamri et al., 2021).

Sumac plants bloom in spring and summer, and fruit ripening occurs in late summer and early autumn. The harvest period generally takes place in August and September, when the fruits reach full maturity and develop their characteristic reddish-brown color. After harvesting, the fruits are dried and processed for use as a spice. Dried sumac flowers, which are dark red or burgundy in color, are commonly used in cooking either directly or by soaking in water to prepare sumac juice. The resulting liquid, after straining, is utilized as a flavoring agent in various dishes (Rayne and Mazza, 2007; Ünver and Özcan, 2006). The planted area of sumac (Rhus *coriaria* L.) varies significantly depending on the region, with a higher concentration found in the Mediterranean and Middle Eastern regions, where the plant is native and widely cultivated. In Turkey, particularly in the southeastern Anatolia region, sumac is extensively grown both for culinary and medicinal purposes. The cultivation of sumac remains significant due to its economic and cultural value, especially in local markets where it is used as a spice, as well as its potential as a source of bioactive compounds for the pharmaceutical and nutraceutical industries.

Propolis is a resinous substance collected by honeybees from tree buds and other botanical sources. It contains a diverse range of biologically active compounds such as flavonoids and phenolic acids, which contribute to its antioxidant, antimicrobial, and anti-inflammatory properties. Historically used in traditional medicine, propolis has gained renewed scientific interest for its potential roles in immunomodulation, wound healing, and cancer prevention (Kasote et al., 2022; Kolaylı et al., 2023).

Numerous studies have demonstrated that *Rhus coriaria* possesses a wide range of biologically active properties, including antioxidant (Alsamri et al., 2021; Bursal & Köksal, 2011), antimicrobial (Ashoori et al., 2020), antidiabetic (Tohma et al., 2019), antiinflammation (Momeni et al., 2019), neuroprotective (Khalilpour et al., 2019) and antitumor (Athamneh et al., 2017) activities. This study was aimed, the phenolic and antioxidant properties of propolis were compared with sumac (*Rhus coriaria*) plant grown in Doğanşehir district of Malatya province. Considering the growing demand for plant-based antioxidants with functional health benefits, sumac presents itself as a promising candidate for comparison with propolis, not only due to its rich phenolic content and traditional use, but also because it remains underrepresented in antioxidant research despite exhibiting comparable bioactive potential.

MATERIALS AND METHODS

Samples

Fresh sumac plant was collected from Erkenek/Karanlıkdere neighborhood of Doğanşehir district of Malatya province, Turkey in September 2023. Raw propolis sample was obtained from Malatya region in 2023 and used by pulverizing (Figure1). Approximately 10 g of dried sumac and powdered propolis samples were extracted in 100 mL of 70% ethanol. The extraction process was carried out in two stages: first, the sample was subjected to ultrasonic bath extraction for 2 h, then shaken in a shaker for 24 h. Filtration was carried out in two stages: first, coarse filtration was performed, then fine filtration was performed using high-quality, fine-pore filter paper. The obtained clear sumac and propolis extract was stored in a closed container in the refrigerator to be used in the study (Kara et al., 2022; Kolaylı and Birinci, 2024)

A) Propolis

B) Sumac

Figure 1. Powdered sumac and propolis samples

The selection of 70% ethanol as the extraction solvent was based on both literature precedence and its proven efficiency in recovering a broad spectrum of phenolic and flavonoid compounds from plant-based matrices. Ethanol–water mixtures, particularly at concentrations between 50–80%, have been widely reported to offer an optimal polarity for extracting both hydrophilic and moderately lipophilic compounds (Dai and Mumper, 2010; Do et al., 2014). In this context, 70% ethanol was chosen as a balanced solvent system capable of efficiently solubilizing a wide range of antioxidant and phenolic constituents from both sumac and propolis.

Total Phenolic Content (TPC)

TPC was evaluated spectrophotometrically using the Folin-Ciocalteu method (Slinkard and Singleton, 1977). In this procedure, a reaction mixture was prepared by combining 20 µL of the extract with 400 µL of 0.2 N Folin-Ciocalteu reagent and then diluted with 680 µL of distilled water. The mixture was incubated at room temperature for 3 min, then 400 µL of 10% Na_2CO_3 solution was added and the mixture was incubated at 25 °C for 2 h. The absorbance of the solution was then measured at 760 nm using a UV-Vis spectrophotometer (Thermo Scientific Evolution TM 201, Madison, USA). In the preparation of the standard graph, different concentrations of gallic acid (1; 0.5; 0.25; 0.125; 0.0625 and 0.03125 mg/mL) were used. The graph was drawn with the absorbance values found against concentration and the amount of phenolic substance as gallic acid equivalent was found according to the graph.

Total Flavonoid Content (TFC)

The total flavonoid content in the ethanolic extract was measured using a modified procedure based on the method of Fukumoto and Mazza (Fukumoto and Mazza, 2000) In this modification, Al $(NO_3)_3$ was used instead of $AlCl_3$ due to its lower water solubility. To initiate the assay, 50 µL of the ethanolic extract was mixed with 100 µL of 10% Al $(NO_3)_3$ and 100 µL of 1.0 M NH_4CH_3COO. The resulting solution was diluted to a final volume of 3.0 mL using 99% methanol and incubated at 25 °C for 45 min. After incubation, the absorbance was measured at 415 nm. A calibration curve was established using six quercetin standards with concentrations ranging from 0.031 to 0.50 mg QUE/mL. Total flavonoid content was calculated and expressed as milligrams of quercetin equivalents (QUE) per 100 grams of extract according to the standard curve.

Ferric Reducing/Antioxidant Power (FRAP)

The total antioxidant capacity of the ethanolic extract was evaluated using the Ferric Reducing Antioxidant Power (FRAP) test according to method Benzie (Benzie and Strain, 1996). For the preparation of FRAP reagent (Fe-III-TPTZ), a mixture of TPTZ dissolved in 40 mM HCl, acetate buffer and 20 mM $FeCl_3.6H_2O$ solution was made in a test tube. Then, 3 mL of the prepared FRAP reagent was combined with 100 µL of the extract and incubated at 37 °C for 4 min. The absorbance was measured at 595 nm. A calibration curve was established using varying $FeSO_4.7H_2O$ concentrations (1000 to 31.25 µmol/mL). The results were expressed as µmol $FeSO_4$ $.7H_2O$ equivalent per grams of weight.

ABTS• Radical Scavenging Capacity

The radical scavenging activity of ethanolic extracts was evaluated by a spectrophotometric method using 2,20-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS$^{\cdot}$). ABTS$^{\cdot}$ was dissolved with deionized water to a concentration of 7 mM and potassium persulfate was added to 2.45 mM. The mixture was incubated at room temperature and in the dark for 12 h. Then, the mixture was diluted with 0.01 M PBS (phosphate buffered saline), pH 7.4, to obtain an absorbance value of 0.70 at 734 nm. Trolox was used as a standard and the results obtained were expressed as SC_{50} value as the concentration of samples that scavenged 50% of ABTS$^{\cdot}$ radicals (Kolayli et al., 2016).

Phenolic Compounds in RP-HPLC-PDA

Before the analysis of phenolic components of the ethanolic extracts by RP-HPLC-PDA, liquid-liquid extraction was performed to enrich the sample (Kolaylı and Birinci, 2024). A 10 mL portion of the extract was evaporated using a rotary evaporator at 40 °C. The resulting residue was redissolved in 10 mL of distilled water and the pH was adjusted to 2 with concentrated HCl. The organic phases were collected after three consecutive extractions with diethyl ether and ethyl acetate. After evaporation of the solvent, the residue was dissolved in 2 mL of methanol, filtered through a 0.45 µm RC membrane and analyzed for phenolic content. The phenolic composition of the extract was determined using an RP-HPLC-PDA system equipped with a photodiode array (PDA) detector (Shimadzu Liquid Corporation LC 20AT) and a C18 column (250 mm × 4.6 mm, 5 µm; GL Sciences) (Kara and Birinci, 2024). A calibration curve was established with 26 phenolic standards. The mobile phase was (A) 2% acetic acid in water and (B) 70:30 mixture of acetonitrile and water, the injection volume was optimized at 20 µL, the column temperature was 30 °C, and the flow rate was 1.0 mL/min.

RESULTS

The total phenolic and flavonoid content of ethanolic sumac and propolis extracts are presented in Table 1. The average total phenolic content (TPC) was 49 mg GAE/g in the sumac extract, while it was approximately three times higher in the propolis extract. The total flavonoid content was approximately 31.7 mg QUE/g in the propolis extract, compared to 3.36 mg QUE/g in the sumac extract. A comparative analysis of the two extracts reveals that propolis exhibits a higher flavonoid content. Specifically, flavonoids account for approximately 20% of the total phenolic content in propolis, whereas they represent only about 6.8% of the total phenolic content in sumac.

Table 1. Total phenolic and flavonoid contents of the samples

	Total Phenolic Content (mg GAE/g)	Total Flavonoid Content (mg QUE/g)	%TFC/TPC
Sumac	49.11 ± 1.32	3.36 ±0.15	%6.84
Propolis	156.20±2.78	31.70±1.21	%20.29

In this study, the antioxidant capacity of propolis and sumac extracts was compared as a measure of their biological activity. The ferric reducing antioxidant power (FRAP) method, a straightforward and reliable assay for determining total antioxidant capacity, was used. Higher FRAP values correspond to greater antioxidant potential, with the FRAP value of propolis found to be approximately three times higher than that of sumac extracts (Table 2). The antioxidant capacity of both sumac and propolis is primarily attributed to their polyphenolic content. However, unlike propolis, sumac is a natural product that also contains significant amounts of ascorbic acid, which contributes to its antioxidant capacity. Indeed, the ascorbic acid content in sumac has been reported to range from 10 to 44 mg/kg, indicating that polyphenols are not the sole determinant of its antioxidant activity (Fereidoonfar et al., 2019).

Table 2. Total antioxidant capacities of the samples

	Total antioxidant capacity FRAP (µM $FeSO_4.7H_2O$/g)	ABTS radical scavenging capacity SC_{50}(mg/mL)
Sumac	463.17 ± 2.26	0.93±0.01 *(Std.Troloks0.20±0.01)*
Propolis	1662.30±68.20	0.021±0.00

Free radicals are atoms or molecules that contain unpaired electrons, making them highly reactive. In this study, ABTS molecule was used as a model radical to evaluate antioxidant activity (Kolayli et al., 2016). ABTS radical is a radical commonly used to evaluate antioxidant activity, especially to evaluate radical scavenging capacity. The SC_{50} value calculated in this experiment represents the concentration of an antioxidant required to neutralize 50% of radicals in the experimental medium. Consequently, a lower SC_{50} value corresponds to a higher antioxidant capacity, which reflects the effectiveness of the substance in radical scavenging. In our study, it is seen that the radical scavenging activity of propolis is much higher than that of sumac.

In our study, the phenolic profiles of both ethanolic extracts were analyzed using RP-HPLC-PDA. Samples enriched through liquid-liquid extraction were evaluated against 26 phenolic standards. The results are summarized in Table 3. The identified phenolic compounds were categorized into two main groups, phenolic acids and flavonoids, and their contents were compared within the table. Gallic acid was identified as the major component of the sumac plant, followed by protocatechuic acid and syringic acid. Chrysin and pinocembrin were determined as the flavonoids present in sumac. Similar to our study, it has been reported that gallic acid and protocatechuic acid are the major phenolic compounds in sumac (Elagbar et al., 2020; Kosar et al., 2007). In propolis, gallic acid was not detected, while hydroxycinnamic acids were found to be more abundant, with flavonoids being higher in concentration. Among the phenolic acids, caffeic acid and its ester derivative, caffeic acid phenethyl ester (CAPE), are among the most important markers of propolis, while chrysin, pinocembrin, and rhamnetin were also identified as flavonoids present in propolis.

Table 3. The phenolic compounds of the samples using HPLC-PDA

	Phenolic Standards (μg/g)	Sumac	Propolis
Phenolic acids	***Hydroxybenzoic acids***		
	p-OH Benzoic acid	-	23.10
	Vanillic acid	-	
	Protocathehuic acid	143.11	-
	Gallic acid	1693.58	-
	Chlorogenic acid	-	-
	Syringic acid	68.98	-
	Ellagic acid	-	-
	Hydroxycinnamic acids		
	t-cinnamic acid	-	-
	Ferulic acid	-	960.80
	p-Coumaric acid	-	1210.20
	Caffeic acid	-	1430.22
	Caffeic acid phenethyl ester (CAPE)	-	1750.09
Flavonoid	***Flavonol***		
	Rhamnetin	-	-
	Quercetin	-	760.20
	Rutin	-	-
	Myricetin	-	-
	Galangin	-	-
	Flavan-3-ols		
	Epicatechin	-	-
	Catechin hydrate	-	-
	Flavones		
	Chrysin	8.14	1820.33
	Daidzein	-	-
	Apigenin	-	-
	Luteolin	-	-
	Flavanones		
	Pinocembrin	8.58	2055.06
	Hesperetin	-	806.45
	Naringenin	-	-

(-): not detected

DISCUSSION

Propolis is a resinous substance collected from the hives of honeybees, renowned for its high biologically active value due to its rich polyphenol content. The most prominent feature of this complex natural mixture, which is poorly soluble in water but highly soluble in ethanol, is its substantial polyphenolic composition (Kumova, 2002).

Similarly, sumac (*Rhus spp*.) is a plant belonging to the Anacardiaceous family (gum tree family), usually growing in the Mediterranean, and Middle East regions. The red-colored fruits of this shrub-shaped plant are used as a spice after being dried and ground. Sumac spice adds flavor to dishes with its sour and aromatic taste and is frequently preferred in salad dressings, meat dishes and appetizers

(Batiha et al., 2022). Apart from its culinary uses, sumac water extracts are valued for their health benefits, including antioxidant, antimicrobial, and anti-inflammatory properties. Traditionally, sumac has been utilized in the treatment of sore throat, digestive disorders, and inflammation, and it is also a rich source of vitamin C (Zannou et al., 2025).

This study compares the phenolic composition and antioxidant properties of propolis and sumac extracts. For the first time, the phenolic content of these two natural extracts was directly compared, revealing that both are polyphenol-rich, with propolis exhibiting approximately three times the polyphenol content of sumac. Additionally, propolis demonstrated a higher concentration of flavonoids. Polyphenols, secondary metabolites in plants, play a critical role in their biological activities. These compounds are primarily categorized into two major subclasses: phenolic acids and flavonoids, with flavonoids being the largest subclass. They are particularly significant due to their potent anti-inflammatory effects, contributing to their overall biological efficacy (Abbas et al., 2017).

A study conducted on 136 sumac trees in Iran reported that the total phenolic content (TPC) ranged from 77.54 to 389.30 mgGAE/g DW (Fereidoonfar et al., 2019). These values are notably higher than those observed in our study, suggesting significant methodological differences in the calculation or measurement techniques. Conversely, the total flavonoid content (TFC) in the same study was reported to range between 2.19 and 7.15 mg, which aligns closely with our findings. A study conducted using LC/MS-MS identified the presence of 25 phenolic compounds in sumac. Additionally, the study reported that the sumac plant is characterized by its high tannin and anthocyanins content (Tohma et al., 2019). In this study, the amount of TPC in aqueous sumac extracts was reported as 55 mg GAE/g. However, ethanolic extracts have been reported to contain higher TPC.

In a study, it was reported that sumac fruits contain Delphinidin-3-glucoside, Cyanidin-3-glucoside, Cyanidin-3-rutinoside, and Cyanidin chloride from anthocyanins. In the same study, it was reported that the sour taste of sumac fruits is caused by organic acids such as citric acid, malic acid, oxalic acid, tartaric acid (Zannou et al., 2025).

The total phenolic content of propolis extracts varies significantly depending on regional, national, and floral characteristics. Studies focusing on Anatolian propolis have demonstrated a wide range of total phenolic content, typically between 45 mgGAE/g and 274 mgGAE/g. This variation highlights the influence of geographical and botanical factors on the phenolic composition of propolis (Can et al., 2024; Kolaylı et al., 2023). Our results showed that the antioxidant capacities of both extracts were found to be related to the total amount of phenolic substances.

In this study, the FRAP method reflects total antioxidant capacity, while ABTS method indicates radical scavenging activity. Although there is a positive correlation between both methods, there are differences between their antioxidant mechanisms of action. In this study, antiradical activity of the extracts was analyzed according to ABTS methods. ABTS radical (2,2'-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid)) is a chemical substance widely used in antioxidant capacity measurements. In particular, the radical form of ABTS ($ABTS^{\cdot+}$) is blue-green in color and its color decreases or disappears when it reacts with an antioxidant substance. This color change is measured spectrophotometrically to determine the antioxidant capacity of a substance (Kut et al., 2022). The ABTS radical is commonly used in what is known as the Trolox Equivalent Antioxidant Capacity (TEAC) test and the results are expressed in Trolox (vitamin E analog) equivalents. The ABTS method is widely preferred in the food, pharmaceutical and biochemistry fields as it is effective in measuring hydrophilic and lipophilic antioxidants (Cano et al., 2023).

According to the results from our HPLC analysis based on 26 phenolic standards, it is evident that propolis has a richer polyphenolic profile compared to sumac. Our findings indicated that sumac extract was predominantly rich in gallic acid, with smaller amounts of protocatechuic acid, chrysin, and pinocembrin. Consistent with our results, previous studies have reported sumac extracts as being particularly high in gallic acid (Zannou et al., 2025). Propolis was characterized by the presence of hydroxycinnamic acids and flavanones, which are typical of Anatolian propolis (Can et al., 2024). Moreover, key active constituents in propolis, including caffeic acid, rutin, quercetin, pinocembrin, and hesperetin, were identified, although their concentration and presence vary according to the regional floral characteristics. The quality and biological value of Turkish (Anatolian) propolis demonstrate regional variations, with distinct types such as pine propolis in areas rich in oak forests and chestnut propolis in regions abundant with chestnut trees (Cora et al., 2023).

Conclusıon: In conclusion, both propolis and sumac are natural botanical products characterized by high polyphenolic content and significant antioxidant properties, with notable similarities and differences between them.

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