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Using sumac (*Rhus coriaria* L.), as a miraculous spice with outstanding pharmacological activities

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Abstract

Sumac is the wine-colored ground spice, belonging to the cashew family (Anacardiaceae). The most important components of sumac ethanolic extract obtained from sumac are Trans-Caryophyllene, diethyl ester, Butanedioic acid, Cembrene, 1,7-Nonadien-4-ol,4,8-dimethyl, Malate, Palmitate, 9-Octadecenoic acid, Ethyl Linoleic acid, Phytol and Ethyl Linoleate. In the Middle East, sumac is used as a spice and is extensively consumed with Kebabs and grilled meats. It is traditionally used by native Indians of North America in the treatments of bacterial diseases, such as syphilis, gonorrhea, gangrene and dysentery. In traditional medicine of Middle Eastern countries, it has been used for cholesterol reduction and sweating because it has shown antibacterial, hypoglycemic activities and even antioxidant properties due to the presence of tannin fractions in both of their fruits and leaves. The most important health benefits of sumac are reduced cholesterol, balance blood sugar levels, rich in antioxidants, calms muscle aches, reduce the chance of bone depletion, and it can help in the fight against cancer. In this review article all relevant papers of different scholars and researchers were searched in Google Scholar, Science Direct, Scopus and PubMed. Sumac has numerous health benefits and important pharmacological activities, and it can be considered as a valuable source of nutraceuticals, and an efficient natural drug.

Keywords: antioxidant; Kaempferol; Isoquercitrin; sumac; traditional medicine

Introduction

Traditional medicines deal with common principles and methods of education, innovation, prevention, treatment and practical researches which can benefits the society, patients and improvement of sciences (Shahrajabian *et al.*, 2020 a,b,c,d,e). Traditional medicinal plants have notable function for prevention and treatment of diseases by considering their traditional utilizations (Shahrajabian *et al.*, 2021 a,b,c,d,e,f). Traditional medicine is a collection of written and oral, practical and theoretical knowledge which collected from Iranian, Chinese, Greek, and Indian ancient knowledge and wisdom (Marmitt *et al.*, 2021; Sun *et al.*, 2021 a,b,c,d). *Rhus coriaria* L. (sumac), belonging to the Anacardiaceae family, is a plant with antioxidant properties whichs grows in Iran, Southern Europe, Mediterranean countries, North Africa, and Afghanistan (Nasar-Abbas and Halkman, 2004; Yang *et al.*, 2016; Abdel-Mawgoud *et al.*, 2019; Khoshkharam *et al.*, 2021). It is considered a reasonable cure in traditional medicine for its analgesic, anorexic, antidiarrhetic, antiseptic, and antihyperglycemic properties (Rayne and Mazza, 2007). The name is originated from "sumaga", meaning

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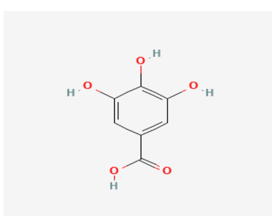
red (Wetherilt and Pala, 1994). They have a milky or resinous juice; compound or simple leaves; small flowers, with the parts in fours or sixes; and one-seeded, small dry, usually hairy, sometimes highly colored fruits, generally in dense clusters (Bayram *et al*., 2005). The name sumac is given also to the commercial preparation of the ground and dried leaves of the Sicilian or tenners sumac (*Rhus coriaria*) of Southern Europe, long applied in making leather (Bayram *et al*., 2005). *Rhus coriaria*, found mostly in the Middle East and Mediterranean basin, has been used in spice blends and in traditional medicines for hundred years (Kirby *et al*., 2013), while *Rhus typhina*, the Staghorn sumac, also called *Rhus hirta*, is a species found throughout North America (Rayne and Mazza, 2007). Sumac can grow in non-agriculturally viable locations, and has a long history of utilized by indigenous people for medicinal and different purposes (Chen and Chen, 2011), and this shows potential for commercializing it without competing for food production land use (Wyk and Wink, 2004). Many compounds have been isolated from different parts of sumac, such as fatty acids, phenolics, organic acids, volatile oils, proteins, fiber, vitamins and minerals (Ozcan and Haciseferogullari, 2004; Anwer *et al*., 2013). Sumac extract was characterized by both 7-methyl-cyanidin 3-galactoside and gallic acid derivatives (Romeo *et al*., 2015). In the Middle East, it is also used as the spice, to give sour lemon taste to grilled stews and meats, but in vegetable and rice dishes too (Giovanelli *et al*., 2017). The red fruits are tightly ranged together into an inverted cone-shaped spike of 5-30 cm, and the fruits are tiny little spheres tightly packed together forming dense clusters of reddish drupes called sumac bobs (Sakhr and El Khatib, 2020). The dimension and physical properties of *Rhus coriaria* are length (4.72±0.030 mm), width (3.90±0.028 mm), weight (0.018±0.001 g), thickness (2.64±0.025 mm), mean diameter (3.64±0.023 mm), projected area (0.164±0.005 cm^2), volume (19.49±0.442 mm^3), bulk density (304.25±.364 kg/m^3), and porosity (68.52±0.578%) (Ozcan and Haciseferogullari, 2004). In Iran, sumac is grown in Mazandaran, Khorasan, Azadbayegan, Ghazvin, Shiraz, Ghom and Hamedan (Khoshkharam *et al*., 2020). Syrian sumac (*Rhus coriaria* L.) is famously used in Mediterranean region and the Middle East as a spice sauce and drink and Chinese sumac (*Rhustyphina* L.) is indigenous to the Eastern area of North America, is not extensively cultivated in China's North, Northwest and many other regions such as Lanzhou, Beijing, Hebei, Shanxi where it is usually called huojushu (Kossah *et al*., 2009). Edible sumac varieties consist of smooth sumac (*Rhus glabra*), dwarf or winged sumac (*Rhus copallina*), staghorn sumac (*Rhus typhina*), lemonade berry (*Rhus integrifolia*), Southwestern sumac (*Rhus microphylla*), sweet sumac (*Rhus aromatic*), sugar bush (*Rhus ovata*), and squaw berry (*Rhus trilobata*) (Khoshkharam *et al*., 2020). The aim of this manuscript is introduced and survey the most important pharmaceutical and health benefits of sumac and present chemical constituents of sumac.

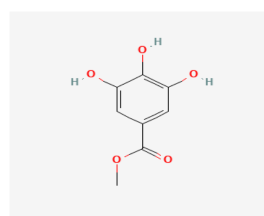
Chemical Components and Nutritional Constituents

Rhus coriaria consists of numerous substances including polyphenols such as quercetin, gallic acid, kaempferol, methyl gallate (Shabana *et al*., 2011), and hydrolysable tannins, which shows a significant strong antioxidant impact (Kosar *et al*., 2007). The fruit of sumac contains phenolic acids, flavonols, hydrolysable tannins, anthocyans and organic acids such as citric, malic and tartaric acids (Ozcan and Haciseferogullari, 2004; Kossah *et al*., 2010). The main compound found in Rhus family is hydrolysable gallotannins, and it is the main structural unit in the polyol D-glucose, esterified by gallic acid at its hydroxyl groups to give the *β*-pentagalloyl-D-glucose (Zalacain *et al*., 2003). Also, gallic acid contains notable anti-obesity (Hsu and Yen, 2007), hepatoprotective (Jadon *et al*., 2007), antioxidant (Yen *et al*., 2002) and anticancer (Sun *et al*., 2016) activities. Kosar *et al*. (2007) also reported that while gallic acid was the principle phenolic acid in the extracts, anthocyanin fraction including cyanidin, pelargonidin, peonidin, petunidin, coumarates and delphinidin glucosides. The antibacterial and antioxidant activities of sumac extract are linked to its phenolic compounds, containing tannins and gallic acid, and different flavonoids (Nimri *et al*., 1999). *R. coriaria* methanol extract was determined to contain high amounts of tannins (0.365 mg TAE/mg extract) contents, and total flavonoids (0.177 mg QE/mg extract) (Taskin *et al*., 2020).

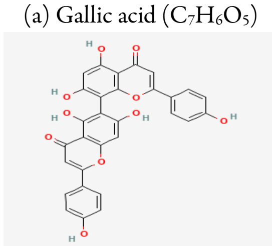
Leaves of staghorn sumac (*Rhus typhina*) present several galloyltransferases that catalyze the β-glucogallin dependent transformation of 1,2,3,4,6-pentagalloylglucose to gallotannins (Niemetz and Gross, 2001). It has been also reported that ellagitannins and gallotannins, the two subclasses of hydrolysable tannins of *Rhus typhina*, are derivatives of 1,2,3,4,6-penta-*O*-galloyl-β-D-glucopyranose (Niemetz and Gross, 2005). Phytochemical compounds detected and characterized in *R. coriaria* L. fruits by HPLC-QTOF-MS in positive and negative ionization modes are Malic acid I, Quinic acid I, Malic acid hexoside I, Malic acid hexoside II, Malic acid hexoside III, Oxydisuccinic acid, Malic acid II, Malic acid III, Quinic acid II, *O*-Succinoyl-di-*O*-caffeoylquinic acid, Malic acid derivative, Caftaric acid, Galloylhexose I, Galloylhexose II, Levoglucosan gallate I, Galloylhexose III, Levoglucosan gallate II, Galloylhexose IV, *O*-galloylnorbergenin I, Digalloyl-hexoside I, Galloylhexose derivative I, *O*-galloylnorbergenin II, Digalloyl-hexoside II, Protocatechoic acid, Galloylshikimic acid I, Gallic acid hexose derivative, Syringic acid hexoside, Gallic acid *O*-malic acid, Galloylshikimic acid II, Digalloyl-hexose malic acid II, Coumaryl-hexoside, Digalloyl-hexoside IV, Galloylquinic acid II, Trigalloyllevoglucosan I, Kaempferol hexoside or Luteolin hexoside I, Tri-galloyl-hexoside I, Penstemide, Digallic acid I, Digalloyl-hexoside V, methyl gallate, Digallic acid II, Coumaric acid, Myricetin-hexose malic acid III, Myricetin-3-*O*-glucuronide, Myricitin derivative, Myricitin derivative, Myricetin-3-*O*-glucoside, Tetra-*O*-galloylhexoside II, Horridin, Pentagalloyl-hexoside I, Oxoglycyrrhetinic acid, Dihydroisovaltrate, Betunolic acid II, Vebonol, Moroctic acid, Triterpenoid derivative, Linoleic acid amide, Sespendole, Vapiprost, Rhamnetin I, Rhamnetin II, Hexadecadienoic acid, Deacetylforskolin, and Butein (Abu-Reidah *et al.*, 2015). It has rich mineral compounds such as aluminum, bromine, barium, calcium, chlorine, chrome, copper, iron, manganese, magnesium, potassium, lithium, nitrogen, nitrate, phosphorus, zinc, strontium, titanium and vanadium, of which, calcium, magnesium, phosphorous, and potassium are main elements found in sumac fruits (Anwar *et al.*, 2018;).Egyptian sumac was more enriched in *o*-cymene, limonene, and β-ocimene, while Jordanian and Palestinian specimens showed more close volatile profile being enriched in naphthalene and α-pinene (Farag *et al.*, 2018). The most important isolated essential oil of sumac fruit in Iranian populations were (*E*)-Caryophyllene (5.9-50.3%), *n*-nonanal (1.8-23.3%), cembrene (1.9-21.7%), α-pinene (0.0-19.7%), (*2E,4E*)-decadienal (2.4-16.5%), and nonanoic acid (0.0-15.8%) (Morshedloo *et al.*, 2018). In one experiment, on the basis of NMR and mass spectral data, the fruit extract of winged sumac contained a new galloyl derivative, (*R*)-galloyl malic acid dimethyl ester, and eleven known compounds, gallic acid, glucogallin, methyl gallate, methyl m-digallate, quercetin, methyl p-digallate, rhamnazin, myricetin, betulinic acid, kaempferol, and oleanolic acid (Ma *et al.*, 2012). Structures of the most important phenolic compounds from *Rhus coriaria* fruit is shown in Figure 1. Structures of the most notable anthocyanins from *Rhus coriaria* are presented in Figure 2.



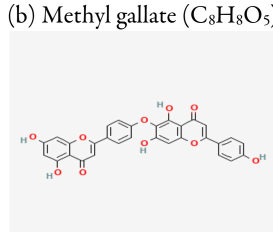
(a) Gallic acid ($C_7H_6O_5$)



(b) Methyl gallate ($C_8H_8O_5$)

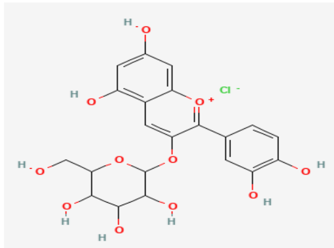


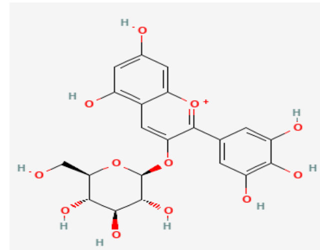
(c) Agathisflavone ($C_{30}H1_8O_{10}$)

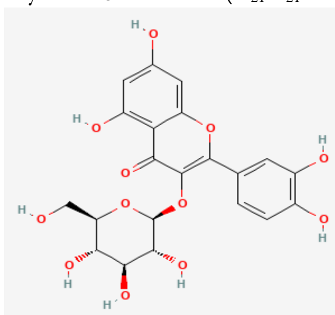


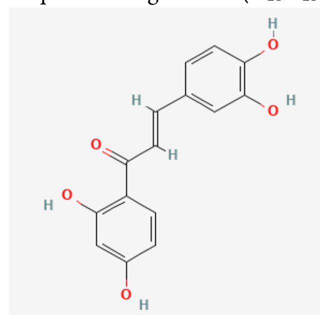
(d) Hinokiflavone ($C_{30}H_{18}O_{10}$)

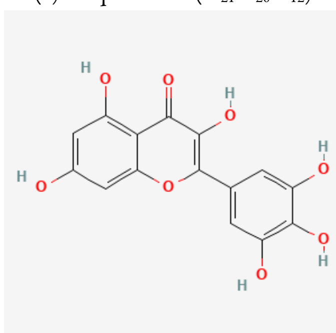
Figure 1. Structures of some of selected phenolic compounds from *Rhus coriaria* fruit


(a) Cyanidin 3-Glucoside ($C_{21}H_{21}ClO_{11}$)


(b) Delphinidin 3-glucoside ($C_{21}H_{21}O_{12}^{+}$)


(c) Isoquercitrin ($C_{21}H_{20}O_{12}$)


(d) Butein ($C_{15}H_{12}O_5$)


(e) Myricetin ($C_{15}H_{10}O_8$)

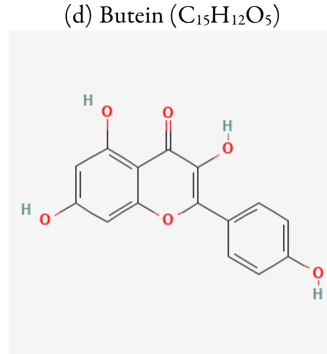

(f) Kaempferol ($C_{15}H_{10}O_6$)

Figure 2. Structures of some anthocyanins from *Rhus coriaria*

Potential Health Benefits in Traditional Medicine

In Iran, sumac is used as a spice and is extensively consumed with Kebabs and grilled meats (Fereidoonfar *et al.*, 2018; Langroodi *et al.*, 2018). *Rhus glabra* L. is traditionally used by native Indians of North America in the treatments of bacterial diseases, such as gonorrhea, syphilis, gangrene and dysentery (Erichsen-Brown, 1989). Sumac is often used as a spice by grinding the dried fruits with salt for salads and Kebabs, and is also broadly utilized as a medicinal herb in Iran and Turkey, particularly for skin problems and wound healing (Sezik *et al.*, 1991). In traditional Chinese medicine, all parts of it have been used for treating diseases; for example, the leaves are used for treating diarrhea and inflammations; the root is used for treating jaundice and malaria; the fruits and seeds are commonly used for treating dysentery and hepatitis (Djakpo and Yao, 2010; Zhang *et al.*, 2018). In traditional Arabic Palestinian herbal medicine, this plant has been applied in the treatment of cancer, diarrhea, stroke, dysentery, hypertension, ophthalmia, haematemesis, stomach ache, diuresis, liver disease, diabetes, measles, atherosclerosis, headaches, small-pox, aconuresis, teeth and gum ailments, animal bites, liver disease and dermatitis (Shafiei *et al.*, 2011; Abu-Reidah *et al.*, 2015). Sumac fruit has also been introduced in Iranian traditional medicine as a herb with some therapeutic activities, and traditionally the powdered fruits have been prescribed as astringent, anti-trachoma, anti-diarrhea, and anti-pus in infectious wounds (Ahmadian-Attari *et al.*, 2017). Sumac is utilized in the Iranian traditional medicine as an astringent and stancher agent, and it is also used to eye trachoma, and to suppress the incidence of pox in eye (Mazaheri *et al.*, 2017). This plant is used in traditional medicine of Jordan for cholesterol reduction and sweating that sumac indicated antibacterial, hypoglycemic properties and even antioxidant activities because of the presence of tannin fractions in both of their fruits and leaves (Adwan *et al.*, 2009; Aliakbarlu *et al.*, 2013). In some Eastern Mediterranean regions powdered sumac is applied in the composition of Za'atar, a mixture of a homemade earthy and herby savory blend of dried thyme-like herbs such as *Thymbra spicata* and *Origanium syriacum*, used for a numerous of dishes specially for the Lebanese flatbread "Mankouche" (Alwafa *et al.*, 2021). In traditional Iranian medicine, sumac has been consumed as an anti-diarrhea, hemostasis factor, anti-pus, and trachea treatment (Tohma *et al.*, 2019).

Potential Health Benefits in Modern Pharmaceutical Science

Rhus coriaria contains significant antimicrobial and antioxidant activities (Kossah *et al.*, 2009; Rima *et al.*, 2011; Wu *et al.*, 2013). *Rhus coriaria*-fortified yogurt indicated a significant boost in total phenolic constituents and antioxidant activity in comparison with plain yogurt (Perna *et al.*, 2018). Former studies have shown the positive antimicrobial effects of sumac extracts on *Bacillus* spp., *Listeria monocytogenes*, *Citrobacter freundii*, *Staphylococcus aureus*, *Escherichia coli, Hafniaalveri*, *Proteus vulgaris*, *Salmonella typhi*, *Salmonella enteritidis*, and *Shigella flexneriin vitro* conditions (Nasar-Abbas and Halkman, 2004; Nasar-Abbas *et al.*, 2004; Fazeli *et al.*, 2007). The methanolic extract of *Rhus coriaria* may be considered as an efficacious natural scolicidal agent (Moazeni and Mohseni, 2012). The application of sumac extracts as a potential natural preservative have been used in food industry, for the control of natural microflora of broiler meat has been found in raw broiler wings (Gulmez *et al.*, 2006), and raw broiler drumsticks (Vatansever *et al.*, 2008). Sumac supplementation revealed to have a potential weight-reduction impact, along with a positive influence on insulin resistance in patients who were obese or overweight (Heydari *et al.*, 2019). The analgesic impacts for the hydro alcoholic leaf extract of *Rhus coriaria* (HRCLE) in a rat model may be mediated through both central and peripheral mechanisms, and the presence of flavonoids might be accountable for the antinociceptive characteristic of this plant (Mohammadi *et al.*, 2015). In one experiment, sumac indicated better activity against the tested bacteria compared to avishan-e shirazi suppressing *Bacillus cereus* and *Staphylococcus aureus* at concentrations of 0.05% and 0.1%, respectively, and this common Iranian spice which is traditionally used as astringent agent has promising inhibitory impacts on food-borne bacteria and could be considered as natural food preservatives (Fazeli *et al.*, 2007).

Its extract recently underwent evaluation as a potent biocontrol candidate that works against human pathogens (Nasar-Abbas and Halkman, 2004). Its extract can be judged as an affordable and eco-friendly replacement to chemical fungicides in the management of tomato anthracnose disease caused by *Colletotrichum acutatum*, and it can also cause significant improvement of the shoot height, dry shoot height, dry root length, root length, chlorophyll content and leaf surface area of treated plants (Rashid *et al.*, 2018). Some of the fatty acid compositions of sumac are Palmitic acid, Myristic acid, Palmitoleic acid, Stearic acid, Linoleic acid, Oleic acid, and Linolenic acid; and vitamin content of sumac are Nicotinamide (PP), Thiamin (B_1), Riboflavin (B_2), Pyridoxine (B_6), Cyanocobalamin (B_{12}), Biotin (H), and Ascorbic acid (C) (Kossah *et al.*, 2009). Sumac with a fatty diet effectively decreased blood cholesterol and may possibly help in both prevention and treatment of hyperlipidemia in a small sample of white Wistar rats (Soltani *et al.*, 2017). Clinical studies using sumac or its major constituents, proposed that this herbal product may represent an appropriate therapeutic tool in the management of metabolic-related conditions such as liver-atherosclerosis disorders (Khalil *et al.*, 2021a). It has been reported that some active bio-active constituents of sumac have impacts against metabolic syndrome, such as Gallic acid on diabetes, obesity, NAFLD, oxidative-inflammatory damage; Methyl gallate on oxidative-inflammatory damage, cancer and obesity; Quercetin on obesity and hypertension, Myricetin on obesity and NAFLD; and Cyanidin, delphinidin on obesity, NAFLD, diabetes, and inflammation (Khalil *et al.*, 2021a). Sumac fruit powder improved intestinal morphology of rainbow trout, and it may boost antioxidant status in rainbow trout, but dietary sumac fruit powder did not influence the serum biochemistry in rainbow trout (Diler *et al.*, 2021). Sakhr and El Khatib (2020) reported that sumac can be applied as an effective food preservative and harmless, natural food additive. Sumac, as an adjuvant therapy, may reduce serum levels of insulin, fasting blood sugar (FBS), and HOMA-IR (Ghafouri *et al.*, 2021). The free phenolics fraction of *Rhus* family fruits has an effective lipase inhibitory activity, and can potentially treat obesity-related problems; quercetin and myricetin were the principle phenolics in all fractions with good dose-dependent lipase inhibitory impacts, and myricetin had a positive inhibitory effect (Zhang *et al.*, 2018; Wu *et al.*, 2019). Increase in the body weight gain, feed conversion ration because of increased antibody level, intestinal morphology, and some notable microbial population in female broiler chicks receiving the sumac and dried when power (Kheiri *et al.*, 2015). The most important pharmaceutical and health benefits of sumac are shown in Table 1.

Table 1. Health benefits of sumac

Pharmaceutical benefits	Mechanisms and effects	Reference
Anti-bacterial activity	It has shown notable antibacterial activity, particularly against *Staphylococcus aureus*.	Ahmadian-Attari *et al.* (2016) El-Khatib and Salame (2019)
	Sumac leaf extract is a novel green reducing and stabilizing factor for the biosynthesis of silver nanoparticles (Ag NPs), and both Ag NPs and sumac leaf extract additively contribute to the antimicrobial and UV protection of cotton.	Stular *et al.* (2021)
Anti-cancer activity	It has growth inhibitory impacts on cervical cancer cells in a time- and a concentration-dependent manner, which can be utilized as a therapeutic drug agent for uterus cervix cancer.	Abdallah *et al.* (2019)
Anti-diabetic activity	The favorite influence of sumac consumption on apolipoprotein (apo) B, serum glycemic status, apoA-I and total antioxidant capacity (TAC) levels in type 2 diabetic patients were reported.	Shidfar *et al.* (2014)
	Rhus coriaria L. lyophilized extract has a healing impact on diabetes and diabetes-related complications.	Dogan and Celik (2016)
Anti-inflammation activity	The potential impacts of *R. coriaria* fruit extracts, commonly mERC, as preventive candidate in the treatment of keratinocyte inflammation through their inhibitory impacts on the production of skin pro-inflammatory mediators.	Khalilpour *et al.* (2019)
	Sumac powder increased significantly hepatic fibrosis and glycemic status.	Kazemi *et al.* (2020)

	Supplementation with sumac lead to a significant decline in inflammation and oxidative stress.	
	The neuro-inflammation inhibitory activity of *R. coriaria* extracts consists of the inhibition of NF-κB signaling pathway, and it might carry therapeutic potential against neurodegenerative diseases.	Khalil *et al.* (2021b)
Anti-microbial activity	Bactericidal impacts of sumac on Gram positive organisms, *Bacillus* species such as *Bacillus cereus*, *Bacillussubtilis*, *Bacillus megaterium*, and *Bacillus thuringiensis* were reported.	Nasar-Abbas and Halkman (2004) El Khatib and Salame (2019)
	Sumac water extract and oregano oil suspensions reduced *Salmonella Typhimurium* populations on the surfaces of tomatoes without influencing the sensory properties of tomatoes.	Gunduz *et al.* (2010) Rouhi-Boroujeni *et al.* (2016)
	Its extract indicated a strong antimicrobial activity with concentration dependence and a broad antimicrobial spectrum for various tested bacteria species. *Staphylococcus aureus* and *Salmonella enteric* were recognized to be sensitive Gram positive and Gram-negative bacteria, respectively, with a minimum inhibitory concentration of <0.78%.	Mahdavi *et al.* (2018)
Antioxidant activity	The aqueous and alcoholic extracts of sumac in especial methanolic (SSE) are appropriate scavengers for reactive oxygen species (ROS) are a potential source of natural antioxidant, that may be applied in food and pharmaceutical industry.	Candan (2003) Kosar *et al.* (2007) Alishah *et al.* (2012) Mohit *et al.* (2021)
	Compared to ethanol extracts, the water extracts of sumac have effective antioxidant and radical scavenging activities.	Bursal and Koksal (2011) Fereidoonfar *et al.* (2019)

Conclusions

The sumac group *Rhus* L. belongs to Anacardiaceae family, is considered the largest and the most heterogeneous taxon and is commonly connected to as the *Rhus* complex in the sumac. Sumac is a prominent spice in the Middle East, which is made from berries from a bush of the same name. In order to produce the spice from the plant, its fruit is dried and then crushed into a thin red-purple powder. The red berries are delicious and tangy, containing malic acid which is originated in apples. As a spice, it is delicious on meat, in salad dressing, and makes the tasty infused vinegar if you macerate it in apple cider vinegar. The most important phenolic acids and flavonoids are catechin, gallic acid, ferulic acid, apigenin, gentisic acid, P-coumaric acid, chlorogenic acid, isorhamnetin, caffeic acid, quercetin, cinnamic acid, taxifolin, kaempferol, epicatechin, vanillic acid, P-hydroxybenzoic acid, vanillin, anisic acid, pyrogallol, syringaldehyde, sinapic acid, syringic acid and benzoic acid. Organic acids of sumac are citric acid, malic acid, fumaric acid and tartaric acid. The fatty constituents of sumac fruits are palmitic acid, oleic acid, myristic acid, stearic acid, palmitoleic acid, linoleic acid and linolenic acid. The vitamin contents of sumac fruits are riboflavin, thiamin, pyridoxine, cyanocobalamin, biotin, nicotinamide, and ascorbic acid. The principal health advantages of sumac are 1) anti-inflammatory: inflammation is believed to be the main cause of many diseases and Sumac is an anti-inflammatory medicinal herb that assists fight numerous disorders, colds, and the Flu, 2) anti-cancer: it is packed with vitamin C and a great anti-oxidant which means it can promote ward off diseases like cancers, diabetes, and cardiovascular diseases, 3) anti-microbial and anti-fungal: Sumac is anti-microbial and anti-fungal spice which can increase treatment of skin disorders and inflammation, it has also been studies to be effectual in fighting bacteria like Salmonella and can be applied to safely disinfect vegetables and fruits, 4) It has been considered as a potent in regulating cholesterol levels and treating diabetes by decreasing blood sugar, 5) it can boost breast milk production and decrease menstrual cramps, 6) Sumac is a diuretic which means it assists remove toxins from the body via urine and had been utilized traditionally to treat urine digestive and infections disorders. Due to wonderful pharmacological characteristics, sumac is considered as a high potent natural and organic spice with effective pharmacological activities.

Authors' Contributions

Both authors read and approved the final manuscript.

Ethical approval (for researches involving animals or humans)

Not applicable.

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Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

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