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Determination of volatile components and ethnobotanical properties of *Rhus coriaria* l. in Isparta province of Turkey

Abstract. *Rhus coriaria* L., which is from the Anacardiaceae family, is an important as a spice and medicinal plant in Turkey. In recent years, when drugs are insufficient, interest in natural plants has increased and their importance has increased in terms of being a source of raw materials in many industrial areas. In this study, it was aimed to determine the volatile components of sumac fruit samples collected from Kasnak, Kovada Lake, Barla Mountain, Aşağıgökdere and Sütçüler locations in Isparta province and their ethnobotanical use in the region. 159 volatile components of Rhus coriaria, were determined by the Head Void-Solid Phase Micro-Extraction (HS-SPME) technique combined with gas chromatography/mass spectrometry (GC/MS). The main components were α-pinene (Sütçüler 16.95%; Barla Mount 24.41%, Kovada 16.37%, Kasnak Forest 5.81%, Aşağıgökdere 18.20%, limonene (Sütçüler 7.50%; Barla Mountain 8.35%; Kovada 18.07%; Kasnak Forest 11%, 83; Aşağıgökdere 12.38%), 1,3,6-Octatriene, 3,7-Dimethyl- (Sütçüler 13.76%; Barla Mountain 19.36%; Kovada 7.97%; Kasnak Forest 5.53% ; Aşağıgökdere 15.01%) and β-caryophyllene (Sütçüler 7.70%; Barla Mountain 21.55%; Kovada 12.99%; Kasnak Forest 33.63%; Aşağıgökdere 1.18%). To determine the ethnobotanical use of Rhus coriaria in the region, a face-to-face survey of 22 questions was applied to 150 people selected by the stratified sampling model from the local people. The local people use the leaves and flowers of Rhus coriaria as tea, the fruits as a spice, and the sour sauce obtained from the fruits for food purposes. They also stated that they use it for various ailments, especially against Covid-19, for health purposes.
Key words: *Rhus coriaria*, volatile component, ethnobotany, Covid-19.

Introduction

Mankind has always been in interaction with plants from present. They tried the plants that they were sure were not harmful and poisonous and used them in the treatment of various diseases. According to the information obtained in archaeological excavations, human beings have sought healing for their problems by using plants since the early ages. Although people live in different cultures and their usage patterns have changed over time, they have generally used natural plants for religious purposes such as food, medicine, fuel, bait, broom, paint, tool making, evil eye and magic. Some natural plants and their use for various purposes have been passed down from generation to generation [1-6].

Turkey is one of the countries rich in plant diversity. Approximately 13,404 species and subspecies have been identified in our country, and 3,275 taxa of these are endemic. Our country is also rich in medicinal and aromatic plants [7].

Medicinal and aromatic plants are biological, cultural and industrial resources used in many fields. It is used as a medicine in traditional and modern medicine for the prevention of diseases and health. In addition to the use of medicinal and aromatic plants in perfumery and cosmetics, they are used in nutrition as nutritional supplements, herbal tea, flavor and spice. Interest in medicinal and aromatic plants has increased considerably in recent years and continues to increase [8].

In the group of medicinal and aromatic plants, especially those rich in essential oil have special importance. Essential oils and their aromatic extracts are widely used by the fragrance and flavor industries in the preparation of perfumes, food additives, cleaning products, cosmetics and pharmaceuticals, as a source of aroma-chemicals or as synthesis starting materials of nature-identical and semi-synthetic beneficial aroma chemicals. In recent years, it has been observed that there has been a great increase in the demand for essential oil [9].

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Since Turkish society lived in rural areas for many years, they used natural plants. Today, society benefits from a part of wild plants such as food, medicine, fuel, fodder, broom, paint or in the treatment of diseases [10]. The ability of the people living in a region to benefit from the plants around them to meet their various needs can be defined as ethnobotany [11].

Despite the increase in health problems recently, it is seen that drugs are insufficient and the consumption of natural products has increased, and natural plants are used as raw materials for many human and animal medicines [12]. *Rhus coriaria* L. (leather sumac) has an important place among these species. *Rhus coriaria*, which is the only species of the *Rhus* genus in our country, is distributed in the Mediterranean, Southeastern Anatolia, Aegean, Northern Anatolia, Central Anatolia and Thrace regions. *Rhus coriaria*, which is 1-3 m long in the form of shrubs and trees, spreads between 600-1900 m in dry stony, bushes, roadsides, rocky places and forested places [13]. The antidiabetic, hypolipidemic, anti-ischemic, antiviral, antibacterial, DNA protective, antifungal, scolid, non-mutagenic, anti-cancer effects and also, efficiency on passive avoidance learning and non-toxic, It has been determined that it has biological effects such as analgesic effect [14].

In this study, the ethnobotanical characteristics of *Rhus coriaria*, which spreads naturally in Isparta province of Turkey and has an important place in terms of consumption, and its volatile components were determined with samples taken from 5 different places. Thus, it is aimed to popularize its use among the people and to reveal the importance of natural plants against diseases.

Materıals and methods

Material. The research material consists of sumac samples collected from Kasnak forest, Kovada Lake, Barla Mountain, Aşağıgökdere and Sütçüler provinces of Isparta in 2022. Fruit samples were collected from the research areas in September (Figure 1; Figure 2). Aspect and elevation information of the sampled areas in the field were recorded. Recorded and collected plant samples were placed in Isparta University of Applied Sciences Forestry Faculty Forest Botany Laboratory for volatile component analysis according to herbarium techniques.

Figure 1- Sumac plant as study material

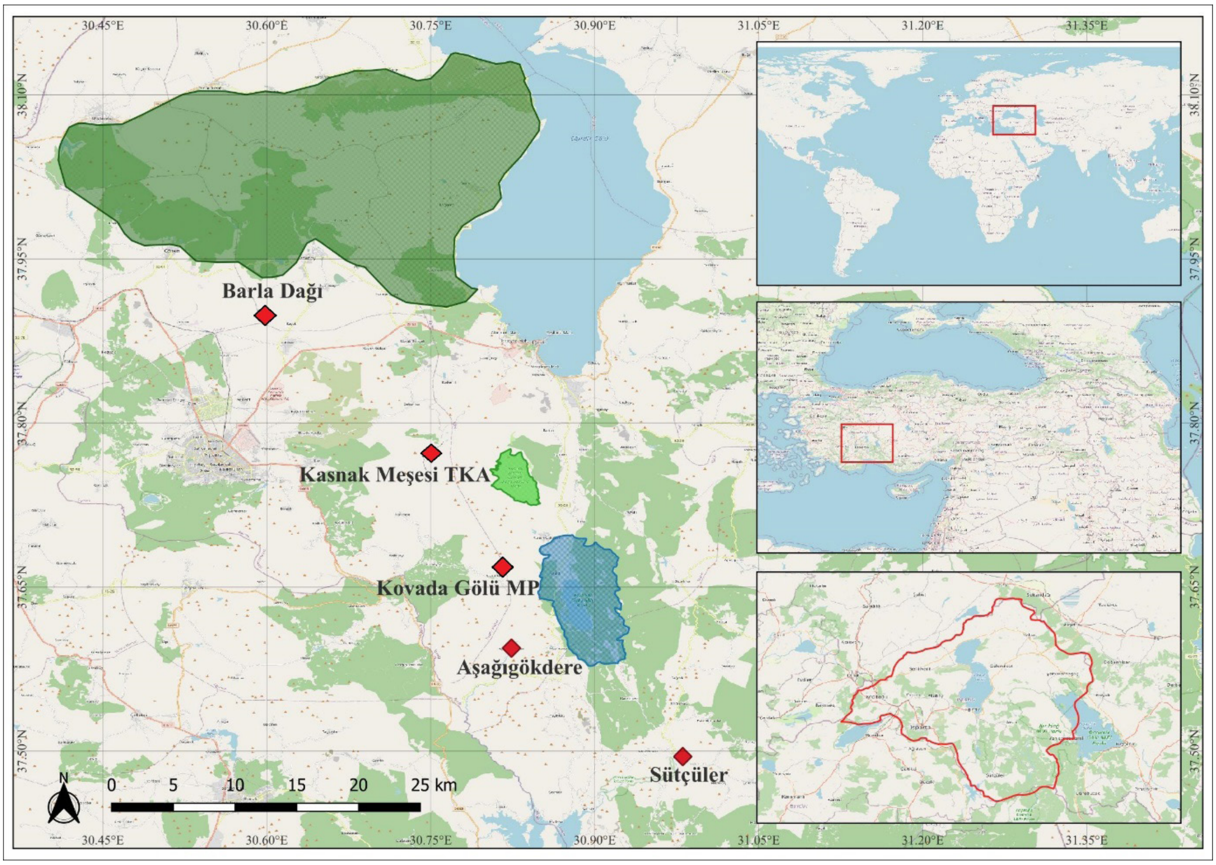

Figure 2- Areas where sumac is collected

Method for the determination of fruit volatile components. At least 1 kg of fruit was collected from each of the five sites (Kasnak Forest, Kovada Lake, Barla Mountain, Aşağıgökdere and Sütçüler) to be used in the volatile component analysis. Collected fruit samples were put into packages and labeled by coding, and information such as collection time, location and altitude were recorded on the label. It was brought to the Herbarium Laboratory of the Faculty of Forestry of Isparta University of Applied Sciences to perform volatile component analysis.

Floral aromatic components of *Rhus coriaria* fruits were determined by Head Void-Solid Phase Micro-Extraction (HS-SPME) technique combined with gas chromatography/mass spectrometry (GC/MS). Based on the solid phase microextraction method (SPME, Supelco, Germany), 2 g flower samples were incubated in a 10 mL bottle at 60°C for 30 minutes, then volatile compounds were absorbed from the headspace using 75 µm [(Thick Carboxene-Polydimethylsiloxane (CAR/PDMS)]. Coated fused silica fiber and immediately injected into the capillary column (Restek Rx-5 Sil MS 30 mx 0.25 mm, 0.25 µm) or an HS-SPME compatible GC-MS instrument (Shimadzu 2010 PLUS). The oven temperature is programmed to increase to 250ºC at a heating rate of 4ºC per minute after being kept at 40ºC for 2 minutes. Injector and detector temperatures are set to 250ºC. The ionization mode was chosen as EI (70 eV) and the carrier gas as helium (1.61 mL/min). Wiley, Nist, Tutor and FFNSC library was used to identify volatile compounds.

Method for determining ethnobotanical use. Ethnobotanical characteristics were surveyed with a questionnaire consisting of 22 questions consisting of the surrounding villages in the sample areas in the Isparta region was prepared and face-to-face interviews were conducted with the local people. This survey was conducted with 150 people selected by the stratified sampling model, consisting of people in Eğirdir Barla, Bedire, Aşağıgökdere, Yukarıgökdere, Kırıntı, Eyüpler villages and Sütçüler District Çandır villages in Isparta region (Figure 3). According to the representation ratios of each substratum in the universe, the sample groups were determined according to the simple random sampling method. The names of the participants were not taken and their information was kept confidential.

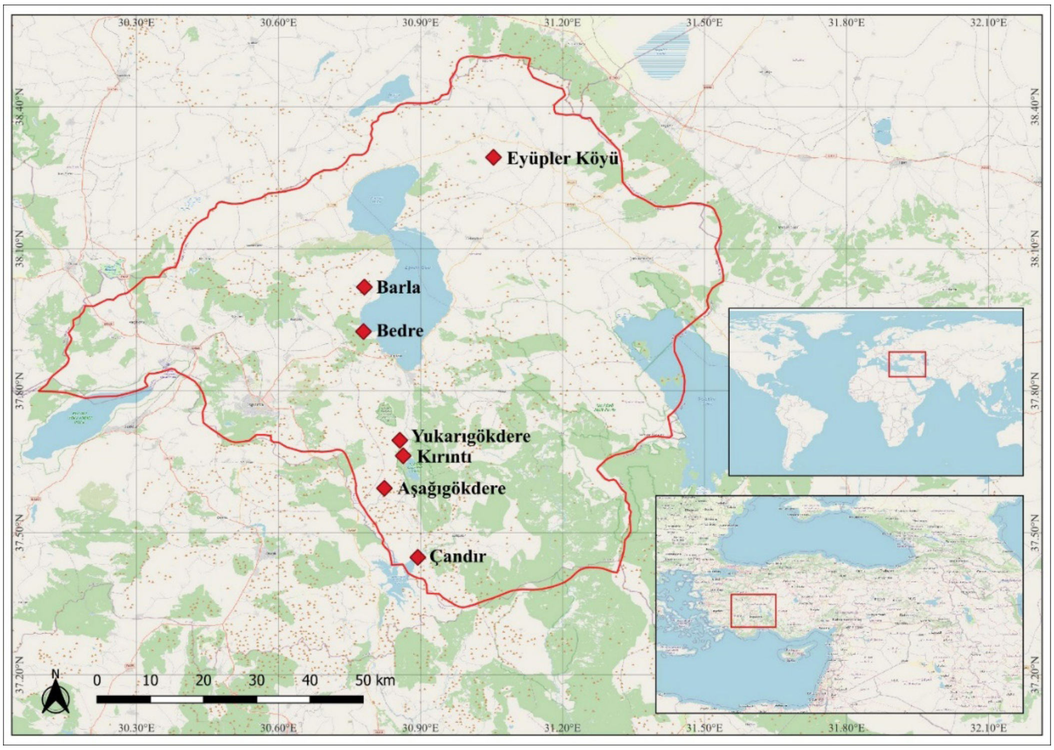

Figure 3- Areas of survey research

Results and discussion

Volatile components were determined from 100 grams of *Rhus coriaria* fruits. In the comparative study of fruit samples taken from five locations (Kasnak Forest, Kovada Lake, Barla Mountain, Aşağıgökdere and Sütçüler) in Isparta province, a total of 159 volatile components were determined, and when the component classes are examined, they consist of monoterpene hydrocarbons and sesquiterpene hydrocarbons. The main components, respectively, are α-pinene (Sütçüler 16.95%; Barla Mountain 24.41%; Kovada Lake 16.37%; Kasnak Forest 5.81%; Aşağıgökdere 18.20%), limonene (Sütçüler 7.50%; Barla Mountain 8.35%; Kovada Lake 18.07%; Kasnak Forest 11.83%; Aşağıgökdere 12.38%), 1,3,6-Octatriene, 3,7-Dimethyl- (Sütçüler 13.76%; Barla Mountain 19%) .36; Kovada Lake 7.97%; Kasnak Forest 5.53%; Aşağıgökdere 15.01%) and β-caryophyllene (Sütçüler 7.70%; Barla Mountain 21.55%; Kovada Lake 12.99%; Kasnak Forest 33.63% ; Aşağıgökdere 1.18%). The results of the volatile component analyses are given in Table 1.

Table 1 – Volatile components and classes of *Rhus coriaria*

	Components	Sütçüler	Barla Dağı	Kovada	Kasnak	A.Gökdere	Class	Formula
1	***α*-Pınene**	16.95	24.41	16.37	5.81	18.20	MH	$C_{10}H_{16}$
2	Camphene	0.34	0.45	0.38	0.12	0.36	MH	$C_{10}H_{16}$
3	2-Heptenal	1.51	0.93	1.87	0.46	1.41	AA	$C_7H_{12}O$
4	Benzaldehyde	0.10	0.12	0.28	*	*	AAI	$C_{10}H_6O$
5	2-β-Pınene	1.40	*	1.54	0.97	1.95	MH	$C_{10}H_{16}$
6	1-Octen-3-One	0.34	0.24	0.34	0.13	0.34	MH	$C_8H_{14}O$
7	1-Octen-3-Ol	0.03	*	0.09	0.07	0.05	AA	$C_8H_{16}O$
8	6-Methyl-5-Hepten-2-One	0.17	0.16	0.87	0.76	0.48	AA	$C_8H_{14}O$

Table continuation

	Components	Sütçüler	Barla Dağı	Kovada	Kasnak	A.Gökdere	Class	Formula
9	β-Myrcene	6.39	6.50	13.57	4.72	9.09	MH	$C_{10}H_{16}$
10	2,4-Heptadienal	0.04	*	*	*	*	AA	$C_7H_{10}O$
11	Capronate	0.03	*	*	*	*	OC	$C_6H_{11}O_2$
12	Octanal	0.50	0.23	1.74	0.55	1.12	AA	$C_8H_{16}O$
13	L-Phellandrene	0.51	0.49	1.10	0.80	0.44	MH	$C_{10}H_{16}$
14	1,4-Dichloro-Benzene	0.05	0.06	*	*	0.02	AH	$C_6H_4Cl_2$
15	Acetic Acid	0.12	0.04	*	*	0.06	AAI	CH_3COOH
16	α-Terpınene	0.23	0.18	0.99	0.41	0.13	MH	$C_{10}H_{16}$
17	Methyl(1-Methylethyl) Benzene	1.34	*	2.06	0.75	0.86	MH	$C_{10}H_{14}$
18	3,3,6,6-Tetramethyl	0.03	*	*	*	*	OC	$C_{12}H_{26}$
19	**Limonene**	7.50	8.35	18.07	11.83	12.38	MH	$C_{10}H_{16}$
20	Cis-Ocimene	3.33	5.10	3.11	1.81	5.84	MH	$C_{10}H_{16}$
21	Oct-3(E)-En-2-One	0.11	0.04	0.12	*	0.12	AAI	$C_8H_{12}O$
22	Benzeneacetaldehyde	0.06	0.03	0.05	*	*	OC	C_8H_8O
23	**1,3,6-Octatriene, 3,7-Dimethyl-**	13.76	19.36	7.97	5.33	15.01	MH	$C_{10}H_{18}$
24	1,5-Heptadıene, 2-Ethyl-6-Methyl-	0.09	0.06	0.11	*	*	MH	$C_{10}H_{16}$
25	Cyclopropanemethanol	0.01	*	*	*	*	AA	C_4H_8O
26	1,4-Cyclohexadiene	0.07	*	1.97	0.82	*	MH	C_6H_8
27	α-Terpınolene	0.17	0.20	0.94	0.78	0.27	MH	$C_{10}H_{16}$
28	1-Isopropenyl – Benzene	0.06	0.07	*	0.07	0.08	MH	$C_9H_{14}N_2$
29	1,3-Cyclopentadıen	0.09	0.12	*	*	*	AH	C_5H_6
30	4-Tridecene	0.07	*	*	*	*	MH	$C_{13}H_{26}$
31	Butanoic Acid	0.14	*	*	*	*	AAI	$C_9H_{18}O$
32	Nonanal	1.92	0.58	*	1.18	2.30	AAI	$C_9H_{18}O$
33	P-Mentha-1,5,8-Triene	0.60	0.14	*	*	0.08	MH	$C_{10}H_{14}$
34	2,4,6-Octatriene	1.54	1.42	0.68	0.73	2.47	MH	C_8H_{12}
35	2-Nonenal	0.18	0.08	*	*	*	AAI	$C_9H_{16}O$
36	α-Guaiene	*	*	*	0,02	*	MH	$C_{15}H_{24}$
37	Ohexene-1-Methanol	0.06	*	*	*	*	AA	C_6H_{12}
38	1-Methoxy-4-(2-Propenyl)- Benzene	0.10	*	*	*	*	SH	$C_{11}H_{16}O$
39	Dodecane	0.04	*	0.21	*	0.06	AH	$C_{12}H_{26}$
40	Capraldehyde	0.19	*	0.58	0.17	0.22	AAI	$C_{10}H_{20}O$
41	Hexyl Ester	0.05	*	*	*	*	AAI	$C_9H_{18}O$
42	Linalyl Acetate	0.40	*	0.49	*	0.50	AAI	$C_{12}H_{20}O_2$
43	2-Decenal	0.51	0.13	*	0.66	0.38	OM	$C_{10}H_{18}O$
44	Endobornyl Acetate	0.13	*	*	*	*	AAI	$C_{12}H_{20}O_2$
45	4-Terpinenyl Acetate	0.12	*	*	*	0.13	AAI	$C_{12}H_{20}O$
46	Tridecane	0.23	*	*	0.20	0.15	OC	$C_{13}H_{28}$
47	Satıven	0.08	*	*	*	*	OC	$C_{15}H_{24}$
48	2-Undecenal	0.08	0.03	0.07	*	0.04	AAI	$C_{11}H_{20}O$
49	α-Ylangene	0.57	0.07	0.10	*	*	SH	$C_{15}H_{24}$
50	α-Copaene	2.57	0.25	*	*	0.24	SH	$C_{15}H_{24}$
51	Tetradecane	0.20	*	0.13	*	0.12	AH	$C_{14}H_{30}$

Table continuation

	Components	Sütçüler	Barla Dağı	Kovada	Kasnak	A.Gökdere	Class	Formula
52	4,11,11-Trimethyl-8-Methylene-	0.05	*	*	*	*	SH	$C_{15}H_{24}$
53	V6-Cedren	0.07	*	*	*	*	SH	$C_{15}H_{24}$
54	10,10-Dımethyl-2,6-Bıs(Methylene)	0.16	*	*	*	0.18	OC	$C_{15}H_{24}O$
55	β-Cubebene	0.17	*	*	*	*	OC	$C_{15}H_{24}$
56	Aromadendrene	0.32	*	*	*	0.22	SH	$C_{15}H_{24}$
57	Isoledene	0.04	*	*	0.05	*	SH	$C_{15}H_{24}$
58	5,9-Undecadien-2-One	0.08	*	*	*	*	OC	$C_{13}H_{22}O$
59	Humulen	0.18	0.09	*	0.24	0.16	SH	$C_{15}H_{24}$
60	α-Humulene	1.10	1.87	0.98	4.00	1.65	SH	$C_{15}H_{24}$
61	Arıstolen	0.08	*	*	*	*	OC	-
62	Trans- cadina	0.84	*	*	*	*	SH	$C_{15}H_{24}$
63	Epi-Bicyclosesquiphellandrene	0.05	*	*	*	*	SH	$C_{15}H_{24}$
64	γ-Cadinene	0.27	0.32	0.28	*	0.29	SH	$C_{15}H_{24}$
65	α-Amorphene	0.37	0.14	*	0.92	0.03	SH	$C_{15}H_{24}$
66	β-Selinene	0.14	*	*	*	*	SH	$C_{15}H_{24}$
67	1,2,4a,5,8,8a-Hexahydro-4,7-Dimethyl-1-(1-Methylethyl)	0.60	*	*	*	*	SH	$C_{15}H_{24}$
68	α-Muurolene	1.81	0.13	0.06	0.67	0.08	SH	$C_{15}H_{24}$
69	Δ-Cadinene	0.81	0.39	0.17	3.29	0.21	SH	$C_{15}H_{24}$
70	Cıs-Calamenene	0.22	*	*	*	*	SH	$C_{15}H_{22}$
71	Epızonaren	0.16	*	*	0.01	*	SH	$C_{15}H_{24}$
72	Dro-1,6-Dimethyl-4-(1-Methylethyl)	0.34	*	*	*	*	SH	$C_{15}H_{18}$
73	α-Calacorene	0.16	*	*	*	*	SH	$C_{15}H_{20}$
74	2-Cyclopenten-1-One	0.03	*	*	*	*	AAI	C_5H_6O
75	Caryophyllene Oxide	0.06	0.45	*	*	*	SH	$C_{15}H_{24}$
76	Dımethyl-2,3,4,4a,5,6-Hexahydro-Naphthalen-2-Yl)-Prop-2-E	0.04	*	*	*	*	OC	$C_{15}H_{24}O$
77	α-Cubebene	0.02	*	*	0.05	*	OC	$C_{15}H_{24}$
78	Torreyol	0.08	*	*	*	*	AA	$C_{15}H_{26}O$
79	Cembrene	1.83	0.47	0.59	3.32	1.10	OC	$C_{20}H_{32}$
80	1,5,9-Cyclotetradecatriene, 1,5,9-Trimethyl-12-(1-Methylethenyl)-	0.03	*	*	*	*	OC	$C_{20}H_{32}$
81	Cis-Pinen-3-Ol	*	0.01	*	*	*	AA	$C_{10}H_{16}O$
82	β-Pinene	*	2.88	*	*	*	MH	$C_{10}H_{16}$
83	Trans-2-(2-Pentenyl)Furan	*	0.03	*	*	*	AAI	C_5H_6O
84	Isomyrcenol	*	0.03	*	*	*	AA	$C_{10}H_{16}O$
85	1-Methyl-4-(1-Methylethyl)- Benzene	*	0.23	*	*	*	AH	$C_{10}H_{12}$
86	Cyclopentene	*	0.09	*	*	*	MH	C_5H_8
87	4-Carene	*	0.06	*	*	*	MH	$C_{10}H_{16}$
88	İsopentyl 2-Methylbutanoate	*	0.06	*	*	*	AAI	$C_8H_{16}O_2$
89	Butyrate <2-Methylbutyl-, 2-Methyl->	*	0.01	*	*	*	AAI	$C_{10}H_{20}O$
90	1,3,5-Undecatriene	*	0.13	*	*	*	MH	$C_{11}H_{18}$
91	β-Fenchyl Alcohol	*	0.05	0.60	*	0.12	AA	$C_{10}H_{18}O$

Table continuation

	Components	Sütçüler	Barla Dağı	Kovada	Kasnak	A.Gökdere	Class	Formula
92	Decanal	*	0.08	*	*	*	OM	$C_{10}H_{20}O$
93	1,6-Octadien-3-Ol, 3,7-Dimethyl-, Acetate	*	0.27	*	1.12	*	AAI	$C_{11}H_{18}O$
94	Bornyl Acetate	*	0.13	0.30	0.64	0.18	AAI	$C_{12}H_{20}O_2$
95	Hept-2-Ene, 3,7,7-Trimethyl-	*	0.09	*	*	*	OC	$C_{10}H_{16}$
96	**β-Caryophyllene**	*	21.55	12.99	33.63	19.18	SH	$C_{15}H_{24}$
97	10,10-Dimethyl-2,6-Bis(Methylene)	*	0.13	*	0.28	*	OC	$C_{15}H_{24}O$
98	Decene	*	0.06	*	*	*	AH	$C_{10}H_{20}$
99	1-Butanol, 3-Methyl	*	0.13	*	0.18	*	AA	$C_5H_{12}O$
100	Neryl Acetone	*	0.04	*	*	*	AAI	$C_{13}H_{22}O$
101	α-Guaiene	*	0.05	*	0.02	*	SH	$C_{15}H_{24}$
102	α-Selinene	*	0.12	0.23	1.91	0.18	SH	$C_{15}H_{24}$
103	β-Elemene	*	0.02	*	*	*	SH	$C_{15}H_{24}$
104	2,6,10,15-Tetramethyl	*	0.01	*	*	*	AAI	$C_{21}H_{44}$
105	Octadecamethylcyclononasıloxane	*	0.01	*	*	*	OC	$C_{18}H_{54}O_9Si_9$
106	Δ-3 Carene	*	*	0.30	*	*	MH	$C_{10}H_{16}$
107	1,2-Dichloro-Benzene	*	*	0.22	*	*	AH	$C_6H_4Cl_2$
108	1,7-Octadıen, 3,6-Dımethylen-	*	*	0.30	*	*	AA	$C_{10}H_{18}O$
109	1-Chloroundecane	*	*	0.03	*	*	MH	$C_{10}H_{21}Cl$
110	Hexadecane, 1-Chloro-	*	*	0.44	*	*	AH	$C_{16}H_{34}$
111	Nonanal	*	*	3.57	*	*	AAI	$C_9H_{18}O$
112	α-Campholene Aldehyde	*	*	0.05	*	0.04	AAI	$C_{10}H_{16}O$
113	2(10)-Pinen-3-One	*	*	0.36	0.14	0.26	MH	$C_{10}H_{14}O$
114	3-Cyclohexen-1-Ol, 4-Methyl-1-(1-Methylethyl)-	*	*	0.64	0.12	*	AA	$C_{10}H_{18}O$
115	Benzene, 1-Methoxy-4-(1-Propenyl)-	*	*	0.20	*	*	AH	$C_{11}H_{16}O$
116	Carvacrol Methyl Ether	*	*	0.24	*	*	OC	C_6H_3
117	2-Decenal	*	*	0.31	*	*	AAI	$C_{10}H_{18}O$
118	Heptadecane, 2,6,10,15-Tetramethyl-	*	*	0.07	*	*	AH	$C_{21}H_{44}$
119	3-Phenylhexan-3-Ol	*	*	0.11	*	*	AA	$C_{12}H_{18}O$
120	Docosanoic Acid	*	*	0.17	*	*	SH	$C_{22}H_{44}O_2$
121	Lımonen	*	*	0.21	0.35	*	MH	$C_{10}H_{16}$
122	Copaene	*	*	0.19	*	*	SH	$C_{15}H_{24}$
123	Cıs-Caryophyllene	*	*	0.08	*	*	SH	$C_{15}H_{24}$
124	Cycloheptasiloxane	*	*	0.12	*	*	OC	O_7Si_7
125	Eudesma-4(14),11-Diene	*	*	0.23	1.94	0.16	SH	$C_{15}H_{24}$
126	Selina-3,7(11)-Diene	*	*	0.11	*	*	SH	$C_{15}H_{24}$
127	Cyclooctasiloxane, Hexadecamethyl-	*	*	0.07	*	*	OC	$C_{16}H_{48}O_8Si_8$
128	Benzaldehyde	*	*	*	0.08	0.11	AAI	C_7H_6O
129	2-Methyl-6-Methylene-2-Octene	*	*	*	0.07	0.09	SH	$C_{10}H_{18}$
130	Linalool	*	*	*	0.51	*	OM	$C_{10}H_{18}O$
131	Pentanoic Acid	*	*	*	0.10	*	AAI	$C_5H_{10}O_2$
132	1,3,8-P-Menthatrıene	*	*	*	0.21	*	sh	$C_{10}H_{14}$

Table continuation

	Components	Sütçüler	Barla Dağı	Kovada	Kasnak	A.Gökdere	Class	Formula
133	Limonen-10-Yl Acetate	*	*	*	0.02	*	MH	$C_{10}H_{16}$
134	α-Terpıneol	*	*	*	1.69	*	AA	$C_{10}H_{18}O$
135	Undecanal	*	*	*	0.08	*	AAI	$C_{10}H_{21}CHO$
136	2-Undecenal	*	*	*	0.03	*	AAI	$C_{10}H_{21}CHO$
137	Ylangene	*	*	*	0.38	0.12	SH	$C_{15}H_{24}$
138	6,8a-Octahydro-7-Methyl-4-Methylene-1-(1-Methylethyl)-	*	*	*	2.51	*	SH	$C_{15}H_{24}$
139	5,9-Undecadien-2-One, 6,10-Dimethyl-	*	*	*	0.14	*	AA	$C_{13}H_{22}O$
140	Octahydro-7-Methyl-3-Methylene-4-(1-Methylethyl)	*	*	*	0.05	*	SH	$C_{15}H_{24}$
141	Selina-3,7(11)-Diene	*	*	*	1.54	*	SH	$C_{15}H_{24}$
142	β-Vatirenene	*	*	*	0.07	*	SH	$C_{15}H_{22}$
143	Germacrene B	*	*	*	0.25	*	SH	$C_{15}H_{24}$
144	1,2,4a,5,8,8a-Hexahydro-4,7-Dimethyl-1-(1-Methylethyl)	*	*	*	0.09	*	SH	$C_{15}H_{24}$
145	Tetracosamethyl-cyclododecasıloxane	*	*	*	0.05	*	OC	$C_{24}H_{72}O_{12}Si_{12}$
146	β-Elemene	*	*	*	0.10	*	SH	$C_{15}H_{24}$
147	3-Carene	*	*	*	*	0.03	MH	$C_{10}H_{16}$
148	3,7-Octadien-2-Ol, 2-Methyl-6-Methylene-	*	*	*	*	0.15	SH	$C_{10}H_{16}O$
149	1,4-Hexadiene, 5-Methyl-3-(1-Methylethylidene)-	*	*	*	*	0.01	SH	$C_{15}H_{24}$
150	2-Propenamide, 2-Methyl-N-Phenyl-	*	*	*	*	0.07	SH	$C_{16}H_{16}N_2O$
151	3-Methyl-Undecane	*	*	*	*	0.03	AH	$C_{12}H_{26}$
152	Hexanoic Acid	*	*	*	*	0.06	AAI	$C_6H_{12}O_2$
153	Trans-Anethole	*	*	*	*	0.10	AA	$C_{10}H_{12}O$
154	α-Gurjunene	*	*	*	*	0.05	SH	$C_{15}H_{24}$
155	5,9-Undecadien-2-One, 6,10-Dimethyl	*	*	*	*	0.07	OC	$C_{13}H_{22}O$
156	Farnesene	*	*	*	*	0.03	SH	$C_{15}H_{24}$
157	β-Guaiene	*	*	*	*	0.06	SH	C_{15}H24
158	Cyclohexane	*	*	*	*	0.05	SH	C_6H_{12}
159	Tetratetracontane	*	0.02	*	*	*	MH	$C_{44}H_{90}$
	Component Number	81	63	59	63	64		
	AA: Aromatic Alcohol	2,40	1,54	6,22	3,97	3,28		
	AAI: Aromatic Aldehyde	3,57	1,44	5,77	3,42	3,76		
	AH: Aromatic Hydrocarbon	0,38	0,47	1,27	-	0,23		
	MH: Monoterpene Hydrocarbon	52,64	70,15	70,10	35,61	67,79		
	OM: Oxygenated Monoterpene	2,84	0,73	1,07	3,90	1,50		
	OC: Other Components	0,51	0,21	-	1,17	0,38		
	SH: Sesquiterpene Hydrocarbon	36,48	24,45	15,59	51,95	23,03		
	Total	100,00	100,00	100,00	100,00	100,00		

A total of 159 volatile components were determined, and when the component classes are examined, they consist of monoterpene hydrocarbons and sesquiterpene hydrocarbons. In our study, the main components were determined as α-pinene, limonene, 1,3,6-Octatriene, 3,7-Dimethyl- and β-caryophyllene.

In previous studies; Brunke et al. (1993) [15] analyzed the volatile components of *Rhus coriaria* samples collected in Adana, Şanlıurfa, Diyarbakır, Hatay, Gaziantep and Kahramanmaraş by GC-MS. Comparative studies have identified more than 120 compounds, the main components of which are terpene hydrocarbons (α-pinene, β-caryophyllene and cembrene), oxygenated terpenes (α-terpineol, carvacrol and β-caryophyllene alcohol), as well as farnesyl acetone, hexahydrofarnesylacetone and aliphatic aldehydes. have been detected.

Kurucu et al. (1993) [16] investigated the essential oils obtained from the leaf, fruit peel and twig/bark of *Rhus coriaria* by hydrodistillation by GC and GC/MS. They determined 63 components in branch/bark oil, 63 components in leaf oil and 85 components in fruit pericarp oil. The main components in pericarp oil are limonene (0.17–9.49%), nonanal (10.77–13.09%), and (Z)-2-decenal (9.90–42.35%), while the main components of leaf oil are β-caryophyllene (0.33–16%, It is a sesquiterpene hydrocarbon defined as 95 and provisionally patchulan (3.08–23.87%), the main components of branch/bark oil are β-caryophyllene (12.35–21.91%) and kembrene (10.71–26,50%).

Rediel et al. (2017) [17] analyzed the organs of *Rhus coriaria* collected in Sicily (Italy) by Gas chromatography Mass spectrometry (GC-MS). Monoterpene and sesquiterpene hydrocarbons are the most abundant, and β-caryophyllene and α-pinene components were identified as the main components.

Morshedloo et al. (2018) [18] evaluated the variability of essential oil compositions in *Rhus coriaria* fruits collected from 14 different locations in Iran. GC-FID and GC-MS analyzes of essential oils identified a total of 57 components. As main components (E)-Caryophyllene (5.9–50.3%), n-nonanal (1.8–23.3%), kembrene (1.9–21.7%), α-pinene (%) 0.0–19.7), (2E,4E)-decadienal (2.4–16.5%), and nonanoic acid (0.0–15.8%) were determined.

Zhalel et al. (2018) [19] (ATCC No. 21332) (BS) evaluated it's chemical composition and antibacterial activities. The chemical composition of *Rhus coriaria* was determined by Gas chromatography Mass Spectrometry (GC-MS). They found that the most common components in Rhus coriaria were β-caryophyllene (34.3%) and cembrene (23.8%).

When we compare other studies with our research, α-pinene, limonene, and β-caryophyllene components support our study. In our study, 1,3,6-Octatriene and 3,7-Dimethyl- components were detected differently. This difference is thought to be related to the region, climate and ecological characteristics.

Separately, a questionnaire consisting of 22 questions was prepared and interviews were conducted with the local people to determine the ethnobotanical characteristics of *Rhus coriaria* L. in the surrounding villages of Isparta province. A total of 150 people were interviewed. Considering some demographic characteristics of the participants of the survey conducted with the local people; 54.7% are female and 45.3% are male. The age of the local people participating in the survey is between 16 and 80 years old. Of the respondents, 32.66% are primary school-secondary education graduates, 36% high school, 27.32% associate degree-undergraduate, and 4% graduate-doctorate (Table 2).

Table 2 – Some demographic characteristics of the respondents

Gender	Number of people	%
Female	82	54,7
Male	68	45,3
Total	150	100
Education Status		
Primary/ Middle School	49	32,67
High School	54	36
Associate/ Bachelor Degree	41	27,33
Master/Doctorate Degree	6	4

90% of the participants in the survey study benefited from the plants that grow naturally in the region before the Covid-19 virus appeared, 84.7% started using the natural plants in the region after the onset of the Covid-19 pandemic, and 88.7% used the sumac plant (Figure 4).

It was determined that 78.7% of them had an increase in the amount of sumac plant use after the onset of the Covid-19 pandemic (Figure 4). According to the results of the research, it was determined that 4.1% of the local people did not use the sumac plant in any way, 16.7% benefited from the sumac plant for health and treatment, 77.3% for food/meal/spice, and 18% for pleasure. 32.2% of the participants in the survey research obtained the sumac plant by collecting them from nature. Of those who collect it from nature, 42% say that the area where the plant is collected is clean and hygienic, 32% of the plants are healthy, 62% of them are harvested in the season, 12.7% of them are all the organs of the plant and 30.7% are It pays attention to the ripeness of its fruits. 83.4% of the participants in the survey study consume the sumac plant by drying its fruits, 14% consume its fruits fresh, and 12.7% consume it by making sour sauce.

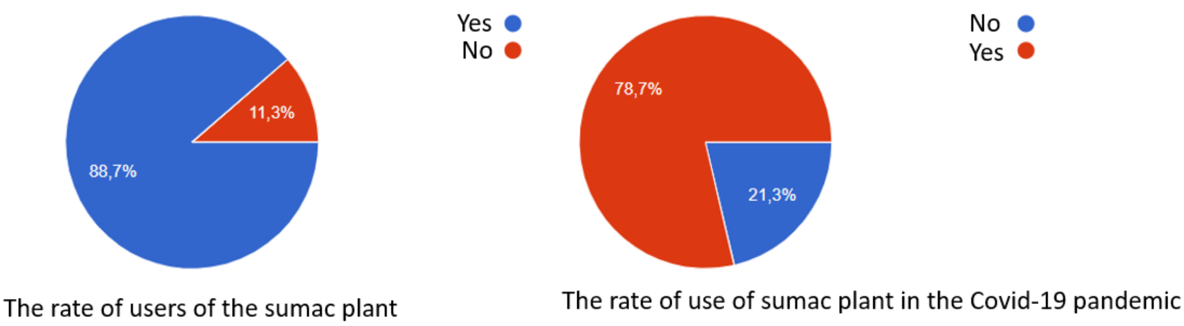

Figure 4- Use status of sumac plant

To the survey question, which parts of the plant species you supply most benefit from, 77.3% of them stated that they benefited from the fruit, 34.7% of the flower, 16% of the stem, 6.7% of the shoot and 4% of the root. Participants stated that it collects the most intensively in the months of August-September-October. They consume leaves and flowers of the sumac as as tea, its fruits as a spice in salads and meals, and the sour sauce obtained from its fruits in salads; They also stated that they use their fruits as a mouthwash against mouth sores. 85.4% of the participants obtain sumac sour from the fruits of the sumac plant. After drying the fruits, pounding them in a mortar and crushing them, they separate the seeds and boil them to obtain sumac syrup. To the question of whether you have seen or heard of any side effects from the sumac plant you are using, 96.7% said no, 2% heard but did not see any side effects, and 1.3% stated that they had side effects. 56.7% family, 45.3% people around, 2% written media, 6.7% books/magazines, 10% visual and audio media, 11.3% quotes and 1.3% of them are the factors that are effective in the consumption of the sumac plant with the rates of advertisements. 66% of the participants heard that the sumac plant can be beneficial against Covid-19. 91.3% of the participants who had Covid-19 used the sumac plant during their treatment (Figure 5).

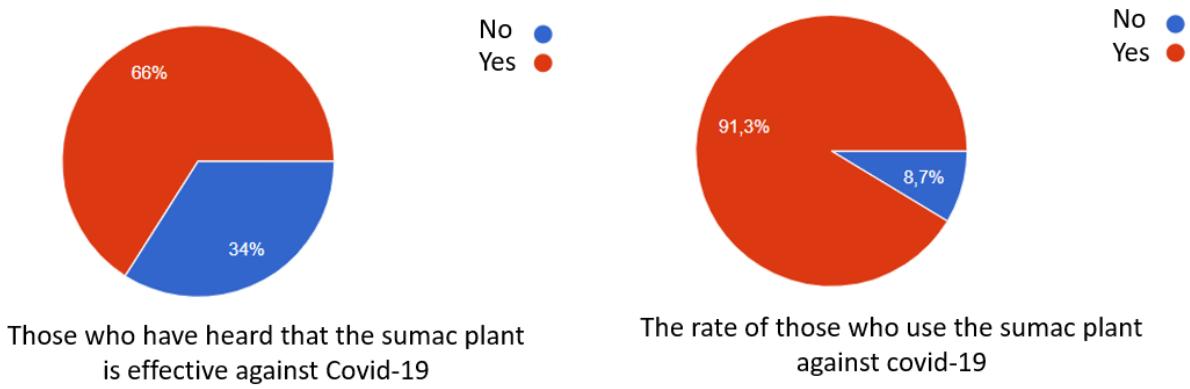

Figure 5- The use of the sumac plant against Covid-19 by the participants

Participants who used the fruits as a tea for treatment reported that they killed germs in the mouth and had a diuretic, breath-opening and throat-relaxing effect. 5.3% of the participants reported that they were selling the products they obtained from the sumac plant, that they were selling them to the surrounding provinces and their relatives, and that 94.7% of them did not. Participants who made the sale were asked whether there was an increase in their sales during and after the Covid-19 pandemic. 96.3% of the participants stated that there was an increase.

In order to determine the ethnobotanical characteristics of *Rhus coriaria* in the surrounding villages of Isparta province, 150 people were interviewed in the region. The local people consume the leaves and flowers of the Rhus coriaria they collect as tea, the fruits as a spice in salads and meals, and the sour sauce obtained from the fruits in salads; They also stated that they use their fruits as a mouthwash against mouth sores. Especially after the Covid-19 pandemic, its use has increased in the region and it has been stated that it has a therapeutic feature in addition to reducing the risk of catching the immune-boosting Covid-19. The local people benefit from the sumac plant economically, as well as for food such as spice, tea, sumac syrup, and for health purposes for the treatment of various diseases.

Previous studies stated that; the decoction prepared from the roots and leaves of *Rhus coriaria* is widely used in stomach diseases, and the decoction prepared from its fruits is widely used among people to reduce kidney stones. It is known that the fresh leaves are laid on the sole of the shoes to treat the cracks in the skin, and chewing the fruit in the form of gum is good for mouth sores and stomach cramps [20-21].

In addition to these, it has been stated that sumac is used in dysentery, liver diseases, conjunctivitis and anorexia, hair treatments, dermatitis, burns and skin diseases [22]. Setorki et al., (2012) [23] stated that sumac plant has a protective effect on oxidative stress and liver enzymes caused by foods with high fat content. The laxative obtained from its fruit is also used in hypertension and diabetes in Azerbaijan [24]. Exporting the extracts prepared from sumac fruit as an herbal tanning agent and being preferred in ink making, dyeing and veterinary medicine has increased the economic value of sumac [25-27].

Baydoun et al. (2017) [28] investigated the ethnobotanical and economic importance of wild plant species in Lebanon and found that *Rhus coriaria* was used for food and herbal medicine. Batiha et al. (2022) [29] stated that in recent years, the use of *Rhus coriaria* (sumac) has developed not only in culinary use and human nutrition but also in the pharmaceutical industry, food industry and veterinary applications. Considered a spice, most of the antioxidant potential and therapeutic roles of *Rhus coriaria* have been increasingly attributed to its constituent tannins, flavonoids, and phenolic acids. They stated that tannin-rich sumac extracts and isolates improve food quality and oxidative stability of animal products such as meat and milk. The studies carried out support our study in terms of ethnobotanical use. Differently, its use has increased in the Covid-19 pandemic and it has been found that it has a therapeutic feature in addition to reducing the risk of catching the immune-boosting Covid-19. Our study is important in this respect.

Conclusion

Rhus coriaria is used extensively as a spice, as well as in the pharmaceutical industry, food industry, paint industry and veterinary field thanks to the secondary metabolites it contains. Instead of collecting *Rhus coriaria*, which is valuable for the economy and health, from natural areas, cultivation studies should be increased and ex-situ and in-situ protection measures should be taken for natural populations. It is recommended to increase the studies on the secondary metabolites of *Rhus coriaria* to popularize food safety with the ‘clean food’ label in our country, especially in the food industry, whose importance has increased in recent years. In addition, it is recommended to carry out detailed studies to evaluate it in the field of health against viruses.

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