DOI: http://dx.doi.org/10.32571/ijct.1326549 **E-ISSN: 2602-277X**

International Journal of Chemistry and Technology

http://dergipark.org.tr/ijct

Research Article

Analysis of essential oil and volatile components of different organs of ısgin (*Rheum ribes* L.) plant by ultrasound-assisted extraction method

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Received: 12 July 2023; Revised: 20 November 2023; Accepted: 29 November 2023

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Citation: Asil, H.; Köroğlu, M. *Int. J. Chem. Technol.* **2023**, 7(2), 131-138.

ABSTRACT

Rheum ribes L. belongs to the family Polygonaceae and is locally known as "ışkın, ucgun, highland banana". In this study, ultrasound-assisted extraction with a solvent mixture of methanol: ethyl acetate was used to isolate the volatiles of the plant from the root, stem, and leaf organs. The essential oils were extracted from the plant roots by water distillation to determine the essential oil content and composition. GC-MS (Gas Chromatography-Mass Spectrometry) was used to analyse the content of essential oils and extracts. Carvacrol (40.41%) and gamma-terpinene (%22.90) were used in the root extracts of the plant., 2,4-ditert-butylphenol (20.76%) and carvacrol (13.52%) in the stem extracts and 2,4-ditert-butylphenol (25.87%) and methyl formate (6.87%) in the leaf extracts. The volatile components of 6-butyl-3-methoxy-2-cyclohexen-1-one (30.06%) and 3-carene (16.42%) were found in the essential oil. When the structure of the volatile components in both the extract and the essential oil of the plant is examined, the presence of versatile volatile components that can be used in the production of pharmacological, bioactive, flavouring, dye material, and perfume indicated that the plant can be used as an important medicinal and aromatic plant source.

Keywords: *Rheum ribes* L., ultrasound-assisted extraction, isgin, volatile components, essential oils

1. INTRODUCTION

Rheum ribes L. is from the family of Polygonaceae and is known locally as "isgin, usgun, ucgun or highland banana". It is a type of perennial vegetable spread from North and Central Asia to other continents. Isgin plant grows between 1000 and 4000 m between hard rocks, stones and slopes and is distributed in the natural fluorescence in Türkiye, Russia, Pakistan, Iran, Afghanistan and Iraq[1]. Isgin is the only type of rhubarb that grows in the rocky countryside of Türkiye between 1800 and 2800 altitudes. The upper parts of the isgin plant can grow up to 150 cm. After the flowers open between June and July, the seeds ripen. [2]

Isgin is a plant that grows in the eastern and southeastern regions of Türkiye and is known as a medicinal aromatic plant and edible by the local people there. Young shoots and stems of isgin are eaten as a vegetable and used to promote digestion, increase appetite and treat cancer by the people living in this region . The fresh stems, roots and leaves of the plant are used as digestion and appetizers in Bitlis, while the roots are consumed for diabetes. [2,3]

It has also been reported that isgin is an important source of vitamins C, A, B1, B2, E and K, which are abundant in it. It is known in folk medicine to have beneficial effects on diseases such as oriental laxative medicine and an antipsoriatic medicine, hypertension, asthma, diabetes, shortness of breath, smallpox, measles, diarrhea, colds, ulcers, hemorrhoids, antiemetics, influenza kidney disease.[2,4,5]

While the isgin plant analyzed in this study is commonly found in eastern Türkiye, this plant has also been found

DOI: http://dx.doi.org/10.32571/ijct.1326549 E-ISSN: 2602-277X

in the natural flora of Hatay. We did not find any research on this plant in Hatay's flora. In order to extract the characteristic features of the general volatile components of this plant, volatile components were determined by using ultrasonic bath, methanol and ethical acetate extraction method, these components were scanned in ethnobotanical databases and their bioactive properties were investigated.

2. MATERIALS and METHODS

2.1. Materials

Plant materials were collected from natural growing areas in Gazelusagi neighborhoods in Hassa district of Hatay province at an altitude of 1515 in May 2020 during the full bloom period. Methanol (MeOH) (Isolab, catalog # 947.043.2500) and ethyl acetate (EtOAc) (Tekkim, catalog # TK.050140.02500) required for the extraction of plants were purchased from the relevant companies and used as received.

2.2. Extraction procedure

Isgin extraction was carried out according to the ultrasonic-assisted solvent extraction method using an ultrasonic bath (input power 180 W, 35 kHz frequency and 25 ◦C). The extraction process of the isgin sample was carried out as follows; The root, stem and leaves of the isgin are divided into small pieces separately. Then, the root (1 g), stem (1 g) and leaf (1 g) are taken and transferred to 3 different one-necked flasks and 60 ml of methanol: ethyl acetate (70:30) solvent mixture is added to them. The sonication process is started and the mixture is sonicated for 15 minutes. After sonication, it is filtered on filter paper and then kept in a refrigerator at + 4 ºC in a lightless environment for GC-MS analysis. 1 µL of this extract is used for GC-MS analysis. [6]

2.4. Extraction of essential oils

2.5. Gas Chromatography-Mass Spectroscopy (GC-MS) analysis

GC-MS analysis was carried out using Hewlett-Packard 6890 series GC-MS analyzer in Hatay Mustafa Kemal University Central Research Laboratory. The column of the device is HP-88 fused silica column (100 m 0.25 mm i.d. film thickness 0.25 µm) and the detector is Hewlett-Packard mass selective detector 6890. GC-MS analysis was performed according to the procedure specified in the literature. The oven is heated to 90 °C and waited for 1 minute at this temperature. Then, the temperature is increased by 15 degrees per minute to 175 ºC and kept for 15 minutes, and then the temperature increased by 5 degrees per minute to 225 ºC and waited for 5 minutes. Finally, the temperature is increased by 10 degrees per minute to 255 ºC and waited for 10 minutes. For flame formation, 60 ml/min H2 (UHP grade), 400 ml/min air (zero grade), Helium (99.99%) as a carrier gas, and 10 ml/min flow rate were used as a gas mixture. The injector temperature was kept at 200 ºC.[9,10]

2.6.Results And Discussion

The extracts of root, stem and leaf parts of bush plants prepared by methanol-ethyl acetate solvents and ultrasonic extraction method were characterized by GC-MS analysis. Although the components of the different organs of the plant are mostly similar, some characteristic components have also been identified. The properties of the components (pharmacological, bioactive, food additive) and usage areas (cosmetics, perfume, food, dye) were determined by literature (PubChem, Sigma Aldrich and Pharmacy Research Databases) searches. In order to obtain essential oil in Hatay Mustafa Kemal University Altınözü Agricultural Sciences Laboratory, after drying the shoot roots used in the studies at room temperature, 1000 g was weighed and distilled for 3 hours in a Clevenger type hydrodistillation device, which was placed separately in glass balloons containing 6000 ml distilled water (solvent). The amounts of essential oils obtained were measured in ml and their % ratios (v/w) were determined. The essential oil obtained is put into dark (amber) glass bottles; It was stored in the refrigerator (+4 °C) until GC-MS analysis analysis.[7,8]

2.7. Characterization of components of isgin extracts

26 components were determined in the root of the isgin and according to the retention time (tR) are given in Table 1. Among the components, according to their properties and amounts, carvacrol (40.41%), gamma-terpinene (22.90%), 2,4-ditert-butylphenol (9.92%), 3-carene (3.08%), alpha-terpinene (1.59%) and stearyl alcohol (1.02%) draw attention.

Carvacrol is a phenolic substance with anticancer, antimicrobial, antioxidant, antifungal bioactivity properties that is predominantly found in plants such as thyme species, black pepper, and bergamot. [11] In addition to being used as a flavoring and preservative in foods, it is also used as a perfume material. [12,13] As a result of our analyzes, it was determined that carvacrol was found as the highest (40.41%) component in the root of isgin.

Gamma-terpinene draws attention with its anti-inflammatory effect, which is especially found in eucalyptus.[14-15] In this study, gamma-terpinene has the highest percentage (22.90%) after carvacrol in isgin root. The uses and properties of the components identified in the root section are given in Table 1. Among these components, salbutamol, aspartame, beta-pinene, perillyl alcohol, stearyl alcohol, 2(5H)-furanone, carvacrol, 2,5-dimethoxyamphetamine, silicone oil have pharmacological properties. Other components have the characteristics of bioactivity, flavoring in foods, perfume material and dye material according to the type. The usage areas of some components could not be found in the literature.

DOI: http://dx.doi.org/10.32571/ijct.1326549 E-ISSN: 2602-277X

Table 1. Chemical components and properties of the root part of the isgin plant.

No	tR	Molecular formula	Common Name	MW (g/Mol)	%	Use
1	6.54	$C_{10}H_{16}$	3-carene	136.23	3.08	Antimicrobial Food Sweetener Perfumery
2	7.70	$C_{13}H_{21}NO_3$	Salbutamol (albuterol)	239.31	0.49	Pharmacology Therapeutic Treatment
3	8.43	$C_{14}H_{18}N_2O_5$	Aspartame	294,30	0.39	Pharmacology Food Sweetener
4	8.76	$C_{10}H_{14}O_2$	Bicyclo [3.3.1] non-6-ENE-3-carboxylic acid	166.22	0.63	Not found
5	9.07	$C_{10}H_{16}$	Beta-pinene	136.23	0.39	Antimicrobial Food Sweetener Perfume Making
6	9.90	$C_{10}H_{16}$	Alpha-terpinene	136.23	1.59	Food Sweetener Perfumery
7	11.17	$C_{10}H_{16}$	Gamma-terpinene	136.23	22.90	Anti-inflammatory Food Sweetener Perfume Making
8	12.05	$C_{10}H_{16}O$	Perillyl alcohol	152.23	0.25	Pharmacology Bioactivity Flavoring in Foods
9	12.78	$C_{10}H_{16}O$	2-Carene epoxide	152.23	1.61	Not found
10	14.32	$C_3H_9NO_2$	2-Amino-1,3-propanediol	91.11	2.07	Not found
11	16.71	$C_{12}H_{18}OSi$	Silane, 2-butenylmethoxymethylphenyl-	206.36	0.66	Not found
12	17.26	$C_{14}H_{30}O$	1-tetradecanol	214.39	0.82	Pesticide Emulsifier in foods
13	23.63	$C_{18}H_{36}$	1-octadecene	252.5	0.98	Fuel additive Surfactant
14	24.06	$C_{15}H_{24}$	Trans-caryophyllene	204.35	0.22	Bioactivity Food Sweetener
15	29.59	$C_{18}H_{38}O$	Stearyl alcohol	270.5	1.02	Pharmacology Bioactivity Texturizer in foods Dye material
16	35.05	$C_{20}H_{42}O$	1-eicosanol	298.5	0.36	Cosmetic
17	35.25	$C_4H_4O_2$	2(5H)-furanone	84.07	0.77	Pharmacology Bioactivity Food Sweetener
18	39.92	$C_{10}H_{14}O$	Carvacrol	150.22	40.41	Pharmacology Bioactivity Food Sweetener Perfumery
19	41.01	$C_{14}H_{22}O$	2,4-ditert-butylphenol	206.32	9.92	Antioxidant Stabilizer
20	41.35	$C_{17}H_{34}O_2$	Methyl palmitate	270.5	0.57	Sweetener in Foods Perfumery
21	45.55	$C_{11}H_{17}NO_2$	2,5-Dimethoxyamphetamine	195.26	0.29	Pharmacology
22	46.60	$C_8H_{24}O_2Si_3$	Silicone oil	236.5	0.95	Pharmacology Cosmetic
23	47.44	$C_{10}H_{14}F_4O_2S$	3-tert-butylsulfanyl-3-fluoro-2-trifluoromethyl-acrylic acid ethyl ester	274.28	0.53	Not found
24	54.73	$C_{26}H_{32}O_2$	Androst-5-en-17-one, 3-hydroxy-16-(phenylmethylene)-	376.5	0.69	Not found
25	54.91	$C_{20}H_{60}O_{10}Si_{10}$	Cyclodecasiloxane, eicosamethyl-	741.5	0.86	Not found
26	55.12	$C_{28}H_{37}NO_3$	Nandrolone phenpropionate methoxime	435.6	0.72	Not found

2.8. Characterization of components of isgin stem extracts

As a result of the analyzes made in the stem, which is used as the edible part of the isgin, 24 components were determined and are given in Table 2. Considering the usage areas and amounts of the components in the stem, the ones with the highest percentages are 2,4-ditert-butylphenol (%20.76), carvacrol (%13.52), 3-carene (%6.81), gamma-terpinene (%6.73), beta-pinene (%3.21) and 1-tetradecanol (%2.57), respectively.

DOI: http://dx.doi.org/10.32571/ijct.1326549 E-ISSN: 2602-277X

2,4-ditert-butylphenol is a phenolic component used as an additive in foods with antifungal and antioxidant properties such as carvacrol.[16,17] Since 2,4-DTBP is a recommended chemical as a natural herbicide for weed management programs,[18] isgin has the potential to be a plant with allelopathic effects.Carvacrol is an important ingredient with its pharmacological, bioactive, food flavoring and perfume making material properties. Carvacrol, which is found at a higher rate (13.52%) in the stem part of isgin, is the second component after 2,4-DTBP.

3-carene is an antimicrobial monoterpene found naturally in various plants and has an antibacterial mechanism against foodborne microbes.[19] In this study, 3-carene was found to be 6.81% in the isgin stalk. Gamma-terpinene was detected at a lower level (6.73%) in the stem part of the isgin than in the root part. It is important for health that it is present in the edible part of the plant and has an anti-inflammatory effect.[20] The properties of isgin stalk components such as pharmacological, bioactive, sweetener, perfume making material, food additive and cosmetics are given in Table 2. The use of some components could not be found in the literature.

Table 2. Chemical components and properties of the stem part of the isgin plant.

No	tR	Molecular formula	Common Name	Mw (g/mol)	%	Use
1	6,57	$C_{10}H_{16}$	Gamma-terpinene	136,23	6,73	Anti-inflammatory Sweetener in Foods Perfumery
2	8,39	$C_{10}H_{16}$	Beta-pinene	136,23	3,21	Pharmacology Sweetener in Foods Perfumery
3	9,91	$C_{14}H_{18}N_2O_5$	Aspartame	294,30	0,60	Pharmacology Sweetener in Foods
4	11,19	$C_{10}H_{16}$	3-carene	136,23	6,81	Antimicrobial Sweetener in Foods Perfumery
5	12,80	$C_{10}H_{16}O$	2-carene epoxide	152,23	0,79	Not found
6	14,05	$C_3H_9NO_2$	2-amino-1,3-propanediol	91,11	5,59	Not found
7	16,68	$C_{12}H_{18}OSi$	Silane, 2-butenylmethoxymethylphenyl-	206,36	0,71	Not found
8	17,27	$C_{14}H_{30}O$	1-tetradecanol	214,39	2,57	Pesticide Emulsifier in foods
9	23,64	$C_{16}H_{32}$	1-hexadecene	224,42	2,68	Dye Colorant
10	29,58	$C_{18}H_{36}$	1-octadecene	252,5	1,94	Fuel additive Surfactant
11	35,04	$C_{20}H_{42}O$	1-eicosanol	298,5	0,89	Cosmetic
12	39,96	$C_{10}H_{14}O$	Carvacrol	150,22	13,52	Pharmacology Bioactivity Sweetener in Foods Perfumery
13	40,36	$C_{15}H_{16}O$	4-cumylphenol	212,29	0,71	Food Additive Pesticide
14	41,00	$C_{14}H_{22}O$	2,4-ditert-butylphenol	206,32	20,76	Antioxidant Stabilizer
15	41,34	$C_{17}H_{34}O_2$	Methyl palmitate	270,5	1,03	Sweetener in Foods Perfumery
16	42,01	$C_{13}H_{18}O_4$	Allyltetramethoxybenzene	238,28	4,88	Not found
17	42,34	$C_{15}H_{16}O$	Naphthalene, 6-methoxy-2-(1-buten-3-yl)-	212,29	1,05	Not found
18	43,63	$C_{11}H_{12}O_3$	Myristicin	192,21	2,24	Bioactivity Sweetener in Foods
19	46,59	$C_8H_{24}O_2Si_3$	Silicone oil	236,5	1,74	Pharmacology Cosmetic
20	47,41	$C_{10}H_{14}F_4O_2S$	3-tert-butylsulfanyl-3-fluoro-2-trifluoromethyl-acrylic acid ethyl ester	274,28	1,07	Not found
21	48,79	$C_{12}H_{14}O_4$	Apiole	222,24	2,41	Pharmacology Bioactivity Sweetener in Foods
22	54,73	$C_{29}H_{50}O$	Clionasterol	414,7	1,05	Pharmacology Bioactivity
23	54,90	$C_{20}H_{60}O_{10}Si_{10}$	Cyclodecasiloxane, eicosamethyl-	741,5	1,07	Not found
24	55,55	$C_{11}H_{17}NO_2$	2,5-dimethoxyamphetamine	195,26	0,54	Pharmacology

Demiray et al[21], after extraction of the stem with hexane, 1-octadecanol (4.3%), methyl linolenate (3.5%), methyl palmitate (2.4%), methyl oleate (2.9%), methyl linoleate (5.7%), heptacosane (13.5). %), and palmitic acid (67.7%) have determined the components. In our study, methyl palmitate was determined as 1.03%.

DOI: http://dx.doi.org/10.32571/ijct.1326549 E-ISSN: 2602-277X

2.9.Characterization of components of isgin leaf extracts

23 components were determined in the leaf extracts of the isgin plant and are given in Table 3 according to the retention time (tR). Considering the use, properties and amounts of the components in the light leaf part, 2,4-ditert-butylphenol (25.87%), methyl formate (6.87%), carvacrol (6.81%), 3-carene (4.08%), gamma-terpinene (%) 3.43) stand out as having the highest percentage.

2,4-ditert-butylphenol is found as the highest component (25.87%) in the leaf as well as in the stem. In the light of studies predicting that 2,4-DTBP can be used as potent inhibitors against coronavirus, the isgin aromatic plant may be a natural solution source for SARS-Cov-2019 for pharmacological studies. [22-24] Methyl formate was determined as 6.87% in the leaf part of the isgin plant. Carvacrol, 3-carene and gamma-terpinene were detected in the leaf as well as in the root and stem of the isgin plant.

Munzuroğlu[25] and his colleagues determined the levels of vitamins A, E and C and selenium in *Rheum ribes* shoots collected from Elazig and Tunceli regions by HPLC and fluorimetry methods. They determined that isgin is rich in vitamin C and poor in vitamins A and E. In our study, retinol (vitamin A) was found to be 1.45% in the leaf and 0.93% in the root essential oil. The properties of the components of the isgin leaf part, such as pharmacological, bioactive, sweetener, perfume making material, food additive, and cosmetics are given in Table 3. The use of some components could not be found in the literature.

Table 3. Chemical components and properties of the leaf part of the isgin plant.

No	tR	Molecular formula	Common Name	Mw (g/mol)	%	Use
1	6.60	$C_{10}H_{16}$	Gamma-terpinene	136.23	3.43	Anti-inflammatory Sweetener in Foods Perfume Making
2	6.91	$C_7H_{14}O2$	Pentyl acetate	130.18	1.82	Pharmacology Sweetener in Foods Perfume
3	8.79	$C_{14}H_{18}N_2O_5$	Aspartame	294,30	1.69	Pharmacology Sweetener in Foods
4	11.20	$C_{10}H_{16}$	3-Carene	136,23	4.08	Antimicrobial Sweetener in Foods Perfumery
5	12.04	$C_{10}H_{18}O$	Eucalyptol	154.25	0.60	Pharmacology Bioactivity Sweetener in Foods Perfumery
6	14.14	$C_2H_4O_2$	Methyl formate	60.05	6.87	Pharmacology Sweetener in Foods
7	16.70	$C_{12}H_{18}OSi$	Silane, 2-butenylmethoxymethylphenyl-	206.36	2.59	Not found
8	17.33	$C_{14}H_{30}O$	1-Tetradecanol	214,39	1.76	Pesticide Emulsifier in foods
9	23.65	$C_{16}H_{32}$	1-Hexadecene	224.42	2.40	Dye Colorant
10	29.59	$C_{18}H_{36}$	1-Octadecene	252.5	1.76	Fuel additive Surfactant
11	32.09	$C_{20}H_{40}O_2$	Emulphor	312.5	1.30	Cosmetic
12	35.04	$C_{20}H_{42}O$	1-eicosanol	298.5	1.05	Cosmetic
13	39.98	$C_{10}H_{14}O$	Carvacrol	150.22	6.81	Pharmacology Bioactivity Sweetener in Foods Perfumery
14	40.37	$C_{15}H_{16}O$	4-cumylphenol	212.29	1.50	Food Additive Pesticide
15	41.01	$C_{14}H_{22}O$	2,4-ditert-butylphenol	206.32	25.87	Antioxidant Stabilizer
16	41.34	$C_{17}H_{34}O_2$	Methyl palmitate	270.5	0.57	Sweetener in Foods Perfumery
17	42.05	$C_{14}H_{12}S$	Ethyldibenzothiophene	212.31	2.77	Not found
18	42.33	$C_{15}H_{16}O$	Naphthalene, 6-methoxy-2-(1-buten-3-yl)-	212.29	2.68	Not found
19	45.70	$C_{11}H_{17}NO_2$	2,5-Dimethoxyamphetamine	195.26	0.62	Pharmacology
20	46.59	$C_8H_{24}O_2Si_3$	Silicone oil	236.5	1.57	Pharmacology Cosmetic
21	54.35	$C_{20}H_{30}O$	Retinol (vitamin A)	286.5	1.45	Pharmacology Bioactivity
22	54.90	$C_{20}H_{60}O_{10}Si_{10}$	Cyclodecasiloxane, eicosamethyl-	741.5	2.09	Not found
23	55.93	$C_{11}H_{17}NO_2$	2,5-Dimethoxyamphetamine	195.26	0.59	Pharmacology

DOI: http://dx.doi.org/10.32571/ijct.1326549 E-ISSN: 2602-277X

2.10. Comparison of isgin root essential oil in terms of chemical compounds

As the essential oil amount of the root of the isgin plant, 0.06% essential oil was obtained. 21 components were determined in the root essential oil of the isgin plant and their retention times are given in Table 4. 6-butyl-3-methoxy-2-cyclohexen-1-one (%30.06), 3-carene (%16.42), 2'-hydroxy-5'-methylacetophenone (%5.97), alpha-santalol (%2.97), carvacrol (%2.79) draw attention in the essential oil of isgin root. There may be different distributions in essential oil components in studies due to different factors such as the growing environment, location, species and extraction method of the isgin plant.

Table 4. The chemical components and properties of the root essential oil of the isgin plant.

No	tR	Molecular formula	Common Name	Mw (g/mol)	%	Use
1	6.90	C_9H_{20}	Heptane, 2,5-dimethyl-	128.25	1.38	Not found
2	10.07	$C_5H_{12}O$	2-Methyl-1-butanol	88.15	1.67	Sweetener in Foods
3	11.18	$C_{10}H_{16}$	Gamma-terpinene	136.23	1.09	Sweetener in Foods Perfumery
4	14.61	$C_6H_{14}O$	3-Methyl-1-pentanol	102.17	1.70	Sweetener in Foods Perfumery
5	21.14	$C_{15}H_{24}O$	Santalol	220.35	1.32	Sweetener in Foods
6	28.35	C_6H_8S	2-Ethylthiophene	112.19	0.62	Sweetener in Foods
7	32.64	$C_{10}H_{16}O$	Perillyl alcohol	152.23	0.98	Pharmacology Bioactivity Flavoring in Foods
8	37.05	$C_{10}H_{16}$	3-Carene	136.23	16.42	Sweetener in Foods Perfumery
9	37.67	$C_{15}H_{24}O$	(Z)-lanceol	220.35	2.52	Not found
10	39.98	$C_{10}H_{14}O$	Carvacrol	150.22	2.79	Pharmacology Bioactivity Sweetener in Foods Perfumery
11	40.35	$C_{15}H_{16}O$	4-Cumylphenol	212.29	1.88	Food Additive Pesticide Making
12	40.85	$C_{16}H_{20}$	2,6-Diisopropylnaphthalene	212.33	1.36	Pesticide
13	41.33	$C_{17}H_{34}O_2$	Methyl palmitate	270.5	0.83	Sweetener in Foods Perfumery
14	42.33	$C_{15}H_{16}O$	Naphthalene, 6-methoxy-2-(1-buten-3-yl)-	212.29	2.35	Not found
15	42.76	$C_9H_{10}O_2$	2'-Hydroxy-5'-methylacetophenone	150.17	5.97	Sweetener in Foods
16	44.36	$C_{15}H_{24}O$	Alpha-Santalol	220.35	2.97	Sweetener in Foods Perfumery
17	45.26	$C_{11}H_{17}NO_2$	2,5-Dimethoxyamphetamine	195.26	1.25	Pharmacology
18	47.25	$C_{10}H_{14}O_2$	6-Pentyl-2H-pyran-2-one	166.22	2.77	Sweetener in Foods
19	47.61	$C_{11}H_{18}O2$	6-Butyl-3-methoxy-2-cyclohexen-1-one	182.26	30.06	Not found
20	49.31	$C_{34}H_{67}NO_5Si_4$	(20R)-11beta,17,20,21-Tetrakis(trimethylsiloxy)pregn-4-en-3-one O-methyl oxime	682.2	2.20	Not found
21	54.36	$C_{20}H_{30}O$	Retinol (Vitamin A)	286.5	0.93	Pharmacology Bioactivity

Nikbakht et al.[26], analyzed *Rheum ribes* stem and flower essential oil grown in Iran by GC-MS and identified 30 components. The most abundant components in the oil are tricosane (26.29%) and heneicosane (26.07%). Ragasa et al.[27], in their study, found tricosane (26.29%), heneicosane (26.07%), pentacosane (10.63%), heptacosane (10.37%) and palmitic acid (3.64%) levels in the essential oil of isgin stem and flower part. Amiri and his colleagues[28], analyzed the hexane extraction and essential oil of isgin by GC-MS in their study. Germacrene D (22.3%), α-pinene (13.5%), terpinolene (12.4%), p-cymene (10.6%), bicyclogermacrene (9.6%), limonene (8.6%) and γ-Terpinene (0.6%) were identified. In our study, gamma-terpinene was determined at the

DOI: http://dx.doi.org/10.32571/ijct.1326549 E-ISSN: 2602-277X

level of 1.09%. Naemi et al.[29], analyzed the essential oil of *Rheum ribes* flower grown in Iran by GC-MS and identified 19 compounds. Palmitic acid (27.08%), n-eicosane (9.9%), n-tetracosane (7.34%), linoleic acid (6.56%) and ethyl linoleate (4.76%) are the main components in the essential oil. In this study, 3-carene was detected in trace amounts, while in our study it was characterized as the main component of *Rheum ribes* root essential oil in the Hatay region with 16.42%. In our study, the highest 2,5-Dimethoxyamphetamine root essential oil (1.25%) was detected in all parts of the isgin plant, respectively, leaf (0.59%), stem (0.54%) and root (0.29%).

2.11.Comparison of isgin's stem, leaf, root parts and root essential oil in terms of chemical compounds

When the 4 parts of the isgin plant, namely the stem, leaf, root and root essential oil, are compared, the percentage comparison of the common components in at least two parts and in each part is given in Table 5. 19 components are common in each part, including stem, leaf, root and root essential oil. 5 components (carvacrol, gamma-terpinene, 3-carene, methyl palmitate, 2,5-dimethoxyamphetamine) in stem, leaf, root and root essential oil; 7 components (2,4-DTBP, aspartame, silicone oil, 1-tetradecanol, 1-octadecene, cyclodecasiloxane, eicosamethyl-) in stem, leaf and root parts; 7 components (1-hexadecene, beta-pinene, vitamin A, 2-amino-1,3-propanediol, 3-tert-butylsulfanyl-3-fluoro-2-trifluoromethyl-acrylic acid ethyl ester, 2-carene epoxide, silane, 2-butenylmethoxymethylphenyl) is found in common in 2 parts. Carvacrol, 2,4-DTBP, gamma-terpinene and 3-carene components were detected at characteristically higher levels.

Table 5. Comparison of stem, leaf and root parts of isgin plant in terms of chemical compounds.

No	Chemical Composition	Root (%)	Stem (%)	Leaf (%)	Root Essential Oil (%)
1	Carvacrol	40.41	13,52	6.81	2.79
2	2,4-ditert-butylphenol (2,4-DTBP)	9.92	20,76	25.87	-
3	Gamma-terpinene	22.90	6.73	3.43	1.09
4	3-Carene	3.08	6,81	4.08	16.42
5	Aspartame	0.39	1.69	0.60	-
6	Methyl palmitate	0.57	1,03	0.57	0.83
7	Silicone oil	0.95	1,74	1.57	-
8	1-Tetradecanol	0.82	2.57	1.76	-
9	1-Octadecene	0.98	1.94	1.76	-
10	2,5-Dimethoxyamphetamine	0.29	0,54	0.59	1,25
11	1-Hexadecene	-	2.68	2.40	-
12	4-Cumylphenol	-	0,71	1.50	1.88
13	Beta-Pinene	0.39	3.21	-	-
14	Retinol (Vitamin A)	-	-	1.45	0.93
15	Cyclodecasiloxane, eicosamethyl-	0.86	1,07	2.09	-
16	2-Amino-1,3-propanediol	2.07	5.59	-	-
17	3-tert-Butylsulfanyl-3-fluoro-2-trifluoromethyl-acrylic acid ethyl ester	0.53	1,07	-	-
18	2-Carene epoxide	1.61	0.79	-	-
19	Silane, 2-butenylmethoxymethylphenyl-	-	0.71	2.59	-

3. CONCLUSİONS

In the study, essential oils were obtained from plant roots by water distillation method to determine the essential oil ratio and composition. There may be different distributions in essential oil components in studies due to different factors such as the growing environment, location, species, and extraction method of the isgin plant. As a result of our analysis on different organs and root essential oils of the ISGIN plant, carvacrol, Gamma-terpinene, 3-Carene, Methyl palmitate, 2,5-Dimethoxyamphetamine were found to be common in all of them. The highest components in the stem, leaf and root organs of the isgin plant were determined as 2,4-DTBP (20.76%), 2,4-DTBP (25.87%) and carvacrol (40.41%), respectively.

When a database search was made on the components in the root, stem, leaf extract, and essential oil of the isgin, it was revealed that the components have properties such as pharmacological, bioactive, sweetener, perfume-making material, food additive, cosmetics, and it is an important herbal source for medicine, food, and traditional treatment methods. Due to the 2,4-DTBP component found in the isgin plant as potent inhibitors against coronavirus, the plant may be a natural source of solution for SARS-Cov-2019. However, 2,5-Dimethoxyamphetamine, which is found both in the essential oil of the plant and in the extracts of the organs, should be used carefully because it is an addictive component. In terms of the importance of the study, it is important to carry out both pharmacological and health studies of the components found in detail.

DOI: http://dx.doi.org/10.32571/ijct.1326549 **E-ISSN: 2602-277X**

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