The Effect of Covid-19 on medicinal and aromatic plants use: The case of Turkey

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Abstract. Covid-19, one of the coronaviruses, emerged in Wuhan, China, due to zoonotic infection towards the end of December 2019. According to WHO data, Covid-19 has been present among 267.865.289 people in 222 countries, causing death for 5.285.888 (December 12, 2021). Furthermore, these figures are increasing every day. In Turkey, 8.984.407 people have been infected thus far, and 78.602 have died (December 12, 2021). The following questions were investigated in this study: Does Covid-19 affect the use of medicinal and aromatic plants? If it does, what are the changes? What types of herbs are used and in which ways are they used? Who advises people to use these herbs? According to the results, 113 taxa belonging to 61 families and 105 genera were used by the participants at the genus, species and subspecies levels. Herbs that were widely used are *Thymus* spp., *Tilia* spp., *Salvia* spp., *Zingiber officinale* Roscoe, *Mentha* spp., *Curcuma longa* L., *Rosa canina* L., *Camellia sinensis* (L.) Kuntze, *Lavandula* spp., *Matricaria* spp., respectively. There was a positive and moderate-level relationship between medicinal and aromatic plants before and after COVID-19 and another positive and moderate-level relationship between the frequencies of using medicinal and aromatic plants before and after the pandemic. The relationships were significant for both questionnaire items. Moreover, there was a significant difference between the frequency of use of medicinal and aromatic plants before and after Covid-19.

Keywords: Coronavirus, Covid-19, drug, herb, Medicinal and aromatic plants.

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Introduction

New coronaviruses have emerged in different regions of the world within the last few years and there are still discoveries (Maier, Bickerton & Britton, 2015). Some of these viruses have caused a pandemic in the past. The severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) pandemic occurred in 2002 and caused 8422 persons to get infected and 916 to die. The Middle East Respiratory Syndrome Coronavirus (MERS - CoV), which caused a pandemic in 2012, was transmitted to humans from dromedaries. It caused 1401 humans to get infected and 543 to die (Koh & Sng, 2010; WHO, 2020a). Covid-19 has emerged in Wuhan, China, due to zoonotic infection towards the end of December 2019 (Mackenzie & Smith, 2020). The virus was described as new type of coronavirus at 9 o'clock on January 7, and the new coronavirus in 2019 was named 2019-nCoV by the World Health Organization (WHO, 2020b). The virus spread to different countries and caused deaths in time. WHO classified and announced Covid-19 as a global pandemic on March 11, 2020. All infection cases and recent pandemics show that coronaviruses emerge unexpectedly, spread easily, cause disastrous outcomes, and threaten humans and economies (Li *et al*., 2020).

According to WHO data, Covid-19 has been present among 267.865.289 people in 222 countries, causing death for 5.285.888 (December 12, 2021). Furthermore, these figures are increasing every day. In Turkey, 8.984.407 people have been infected thus far, and 78.602 have lost their lives (December 12, 2021) (WHO, 2021). The vaccination-related efforts have been made rapidly to cope with this virus. Since the period SARS-CoV-2 virus and its genome was defined, more than 300 vaccines have been developed, and more than 40 vaccines have been undergoing clinical assessments. Ten of these vaccines are in Phase III clinical assessment, while 3 completed this phase with positive results. Some new vaccines were approved for urgent use (Forni & Mantovani, 2021). According to the current data from the World Health Organization, 22 different vaccines are in the assessment phase. Eight of these vaccines successfully completed the relevant process, and three are expected to do the same in the near future (WHO, 2021).

A total of 8.158.815.265 doses of vaccine have been administered until December 12, 2021 (WHO, 2021).

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Specific reasons such as the high global population, limited size of vaccine production, difficulties in providing the vaccines, and mutation of Covid-19 make the fight against the virus more challenging. People who have yet to access the vaccine utilize the medicinal and aromatic plants used since ancient times to protect themselves. Specific studies during this period indicated that natural products could be used solely or in combination to prevent/treat Covid-19 infection (Benarba & Pandiella, 2020).

According to the report published by Kew Royal Botanic Garden in 2020, there are a total of 347,298 herbs known thus far, and 1942 new herbs were introduced to the world solely in 2019 (Antonelli *et al.*, 2020). In addition to the current species, new species are found every day. The presence of different climate types and the geomorphological and geographical structure in Turkey paves the way for a rich flora in the country (Davis, 1965-1985). Relevant studies indicated that Turkey's number of herb species is 11,707 at the species and subspecies taxonomic level (Guner *et al.*, 2012). The rate of endemism is 34% (3649) (Ozhatay *et al.*, 2009; Atik *et al.*, 2010; Guner *et al.*, 2012). Despite the presence of 11,707 taxa, only 500 are used for treating diseases (Baytop, 1984; Polat *et al.*, 2012). The studies in this field make contributions to our efforts to gain more information about the herbs that are in the flora of Turkey and that can be used to treat diseases (Bahtiyarca Bagdat, 2006; Doganoglu *et al.*, 2006; Faydaoglu & Surucuoglu, 2011; Faydaoglu & Surucuoglu, 2013; Aslan & Karakus, 2019; Goktas & Gidik, 2019).

Herbs have been essential for human life since the emergence of humanity. Herbs have been used in many fields, including gastronomy or industry (such as paint, spice, medication, sorcery, poison, etc.) (Baytop, 1984). People have been oriented to consume natural herbs because they desire to use natural products before access to vaccines or other medication against new diseases such as Covid-19. Using herbs for treatment-related purposes is not a new method.

Herbs have been used since ancient times, and their number is increasing every day. The number of herbal drugs which was around 250 during the era of Mesopotamian civilization, reached 600 during the period of the Greeks (Saber, 1982). This figure which reached 4000 during the Arabic-Persian era (Levey, 1973), became approximately 13,000 at the beginning of the 19th century (Dragendorff, 1898) and 25,791 in the 21st century (Antonelli *et al.*, 2020). It should also be noted that the figure is still on the rise.

Traditional drugs produced from herbs were used in China during the first days of the epidemic. In a study, these drugs were administered to 214 patients. This procedure resulted in recovery for 90% of the patients. Moreover, it prevented healthy people from getting infected by Covid-19 and improved the general medical status of those with mild or severe symptoms (Hong-Zhi *et al.*, 2020). Studies conducted in the Chinese city of Zhejiang also present similar results (Xu K. *et al.*, 2020). Certain experts at Wuhan University Zhongnan hospital promoted traditional herbs for treating and preventing Covid-19, and they even added this use in their guides (Jin *et al.*, 2020).

People have preferred medicinal and aromatic plants to protect/treat themselves from Covid-19. As a result of the research, no information regarding the biological impact of these herbs on Covid-19 was found. Still, the herbs are rich in terms of bio-active substances and they have numerous benefits thanks to the variety of secondary metabolites they contain (El Alami *et al.*, 2020). With their active bio-compounds, herbs strengthen the host's immune system against viral pathogens and help develop the immune response. Therefore, they are considered the protective and supplementary treatment option (Sekeroglu & Gezici, 2020).

Thus far, scientific research has indicated that many herbs produced naturally and used as food, herbal tea, spice, seasoning, incense, etc., in Turkey successfully protect against microbial diseases and treatment of these conditions (Sekeroglu & Gezici, 2020).

The following questions were investigated in this study: Does Covid-19 affect the use of medicinal and aromatic plants? If it does, what are the changes? What types of herbs are used and in which ways are they used? Who advises people to use these herbs? The research hypothesis was as given below "There is no difference between the averages of use of aromatic plants before and after Covid-19 in terms of gender, age, or educational status".

Material and Methods

The main material of this study consisted of herbs obtained with the statements of the survey participants. Flora of Turkey (Davis, 1965-1985; Davis et al., 1988; Guner et al., 2000) was used to standardize the plant nomenclature. If not found, then the Turkey Plant List (Vascular Plants) (Guner *et al.*, 2012), treatment with plants in Turkey (Baytop, 1984), and A Dictionary of Vernacular Names of Wild Plants of Turkey (Baytop, 1997) were used.

The survey developed for "The Use of Medicinal and Aromatic Plants During Covid-19 Pandemic" contained two sections, including demographic information and various theses about the use of medicinal and aromatic plants during the Covid-19 pandemic. The demographic information section had four questions about the participants' sex, age, marital status and educational status. The other section had 16 theses about the use of medicinal and aromatic plants.

Survey participants were selected randomly from different cities in the seven geographical regions of Turkey which are Bursa (town center and İnegöl district), Adana (town center), Adıyaman (town center and Besni, Kahta districts), Ankara (town center), Alanya district, Ardahan (town center and Posof, Göle districts), Artvin (town center and Arhavi, Borçka districts), Bartın (town center), Batman (town center), Edirne (town center and Keşan, Uzunköprü, Havsa districts). There was a curfew due to the Covid-19 pandemic and the surveys were sent to 6000 participants were living in these cities via e-mail.

The online survey study was conducted between January 8 and June 1, 2021 on a voluntary basis (Survey questions are given in Appendix 2). 600 individuals participated in the online survey and the study was completed with the answers of 523 individuals by excluding biased and missing answers from the evaluation. In the first step, we accounted for the frequency distributions of responses. The Spearman Correlation coefficients regarding medicinal and aromatic plants' use and use frequency before and after the Covid-19 pandemic were then determined. A dependent sample t-test was used for the use and use frequency of medicinal and aromatic plants before and after the Covid-19 pandemic. Also, an independent sample t-test was used to compare the average use and use frequency of medicinal and aromatic plants before and after the Covid-19 pandemic in terms of sex. One-way variance analysis (ANOVA) test was used to compare the average use and use frequency of medicinal and aromatic plants before and after the Covid-19 pandemic regarding educational status.

Results

According to the answers given to the questionnaire items, 113 taxa belonging to 61 families and 105 genera were used by the participants at the genus, species and subspecies levels. Moreover, 52 families, 90 genera and 98 taxa at the genus, species and subspecies level were used before the Covid-19 pandemic, and only 20 of these taxa were used before the pandemic, but they were not used after the beginning of the pandemic. According to the results, 52 families, 89 genera and 94 taxa at the genus, species and subspecies level were used after the beginning of the pandemic. Of these taxa, 16 were not used before the pandemic and only after the pandemic's start (Appendix 1).

The participants indicated that the leaves of the herbs were used the most. There were small changes between the sequencing of the use of other parts before and after Covid-19 but the difference between their percentages was not significant (Table 1).

Table 1. Used parts of herbs.

Used parts of herbs	Before Covid-19 (%)	After Covid-19 (%)
Leaf	89.77	85.19
Flower	55.75	57.55
Root	28.64	33.05
Stem	27.11	27.07
Fruit	21.48	23.65
Seed	20.46	25.07
Leafy and flowering branches	19.95	20.51
Bark	8.95	7.98
Above ground parts	6.14	7.12
Resin	3.84	3.13
Bulb	3.32	3.99
Latex	2.56	2.28
Rhizome	1.02	2.85

Participants stated that they used the herbs in the infusion method the most. There were minor changes between the sequencing of their use before and after Covid-19 but the differences between the ways they were used were not significant (Table 2).

Table 2. Manners of using herbs.

	Before Covid-19 (%)	After Covid-19 (%)
Infusion	82.04	79.02
Decoction	28.68	31.34
Honey	17.71	17.17
Oil	16.96	17.17
Powder	15.46	17.98
Raw	11.47	10.90
Incense	5.24	4.90
Paste	4.74	5.45
Crushing	3.99	5.99
Ointment	3.74	4.09
Pill	3.49	4.09
Syrup	3.24	4.36
Clench	2.74	2.72
Puree	1.25	2.72
Sucking	0.50	0.82
Mush	0.50	1.09
Drying	0.25	0.27

The demographic characteristics of 523 individuals who participated in the study for the use of medicinal and aromatic plants during the Covid-19 pandemic showed that 55.8% of participants were female and 44.2% male; 17.0% of participants were in 15-25 age range, 41.5% in 26-35, 24.3% 36-45, 12.8% in 46-55, and 3.8% in 56-65. Among the participants, 1.5% had vocational's school, 22.0% had bachelor's degrees, and 75.9% had postgraduate/master's degrees; 55.5% of participants were married and 44.5% were single (see Table 3).

Table 3. Demographic Distributions of the Participants.

Variable	Level	Frequency	Percentage
Gender	Male	231	44.20
	Female	292	55.80
Age	15-25	89	17.01
	26-35	217	41.49
	36-45	127	24.28
	46-55	67	12.81
	56-65	20	3.82
	65-+	3	0.59
Education	High school	3	0.57
	Vocational school	8	1.53
	Bachelor degree	115	21.99
	Postgraduate/ Master degree	397	75.91
Marital status	Married	290	55.50
	Single	233	44.50

The frequency distribution of answers to the question "Where do you get the medicinal and aromatic plants you use?" is given in Table 4. The participants were allowed to choose more than one option for this question, 45.2% of participants said they purchase medicinal and aromatic plants from herbalists, while 22.4% said they buy these herbs from supermarkets.

Table 4. Distributions of Places where Participants Purchase Medicinal and Aromatic Plants.

Place	Frequency	Percentage
Herbalist	276	45.17
Supermarket	137	22.42
I collect myself	119	19.48
Public-market	58	9.493
Internet	7	1.146
I grow my own plant	7	1.146
From the villagers	4	0.655
Pharmacy	3	0.491

The frequency distribution of the answers given to the question "Do you believe the medicinal and aromatic plants you use will improve your immunity and protect you from the virus?" is presented in Table 5. Of the participants, 48.2% answered yes, 38.1% answered not sure, and 19.1% answered no. Table 5 shows the frequency distribution of the answers to the question, "Do you think Covid-19 has changed the habit of using medicinal and aromatic plants?". Of the participants, 23.7% answered yes, 15.4% answered not sure, and 60.8% answered no.

Table 5. Distributions of participants' opinions on the Effects of Medicinal and Aromatic Plants on Immunity and due to Covid-19.

Immunity	Frequency	Percentage
Yes	224	42.83
No	100	19.12
Not sure	199	38.05
Habit	**Frequency**	**Percentage**
Yes	124	23.71
No	318	60.80
Not sure	81	15.49
Education	**Frequency**	**Percentage**
Yes	40	7.65
No	483	92.35

The frequency distribution of the answers to the question "Did you receive education about medicinal and aromatic plants?" is given in Table 5. Of the participants, 7.65% answered yes, while 92.35% answered no.

The frequency distribution of the answers to the question "How do you decide which herbs you should use?" is given in Table 6. The participants were allowed to choose more than one option for this question. Most participants answered as information provided by parents and the recommendations of friends and family.

Table 6. Distributions of Participants' Decision-Making about Medicinal and Aromatic Plants.

Decision	Frequency	Percentage
Information given by the recommendations of parents	197	25.29
Information given by the recommendations of friends and family	155	19.90
Doctor's recommendation	96	12.32
TV Shows	80	10.27
Seller's recommendation	70	8.99
Social media	110	14.12
By tasting	4	0.51
Internet	13	1.67
Books	7	0.90
Company training	1	0.13
Experience	4	0.51
Research	15	1.93
Academic studies	27	3.47

A dependent samples t-test was performed for the use and frequency of medicinal and aromatic plants before and after Covid-19. Accordingly, the difference between the mean figures regarding the use of medicinal and aromatic plants before and after Covid-19 was not significant ($p > 0.05$) except for the frequency of use of medicinal and aromatic plants before and after Covid-19 ($p < 0.05$).

Regarding gender, an independent samples t-test was performed to compare the use and frequency of medicinal and aromatic plants before and after Covid-19. The difference between the use of medicinal and aromatic plants before and after Covid-19 was significant ($p < 0.05$). However, the frequency was not significant ($p > 0.05$).

In terms of age and educational status, one-way analysis of variance (ANOVA) was performed to compare the use and frequency of use regarding medicinal and aromatic plants before and after Covid-19. The difference between the frequency of medicinal and aromatic plant use before Covid-19 was significant (0.018) because of the age groups 15-25 and 46-55, but the frequency of medicinal and aromatic plant use after Covid-19 was not significant ($p > 0.05$). Similarly, for the educational status, the use and frequency of medicinal and aromatic plants before and after Covid-19 did not show any significant difference.

Discussion

Accordingly, most participants thought they could develop their immune system using medicinal and aromatic plants and protect themselves from the virus. Scientific research indicated medicinal and aromatic plants that could prevent/treat many diseases and herbs that could stimulate and even improve the immune system (Devasagayam & Sainis, 2002; Chabib *et al.*, 2018; Anywar *et al.*, 2020). According to Pieroni's paper, the plants used in Eastern Turkey were identified

as *Anchusa* spp., *Allium* spp., *Rosa canina* L., licorice root, *Tilia* spp., *Alcea* spp., *Althaea* spp., mint, oregano, thyme, *Thymbra* spp., *Celtis tournefortii* Lam. and *Salvia multicaulis* Vahl. When the taxa are compared to our research, the taxa *Allium* spp., *Rosa canina* L., *Tilia* spp., *Althaea* spp., *Mentha* spp., *Origanum* spp., *Thymus* spp., *Thymbra* spp., *Salvia* spp. show similarities. *Anchusa* spp., *Glycyrrhiza* spp., *Alcea* spp., *Celtis tournefortii* taxa were not indicated by participants, so they were not mentioned in the manuscript. (Pieroni *et al.*, 2020).

The question "How do you decide which herbs you should use?" was asked to participants and they were allowed to choose more than one option for it. Most participants answered as information given by parents and the recommendations of friends and family. The rate of doctor's advice was only 12.32%. Medicinal and aromatic plants may vary and cause different impacts based on their use at different times. There are medicinal and aromatic plants that may cause toxic effects when used in high amounts (Batanouny, 2005; Bellakhdar, 2006; Zekkour, 2008; Hammiche *et al.*, 2013; Hachi *et al.*, 2015; El Alami *et al.*, 2020). Therefore, they should be used when suggested by a practitioner.

Herbs that were widely used before the emergence of the Covid-19 pandemic are *Tilia* spp., *Salvia* spp., *Thymus* spp., *Mentha* spp., *Zingiber officinale* Roscoe, *Matricaria* spp., *Rosa canina* L., *Curcuma longa* L., *Camellia sinensis* (L.) Kuntze and *Lavandula* spp. Herbs that became widely used after the emergence of the Covid-19 pandemic are *Thymus* spp., *Tilia* spp., *Salvia* spp., *Zingiber officinale* Roscoe, *Mentha* spp., *Curcuma longa* L., *Rosa canina* L., *Camellia sinensis* (L.) Kuntze, *Lavandula* spp. or *Matricaria* spp. There was no evidence indicating that most of these herbs had a direct preventive or protective effect against Covid-19, but these herbs are used against respiratory diseases with symptoms like those of Covid-19 and have numerous benefits thanks to their secondary metabolites (Baytop, 1984; Bammi & Douira, 2002; Bahtiyarca Bagdat, 2006; Hseini & Kahouadji, 2007; El Alami & Chait, 2017; Aslan & Karakus, 2019; Goktas & Gidik, 2019; Ersen Bak & Cifci, 2020).

With their antibiotic traits proven in current scientific studies, some rockrose species (*Cistus* spp.), thyme species (*Origanum*, *Thymus* and *Thymbra*), licorice species (*Glycyrrhiza glabra* L.) and the olive tree (*Olea europea* L.) have the potential of relieving and reducing the number of Covid-19 symptoms and improving the progress of the patient with their characteristics that strengthen the immune system and rich phytochemical contents (Sekeroglu & Gezici, 2020). Studies indicated that *Glycyrrhiza glabra* L., among these species, was not used at all, and rockrose species (*Cistus* spp.) were used solely by two people. Although the leaves of *Olea europea* L. were used by a limited number of people before the pandemic, the use rate increased significantly after it. Among these herbs, only *Thymus* spp. was used at a high rate by the participants.

Another relevant study stresses that *Allium sativum*, *Camellia sinensis*, *Zingiber officinale*, *Echinacea* spp., *Nigella sativa*, *Glycyrrhiza glabra*, *Hypericum perforatum* species have the potential to trigger the immune system and strengthen the natural immune system (Sultan *et al.*, 2014). The results of the present study were compared, and all herbs except *Glycyrrhiza glabra* were used by the participants. *Allium sativum* and *Echinacea* spp. herbs were used at a quite limited rate. *Camellia sinensis* and *Zingiber officinale* were among the herbs used the most by the participants.

Compared to the results in the compilation entitled COVID-19 and Herbal Products by Ekici *et al.* (2021), the similarity between the herbal species used in traditional Chinese medicine (Luo *et al.*, 2020) and the herbal species used in the present study was minor. Compared to the species used the most in traditional Indian Medicine (Ayurveda) (Gyawali *et al.*, 2020; Prajapati *et al.*, 2020) *Ocimum* and *Cinnamomum* genera were similar to the *Zingiber officinale, Curcuma longa* L. species. Compared to the Traditional Indian Medicine (Unani Medicine) (Nikhat & Fazil, 2020), *Rosa*, *Rheum*, *Cydonia*, *Zizyphus* and J*uniperus* genera were similar to *Crocus sativus* L., *Zingiber officinale*, *Aloe vera* L., *Rhus coriaria* L., *Morus nigra* L., *Nigella sativa* L. species. Compared to the Traditional African Medicine (Orisakwe *et al.*, 2020), *Capsicum* and *Artemisia* genera were similar to *Curcuma longa* L., *Zingiber officinale* Roscoe, *Allium sativum* L., *Allium cepa* L. species. Compared to the modern phyto-therapy procedures performed during Covid-19 (Silveira *et al.*, 2020), *Althaea officinalis* L. and *Sambucus nigra* L. species were found to be positive in five cases, *Echinacea* and *Pelargonium* genera found to be promising in 12 cases, and *Allium sativum* L., *Eucalyptus globulus* Labill., *Pimpinella anisum* L., *Zingiber officinale* Roscoe species showed a similar effect. Based on the relationship between Covid-19 and aromatherapy (Yazicioglu & Bingol, 2020), *Cinnamomum* spp. were effective against the influenza virus; *Eucalyptus* spp., *Citrus bergamia* Risso, *Lavandula* spp., *Pelargonium graveolens* L'Hér. et Aiton, *Citrus sinensis* (L.) Osbeck, *Eucalyptus* spp., *Rosmarinus officinalis* L., *Melaleuca* spp., *Salvia* spp., *Nigella sativa* L., and *Citrus sinensis* (L.) Osbeck effective against SARS–CoV virus also showed a similar effect.

Authorship Contribution Statement

S.A.K.: Conceptualization, investigation, methodology, data collection, writing – original draft, writing – review & editing; B.E.: Investigation, methodology, statistical analysis, writing – review & editing; E.U.: Conceptualization, supervision, writing – review & editing.

Conflict of Interest

None.

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Appendix 1. Information regarding the herbs used by the interviewed participants.

Local name	Latin name	Family	Before Covid-19		After Covid-19	
			Usage	Usage rate	Usage	Usage rate
Gilaburu	*Viburnum opulus* L.	Adoxaceae	+	0,31	+	0,72
Soğan	*Allium cepa* L.	Amaryllidaceae	+	0,31	+	0,36
Sumak	*Rhus coriaria* L.	Anacardiaceae	+	2,45	+	3,23
Rezene	*Foeniculum vulgare* Miller	Apiaceae	+	8,59	+	7,53
Kimyon	*Cuminum cyminum* L.	Apiaceae	+	2,76	+	3,94
Maydanoz	*Petroselinum crispum* (Miller) A. W. Hill	Apiaceae	+	1,53	+	2,15
Dereotu	*Anethum graveolens* L.	Apiaceae	+	1,53	+	1,79
Yıldız anason	*Pimpinella anisum* L.	Apiaceae	-	-	+	0,36
Cinseng	*Panax ginseng* C. A. Meyer	Araliaceae	+	0,31	+	0,36
Hindistan cevizi	*Cocos nucifera* L.	Arecaceae	+	0,31	+	0,36
Yedi kardeş kanı	*Dracaena* spp.	Asparagaceae	-	-	+	0,36
Aloe vera	*Aloe vera* (L.) Burm.f.	Asphodelaceae	+	2,15	+	2,15
Papatya	*Matricaria* spp.	Asteraceae	+	14,11	+	11,11
Ekinezya	*Echinacea* spp.	Asteraceae	+	0,92	+	1,08
Civan perçemi	*Achillea millefolium* L.	Asteraceae	+	1,23	+	0,36
Andız	*Inula helenium* L.	Asteraceae	-	-	+	0,72
Aynısefa	*Calendula officinalis* L.	Asteraceae	+	0,61	+	0,72
Kadife çiçeği	*Tagetes erecta*	Asteraceae	+	0,31	+	0,36
Devedikeni	*Silybum marianum* (L.) Gaertner	Asteraceae	-	-	+	0,36
Altın otu	*Ceterach officinarum* DC.	Asteraceae	+	1,53	+	0,36
Tarhun	*Artemisia dracunculus* L.	Asteraceae	+	0,31	+	0,36
Tere	*Lepidium sativum* L.	Brassicaceae	+	0,61	+	0,72
Turp	*Raphanus* spp.	Brassicaceae	-	-	+	0,36
Hardal otu	*Brassica* spp.	Brassicaceae	+	0,31	-	-
Günlük otu	*Boswellia* spp.	Burseraceae	+	0,31	+	0,36
Kapari	*Capparis ovata* Desf.	Capparaceae	+	0,31	-	-
Kara mürver	*Sambucus nigra* L.	Caprifoliaceae	+	0,31	+	1,08
Çöven otu	*Gypsophila* spp.	Caryophyllaceae	-	-	+	0,36
Laden	*Cistus* spp.	Cistaceae	+	0,61	+	0,72
Mangostan	*Garcinia* spp.	Clusiaceae	+	0,31	+	0,36
Kızılcık	*Cornus mas* L.	Cornaceae	-	-	+	0,36
Kudret narı	*Momordica charantia* L.	Cucurbitaceae	+	0,31	-	-
Ardıç	*Juniperus* spp.	Cupressaceae	+	0,31	+	0,36
Keçiboynuzu	*Ceratonia siliqua* L.	Fabaceae	+	0,92	+	0,72
Itır	*Pelargonium graveolens* L'Hér. Et Aiton	Geraniaceae	-	-	+	0,36
Tükürük otu	*Ornithogalum umbellatum* L.	Hyacinthaceae	+	0,31	-	-
Kantaron	*Hypericum perforatum* L.	Hypericaceae	+	7,67	+	6,09
Safran	*Crocus sativus* L.	Iridaceae	+	0,61	+	0,36
Adaçayı	*Salvia* spp.	Lamiaceae	+	39,57	+	32,97
Kekik	*Thymus* spp.	Lamiaceae	+	38,34	+	45,52
Nane	*Mentha* spp.	Lamiaceae	+	28,53	+	24,01
Lavanta	*Lavandula* spp.	Lamiaceae	+	11,35	+	11,11
Biberiye	*Rosmarinus officinalis* L.	Lamiaceae	+	10,12	+	5,73
Melisa	*Melissa officinalis* L.	Lamiaceae	+	5,52	+	3,23
Fesleğen	*Ocimum* spp.	Lamiaceae	+	2,76	+	1,79
Dağ çayı	*Sideritis* spp.	Lamiaceae	+	1,53	+	1,79
Zahter	*Thymbra spicata* L.	Lamiaceae	-	-	+	0,36
Karabaş otu	*Lavandula* spp.	Lamiaceae	-	-	+	0,36

Local name	Latin name	Family	Before Covid-19 Usage	Before Covid-19 Usage rate	After Covid-19 Usage	After Covid-19 Usage rate
Deliçay	*Stachys* spp.	Lamiaceae	-	-	+	0,36
Zufa otu	*Hyssopus* spp.	Lamiaceae	+	0,31	-	-
Şalba	*Philomis* spp.	Lamiaceae	+	0,31	-	-
Keklik otu	*Origanum* spp.	Lamiaceae	+	0,31	-	-
Tarçın	*Cinnamomum* spp.	Lauraceae	+	7,67	+	7,17
Defne	*Laurus nobilis* L.	Lauraceae	+	5,21	+	3,23
Sarımsak	*Allium sativum* L.	Liliaceae	+	1,53	+	1,79
Keten tohumu	*Linum usitatissimum* L.	Linaceae	+	0,31	+	0,72
Gül hatmi	*Althaea officinalis* L.	Malvaceae	+	1,84	+	2,51
Hibisküs	*Hibiscus sabdariffa* L.	Malvaceae	+	1,53	+	1,43
Ebegümeci	*Malva sylvestris* L.	Malvaceae	+	0,31	+	0,36
Arap zamkı	*Acacia* spp.	Mimosaceae	+	0,31	+	0,36
Karadut	*Morus nigra* L.	Moraceae	+	0,31	-	-
Muskat	*Myristica fragrans* Houtten	Myristicaceae	+	0,31	-	-
Karanfil	*Eugenia caryophyllata* Thunb.	Myrtaceae	+	2,45	+	3,94
Okaliptüs	*Eucalyptus* spp.	Myrtaceae	+	1,53	+	3,23
Çay ağacı	*Melaleuca* spp.	Myrtaceae	+	1,84	+	2,51
Zeytin	*Olea europaea* L.	Oleaceae	+	1,23	+	6,45
Yasemin	*Jasminum officinale* L.	Oleaceae	+	1,23	+	0,36
Salep	*Orchis* spp.	Orchidaceae	+	0,61	+	0,36
Vanilya	*Vanilla planifolia* Andrews	Orchidaceae	+	0,31	-	-
Haşhaş	*Papaver somniferum* L.	Papaveraceae	+	0,61	+	0,36
Çarkıfelek	*Passiflora incarnata* L.	Passifloraceae	-	-	+	0,36
Susam	*Sesamum indicum* L.	Pedaliaceae	+	0,61	+	1,08
Çam	*Pinus* spp.	Pineaceae	+	0,31	+	1,08
Karabiber	*Piper nigrum* L.	Piperaceae	+	1,84	+	1,79
Darülfülfül	*Piper longum* L.	Piperaceae	+	0,31	-	-
Sinir otu	*Plantago* spp.	Plantaginaceae	+	0,61	+	0,36
Beyaz yulaf	*Avena sativa* L.	Poaceae	+	0,31	+	0,36
Mısır	*Zea mays* L.	Poaceae	+	0,92	+	0,72
Ayrık otu	*Elymus repens* (L.) Gould	Poaceae	+	0,61	-	-
Kuzukulağı	*Rumex acetosella* L.	Polygonaceae	+	0,31	+	0,36
Işkın	*Rheum ribes* L.	Polygonaceae	+	0,31	-	-
Semiz otu	*Portulaca oleracea* L.	Portulacaceae	+	0,31	-	-
Nar	*Punica granatum* L.	Punicaceae	+	0,92	+	1,08
Çörek otu	*Nigella sativa* L.	Ranunculaceae	+	4,91	+	6,81
Hünnap	*Zizyphus jujuba* (L.) H. Karst.	Rhamnaceae	+	0,31	-	-
Kuşburnu	*Rosa canina* L.	Rosaceae	+	13,80	+	13,98
Kiraz	*Cerasus avium* (L.) Moench	Rosaceae	+	2,15	+	1,43
Gül	*Rosa* spp.	Rosaceae	+	1,53	+	1,43
Alıç	*Crataegus monogyna* Jacq.	Rosaceae	+	0,61	+	0,72
Mahlep	*Prunus mahaleb* L.	Rosaceae	+	0,31	+	0,36
Kayısı	*Prunus* spp.	Rosaceae	+	0,31	+	0,36
Geyik elması	*Malus trilobata* C.K. Schneid.	Rosaceae	+	0,31	+	0,72
Elma	*Malus* spp.	Rosaceae	+	0,31	-	-
Ahlat	*Pyrus* spp.	Rosaceae	+	0,31	+	0,36
Ayva	*Cydonia oblonga* Miller	Rosaceae	+	0,31	+	0,36
Aslanpençesi	*Alchemilla arvensis* (L.) Scop.	Rosaceae	+	0,31	-	-
Limon	*Citrus limon* (L.) Burm. fil.	Rutaceae	+	2,45	+	3,23

Local name	Latin name	Family	Before Covid-19		After Covid-19	
			Usage	Usage rate	Usage	Usage rate
Portakal	*Citrus sinensis* (L.) Osbeck	Rutaceae	+	0,92	+	0,36
Bergoman otu	*Citrus bergamia* Risso	Rutaceae	+	0,31	-	-
Sandal ağacı	*Arbutus* spp.	Santalaceae	-	-	+	0,36
Atkestanesi	*Aesculus hippocastanum* L.	Sapindaceae	-	-	+	0,72
Argan	*Argania spinosa* (L.) Skeels	Sapotaceae	-	-	+	0,36
Sığırkuyruğu	*Verbascum* spp.	Scrophulariaceae	+	0,31	-	-
Kırmızıbiber	*Capsicum annum* L.	Solanaceae	+	2,45	+	3,23
Yeşil çay	*Camellia sinensis* (L.) Kuntze	Theaceae	+	12,27	+	11,47
Udi hindi	*Aquilaria malaccensis* Lam.	Thymelaeaceae	+	0,61	+	0,72
Ihlamur	*Tilia* spp.	Tiliaceae	+	51,53	+	43,37
Isırgan	*Urtica* spp.	Urticaceae	+	3,99	+	2,15
Hayıt	*Vitex agnus-cactus* L.	Verbenaceae	+	0,31	-	-
Kırmızı üzüm	*Vitis* spp.	Vitaceae	-	-	+	0,36
Zencefil	*Zingiber officinale* Roscoe	Zingiberaceae	+	19,94	+	26,88
Zerdeçal	*Curcuma longa* L.	Zingiberaceae	+	12,88	+	15,05
Kakule	*Eletteria cardamomum* (Roxb.) Maton var. *minus*	Zingiberaceae	+	0,31	+	0,36

Appendix 2. Translated version of the information requested to participants.

1.Gender:
a) Female b) Male
2. Age:
a) 15-20   b) 21-30   c) 31-40   d) 41-50   e) 51-60
f) 61-70   g) 71-80   h) 81+
3.Marital status:
a) Single b) Married
4.Education:
a) Primary school b) High School c) Vocational school
d) Bachelor degree e) Postgraduate/Master degree
5. Were You Using Medicinal and Aromatic Plants Before Covid-19 pandemic?
a) Yes b) No
6. If yes, which plant species did you use before the pandemic?
……………………………………………………
……………………………………………………
7. How often did you use it before the pandemic?
a) 1 glass per day b) 2-3 glass per day c) 4-5 glass per day d) 6+ glass per day e) 1 glass every 2-3 days f) 1 glass per week g) 1 glass per month h) Other………..
If you want to give the frequency of use of plants separately for each plant, please write;
Plant   Frequency of use
…………   ………………..
8. How would you prefer to use the plants before the pandemic?
a) Infusion   b) Decoction c) Honey d) Oil e) Powder f) Raw g) Incense h) Paste i) Crushing j) Ointment k) Pill l) Syrup m) Clench n) Puree o) Sucking p) Mush r) Drying s) Other……….
9. What parts of plants were you using before the pandemic?
a) Leaf   b) Flower   c) Root   d) Stem   e) Fruit   f) Seed   g) Leafy and flowering branches h) Bark   i) Above ground parts   j) Resin   k) Bulb   l) Latex   m) Rhizome n) Other……….
10. Do you use medicinal and aromatic plants after the Covid 19 pandemic?
a) Yes   b) No

11. If yes, which plant species do you use?
……………………………………………………
……………………………………………………
12. How often do you use it after the pandemic?
a) 1 glass per day b) 2-3 glass per day c) 4-5 glass per day d) 6+ glass per day e) 1 glass every 2-3 days   f) 1 glass per week g) 1 glass per month h) Other………..
If you want to give the frequency of use of plants separately for each plant, please write;
Plant   Frequency of use
…………   ………………..
13. How do you prefer to use the plants after the pandemic?
a) Infusion   b) Decoction c) Honey d) Oil e) Powder f) Raw g) Incense h) Paste i) Crushing j) Ointment k) Pill l) Syrup m) Clench n) Puree o) Sucking p) Mush r) Drying s) Other……….
14. What parts of plants do you using after the pandemic?
a) Leaf   b) Flower   c) Root   d) Stem   e) Fruit   f) Seed   g) Leafy and flowering branches h) Bark   i) Above ground parts   j) Resin   k) Bulb   l) Latex   m) Rhizome   n) Other……….
15. Do you believe that the medicinal and aromatic plants you use will improve your immunity and protect you from the virus?
a) Yes b) No c) Not sure
16. Do you think that the Corona virus has changed your medicinal and aromatic plant usage habits?
a) Yes   b) No   c) Not sure
17. Where do you procure the medicinal and aromatic plants you use?
a) I collect myself b) Herbalist   c)Supermarket   d) Public market e)Internet f) Pharmacy g) Other…….
18. Did you receive education about medicinal and aromatic plants?
a) Yes   b) No
19. How do you decide which herbs you should use?
a) Information given by the recommendations of parents   b) Information given by the recommendations of friends and family   c) Doctor's recommendation   d) TV shows   e) Seller's recommendation   f) Social media   g) Other…….