

# Traditional Medicines Used as Adjuvant Therapy for COVID-19 Symptoms in Syria: An Ethno-medicine Survey

Chadi Khatib (✉ [chadi.khatib@gmail.com](mailto:chadi.khatib@gmail.com))

Damascus University <https://orcid.org/0000-0002-4061-1506>

Abdulhakim Nattouf

Damascus University

Mohamad Isam Hasan Agha

Damascus University

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## Research

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# Abstract

**Context:** The use of traditional Arabic medicine (TAM) has spread to treat various diseases in Syria since ancient time. They are cost-effective with fewer side effects and are more suitable for long-term use compared with chemically synthesized medicines.

**Objective:** We conducted ethnobotanical and ethno-medicine research on plants traditionally used as adjuvant therapy for COVID-19 symptoms in Syria.

**Methods:** Information was collected in the period of (September 1st, 2020 to December 21st, 2020), from Southern Region (Damascus, As Suwayda, Dar'a), Northern region (especially Aleppo), Central region (Himis, Hamah), Western coastal region (Latakia, Tartus) Eastern Region (Dayr az Zawr, Al Hasakah) in Syria. 150 informants were divided into two groups one of them is pharmacists who interested in herbal remedies 73.34% (63.64% female and 36.36% male of them), and the other is herbalists 26.66% who are called "*attarin*" traditional healers and bee therapists. Medicinal plants being mentioned by the Informants were recorded with local names and photographed. Each reported medicinal plant species was gathered, compressed, dehydrated, and identified.

**Results:** In this research we listed a total of 26 medicinal species relating to 15 botanical families were generally utilized by pharmacists and herbalists in the prevention and treatment of COVID 19. The calculated results of medicinal use-value MUV showed that *Pimpinella anisum* L. was ranked first (MUV=0.933) followed by *Zingiber officinale* Roscoe. (MUV=0.920), then *Thymus syriacus* Boiss. (MUV=0.9).

**Conclusion:** There may be some effective Syrian traditional herbal remedies in preventing and treating COVID-19 symptoms for some people, but the lack of information on the mechanism of effect, the appropriate dosage, side effects, toxicity and drug interactions makes them questionable, as they need more research and study.

## 1. Introduction

The World Health Organization affirms that the use of traditional medicines (TM) has a long history in maintaining health and preventing and treating diseases, especially chronic diseases. The use of Complementary & Alternative Medicine / Traditional Medicine (CAM / TM) is an inspiration for modern pharmaceutical research. And a source of effective treatments for many diseases [1], as the organization estimates that a large proportion of the world's population depends mainly on traditional medicinal treatments for their health care, and plants have formed the basis of folk traditional medicine systems, including Ayurveda. Medicine, Greco-Arabic Medicine, Chinese Medicine and others. These systems of medicine have led to the emergence of some important medicines of natural origin that are still used today [2], as these medicines of natural origin offer an infinite variety of compounds. In chemical terms, these are often basic compounds whose structure can be utilized and the development of new compounds can be utilized by structure-to-effect relationship [3, 4]. Many common natural ingredients have been used in traditional methods of treating ailments [5].

Coronavirus (CoVs), a class of single-stranded RNA viruses, can affect both animals and humans, causing respiratory, gastrointestinal, hepatic, and neurologic diseases [6]. The first case of the novel coronavirus was reported on December 30, 2019, in the city of Wuhan, Hubei province, P.R. China [7, 8].

This causative virus was temporarily named as severe acute respiratory syndrome coronavirus 2 and the resulting disease was named coronavirus disease 2019 (COVID-19) by the World Health Organization [9]. On March 11th, the WHO formally announced that COVID-19 was a pandemic [10]. COVID-19 was confirmed to have reached Syria on March 22th 2020. according to Syrian Health Ministry (<http://www.moh.gov.sy/>).

People with COVID-19 have had a wide range of symptoms reported – ranging from mild symptoms to severe illness. symptoms may appear 2–14 days after exposure to the virus. people with these symptoms may have COVID-19: fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, diarrhea [11]. Considering that viruses have become a major cause of death in

many life-threatening diseases [12], and because viruses are RNA or DNA surrounded by a nuclear envelope, these viruses have the ability to harness the molecular components of host cells to complete their cycle of replication and replication, which is They contain few targets that antiviral agents [13] can act upon, and despite the tremendous advances in chemical anti-viral drugs, there are many problems that can be encountered when using chemical treatments, including safety and efficacy limitations, as well. On the high costs [14, 15], it is why people have used diverse medicinal plants as alternatives which originated from ancient popular medicine. Medicinal plants continue to be used in cities and rural communities in Syria as part of healthcare, because of their low cost and the easy access to plant products in all markets across the country.

Syria is one of the nations of the Mediterranean area with diverse climatic conditions that are favorable for the development of rich and varied vegetation, and is rich in plant species. Moreover, Syrians have excellent medical knowledge and traditional experience of basic medicinal plants.

## 2. Methods

### 2.1. Study area

Syria is located on the east coast of the Mediterranean sea in southwestern Asia (Fig. 1).

### 2.2. Epidemiological situation of Syria

The study was conducted (September 1st, 2020 to December 21st, 2020), the Ministry of Health in Syria had reported that 16401 confirmed COVID-19 total cases had been reported nationally, and 10,885 recovered cases, while 1094 deaths, till 13th march 2021, according to Syrian Health Ministry (<http://www.moh.gov.sy/>).

### 2.3. Methodology

#### 2.3.1. Ethnopharmacological data collection

A semi structured questionnaire was prepared in order to document indigenous anti-coronavirus plant use, traditional knowledge and the level of utilization of traditional medicinal plants for prevention and treatment of COVID-19. 150 informants were divided into two group one of them is pharmacists who interested in herbal remedies 73.34% (63.64% female and 36.36% male of them), and the other is herbalists 26.66% who are called "*attarin*" traditional healers and bee therapists. 40% of the surveyed informants were from Southern Region (Damascus, As Suwayda, Dar'a), 20% were from Northern region (especially Aleppo), 15% were from Central region (Himis, Hamah), 15% were from Western coastal region (Latakia, Tartus) and 10% were from Eastern Region (Dayr az Zawr, Al Hasakah). A questionnaire was administered to the informants through face-to-face interviews over the period of September 1st, 2020 to December 21st, 2020, ranging from 15 to 30 min.

The inclusion criteria was that the pharmacists had interested in herbal remedies, and the herbalist had to be famous in his area. Herbalists were excluded if their experience less than 3 years. Information that had been carried to the region from the outside and that was not used or confirmed were not included and recorded

The information gathered during the present study included socio-demographic characteristics of the interviewed informants (age, gender, academic level, and experience in herbalism) and ethnopharmacological information, including the local and scientific name of the species, local names, plant parts used, modes of use, conservation method, administration mode and toxicity, all documented data were then translated into English and Latin (Appendix A).

#### 2.3.2. Taxonomic identification of the species

Medicinal plants being mentioned by the Informants were recorded with local names and photographed. Each reported medicinal plant species was gathered, compressed, dehydrated, and identified, the taxonomic identity of the plants was confirmed by Prof. Abdel Aleem Bello (PhD / Botanical Taxonomy) and Dr. Bayan Tiba (PhD / Botanical Taxonomy) Aleppo university, As far as possible, the name of the plants was updated by consulting the latest literature; generic and species names followed the plant list (<http://www.theplantlist.org>). All voucher specimens have been preserved during documentation and deposited in the Damascus University, faculty of pharmacy, pharmacognosy labs Herbarium for future reference.

#### 2.3.3. Ethics approval and consent to participate

The study was approved by the Ethics Committee of the University of Damascus. Before beginning data collection, we obtained verbal informed permission in each case site-wide and then individually before each interview. We also informed pharmacists and herbalists that it was an academic project and that the investigation was for research purposes only, and not for any financial or other benefits. Informants provided verbal informed consent to participate in this study; They were free to withdraw their information at any time. These informants freely accepted the interview.

#### 2.3.4. Consent for publication

The study has a consent for publication by the faculty of pharmacy - University of Damascus on 1/3/2021 .

#### 2.3.5. Data analysis

The data collected through interviews of the informants (herbalists and pharmacists) were classified and examined with the statistical program IBM® SPSS® Statistics 26, to determine the proportions of different variables such as ethnopharmacological data. Quantitative value indices were analyzed using different statistical quantitative tools i.e. the use reports (UR) of a species, and medicinal use value (MUV). [17]

#### Medicinal use-value (MUV) and use reports (UR)

The use reports (UR) of a species or its importance in the culture of a community is denoted by its mentioning rate or its mention frequency by informants. The UR of the species of plants being utilized was evaluated using the formula [18]:

$$UR = N_i/n$$

$N_i$ : the number of times a particular species was mentioned

$n$ : the total number of times that all species were mentioned

The MUV of recorded medicinal plants was determined by applying the following formula [19]:

$$MUV = \sum UR_i/N$$

$\sum UR_i$ : the total number of use reports per plants

$N$ : the total of interviewees questioned for given medicinal species

The MUV rate will be more important if there are several useful records for a species, implying that the plant is significant, whereas they will be near 0 if there are few reports compared to its use [17, 20].

## 3. Results

### 3.1. Demography data of informants

In total, 150 informants were divided into two groups one of them is pharmacists who interested in herbal remedies 73.34% (63.64% female and 36.36% male of them), and the other is herbalists 26.66% who are called "*attarin*" traditional healers and bee therapists. All of them were interrogated using semi-structured questionnaires. 40% of the surveyed informants were from Southern Region (Damascus, As Suwayda, Dar'a), 20% were from Northern region (especially Aleppo), 15% were from Central region (Himis, Hamah), 15% were from Western coastal region (Latakia, Tartus) and 10% were from Eastern Region (Dayr az Zawr, Al Hasakah). (Table 1). In Syria, both genders were interested in herbal medicines. So that, the ratio is close to each other, male 53.33%, female 46.66% (bearing in mind that only females are pharmacists and there are no female as traditional non-specialist herbalists).

In this study, results showed that the majority of informants interviewed were between 30 and 50 years old (95), while 33 of the informants were younger than thirty years old. and 22 of the informants were over 50 years old. Regarding the academic level, our results showed that (40%) of the herbalists from informants had secondary education, 37.5% had primary education, and 22.5% of the herbalists had graduate education, and no one was illiterate.

Table 1  
Demographic characteristics of the informants (n = 150).

Variables	Categories	Number of informants	%
Gender	Male	80	53.33
	Female	70	46.66
Age	Less 30 years	33	22
	Between 30–50	95	63.34
	Above 50 years	22	14.66
Academic level	Illiterate	0	0
	Primary	09	6
	Secondary	16	10.6
	University	15	10
	Pharmacists	110	73.4
Years of experience	Between 03–10 years	40	26.6
	Between 10–20 years	60	40
	Over 20 years	50	33.4

### 3.2. Botanical families of plants used

The present research showed that a total of 26 plant species belonging to 15 families were frequently used by pharmacists and herbalists from Syria in the prevention and treatment of COVID-19 symptoms. The family Lamiaceae was represented by the largest number of plant species (six species, 23.07%), whereas each of Apiaceae, Myrtaceae (two species, 11.53%), Asteraceae, and Zingiberaceae contributed with two species to each family. The remaining ten botanical families were represented by one species in each. The vernacular names, scientific names of documented species, their families, mode of preparations, used parts, MUV, were illustrated in Table 2.

Table 2  
List of plant species used to treat the symptoms of COVID-19 in the Syria.

Family	Scientific name	Common name	Part used	Mode of preparation	Bioactive compounds	Biological activities	MUV
Anacardiaceae	<i>Rhus aromatica</i> Aiton	Sumach: سومخ	Fruits	Decoction	Volatile Oil, Phenol Glycosides, Steroids, Tannins, Triterpenes [21]	Antiviral, Antimicrobial [22, 23]	0.333
Apiaceae	<i>Pimpinella anisum</i> L.	Yansoon: يانسون	Seeds	Infusion	Volatile Oil, Caffeic Acid Derivatives, Flavonoids, Fatty Oil, Proteic Substances [21]	Anti-Inflammatory, Antioxidant, Antiviral, Antibacterial, Anticancer [24, 25, 26]	0.933
	<i>Foeniculum vulgare</i> Mill.	Shamra: شمر	Seeds	Infusion	Volatile Oil, Hydroxycoumarins, Pyranocoumarins, Flavonoids, Fatty Oil [21]	Antioxidant, Anti-Inflammatory, Antiviral, Anticancer [27, 28, 29, 30]	0.233
	<i>Coriandrum sativum</i> L.	Kozbara: كوزبارا	Fruits, Seeds	Infusion	Volatile Oil, Fatty Oil, Hydroxycoumarins [21]	Antimicrobial, Antiviral, Antioxidant [31, 32, 33]	0.133
Aquifoliaceae	<i>Ilex paraguariensis</i> A.St.-Hil.	Mate: ماتي	Leaves	Decoction	Volatile Oil, Purine Alkaloids, Caffeic Acid Derivatives, Flavonoids, Triterpene Saponins, Nitrite Glycosides [21]	Antimicrobial, Antiviral, Antioxidant, Anticancer [34, 35, 36, 37]	0.266
Araliaceae	<i>Panax ginseng</i> C.A.Mey.	Ginseng: جنسنگ	Roots	Powder, Decoction	Triterpene Saponins, Polysaccharides, Polyynes [21]	Antimicrobial, Antiviral, Antioxidant, It Has Expected Potential Against COVID-19, Anti SARS-Cov-2 Infection [38, 39, 40, 41]	0.8
Asteraceae	<i>Artemisia herba-alba</i> Asso	Chih: شيه	Leaf	Decoction	Volatile Oil, Sesquiterpene Lactones, Lipophilic Flavonoids, Polyynes, Hydroxycoumarins [21]	It Has Expected Potential Against COVID-19, Anti SARS-Cov-2 Infection, Antimalarial, Antioxidant, Antibacterial, [42, 43, 44, 45, 46]	0.733

Family	Scientific name	Common name	Part used	Mode of preparation	Bioactive compounds	Biological activities	MUV
	<i>Matricaria chamomilla</i> L.	Babounj: ⦿⦿⦿⦿⦿⦿	Flowers	Infusion	Volatile Oil, Flavonoids, Unbound Highly Methoxylized Flavonoids, Hydroxycoumarins, Mucilages [21]	Antiviral, Antimicrobial, Anticancer, Antioxidant [47, 48, 49, 50]	0.7
Fabaceae	<i>Glycyrrhiza glabra</i> L.	Arq Sous: ⦿⦿⦿⦿	Rhizome	Decoction	Volatile Oil, Triterpene Saponins, Flavonoids, Isoflavonoids, Cumestan Derivatives, Hydroxycoumarins, Steroids [21]	Anti-Inflammatory, Antimicrobial, Antioxidant, Antiviral, [51, 52, 53]	0.266
Lamiaceae	<i>Melissa officinalis</i> L.	Malissa:⦿ ⦿⦿⦿	Leaves, Flowers	Infusion	Volatile Oil, Phenol Glycosides, Caffeic Acid Derivatives, Flavonoids, Triterpene Acids [21]	Antiviral, Antimicrobial, Antioxidant [54, 55, 56, 57]	0.333
	<i>Mentha pulegium</i> L.	Nana:⦿⦿⦿ ⦿	Leaves	Infusion	Volatile Oil, Tannins, Flavonoids [21]	Antiviral, Antimicrobial, Antioxidant [58, 59, 60]	0.533
	<i>Micromeria myrtifolia</i> Boiss. & Hohen	Zofa:⦿⦿⦿	Aerial Parts	Infusion	Volatile Oil, Tannins, Bitter Principles, Flavonoids [21]	Antiviral, Antimicrobial, Antioxidant, Anti-Inflammatory [61, 62, 63]	0.6
	<i>Origanum syriacum</i> L.	Zaoba:⦿⦿ ⦿	Aerial Parts	Infusion	Volatile Oil, Flavonoids, Caffeic Acid Derivatives [21]	Antiviral, Antimicrobial, Antioxidant [64, 65, 66, 67]	0.4
	<i>Rosmarinus officinalis</i> L.	Ikli eljabal:⦿⦿ ⦿⦿⦿⦿ ⦿⦿	Leaf	Infusion	Volatile Oil, Caffeic Acid Derivatives, Diterpenes (Bitter), Flavonoids, Triterpenes [21]	Antiviral, Antimicrobial, Antioxidant, [68, 69, 70]	0.466
	<i>Thymus syriacus</i> Boiss.	Zaatar: ⦿⦿⦿⦿	Aerial Parts	Infusion	Volatile Oil, Flavonoids, Caffeic Acid Derivatives [21]	Antimicrobial, Antioxidant, Antimicrobial [71, 72, 73]	0.9

Family	Scientific name	Common name	Part used	Mode of preparation	Bioactive compounds	Biological activities	MUV
Lauraceae	<i>Cinnamomum cassia</i> (L.) J.Presl	Qarfa: قرفة	Bark	Powder	Volatile Oil, Diterpenes, Tannins, Oligomere Proanthocyanidins, Mucilages [21]	It Has Expected Potential Against COVID-19, Anti SARS-Cov-2 Infection, Antimicrobial, Antioxidant  [74, 75, 76, 77]	0.2
Myrtaceae	<i>Eucalyptus globulus</i> Labill.	Kena el-sham: كينا الشام	Leaves	Infusion For Inhalation	Volatile Oil, Flavonoids [21]	It Has Expected Potential Against COVID-19, Anti SARS-Cov-2 Infection, Antimicrobial, Antioxidant  [78, 79, 80, 81]	0.4
	<i>Myrtus communis</i> L.	Aas: آس	Fruits, Leaves	Infusion	Volatile Oil, Tannins, Acylphloroglucinols [21]	It Has Expected Potential Against COVID-19, Anti SARS-Cov-2 Infection, Antimicrobial, Antioxidant  [82, 83, 84, 85]	0.266
	<i>Eugenia caryophyllata</i> Thunb.	Qronfel: قرونفل	Aromatic Flower Buds	Maceration	Volatile Oil, Flavonoids, Tannins, Triterpenes, Steroids [21]	Anti-Inflammatory, Antimicrobial, Antioxidant  [86, 87, 88]	0.366
Oleaceae	<i>Olea europaea</i> L.	Zitoun: زيتون	Leaf, Fruits	Decoction, Oil	Flavonoids, Flavone Glycosides, Flavanones, Iridoids, Triterpenes, Biophenols [21]	Antioxidant, Antiviral, Antimicrobial  [89, 90, 91]	0.166
Ranunculaceae	<i>Nigella sativa</i> L.	Hbet elbarka: حبت البركا	Seed	Powder, Oil	Nigellidine, Nigellicine, Carvacrol, Thymol, A- Hederin [92]	Anti-Inflammatory, Antiviral, Antimicrobial  [93, 94, 95]	0.66



Family	Scientific name	Common name	Part used	Mode of preparation	Bioactive compounds	Biological activities	MUV
Rosaceae	<i>Rosa xdamascena</i> Mill.	Ward Shami: ⬜⬜⬜⬜ ⬜⬜⬜⬜	Petals	Infusion, Syrup	Volatile Oil, Flavonol Glycosides [96, 97]	Anti-Inflammatory, Antioxidant, Antimicrobial  [98, 99, 100, 101]	0.533
Rutaceae	<i>Citrus limon</i> (L.) Osbeck	Limon: ⬜⬜⬜⬜	Fruit	Maceration	Volatile Oil, Flavonoids, Vitamin C [21]	Anti-Inflammatory, Antioxidant, Antimicrobial  [102, 103, 104]	0.633
Solanaceae	<i>Capsicum annuum</i> L.	Flaefleh hamra: ⬜⬜⬜⬜⬜⬜ ⬜⬜⬜⬜	Fruit	Powder	Volatile Oil, Capsaicinoids, Carotinoids, Flavonoids, Steroid Saponins [21]	Anti-Inflammatory, Antioxidant, Antimicrobial  [105, 106, 107]	0.2
Zingiberaceae	<i>Curcuma longa</i> L.	Curcum: ⬜⬜⬜⬜	Rhizome	Powder	Volatile Oil, Curcuminoids, 1,5-Diaryl-Penta-1,4-Dien-3-One Derivatives [21]	Anti-Inflammatory, Antioxidant, Antimicrobial  [108, 109, 110, 111]	0.4
	<i>Zingiber officinale</i> Roscoe	Zangabel: ⬜⬜⬜⬜⬜⬜⬜⬜	Rhizome, Root	Powder, Fresh	Volatile Oil, Sesquiterpene Bitter Principles [21]	Anti-Inflammatory, Antioxidant, Antimicrobial, Antiviral  [112, 113, 114, 115, 116]	0.92

### 3.3. Medicinal use plants (MUV)

Medicinal use plants (MUV) are utilized to find the most frequently used plant species in the study area. Its value ranged from 0.133 to 0.933 (Table 2). The calculated results of MUV showed that *Pimpinella anisum* L. was ranked first (MUV = 0.933) followed by *Zingiber officinale* Roscoe. (MUV = 0.920), *Thymus syriacus* Boiss. (MUV = 0.9), then *Panax ginseng* C.A.Mey. (MUV = 0.8), *Artemisia herba-alba* Asso (MUV = 0.733), *Matricaria chamomilla* L. (MUV = 0.7), *Nigella sativa* L. (MUV = 0.66), *Citrus limon* (L.) Osbeck (MUV = 0.633), *Micromeria myrtifolia* Boiss. & Hohen (MUV = 0.6), *Mentha pulegium* L. and *Rosa xdamascena* Mill. (MUV = 0.533), *Rosmarinus officinalis* L. (MUV = 0.466), *Origanum syriacum* L. and *Eucalyptus globulus* Labill. and *Curcuma longa* L. (MUV = 0.4), *Eugenia caryophyllata* Thunb. (MUV = 0.4), *Melissa officinalis* L. and *Rhus aromatica* Aiton (MUV = 0.4), *Ilex paraguariensis* A.St.-Hil. and *Glycyrrhiza glabra* L. and *Myrtus communis* L. (MUV = 0.266), *Cinnamomum cassia* (L.) J.Presl and *Capsicum annuum* L. (MUV = 0.2), *Olea europaea* L. (MUV = 0.166), while the lowest value was found for *Coriandrum sativum* L. (MUV = 0.133).

### 3.4. Parts of the plant used

In our study area, different plant parts harvest for the preparation of herbal remedies (e.g., aerial parts, seed, rhizome, flower, and leaf). The interview results revealed that leaves were the most frequently used part of the medicinal plants 25.8% of the total,

followed by the fruit (19.35%), rhizome (16.12%), each of seed and flower (12.9%), aerial parts (9.6%), and bark (3.22%) (Table 2).

### 3.5. Modes and conditions of medicine preparation

In Syria, the most of the herbal recipes (81.3%) were made from fresh material followed by their dried form (18.7%). The recipes in the most cases were obtained from single herb, but some of recipes were prepared together, and there is a famous local mixture called Damask tisane (*zhourate Shamieh*) or (Syrian *zahraa*) [117]. The major solvent was water (59%), honey (22%), seeds oil (22%) and vinegar (2%). Herbalists and pharmacists advise various methods of preparation for COVID-19 symptoms. A mode of traditional medicine preparation reported was infusion (41.19%), followed by decoction and powder (19.35%), then maceration and oil (6.45%). (Table 2).

### 3.6. Symptoms, and treatment of COVID-19

The pharmacists explained that most of the complaints from people not diagnosed with an actual infection with Covid-19 were asking to obtain vitamin C, effervescent tablets and capsules of the mineral zinc as a dietary supplement, vitamin D in addition to propolis solution and sugar lozenges of propolis and menthol, in addition to some of the herbs mentioned in (Table 2), in order to improve their immunity. While many patients prefer to use herbs only to improve common COVID-19 symptoms which include fever, tiredness, sore throat, loss of taste and smell, headache, and dry cough.

While herbalists (40) confirmed that most of their visitors relied on natural healing, and they requested the herbs mentioned in (Table 2), in addition to different types of honey and propolis. Symptoms, they said, were improved within a week of using the herbs. In any case, this information is considered insufficient, and it needs study and clinical evaluation, but it is used by many who had symptoms similar to those of Covid-19 but did not confirm infection with labs analysis, and they relied on self-medication. Both of pharmacists and herbalists reported that the herbal remedies shortened the duration of fever and common cold by a few days and symptoms of fatigue.

## 4. Discussion

Many countries have inherited traditional customs for their peoples in the field of treatment and hospitalization from diseases and pain, and these norms have their roots in the depths of the culture and history of these peoples. Some of these customs or therapeutic forms are in the field of traditional medicine [1].

Traditional medicine (TM), as defined by the World Health Organization (WHO), is the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement, or treatment of physical and mental illness. Some traditional medicine systems are supported by huge volumes of literature and records of the theoretical concepts and practical skills; others pass down from generation to generation through verbal teaching. To date, in some parts of the world, the majority of the population continue to rely on their own traditional medicine to meet their primary health care needs. When adopted outside of its traditional culture, traditional medicine is often referred as "complementary and alternative medicine (CAM)" [118].

Where the first records of traditional medicine, such as cedar oils, cypress, licorice, dates and poppy oils, date back to 2600 BC and are still used today, and 80% of the world's population depends on traditional medicine based on Plants, as compounds derived from plant species form the basis of 50% of modern medicinal prescriptions. Therefore, the knowledge and traditions of indigenous and local communities must be preserved [119].

Herbal products are a source of interest for scientists to research the development of new drugs for many diseases. COVID-19, caused by the novel coronavirus (SARS-CoV-2), is a deadly infectious disease that has claimed many lives so far. Medicinal plants are the first choice for traditional healers in many societies to prevent and treat many diseases and ailments. Since the outbreak of the COVID-19 pandemic, many traditional herbal medicines have been used, and some of them have given good results among COVID-19 patients, especially those who had symptoms and did not confirm laboratory tests, especially in Syria.

In this study a semi structured questionnaire was prepared in order to document indigenous anti-coronavirus plant use in Syria, traditional knowledge and the level of utilization of traditional medicinal plants for prevention and treatment of COVID-19. 150 informants were divided into two groups one of them is pharmacists who interested in herbal remedies 73.34% (63.64% female and 36.36% male of them), and the other is herbalists 26.66% who are called "attarin" traditional healers and bee therapists. 40% of the surveyed informants were from Southern Region (Damascus, As Suwayda, Dar'a), 20% were from Northern region (especially Aleppo), 15% were from Central region (Himis, Hamah), 15% were from Western coastal region (Latakia, Tartus) and 10% were from Eastern Region (Dayr az Zawr, Al Hasakah), according the result both genders are interested in herbal medicines. However, the numbers of female pharmacists participants were higher than those of males. while the herbalists as Men were predominantly represented in the sample because of their work. Females were rarely found at herbal markets as herbalists during our interviews. Regarding the age groups, results showed that the majority of informants interviewed were between 30 and 50 years old (95), while 33 of the informants were younger than thirty years old. and 22 of the informants were over 50 years old. Regarding the academic level, our results showed that (40%) of the herbalists from informants had secondary education, 37.5% had primary education, and 22.5% of the herbalists had graduate education, and no one was illiterate.

The present study revealed that a total of 26 medicinal species relating to 15 botanical families were generally utilized by pharmacists and herbalists in the prevention and treatment of COVID 19. The family Lamiaceae was represented by the largest number of plant species (six species, 23.07%). The calculated results of MUV showed that *Pimpinella anisum* L. was ranked first (MUV = 0.933) followed by *Zingiber officinale* Roscoe. (MUV = 0.920), *Thymus syriacus* Boiss. (MUV = 0.9), then *Panax ginseng* C.A.Mey. (MUV = 0.8). These medicinal species having high MUV must be further assessed for phytochemical, pharmacological, and toxicological studies to identify their active constituents for an effective and non-toxic drug extraction.

The interview results revealed that leaves are the most frequently used part of the medicinal plants 25.8% of the total, followed by the fruits 19.35%, and the seeds 12.9%. The choice of leaves was due to its easy availability, collection, and it is traditionally used in drug preparation. The most of the herbal recipes (81.3%) were made from fresh material followed by their dried form (18.7%). The recipes in the most cases were obtained from single herb, but some of recipes were prepared together, and there is a famous local mixture called Damask tisane (*zhourate Shamieh*) or (Syrian *zahraa*). The major solvent was water (59%), honey (22%), seeds oil (22%) and vinegar (2%). Herbalists and pharmacists advise various methods of preparation for COVID-19 symptoms. A mode of traditional medicine preparation reported was infusion (41.19%), followed by decoction and powder (19.35%), then maceration and oil (6.45%). The frequent employment of the infusion because of its easy-to-prepare and popular traditional method used in Syria to prepare aromatic medicinal herbs and it is more suitable for aromatic plants due to avoid the excessive heat to maintain an aromatic and volatile oils.

Popular and traditional drinks spread in Syria very widely, such as mate with aromatic medicinal herbs (hot drink as decoction), julep and Damask rose syrup (cold drink as maceration), licorice syrup (cold drink as maceration) and tamarind (cold drink as maceration), which may have an important effect in curbing infection with viral and bacterial diseases that affecting the respiratory system.

These medicinal plants contain a wide variety of bioactive compounds including volatile oil, phenol glycosides, flavonoids, fatty oils, hydroxycoumarins, triterpenes, tannins, steroids, mucilages, and organic acids. Many of these effective compounds in the studied medicinal plants have antiviral effects, especially those that contain anthocyanates, which are colored phenols found in many colorful plants and fruits. As many studies have shown its great role as an antioxidant and in delaying aging [120, 121]. Scientific evidence for the role of these compounds in suppressing infections and inhibiting the growth of germs [122] has been proven. The study of the anti-viral effect of antocyanates had a large place in global research, as it showed its inhibitory effects on many stages of the virus's life, which led to its suggestion as effective treatments for viral infections[123]. And the other flavonoid derivatives have also been reported to possess antiviral activity against a wide range of viruses such as HSV, HIV, Coxsackie B virus, coronavirus, cytomegalovirus, poliomyelitis virus, rhinovirus, rotavirus, poliovirus, and rabies virus [17, 124, 125]. Phenolic compounds, polyphenols, steroids, terpenoids, other active phytochemicals, and their derivatives are common plant secondary metabolites that contain aromatic rings with 1 or several hydroxyl groups. For a wide range of viruses, several studies confirmed the abovementioned activity of several phenolic antiviral compounds such as curcumin, luteolin-7glucoside, epicatechin gallate, catechin, demethoxycurcumin, bavachinin, apigenin-7 glucoside, silvestrol, hypericin, psoralidin,

mycophenolate mofetil, corylifol, and tomentin [17, 126, 127, 128]. Also polyphenols are capable of binding easily with the lipoproteins of the virus envelope, which can prevent the viral invasion in host cells [17, 129].

Volatile and aromatic oils (anethole, chamazulene, limonene, thymol, eucalyptol, verbenone,  $\gamma$ -terpinene, sabinene, caryophyllene, linalool, myrcene, camphor, camphene, borneol, menthol, eugenol, carvacrol, myrtenol, etc.) from many medicinal plants such as *Origanum syriacum* L., *Micromeria myrtifolia* Boiss. & Hohen, *Mentha pulegium* L., *Melissa officinalis* L., *Artemisia annua* L., *Rosmarinus officinalis* L., *Rosa xdamascena* Mill., *Pimpinella anisum* L., *Citrus limon* (L.) Osbeck, *Eugenia caryophyllata* Thunb., *Coriandrum sativum* L., and other aromatic plants with antiviral activities were well documented by several researchers [17, 129, 130, 131, 132]. Eucalyptol, a vital essential oil from *Eucalyptus globulus* Labill. was identified as an effective antiviral compound against coronavirus, especially COVID-19 because this major component of eucalyptus oil consists of ether (-O), ketone (= O), and hydroxyl (-OH) groups which play the main inhibitory role against SARS-CoV-2 [133]. Essential oils can insert nonspecifically into the lipid double layer of the viral envelope, which alters the fluidity of the membrane [132].

Many people consider herbal remedies to be harmless, but using them without medical advice may lead to harmful effects on health, and in other cases some treatments may be ineffective and thus the condition of a person with COVID-19 may worsen as a result of not being treated effectively.

There may be some effective herbal remedies in preventing and treating COVID-19 for some people, but the lack of information on the mechanism of effect, the appropriate dosage, side effects, toxicity and drug interactions makes them questionable, as they need more research and study. So far, there is no WHO-approved herbal remedy for COVID-19.

## 5. Limitations

There is insufficient information about the pharmacokinetic efficacy of the medicinal plant species in this study. These herbs that have been reported that have been used traditionally as adjuvant to relieve and treat symptoms of COVID-19, the effects of which remain unknown.

## 6. Conclusion

This research is working on studying some of the folk remedies that are widespread and naturally widespread in Syria. The importance of this research falls within the global efforts exerted to search for natural remedies that are cheap and effective to limit the spread of viral infections in general and in particular the emerging corona virus (COVID-19). The studied plants may have dual antiviral and immunomodulating effects, and thus can be adopted in preventing the spread of viral infection. Therefore, studies must be conducted on evaluating the effectiveness of Syrian medicinal plants rich in flavonoids and volatile oils as antiviral, especially the emerging corona virus, COVID-19.

## Declarations

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This study did not receive any particular gift from funding companies in the public, commercial, or not-for-profit sectors.

### Declaration of Competing interests

We declare that there is no conflict of interest with any business organization concerning the study.

### Authors' Contributions

C.H.: Data collection, methodology, investigation, compiled the literature sources, data analysis, evaluation, and interpretation, realization manuscript, helped in data, and made a substantial contribution to data analysis. A.N.: Evaluation the clinical data, performed data analysis and drafted the manuscript. M.I.H.A.: Review & editing, designed the research and identification of plant species. All contributors understand and accepted the final document.

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## Figures



**Figure 1**

Geographical Location of the study area, Syria [16]. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

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