Ethnopharmacological survey on medicinal plants used by Algerian population to prevent SARS-CoV-2 infection
Messaoud Belmouhoub, Boubekeur Aberkane and Mostapha Bachir-Bey

Correspondence
Messaoud Belmouhoub¹, Boubekeur Aberkane² and Mostapha Bachir-Bey³.

¹Department of Medicine, Faculty of Medicine, University of Constantine 3, 25000 Constantine, Algeria.
²Department of Biological Sciences, Faculty of Natural and Life Sciences and Earth Sciences, University of Bouira, 10000 Bouira, Algeria.
³Laboratory of Applied Chemistry, Department of Food Sciences, Faculty of Life and Natural Sciences, University of Bejaia, 06000 Bejaia, Algeria.

*Corresponding Author: mostapha.bachirbey@univ-bejaia.dz

Research Research & Applications 22:38 (2021)

Abstract
Background: The world is confronted with an acute pneumonia outbreak caused by SARS-CoV-2 and the use of plants remains the best choice for many populations to prevent the infection by this virus. This work is an ethnopharmacological survey on medicinal plants used for the prevention of SARS-CoV-2 infection by the Algerian population.

Method: This study was carried out in 2020 in three Algerian provinces (Bejaia, Bouira, and Boumerdes). Ethnobotanical information was obtained using a questionnaire by direct interview with 55 herbalists.

Results: The results indicated that the herbalists are predominantly men (94%) whose 70% of them have more than 5 years of experience in the field. The survey revealed that 25 medicinal plants belonging to 17 families were used by the population to prevent SARS-CoV-2 with a dominance of Asteraceae, Lamiaceae, and Zingiberaceae. The frequently used plants are Syzygium aromaticum (L.) Merr. & L.M. Perry (92.72%), Origanum vulgare L. (78.18%), Mentha × piperita L. (50.9%) and Zingiber officinale Roscoe (50.9%). The plant part used is depending on the plant; the aerial parts are the most used, followed by fruit, then leaf, rhizome, seed, and flower, whereas bark, bulb and root are rarely exploited. The more frequently used methods of plant preparation are infusion (72%) followed by decoction (68%), and then maceration (28%).

Conclusion: This survey is a good enrichment of knowledge on the plants used by the Algerian population for the prevention of SARS-COV-2 infection. This study also provides researchers with important information that can be exploited to develop remedies and preventive drugs against COVID-19.

Key words: SARS-Cov-2, ethnopharmacology survey, medicinal plant, Algerian population, herbalist.
Background

The new coronavirus, COVID-19 virus or SARS-CoV-2, first appeared in Wuhan city (China) in December 2019, then it spread very quickly across the world. Globally, as of July 9, 2021, there have been 185,291,530 confirmed cases of COVID-19, with 4,010,834 deaths (WHO 2021).

Coronaviruses are a group of enveloped viruses with a positive-sense single-stranded RNA genome approximately 26–32 kilobases in size (Su, et al. 2016). They belong to the order of Nidovirales, family of Coronaviridae, and subfamily of Orthocoronavirinae (Tang, et al. 2020). Seven coronaviruses infecting humans (HCoV) have been identified since 1960: HCoV-229E and HCoV-OC43 in the 1960s, SARS-CoV in 2003, HCoV-NL63 and HCoV-HKU1 identified in 2004 and 2005, respectively (Vabret, et al. 2009), MERS-CoV in 2012, and SARS-CoV-2 in December 2019 (Tang, et al. 2020). Four of these viruses cause common cold symptoms in humans: HCoV-229E, HCoV-OC43, HCoV-NL63 and HCoV-HKU1 (Zhu, et al. 2020). The other three strains SARS-CoV, MERS-CoV, and SARS-CoV-2 attack the lower respiratory system and cause viral pneumonia. In addition to lung infection, SARS-CoV-2 may also affect other organs like heart, kidney, liver, and gastrointestinal system (Liu, et al. 2020).

The electron microscopy studies reveal that SARS-CoV-2 has a spherical form with a diameter varied from about 60 to 140 nm and that its envelope is studded with glycoprotein spikes about 9 to 12 nm, which gave the virus its crown-like appearance (Zhu, et al. 2020). The complete genome sequencing revealed that SARS-CoV-2 RNA has 29.9 kb (Baig, et al. 2020), with 79.5% similarity in genetic sequence to SARS-CoV RNA (Guo, et al. 2020).

The death rate caused by SARS-CoV-2 in some countries is higher than in others (WHO 2021). This suggests that external factors such as diet habits, climate, and attachment of the populations to traditional treatment can influence the disease spread and hence the death rate.

In fact, the consumption of specific foods and the use of certain medicinal plants in order to prevent the transmission of infections is a method followed by several human societies. Currently, the practice of traditional medicine varies considerably from one region to another in the world, and this is based on the geography of countries, cultures, and heritage of human societies in medicinal plants and natural treatments (Antwi-Baffour, et al. 2014; Bellik, et al. 2020). In addition, the use of medicinal plants is more important in poor and developing countries than in developed countries (Mukhtar, et al. 2008; Shah, et al. 2015). Some societies depend on a healthier diet, which is usually rich in herbs and spices that contain biologically active components, such as antioxidants and immunostimulants (El Sayed, et al. 2020; Tapsell, et al. 2006). For example, in North African and Mediterranean societies, such as in Egypt, Libya, Tunisia, Algeria, and Morocco, spices constitute an indispensable part of the daily diet (Benkerroum 2013), with the common uses of numerous medicinal plants, special vegetables, and fruits known by their antiviral effect (Aanouz, et al. 2020).

Several studies have reported the potential effects of natural substances against replication of many viral species, such as influenza virus (Dang, et al. 2015; Watanabe, et al. 2014), hepatitis B virus (HBV) (Wu 2016), human immunodeficiency virus (HIV) (Rashed, et al. 2012), Herpes Simplex Virus (HSV) (Yıldırım, et al. 2016), the Middle East respiratory syndrome-related coronavirus (MERS-CoV) (Jahan and Ahmet 2020), and severe acute respiratory syndrome coronavirus (SARS-CoV) (Sytar, et al. 2021).

Such studies attract the attention of scientists to explore natural antiviral components of plants, however, the investigation of antiviral natural substances is still insufficient and the search for new drugs from natural substances must be further enhanced (Mukhtar, et al. 2008).

Currently, the majority of viral infections are treated by synthetic drugs. However, several virus species remain without effective remedy to date (Ben-Shabat, et al. 2020). Furthermore, in certain cases, synthetic substances show a narrow spectrum of activity with limited therapeutic usefulness and considerable toxicity (Pushpa, et al. 2013). In this regard, medicinal plants and some natural products may be an important source of antiviral molecules and can serve as a proper alternative for treating numerous viral infections with limited side effects (Hussain, et al. 2017).

In Algeria, since the appearance of COVID-19 pandemic until July 9, 2021, in total, 143,652 confirmed cases and 3,798 deaths have been recorded by the World Health Organization (WHO 2021).
A large number of medicinal plants and spices are used by the Algerian population to treat or prevent many diseases. In this last decade, several ethnobotanical surveys showed that the Algerian population is very attached to phytotherapy and traditional treatment (Allali, et al. 2009; Boudjelal, et al. 2013). However, to our knowledge, no ethnobotanical study concerning SARS-CoV-2 pandemic has been carried out in the center of Algeria. Therefore, the purpose of the present investigation was to determine the most frequently used plants by the Algerian population, their availability (growth) in this region, their used parts, and the mode of their use.

**Objectives of the study**
The purpose of the present investigation is to determine the medicinal plants mostly used by the Algerian population to prevent SARS-CoV-2 infection.

**Materials and Methods**

**Description of the survey area**
The study was conducted in three different provinces, Bejaia, Bouira, and Boumerdes. These provinces are located in central northern Algeria; they are bordered by the Mediterranean Sea from the North, Jijel province from the East, Sétif, Bordj-Bou-Arreridj, M’sila, and Médéa provinces from the south, and Bôida and Algiers provinces from the west (Fig. 1). The survey area covers 9135 km², with an estimated population of about 2,461,000 who speak Arabic and Kabyle. The density of population is estimated at 269 inhabitants/Km² and the majority occupies urban areas (ONS 2017).

The study area is located in plain Tellian Atlas; it is characterized by the importance of the mountainous land which occupies more than half of the total surface of the study area. It is also characterized by an important vegetation cover where thousands of plant species are growing. The arboriculture is marked by the predominance of the olive tree, followed by fig and citrus tree. The dominant climate of the studied area is the Mediterranean, rainy and mild climate in winter and dry and hot in summer, but it varies from area to area. For example, in the mountains, the climate is characterized by rainy and very cold winter (ONS 2017).
Collection of information
An ethnobotanical study was conducted from June to September 2020 in three Algerian provinces, Bejaia, Bouira, and Boumerdes (Fig. 1). The Ethnobotanical information was obtained using a structured questionnaire by direct interview with 55 herbalists. The choice of herbalists was random, without taking into consideration any parameter about them. Whereas the most populated urban areas are given priority during this study, this allowed us to collect as much information as possible.

The used questionnaire was divided into two parts, the first aims to collect information about plants used, and the second aims to collect information about the herbalists themself (Table 1).

Table 1. Questionnaire of the survey

| Information about plants used | Information about herbalists |
|-------------------------------|-------------------------------|
| Local name | Cultivated, wild or imported | Used parts | Preparation methods | Gender | Age | Professional experience | Academic level |
|--------------------------------|--------------------------------|-------------|---------------------|--------|-----|------------------------|----------------|

Identification of medicinal plants used
All plants used by the population were presented by herbalists in their stores. The common names of each plant have been confirmed by experienced herbalists and ancient inhabitants of the study area then their binomial nomenclatures have been assigned for each plant based on various bibliographical references.

The frequency (F) of plant species used by the population was calculated according to the following formula: $F (%) = \frac{U \times 100}{N}$. Where $U$ is the number of plant citations and $N$ is the number of all herbalists interviewed.

Results

Information about herbalists
In the present investigation, 55 herbalists were interviewed, 52 men (94.54%) and 3 women (5.45%), in three different provinces, Bejaia (30 herbalists), Bouira (22 herbalists), and Boumerdes (3 herbalists). The majority of herbalists interviewed were between 20 and 40 years (about 52.72%); while 45.45% were between 40 and 60 years, and only 1.82% of them were over 60 years. The results show also that the majority of herbalists had a primary or secondary level education (over 90%) and the majority of them (over 70%) had more than 5 years of professional experience.

The information collected about herbalists is presented in Table 2.

Table 2. Information about herbalists (n=55)

| Variables               | Category            | Number of herbalists | Percentage (%) |
|-------------------------|---------------------|----------------------|----------------|
| Gender                  | Male                | 52                   | 94.54          |
|                         | Female              | 3                    | 5.45           |
| Age group               | 20-40               | 29                   | 52.72          |
|                         | 40-60               | 25                   | 45.45          |
|                         | Above 60            | 1                    | 1.82           |
| Academic level          | Primary or Secondary| 50                   | 90.90          |
|                         | University          | 5                    | 09.09          |
| Professional experience | Between 01-05 years | 16                   | 29.09          |
|                         | Between 05-10 years | 16                   | 29.09          |
|                         | Between 10-15 years | 11                   | 20             |
|                         | Between 15-20 years | 4                    | 07.27          |
|                         | Over 20 years       | 8                    | 14.54          |
Information about plants used

The results show that 25 medicinal plants belonging to 17 families were used by the population, with a predominant use of Asteraceae, Lamiaceae, and Zingiberaceae with three species for each family (12% for each family), followed by Myrtaceae and Rutaceae by two species for each (8%). The remaining 12 families contribute by one species for each (4%) (Table 3). Some plants do not grow in this region, so they are imported from other regions of the country or from other countries. Of these plants, 36% grow in the wild, 36% are cultivated, and 28% are not indigenous to the area but brought from other parts of Algeria or outside the country. The vernacular and binomial names of plants, used parts, preparation methods, and the frequency of plants citations are illustrated in Table 3.

Table 3. List of medicinal plants used to prevent SARS-CoV-2 in the study area.

| Family of plant species | Name of plant species | Arabic name (Local name) | English name | Status | Used parts | Methods of preparation | Number of citations (Frequency (%)) |
|-------------------------|-----------------------|--------------------------|--------------|--------|------------|------------------------|----------------------------------|
| Anacardiaceae            | Pistacia lentiscus L.  | Dharou (Amadaqha)        | Lentisk      | W      | Leaf       | Dec.                   | 6 (10.90%)                       |
| Apiaceae                | Pimpinella anisum L.   | Yansoun (Avesvas)        | Anise        | Cu     | Seed       | Mac. or Dec.           | 3 (5.45%)                        |
| Asteraceae              | Artemisia herba-alba   | Chih (Chih)              | White wormwood | Imp    | A. parts   | Dec. or Inf.           | 18 (32.73%)                      |
|                         | Assio                  |                          |              |        |            |                        |                                 |
|                         | Chamaemelum nobile     | Babondje (Wamlal)        | Ramon chamomile | W    | A. parts   | Dec. or Inf.           | 1 (1.82%)                        |
|                         | (L.) All.              |                          |              |        |            |                        |                                 |
|                         | Aucklandia costus      | Al-Qust Al- hindi        | Indian costus | Imp   | Root       | Dec., Inf. or Vap. (Inh.) | 20 (36.36%)                      |
|                         | Falc.                  |                          |              |        |            |                        |                                 |
| Brassicaceae            | Lepidium sativum L.    | Rechad (Guerninouche)    | Garden cress | W    | Seed       | Dec. or Fresh          | 1 (1.82%)                        |
| Iridaceae               | Crocus sativus L.      | Zaafafrane               | Saffron crocus | Imp.   | Flower     | Inf. or cooked         | 1 (1.82%)                        |
| Lamiaceae               | Lavandula stoechas L.  | Khozama (Amezir)         | Spanish lavender | W    | A. parts   | Dec. or Inf.           | 2 (3.63%)                        |
|                         | Mentha × piperita L.   | Naânaâ (Naâna)           | Peppermint   | Cu    | A. parts   | Inf. or extracted essential oil | 28 (50.90%)                     |
|                         |                        |                          |              |        |            |                        |                                 |
|                         | Origanum vulgare L.    | Zaâtar (Zaâtar)          | Oregano      | W    | A. parts   | Dec., Inf. or Mac.     | 43 (78.18%)                      |
| Lauraceae               | Neolitsea cassia (L.)  | Korfa (Elqurfa)          | Chinese cinnamon | Imp   | Bark       | Dec. or Inf. (in tea)  | 6 (10.90%)                       |
|                         | Kosterm.               |                          |              |        |            |                        |                                 |
| Liliaece                | Allium sativum L.      | Thoum (Thicherth, thiskerth) | Garlic      | Cu    | Bulb       | Dec., Inf. or Fresh   | 3 (5.45%)                        |
| Moraceae                | Ficus carica L.        | Tine (Thanquitt)         | Fig tree     | Cu    | Fruit (dried) | Fresh (in olive oil) | 1 (1.82%)                       |
| Myrtaceae               | Eucalyptus globulus    | Oukalitous (kalitous)    | Eucalyptus   | W    | Leaf       | Inf.                   | 11 (20%)                         |
|                         | Labill.                |                          |              |        |            |                        |                                 |
|                         | Syzygium aromaticum    | Coronfel (qranfel)       | Clove        | Imp.   | Flower buds | Dec., Inf. (in tea), Mac. or Fresh | 51 (92.72%)                     |
|                         | (L.) Merr. & L.M. Perry |                          |              |        |            |                        |                                 |
Frequency of plants used

Among the 25 medicinal plants used by the population to prevent SARS-CoV-2 infection, some of them are used frequently and cited by at least 9 herbalists (over 15% of frequency); the plants mostly used are respectively: *Syzygium aromaticum* (L.) Merr. & L.M. Perry (92.72%), *Origanum vulgare* L. (78.18%), *Mentha × piperita* L. (50.9%), *Zingiber officinale* Roscoe (50.9%), *Aucklandia costus* Falc. (36.36%), *Artemisia herba-alba* Asso, (32.73%), *Aloysia citriodora* Palau (27.27%), *Eucalyptus globulus* Labill. (20%), *Nigella sativa* L. (18.18%), and *Citrus × limon* (L.) Osbeck (16.36%) (Fig. 2).

Figure 2. Frequency of popular plants used by the population to prevent SARS-CoV-2 infection.
Parts of the plants used
The result obtained in this study shows that several plant parts are used by the population to prepare herbal remedies (Fig. 3). The parts of plants most commonly used by the population are the aerial parts with 24%, followed by fruit (16%), then leaves, rhizome, and seed with 12% for each part, flower, and bark by 8%. The other parts of plants namely bulb and root are used only by 4% for each.

Methods of preparation
The results showed that the studied population employed various methods to use medicinal plants; the principal method reported was infusion (72%), followed by decoction (68%), and then maceration (28%). The percentage of other preparation methods did not exceed 20% (Fig. 4).
Concerning the most frequently used plants (Fig. 5), several methods are followed to use each plant; four different methods are used for *A. costus* and *S. aromaticum*, three for *A. herba-alba, C. × limon, N. sativa, O. vulgare*, and *Z. officinale*, and two methods are followed for *A. citriodora* and *M. × piperita*. The solvent most frequently used is water, but milk, tea, olive oil, and honey are also used to dissolve some plant powders.

**Discussion**

Currently, several societies around the world try to prevent or treat SARS-CoV-2 using traditional treatments, especially in the poor and developing countries. In Algerian society for example, since the apparition of this pandemic, people use more medicinal plants and some natural products known for their curative effect against viral and bacterial infections, especially infections affecting the respiratory system. In fact, during our study, the herbalists interviewed noted that the demand for plants by the population has increased enormously during this period.

In this study, men dominate the practice of traditional medicine in the study area with over 94% that is probably due to the type of work and to the cultural traditions of the region, where women are not oriented to practice some works such as trade and hard works. Nevertheless, in Algerian society, women practice traditional medicine and have important knowledge, especially old women, but their practice is done at home to treat especially their relatives.

The age of all herbalists varies between 20 and 60 years, except one, and more than half (52.72%) are young men (20–40 years). The majority of herbalists interviewed (90%) have only primary or secondary academic levels, but more than 70% of them have over 5 years of professional experience.

Although none of the herbalists had a certificate or diploma in herbalism, the majority of them have a long professional experience (5 to over 20 years), and they have acquired their knowledge from generation to generation.

The present study revealed that 25 medicinal plants belonging to 17 families were used by the population to prevent SARS-CoV-2 infection (Table 2). Some plants are significantly used (Fig. 2), that being the case of *S. aromaticum* (92.72%), *O. vulgare* (78.18%), *M. × piperita* (50.9%), *Z. officinale* (50.9%), *A. costus* (36.36%), *A. herba-alba* (32.73%), *A. citriodora* (27.27%), *E. globulus* (20%), *N. sativa* (18.18%), and *C. × limon* (16.36%).

![Figure 5. Methods of preparation used according to plant.](image-url)
The choice of medicinal plants used by the Algerian population against SARS-CoV-2, the preparation methods, and plants parts used are not based on scientific knowledge, but rather on a traditional medicine heritage and social culture of the population, as has been confirmed by the interviewed herbalists. On the other hand, some plants chosen by the population are inspired from Islamic medicine such as Black cumin, ginger, and Indian costus, which is the case of other Muslim countries (Alqethami, et al. 2017; El Sayed, et al. 2020; Sheikh 2016). Some authors have reported that the Muslim societies are interested in the remedies mentioned in prophetic medicine (Aati, et al. 2019; Alqethami, et al. 2017) such, N. sativa (Maideen 2020), A. costus (Abdallah, et al. 2017), honey (El Sayed, et al. 2020), Z. officinale, and olive oil (Mehmood, et al. 2021).

Although the anti-SARS-CoV-2 effect of the plants used in this study has not yet been scientifically demonstrated, but several experimental studies confirmed that some of these plants inhibit the multiplication of many other viral species and can probably inhibit SARS-CoV-2 multiplication.

Recent experimental studies have reported that some components of S. aromaticum, such as β-caryophyllene (Narkhede, et al. 2020) and Eugenol (Rizzuti, et al. 2021), present a high degree of interaction with the main protease of SARS-CoV-2, thus these herbal molecules may be potent inhibitors of SARS-CoV-2 multiplication. On the other hand, S. aromaticum extract can improve the function of the immune system by immunomodulatory effect of eugenol present in its essential oils (El-Saber Batia, et al. 2020). Other studies have shown that phenolic compounds of O. vulgare have a potent inhibitory effect against respiratory syncytial virus (RSV) multiplication (Zhang, et al. 2014). Kumar, et al. (2020) have shown that carvacrol, a monoterpenoid phenol found in O. vulgare, can interact with SARS-CoV-2 main protease and exert it inhibition.

Concerning Z. officinale, it is well known by the Algerian population for its beneficial effect on the respiratory system. This plant is commonly used in Algeria as spices and as a medicinal plant. In last decade, several studies showed the potent effect of ginger extract to treat respiratory system diseases. The study conducted by Chang, et al. (2013) showed that the water extract of fresh ginger is effective against the human respiratory syncytial virus (HRSV). Another study showed that Ginger extract efficiently protects the lungs from histopathological damage due to hyperoxia and inflammation (Çifci, et al. 2018).

In addition, our study showed that M. × piperita is commonly used to prevent SARS-CoV-2 infection; in fact, this plant is used daily by the population as herbal tea. Some publications reported that this plant has a high antiviral activity against coronavirus group (Serlahwaty and Giovani 2020; Sytar, et al. 2021). The study conducted by Li, et al. (2017) has shown that phenolic acids and flavonoids of M. × piperita have good anti-inflammatory action and exert a potent effect against RSV.

Although A. costus is imported from other countries (India and Pakistan), it is well known in Algerian society and is widely used in complementary medicine (Ahmad, et al. 2009). This plant is known in Arab countries as “Al-Qust Al-Hindi” and used by traditional healers since the era of the Islamic civilization (Abdallah, et al. 2017). In prophetic medicine, the Prophet Muhammad peace be upon him cited that A. costus contains seven types of remedies among them being a treatment for pleurisy (El-Far, et al. 2018). Currently, the roots of this plant are commonly used in Algeria to prevent SARS-CoV-2 infection, either by inhalation, infusion, or decoction.

Some studies have shown that dehydrocostus lactone and alantolactone, two sesquiterpenes of A. costus, have a good anti-inflammatory (Butturini, et al. 2011; Lim, et al. 2015) and immunomodulatory effects (Yuuya, et al. 1999). In addition, the experimental study conducted by El-Rahman, et al. (2020) showed that the ethanolic extract of roots of A. costus exerts a protective action against damaged lung tissue.

Another study has shown that active compounds isolated from A. costus such as costunolide and dehydrocostus lactone exert a considerable activity against hepatitis B virus (HBV) (Chen, et al. 1994).

The present investigation revealed also that other plants are used by the Algerian population, whose probable effects against SARS-CoV-2 have been shown by recent studies. Among these plants, A. herba-alba (Asdadi, et al. 2020), E. globulus (Asif, et al. 2020; Cermelli, et al. 2008), N. sativa (Mukhtar, et al. 2008), and C. × limon (Senthil Kumar, et al. 2020).

In addition, certain foods and spices which are part of the daily diet in Algeria may prevent the infection by SARS-CoV-2, as has been reported by some studies, such as olive oil (Chowdhury 2020; Michele, et al. 2020), vinegar...
Conclusion
The present investigation clearly shows that phytotherapy is widely adopted by Algerian society, and there is a high diversity of medicinal plants used for the complementary treatment of viral infections especially in cases of lack or total absence of drug treatment. In addition, the studied population showed significant knowledge in the traditional treatment of viral infections and carefully selects herbs that have beneficial effects on lung infections. In fact, the antiviral activity of the majority of the plants used has been demonstrated by experimental studies; however, their action against SARS-CoV-2 has not yet been confirmed. This work constitutes a good contribution of the Algerian heritage of medicinal plants in the fight against the spread of SARS-CoV-2, thorough pharmacological and phytochemical investigations are needed to reveal the real effect of these plants on SARS-CoV-2 as well as their active components involved.

Declarations

Ethics approval and consent to participate: The author discussed with individual herbalists individually before interviewing and permissions were obtained from all participants prior to each interviews/discussion.

Consent for publication: The manuscript contains original field and investigation/interviews of herbalists.

Availability of data and materials: The data sets and report generated are available for interested researchers, students, and institutions upon request.

Funding: This work was financed by the Directorate General of Scientific Research and Technological Development (DGRSDT, Algerian Ministry of Higher Education and Scientific Research).

Authors’ contributions: Messaoud Belmouhoub: Conceptualization, original draft; Writing - review & editing, Data curation, Investigation, Methodology, Validation. Boubekeur Aberkane: Data curation, Formal analysis. Mostapha Bachir-Bey: Validation, Supervision, Writing- Reviewing and Editing.

Acknowledgements
The authors are grateful to the Directorate General of Scientific Research and Technological Development (DGRSDT, Algerian Ministry of Higher Education and Scientific Research) for the financial support. We would also like to thank Mr. Mustapha Lazazen and Mr. Brahim Oukaour for their help in preparing the manuscript.

Literature cited

Aanouz I, Belhassan A, El-Khatabi K, Laklifi T, El-Ldrissi M, Bouachrine M. 2020. Moroccan Medicinal plants as inhibitors against SARS-CoV-2 main protease: Computational investigations. Journal of Biomolecular Structure and Dynamics 39:2971-2979.

Aati H, El-Gamal A, Shaheen H, Kayser O. 2019. Traditional use of ethnomedicinal native plants in the Kingdom of Saudi Arabia. Journal of ethnobiology and ethnomedicine 15:1-9.

Abdallah EM, Qureshi KA, Ali AM, Elhassan GO. 2017. Evaluation of some biological properties of Saussurea costus crude root extract. Bioscience Biotechnology Research Communications 10:601-611.

Ademiluyi AO, Oyeniran OH, Oboh G. 2020. Tropical food spices: A promising panacea for the novel coronavirus disease (COVID-19). eFood 1:347-356.

Ahmad M, Khan MA, Marwat SK, Zafar M, Khan MA, Hassan TU, Sultana S. 2009. Useful medicinal flora enlisted in Holy Quran and Ahadith. American-Eurasian Journal of Agricultural & Environmental Sciences 5:126-140.

Allali H, Benmehdi H, Dib M, Tabti B, Ghalem S, Benabadj N. 2009. Phytotherapy of diabetes in west Algeria. Asian journal of chemistry 20:2701.

Alqethami A, Hawkins JA, Teixidor-Toneu I. 2017. Medicinal plants used by women in Mecca: urban, Muslim and gendered knowledge. Journal of ethnobiology and ethnomedicine 13:1-24.

Antwi-Baffour SS, Bello AI, Adjei DN, Mahmood SA, Ayeh-Kumi PF. 2014. The place of traditional medicine in the African society: The science, acceptance and support. American Journal of Health Research 2:49-54.
Asdadi A, Hamdouch A, Gharby S, Hassani LMI. 2020. Chemical characterization of essential oil of Artemisia herba-alba asso and his possible potential against covid-19. Journal of Analytical Sciences and Applied Biotechnology 2:67-72

Asif M, Saleem M, Saadullah M, Yaseen HS, Al Zarzour R. 2020. COVID-19 and therapy with essential oils having antiviral, anti-inflammatory, and immunomodulatory properties. Inflammopharmacology 1-9.

Baig AM, Khaleeq A, Ali U, Syeda H. 2020. Khaleeq A Ali U and Syeda H, 2020 Evidence of the COVID-19 virus targeting the CNS: Tissue distribution, host-virus interaction, and proposed neurotropic mechanisms. ACS Chemical. Neuroscience 11:995-998.

Bellik Y, Bachir-Bey M, Fatmi W, Kouidri M, Souagui Y, Selles SMA. 2020. Micronutrients and phytochemicals against COVID-19: Mechanism and molecular targets. Annals of Phytopharmacology 9:15-29.

Ben-Shabat S, Yarmolinsky L, Porat D, Dahan A. 2020. Antiviral effect of phytochemicals from medicinal plants: applications and drug delivery strategies. Drug Delivery and Translational Research 10:354-367.

Benkerroum N. 2013. Traditional fermented foods of North African countries: technology and food safety challenges with regard to microbiological risks. Comprehensive Reviews in Food Science and Food Safety 12:54-89.

Boudjelal A, Henciri C, Sari M, Sarri D, Hendel N, Benkhaled A, Ruberto G. 2013. Herbalists and wild medicinal plants in M’Sila (North Algeria): An ethnopharmacology survey. Journal of Ethnopharmacology 148:395-402.

Butturini E, Cavalieri E, de Prati AC, Darra E, Rigo A, Shoji K, Murayama N, Yamazaki H, Watanabe Y, Suzuki H. 2011. Two naturally occurring terpenes, dehydrocostuslactone and costunolide, decrease intracellular GSH content and inhibit STAT3 activation. PLoS One 6:e20174.

Cermelli C, Fabio A, Fabio G, Quaglio P. 2008. Effect of eucalyptus essential oil on respiratory bacteria and viruses. Current microbiology 56:89-92.

Chang JS, Wang KC, Yeh CF, Shieh DE, Chiang LC. 2013. Fresh ginger (Zingiber officinale) has anti-viral activity against human respiratory syncytial virus in human respiratory tract cell lines. Journal of Ethnopharmacology 145:146-151.

Chen S, Li Y, He F. 1994. Effect of Saussurea lappa on gastric functions. Chinese journal of integrated traditional and Western medicine 14:406-408.

Chowdhury AI. 2020. Role and effects of micronutrients supplementation in immune system and SARS-Cov-2 (COVID-19). Asian Journal of Immunology 4:47-55.

Çifci A, Tayman C, Yakut H, Halil H, Cakir E, Cakir U, Aydemir S. 2018. Ginger (Zingiber officinale) prevents severe damage to the lungs due to hyperoxia and inflammation. Turkish journal of medical sciences 48:892-900.

Dang Z, Jung K, Zhu L, Xie H, Lee K-H, Chen C-H, Huang L. 2015. Phenolic diterpenoid derivatives as anti-influenza virus agents. ACS medicinal chemistry letters 6:355-358.

El-Far AH, Shaheen HM, Alsenosy AW, El-Sayed YS, Al Jaouni SK, Mousa SA. 2018. Costus speciosus. Traditional uses, phytochemistry, and therapeutic potentials. Pharmacognosy Reviews 12:120-127.

El-Rahman GIA, Behairy A, Elseddawy NM, Batiha GE-S, Hozzein WN, Khodeer DM, Abd-Elhakim YM. 2020. Saussurea lappa ethanolic extract attenuates triamcinolone acetonide-induced pulmonary and splenic tissue damage in rats via modulation of oxidative stress, inflammation, and apoptosis. Antioxidants 9:396.

El-Saber Batiha G, Magdy Beshbishy A, El-Mleeh A, Abdel-Daim MM, Prasad Devkota H. 2020. Traditional uses, bioactive chemical constituents, and pharmacological and toxicological activities of Glycyrrhiza glabra L. (Fabaceae). Biomolecules 10:352.

El Sayed SM, Almaramhy HH, Aljaheni YT, Okashah AM, El-Anzi ME, AlHarbi MB, El-Tahlawi R, Nabo MMH, Aboonq MS, Hamouda O. 2020. The evidence-based TaibUVID nutritional treatment for minimizing COVID-19 fatalities and morbidity and eradicating COVID-19 pandemic: a novel Approach for Better Outcomes (A Treatment Protocol). American Journal of Public Health Research 8:54-60.
Guo Y-R, Cao Q-D, Hong Z-S, Tan Y-Y, Chen S-D, Jin H-J, Tan K-S, Wang D-Y, Yan Y. 2020. The origin, transmission and clinical therapies on coronavirus disease 2019 (COVID-19) outbreak—an update on the status. Military Medical Research 7:1-10.

Henss L, Auste A, Schürmann C, Schmidt C, von Rhein C, Mühlebach MD, Schnierle BS. 2021. The green tea catechin epigallocatechin gallate inhibits SARS-CoV-2 infection. Journal of General Virology 102:001574

Hussain W, Haleem KS, Khan I, Tauseef I, Qayyum S, Ahmed B, Riaz MN. 2017. Medicinal plants: a repository of antiviral metabolites. Future Virology 12:299-308.

Jahan I, Ahmet O. 2020. Potentials of plant-based substance to inhabit and probable cure for the COVID-19. Turkish Journal of Biology 44:228-241.

Kumar A, Choudhir G, Shukla SK, Sharma M, Tyagi P, Bhushan A, Rathore M. 2020. Identification of phytochemical inhibitors against main protease of COVID-19 using molecular modeling approaches. Journal of Biomolecular Structure and Dynamics 39:3760-3770.

Li Y, Liu Y, Ma A, Bao Y, Wang M, Sun Z. 2017. In vitro antiviral, anti-inflammatory, and antioxidant activities of the ethanol extract of Mentha piperita L. Food science and biotechnology 26:1675-1683.

Llimisaca-Contreras SA, Naranjo-Morán J, Pino-Acosta A, Pieters L, Vanden Berghe W, Manzano P, Vargas-Pérez J, León-Tamariz F, Cevallos-Cevallos JM. 2021. Plants and natural products with activity against various types of coronaviruses: A review with focus on SARS-CoV-2. Molecules 26:4099-4111.

Maideen NMP. 2020. Prophetic medicine-Nigella Sativa (Black cumin seeds)—potential herb for COVID-19? Journal of pharmacopuncture 23:62-70.

Mehmood A, Khan S, Khan S, Ahmed S, Ali A, Hamza M, ur Rehman S, Khan AM, Shah AH, Bai Q. 2021. In silico analysis of quranic and prophetic medicinals plants for the treatment of infectious viral diseases including coronavirus. Saudi Journal of Biological Sciences 28:3137-3151.

Michele CA, Angel B, Valeria L, Clementi M, Poli G, Bussi M, Pianta L, Trimarchi M, Vicenzi E, Poli G, Bussi M, Pianta L, Trimarchi M, Vicenzi E, Bussi M, Pianta L, Trimarchi M, Vicenzi E. 2020. Vinegar and its active component acetic acid inhibit SARS-CoV-2 infection in vitro and ex vivo. bioRxiv 1-15.

Pushpa R, Nishant R, Navin K, Pankaj G. 2013. Antiviral potential of medicinal plants: A overview. International Research Journal of Pharmacy 4:8-16.

Rashed K, Zhang X-J, Luo M-T, Zheng Y-T. 2012. Anti-HIV-1 activity of phenolic compounds isolated from Diospyros lotus fruits. Phytopharmacology 3:199-207.

Rizzuti B, Ceballos-Laita L, Ortega-Alarcon D, Jimenez-Alesanco A, Vega S, Grande F, Conforti F, Abian O, Velazquez-Campos A. 2021. Sub-micromolar inhibition of SARS-CoV-2 3CLpro by natural compounds. Pharmaceuticals 14:892
Senthil Kumar K, Gokila Vani M, Wang C-S, Chen C-C, Chen Y-C, Lu L-P, Huang C-H, Lai C-S, Wang S-Y. 2020. Geranium and lemon essential oils and their active compounds downregulate angiotensin-converting enzyme 2 (ACE2), a SARS-CoV-2 spike receptor-binding domain, in epithelial cells. Plants 9:770.

Serlahwaty D, Giovani C. 2020. In silico screening of mint leaves compound (Mentha piperita L.) as a potential inhibitor of SARS-CoV-2. Pharmacy Education 81-86

Shah GM, Hussain M, Abbasi AM. 2015. Medicinal plants used to treat respiratory tract illness in Kaghan Valley, Himalayan Region-Pakistan. Allergic Diseases: Recent Advances 1-19.

Sheikh BY. 2016. The role of prophetic medicine in the management of diabetes mellitus: A review of literature. Journal of Taibah University Medical Sciences 11:339-352.

Su S, Wong G, Shi W, Weifeng S, Jun L, Alexander C, Ilyong Z, Wenjun L. 2016. Epidemiology, genetic recombination, and pathogenesis of coronaviruses. Trends in Microbiology 24:490-502.

Sytar O, Brestic M, Hajihashemi S, Skalicky M, Kubeš J, Lamilla-Tamayo L, Ibrahimova U, Ibadullayeva S, Landi M. 2021. COVID-19 prophylaxis efforts based on natural antiviral plant extracts and their compounds. Molecules 26:727.

Tang B, Bragazzi NL, Li Q, Tang S, Xiao Y, Wu J. 2020. An updated estimation of the risk of transmission of the novel coronavirus. (2019-nCoV). Infectious disease modelling 5:248-255.

Tapsell LC, Hemphill I, Cobiac L, Sullivan DR, Fenech M, Patch CS, Roodenrys S, Keogh JB, Clifton PM, Williams PG. 2006. Health benefits of herbs and spices: the past, the present, the future. Medical Journal of Australia 185:1-24.

Thimmulappa RK, Kumar MNK, Shivamallu C, Subramaniam KT, Radhakrishnan A, Suresh B, Kuppasamy G. 2021. Antiviral and immunomodulatory activity of curcumin: A case for prophylactic therapy for COVID-19. Heliyon e06350

Vabret A, Dina J, Brison E, Brouard J, Freymuth F. 2009. Coronavirus humains (HCoV) Human coronaviruses. Pathol Biol 57:149-160

Watanabe K, Rahmasari R, Matsunaga A, Haruyama T, Kobayashi N. 2014. Anti-influenza viral effects of honey in vitro: potent high activity of manuka honey. Archives of medical research 45:359-365.

WHO. 2021. World Health Organization. https://covid19whoint (Accessed 11/7/2021).

Wu Y-H. 2016. Naturally derived anti-hepatitis B virus agents and their mechanism of action. World journal of gastroenterology 22:188.

Yildirim A, Duran GG, Duran N, Jenedi K, Bolguł BS, Miraloglu M, Muz M. 2016. Antiviral activity of hatay propolis against replication of herpes simplex virus type 1 and type 2. Medical science monitor: international medical journal of experimental and clinical research 22:422-430.

Yuuya S, Hagiwara H, Suzuki T, Ando M, Yamada A, Suda K, Kataoka T, Nagai K. 1999. Guaianolides as immunomodulators. Synthesis and biological activities of dehydrocostus lactone, mokko lactone, eremanthin, and their derivatives. Journal of natural products 62:22-30.

Zahra FT, Saleem S, Imran M, Ghazal A, Arshad U. 2020. The SARS-CoV-2 pandemic and the role of honey and its products as an emerging therapeutic regime: A review. Biomedica 36:201-205

Zhang X-L, Guo Y-S, Wang C-H, Li G-Q, Xu J-J, Chung HY, Ye W-C, Li Y-L, Wang G-C. 2014. Phenolic compounds from Origanum vulgare and their antioxidant and antiviral activities. Food Chemistry 152:300-306.

Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R. 2020. China Novel Coronavirus Investigating and Research Team. A novel coronavirus from patients with pneumonia in China, 2019. New England Journal of Medicine 382:727-733.