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Traditional herbal medicines and natural remedies used for prevention and treatment of COVID-19 in Algeria

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Abstract. Despite advances in pharmacology, many people in developing countries, especially in Africa and Asia, still rely on crude herbal extracts to manage various ailments. This is partly because these extracts are easily accessible and inexpensive. The therapeutic use of natural remedies during the COVID-19 pandemic have considerably increased in Algeria. The aim of the present study is to collect information about herbal medicines and natural remedies used for prevention and treatment of COVID-19 in Algeria, mainly in the north-eastern region. This study was carried out from 20 May to 23 June, information was collected through interviews among herbalists located in Constantine region, and an online questionnaire as a data collection tool to identify the participants' health statuses, dietary habits and use frequency of herbal medicines and natural products. The collected data were analyzed through google form. A total of 14 species of plants belonging to 9 families were identified as commonly used ethnomedicinal plants for the prevention and management of symptoms associated with Covid-19. Leaves, roots and seeds are the most frequently used plant parts, most of the herbal medicines are prepared in the form of tea, oil and fumigation, administered orally or inhaled. The most important species according to their use frequency are Syzygium aromaticum, Mentha spicata, Origanum vulgare, Artemisia herba alba, Eucalyptus globulus, Zingiber officinale, Saussurea costus, Aloysia citrodora, Peganum harmala, Allium cepa, Ficus carica, Cinnamomum verum and Matricaria chamomilla. Moringa oleifera was used as dietary supplements to boost the immune system.These herbs were mostly administered with other ingredients such as sesame seed, black seed, lemon juice, olive oil and honey. Honey is the adjuvant most added to different herbal remedies. In this study, Syzygium aromaticum, Mentha spicata, Origanum vulgare and Zingiber officinale, are in first position in relative importance.

Keywords: Herbal medicines, natural remedies, COVID-19, phytotherapy, survey.

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1 Introduction

Medicinal plants have been used in healthcare since time immemorial, they represent an important source of active ingredients which have complementary or synergistic therapeutic activities, to combat the serious diseases all over the world. The utilization of herbal medicine in the prevention and the treatment of diseases increases every day. Phytotherapy is commonly defined as the study of the use of natural sources as medicines or health promoting agents. It should be perceived as an allopathic discipline, because the effects that are expected from medicinal plants are directed against the causes and the symptoms of a disease. Traditional phytotherapy is a substitution therapy that is intended to treat the symptoms of affections. It is based on the use of plants according to the virtues discovered empirically. The other existing form of phytotherapy is clinical phytotherapy. A holistic approach to the patient and his environment is necessary to determine treatment, as well as a complete clinical examination [1]. Its mode of action is based on long-term treatment acting on the neuro-vegetative system. This time the indications are linked to a treatment of complementarity. They complement or reinforce the effectiveness of a treatment of classic allopathic disease for acute pathologies of moderate importance (influenza infection, O.R.L pathologies ...). The severe acute respiratory syndrome CoV-2 (SARS-CoV-2) named novel COVID-19 (coronavirus disease 2019) is a highly transmissible and pathogenic coronavirus that emerged in late 2019 and has caused a pandemic of acute respiratory disease. From a clinical and epidemiological

standpoint, it appears that all ages of the population are susceptible to SARS-CoV-2 infection. However, clinical manifestations differ with age. In general, older men (¿60 years old) with co-morbidities are more likely to develop severe respiratory disease that requires hospitalization, whereas most young people and children have only mild diseases (non-pneumonia or mild pneumonia) or are asymptomatic [2-4]. On infection, the most common symptoms are fever, fatigue and dry cough [2,5]. Less common symptoms include sputum production, headache, haemoptysis, diarrhoea, anorexia, sore throat, chest pain, chills and nausea and vomiting in studies of patients in China [2,4-6]. Self-reported olfactory and taste disorders were also reported by patients [7]. Most people showed signs of diseases after an incubation period of 1–14 days (most commonly around 5 days), and dyspnoea and pneumonia developed within a median time of 8 days from illness onset [2]. While the epidemic linked to the SARS-CoV-2 coronavirus has spread around the world, research is mobilized to accelerate the production of knowledge on this virus, on the disease it causes (Covid-19) as well as ways to cure and prevent it. To date, there are no generally proven effective therapies for COVID-19 or antivirals against SARS-CoV-2, although some treatments have shown some benefits in certain subpopulations of patients or for certain endpoints. Vaccination is the only effective method for prevention and control of COVID-19. As of February 18, 2021, seven different vaccines at least have been made available in countries. In parallel, researchers and manufacturers are conducting large-scale clinical trials to evaluate various therapies for COVID-19. Medicinal plants play vital roles in disease prevention and their

promotion and use fit into all existing prevention strategies. Natural products and herbal medicine have a long track record to treat respiratory infection and many have been approved as drugs, over-the-counter nutrition or food additives. Those products generally have satisfactory safety profiles. The minimal toxicity makes natural products and herbal medicines ideal prophylactic candidates for long-term use. Based on recent in silico results, an array of natural products has been found highly potent in blocking enzyme function and membrane receptors of human coronavirus. Moderate dosing of such bioactive compounds may prevent or at least slow down SARS-CoV-2 infection process. In addition, the progression of COVID-19 is featured with uncontrolled inflammation, like cytokine release syndrome, so anti-inflammatory herbs will be a potential tool to suppress such fatal symptoms. The stability of natural products and herbal medicines in the human gastrointestinal tract is barely an issue. The low pH in gastric environment, digestive enzymes, and gut microbiome have less impact on the bioavailability of natural products and herbs compared to antibody and other prophylactics. This advantage makes oral dosing rather than IV administration possible [8]. In this review we will see the role that herbal medicines and natural remedies have played during COVID-19 within Algerian population and collect information about most used herbal medicines and natural remedies for prevention and treatment of COVID-19 in Algeria, mainly in the north-eastern region.

2 Materials and Methods

2.1 Study design and sampling

Semi-structured questionnaires and open questions were conducted including herbalists, to identify medicinal plants and natural remedies used for prevention and treatment of COVID-19. This part of our study has been carried out between 1st and 20 June 2021, several times. We interviewed 13 herbalists individually practicing in the area of Constantine, after obtaining their consent. Herbalists were from two districts : 41.6% were from Ali Mendjli, 58.4% were from El Khroub. The average age of the individuals participating in the current study was 40 9 years, all of them were men. The present interview was constructed in arabic by the members of the research team to explore changing consumption habits of herbal medicines in both qualitative and quantitative terms and investigate use frequency of herbal medicines by people, before and after the pandemic. The information gathered included ingredients of remedies, vernacular names, local names, parts used, modes of preparation/administration, and their level and purpose of utilization.

On the other hand, we performed a cross-sectional survey from 20 may to 23 June 2021 using a questionnaire. Data collection was conducted both in-person and online using purposive sampling to include participants of all ages and diverse educational and socioeconomic backgrounds.

2.2 The questionnaire

The online survey was created by the authors in arabic using google forms and the content validity of the questionnaire was ensured via consultations with experts. Participants were recruited via social media platforms. We also conducted in-person surveys.

The questionnaire applied to the participants included 24 questions divided into 3 parts. The first part was for sociodemographic characteristics such as gender, age, place of residence, professional status, health statuses (presence of chronic disease). The second part contained questions related to COVID-19. First, participants were asked whether they had experienced any Covid-19 related symptoms or not, and if they contracted COVID-19. They were also asked about their preventive measures and if they were vaccinated. A list of the common symptoms of Covid-19 (fever, dry cough, tiredness, sore throat, difficulty breathing) based on the WHO guidelines was provided with the questionnaire to help participants with the identification of Covid-19 symptoms.

Those who did not experience any symptoms were asked if they had taken any dietary supplements, herbal medicines or functional foods, as preventive measures to lower the risk of contamination. Those who experienced one or more symptoms associated with Covid-19, they were asked if they were tested positive and which test they used, as well as if they had taken any medicines, dietary supplements, herbal medicines or functional foods, to manage those symptoms. The third part concerns the participants' use of medicines, dietary supplements, herbal medicines or functional foods as preventive and curative measures against Covid-19. A list of common medicines, dietary supplements based on results obtained from the survey including herbalists, were proposed with the questionnaire to help participants with the identification of products used. Finally, participants were asked about the efficacy of remedies used, whether for prevention or for treatment.

3 Results

3.1 Survey including herbalists

The use frequency of natural remedies during the pandemic was questioned. Results showed that the utilization of herbal medicines was widespread in all age groups and it was found that the use of some medicinal plants have considerably increased during this period to the point where the prices of certain plants such as Aloysia citrodora have doubled. The most commonly used herbal medicine were Syzygium aromaticum (91.6%), Mentha spicata (91.6%), Origanum vulgare (83.3%), Artemisia herba alba (58.3%), Honey (58.3%), Eucalyptus globulus (50%), Zingiber officinale (50%), Saussurea costus (50%), Aloysia citrodora (25%), Peganum harmala (16.6%), Allium cepa (16.6%) and Matricaria chamomilla (8.3%) to lower the risk of Covid-19 infection and mainly to treat symptoms (fever, dry cough, loss of taste and smell, and headache). Honey and Moringa oleifera (16.6%) were used as dietary supplements to boost the immune

system (Tab 1). Herbalists reported that the treatment with herbal remedies improved the rate of recovery from symptoms. These herbs were taken alone or in combination, some species were administered with other ingredients such as sesame seed, black seed, lemon juice, olive oil and honey. Honey is the adjuvant most added to different herbal remedies.

Concerning plant parts and preparation mode used, leaves were the plant parts mostly used, in addition to roots and seeds. Infusion, decoction and fumigation were the major modes of preparation. Oral and inhalation were the most reported ways of administration. When asked about the source of information related to the use of these herbal medicines, most herbalists said they had relied on the traditional treatment of respiratory infections.

4 Online survey

Participants' characteristics:

A total of 310 peoples participated in the survey. The age of the participants ranged from 18 to 75 years, and the majority (43.2%) ranged from 26-35 years. Among them, 70% were female, 77.4% lived in the north-east area, and 72.1% had received university (undergraduate and graduate) education. 11.6% were suffering from one or more chronic diseases. 68.8% have experienced common symptoms of Covid-19. 28% contracted COVID-19 (tested positive). Most of the participants (85.1%) reported following the behavioral preventive guidelines.

Medication use :

About 3.6% of the participants have received COVID-19 vaccine. 37.8% of participants having contracted COVID-19, took medications to manage the symptoms. Paracetamol (70.7%) was the most commonly used drug, followed by antibiotics (mostly azithromycin) (47.2%), and anticoagulant (lovenox) (12.4%). Mineral supplements (mostly zinc) (70.9%) and vitamin supplements : vitamin C (84.4%) and vitamin D (32.6%), were also used for prevention and during the treatment. Use of herbal medicines and functional food: A large number of participants (56.8%) reported having taken herbal medicines to lower the risk of Covid-19 infection and to treat symptoms (fever, dry cough, loss of taste and smell, and headache). The most commonly used herbal medicine were Syzygium aromaticum (56.6%), Origanum vulgare (53.8%), Zingiber officinale (39.8%), Aloysia citrodora (35.1%), Artemisia herba alba (28.3%), Mentha spicata oil (16.7%), Eucalyptus globulus oil (8.4%), Ficus carica (8.8%) and Cinnamomum verum (cannelle) (7.6%), other herbal foods such as black seed, lemon juice, olive oil and honey were taken alone or in combination (6.5%). While the rate of using functional foods during the pandemic period was 24.1%, with 93.3% for fruits and vegetables, and 11.1% for meats. Most participants (85.1%) approved the efficacy of the used natural remedies.

Table 1. List of plant species used by participants to treat COVID-19.

Family/ Scientific and local name	Part used	Preparation/ administration	Usage	Main constituents	Biological activities
Lamiaceae/ *Origanum vulgare* Origan/ الزعتر	Leaves	Infusion Essential oil (inhalation)	Cough, fever, and cold	Essential oil: carvacrol, p-cymene, c-terpinen Phenolic acids: gentisic, chlorogenic, p-coumaric and rosmarinic acids. Flavonoids: hyperoside, isoquercitrin, rutin, quercitrin, quercetin and luteolin	Antimicrobial, antiviral, antioxidant, anti-inflammatory, antispasmodic, antiurolithic, antiproliferative, neuroprotective
Myrtaceae/*Syzygium aromaticum* Girofle/القرنفل	Dried cloves	Essential oil (inhalation) infusion	Improved the rate of recovery from loss of taste and smell.	Essential oil: eugenol eugenol acetate α,β-caryophyllene Tanins : tanins gallique, ellagique Flavonoids: quercetin, myricetin, kaempferol, rhamnetin, eugenitin	Anti-infective (bactericidal, virucidal and parasiticidal), Immunostimulants, anesthetic, anticoagulant
Lamiaceae/ *Mentha spicata* Menthe verte /النعناع	Leaves	Essential oil (inhalation) Infusion	Improved the rate of recovery from loss of taste and smell.	Essential oil: carvone, limonene, 1,8-cineole Phenolic acids: rosamarinic acid, gallic acid, caffeic acid Flavonoids: Luteolin, quercetin, apigenin	Anti-inflammatory, carminative, antiemetic, diaphoretic, antispasmodic, analgesic, stimulant, anticatarrhal
Verbenaceae/ *Aloysia citrodora* verveine /التيزانة	Leaves	Infusion/ decoction Essential oil	Preventing and managing respiratory problems	Essential oil: citral, limonene, geraniol and sesquiterpenes Phenolic compounds : vitexine, lutéoline-7-O-glucoside, apigénine-7-O-glucoside, flavones et leurs dérivés (salvigénine, eupafoline, hispiduline, etc).	Diuretic, expectorant, anti-inflammatory, antispasmodic, antibacterial, antiasthmatic, and antifungal
Asteraceae/*Artemisia herba alba* Armoise/الشيح	Leaves	Infusion/ decoction	Preventing and managing respiratory problems	Essential oil: camphor, α/β-thujones, 1,8-cineole and chrysanthenyl derivatives Phenolic compounds : chlorogenic acid, caffeoylquinic acid and caffeic acid derivatives,	Antispasmodic, antidiabetic, antimicrobial, antioxidant and insecticidal.

				quercetin and pultetin derivatives, hispidulin, cirsilineol, isovitexin, rutin, schaftoside, isoschaftoside, and vicenin-2	
Myrtaceae/ *Eucalyptus globulus* Eucalyptus/الكاليتوس	Leaves	Fumigation (inhalation)	Disinfectant and air purifier Preventing and managing respiratory problems	Essential oil: Eucalyptol, α-pinene, p-cymene β-myrcene Terpinen-4-ol γ -terpinene	Antioxidant, antimicrobial, insecticide, antibacterial fungicide
Zingiberaceae/*Zingiber officinale* Gingembre/الزنجبيل	Roots	Infusion/ decoction	To boost the immune system and managing respiratory problems	Essential oil: β-bisabolene, α-curcumene, zingiberene β-farnesene, α -sesquiphellandrene Phenolic compounds : gingerols, shogaols, paradols, quercetin, zingerone, gingerenone-A, and 6-dehydrogingerdione	Antioxidant, anti-inflammatory, antimicrobial, anticancer, neuroprotective, cardiovascular protective, respiratory protective, antiobesity, antidiabetic, antinausea, and antiemetic
Lauraceae/ *Cinnamomum verum* Cannelle/القرفة	Bark	Infusion/ decoction	Cough, cold and used as dietary supplements to boost the immune system.	Essential oil: eugenol cinnamaldehyde camphor Phenolic compounds : tannins.	Antiseptic, antiviral antibacterial, anti diarrhea, antioxidant, anti-inflammatory,
Zygophyllaceae/ *Peganum harmala* Peganum/الحرمل	Leaves seed	Infusion/ decoction smoke/fumigation (inhalation)	Disinfectant and air purifier/ Preventing and managing respiratory problems	Volatils: α-pinene, limonene and styrene α-pinene , trans-verbenole sabinene Alkaloids: harmine, peganine, harmaline, β-carboline and quinazoline.	Antiseptic, antimicrobial and immunomodulatory, antihypertensive, hallucinogenic, antidepressant
Moraceae/ *Ficus carica* Figue/التينة	Fruit	Maceration in olive oil	Dietary supplement respiratory (sore throats, coughs, and bronchial problems)	Volatils: linalool, epoxylinalool germacrene D, β-caryophyllene, and τ-elemene Polyphenols: gallic acid, syringic acid , vanillic acid hexoside, proanthocyanidins. Quercetin, luteolin and apigenin derivatives	Anticancer, hepatoprotective, hypoglycemic, hypolipidemic, and antimicrobial

				Vitamin and minerals	
Asteraceae/ *Saussurea costus* القسط الهندي	Root	Fumigation (inhalation) Oil	Treatment of cough and cold Dietary supplement	Sesquiterpene lactones: costunolide and dehydrocostus lactone. anthraquinones, alkaloids, tannins and inulin.	Anti-viral, antiinflammatory immunomodulatory, treatment of cough and cold, neuroprotective, anticonvulsant, anti-cancer, anti-ulcer, antiarthritic, hepatoprotective,
Moringaceae/ *Moringa oleifera* Moringa/المورينجا	Leaves	Infusion/ decoction	Dietary supplement to boost the immune system	Phenolic compounds: isothiocyanates, apigenin, quercetin and kaempferol derivatives, alkaloids Fatty acids: lauric acid, myristic acid, palmitic acid, arachidonic acid, and oleic acid.	Antioxidant, anti-inflammatory, anticancer, anti-hypertensive, hypolipidemic, hypoglycemic, antimicrobial, and hepatoprotective
Asteraceae/ Matricaria chamomilla Camomille allemande/ البابونج	Flowers	Infusion/ decoction Essential oil	Cough	Volatils: sesquiterpene derivatives polyynes. Phenolic compounds: herniarin and umbelliferone (coumarin), chlorogenic acid and caffeic acid (phenylpropanoids), apigenin, luteolin, quercetin and rutin derivatives and naringenin.	Anti-inflammatory, antiseptic, antispasmodic and mildly sudorific
Amaryllidaceae/ *Allium cepa* Oignon/البصل	Bulb	Crude (inhalation)	Rhinites infectieuses.	Phenolic compounds: quercetin-40 -monoglucoside and quercetin-3,40 -diglucoside cyanidin	Antioxidant, antimicrobial and antidiabetic

5 Discussion

Despite advances in pharmacology, many people in developing countries, especially in Africa and Asia, still rely on crude herbal extracts to treat various ailments. This is partly because these natural remedies are easily accessible and inexpensive in addition to the traditional beliefs in their efficacy and safety compared with other pharmaceuticals. In Algeria, the public still uses herbal medicines to treat various health conditions or support general health in both urban and rural areas.

As the world looks towards science in search of an effective drug or vaccine against SARS-CoV-2, a few countries, with long histories of traditional medicine use, have also started exploring the role of traditional and complementary, alongside conventional treatment. Accordingly, the aim of this study is to identify traditional herbal medicines that have been used in Algeria, to prevent or to manage symptoms associated with Covid-19, and resulted in positive health effects. Hopefully, the study's findings can shed light on potential natural candidates for treating COVID-19 to allow further biological and phytochemical assessment.

According to the results of this study, the use of some medicinal plants have considerably increased during this period. The most commonly used natural remedies medicines to lower the risk of Covid-19 infection and mainly to treat symptoms (fever, dry cough, loss of taste and smell, and headache) were Syzygium aromaticum, Mentha spicata, Origanum vulgare, Artemisia herba alba, Honey, Eucalyptus globulus, Zingiber officinale, Saussurea costus, Aloysia citrodora, Peganum harmala, Allium cepa and Matricaria chamomilla, Ficus carica, Cinnamomum verum. Honey and Moringa oleifera were used as dietary supplements to boost the immune system. These results were in accord with those reported by F,Z. Hamdani and N. Houari [9].

Leaves are the most frequently used part of the medicinal plants followed by seeds and roots. The main method for herbal medicine preparation described was infusion, decoction and fumigation administered orally and by inhalation.

Eucalyptus globulus, Peganum harmala were mainly taken alone or in combination by inhalation (fumigation) as disinfectant and air purifier for prevention and to manage respiratory problems as well. Mentha spicata and syzygium aromaticum oils used by inhalation improved the rate of recovery from loss of taste and smell.

These herbs were mostly administered with other ingredients such as sesame seed, black seed, lemon juice, olive oil and honey. Honey is the adjuvant most added to different herbal medicines.

Medicinal plants reported in this study are a hidden treasure of numerous therapeutic components like thymol, eugenol, curcuminoids, linalool, zingiberene, piperine, alpha crocin, coriandrol, cuminaldehyde, and capsaicin, and are helpful for therapy against various health disorders.These species also include a large number of essential oils [10].

Syzygium aromaticum

The predominant compound in the essential oils of clove is eugenol (phenylpropanoids) derived from the degradation of phenylalanine (amino acid). Eugenol is an active ingredient and has numerous biological activities, it is a strongly anti-infectious compound (bactericides, virucides and parasiticides), and an immunostimulant agent [11-15]. In addition, this molecule provides strong antiplatelet aggregation activity to the essential oil. It is also an antagonist of arachidonic acid (inducer of aggregation platelet) [16]. It has been shown by comparing the IC50 (Median Inhibitory Concentration) of eugenol and aspirin, that eugenol had more antiplatelet power than aspirin [16-17] (up to 5 times higher in some studies) [18].

Origanum vulgare

In North Africa (Algeria and Tunisia), O. vulgare is an aromatic shrub, which is mostly used as a medicinal plant against whooping cough, cough, fever, and bronchitis [19]. Phytochemical investigation of extract of oregano, have shown the presence of many phenolic acids (gentisic, chlorogenic, p-coumaric and rosmarinic acids) and flavonoids (hyperoside, isoquercitrin, rutin, quercitrin, quercetin and luteolin). Bejaoui et al. [20] showed that this species is a rich source of phenolic monoterpenes and carvacrol. Carvacrol is responsible for the biological activities of oregano. Recent investigations have shown many therapeutic properties: antimicrobial, antiviral, antioxidant, anti-inflammatory, antispasmodic, antiurolithic], antiproliferative, neuroprotective [21-25], and uses such as feed additive, in honeybee breeding and in gastrointestinal ailments have been shown.

Zingiber officinale

Ginger (Zingiber officinale) is a common and widely used spice. It is rich in various chemical constituents, including phenolic compounds, terpenes, polysaccharides, lipids, organic acids, and raw fibers. The health benefits of ginger are mainly attributed to its phenolic compounds, such as gingerols, shogaols and paradols. There are also many other phenolic compounds in ginger, such as quercetin, zingerone, gingerenone-A, and 6-dehydrogingerdione [26-27]. Moreover, there are several terpene components in ginger, such as -bisabolene -curcumene, zingiberene, -farnesene, -sesquiphellandrene, which are considered to be the main constituents of ginger essential oils [28]. Accumulated investigations have demonstrated that ginger possesses multiple biological activities, including antioxidant, anti-inflammatory, antimicrobial, anticancer, neuroprotective, cardiovascular protective, respiratory protective, antiobesity, antidiabetic, antinausea, and antiemetic activities [29].

Aloysia citrodora

Aloysia citriodora, commonly known as lemon verbena, is a member of the Verbenaceae family, which is widely distributed in all temperate regions of the world. This plant has been used in folk medicine extensively for its diuretic, expectorant, antispasmodic and anti-rheumatic activities [30]. There are published data on the activities of different extracts of the plant prepared by infusion or decoction [31-34]. Its leaves are mainly used for the preparation of infusions which have been utilized for the relief of gastrointestinal symptoms. However, the lit-

erature is sparse regarding the biological activities of the essential oil extracted from the plant. Phytochemical studies on this plant revealed the presence of triterpenes, flavonoids, iridoids, and phenylpropanoids. Major compounds obtained from the essential oil of Aloysia citriodora are citral, limonene, geraniol and sesquiterpenes [35].

Eucalyptus globulus

Eucalyptus (family, Myrtaceae) is one of the world's most widely planted genera. The Eucalyptus oil is a complex mixture of a variety of monoterpenes and sesquiterpenes, and aromatic phenols, oxides, ethers, alcohols, esters, aldehydes and ketones such as 1,8-cineole (Eucalyptol), citronellal, citronellol, citronellyl acetate, p-cymene, eucamalol, limonene, linalool, -pinene, -terpinene, -terpineol and aromadendrene [36–43]. Several bioactivities such as antioxidant, antimicrobial, insecticide, antibacterial and fungicide effects have also been observed for Essential Oils (EOs) produced by eucalyptus [42,43]. The major identified compounds in the leaf essential oil of E. globulus are Eucalyptol, -pinene, p-cymene, -myrcene, Terpinen-4-ol and -terpinene.

Cinnamomum verum

Cinnamon is among the earliest, most popular spices used by mankind and it has several documented properties against various diseases such as antiseptic, antiviral antibacterial, anti-diarrhea, antioxidant and anti-inflammatory activities [44]. Qualitative phytochemical estimation revealed that cinnamomum extracts contain multiple bioactive constituents namely alkaloids, tannins, saponins, terpenoids and remarkable amounts of polyphenols and flavonoids. Major compounds present in stem-bark oil and root bark oil are cinnamaldehyde, eugenol and camphor [44].

Mentha spicata

Spearmint or mint, Mentha spicata L. a perennial plant of the Lamiaceae family (or Labiaceae, Labiatae), of the genus Mentha, cultivated as an aromatic plant is a species widely used in traditional medicine for its biological properties attributed mainly to polyphenols. It has been used as a folk remedy for treatment of nausea, bronchitis, flatulence, anorexia, ulcerative colitis, and liver complaints due to its anti-inflammatory, carminative, antiemetic, diaphoretic, antispasmodic, analgesic, stimulant, emmenagogue, and anticatarrhal activities [45]. There is large variation in the chemical composition of M. spicata, wild as well as cultivated, around the world. The main constituents were carvone and limonene, followed by 1,8-cineole [46].

Peganum harmala

Peganum harmala (Zygophyllaceae) is a herb native to dry areas from east Mediterranean to northern India. It is claimed that the plant has been used as an important medicinal plant in global folk medicine [47-48]. Peganum harmala smoke has been used traditionally in Middle Eastern and Asian countries as a disinfectant and air purifier. The major components of P. harmala smoke are -pinene, limonene and styrene and those of the volatile oil are -pinene, transverbenol and sabinene. Styrene and some other components with potential antimicrobial and immunomodulatory activities were found in the smoke but not

found in the volatile oil [49]. P. harmala has various alkaloids of diverse structures that are difficult to be synthesized; however, the extract from its ripe fruit or flower contains structurally easier compounds. P. harmala contains -carboline and quinazoline alkaloids which are responsible for the toxicological and pharmacological effects of the plant. Moreover, antihypertensive, hallucinogenic, and antidepressant effects have been reported for P. harmala [50].

Ficus carica

Ficus carica is a native plant to Southwest Asia and widely spread from ancient times in the Mediterranean region. Its fruits (figs) and leaves present important nutritional components (vitamins, minerals, sugars, amino acids, etc.) and health-related effects due to their phytochemical composition. Ficus carica contain numerous bioactive compounds, such as phenolic compounds (phenolic acids), flavonoids (flavonols, flavones, and anthocyanins), coumarins, sterols, and volatiles (monoterpenes, sesquiterpenes, norisoprenoids, ketones, alcohols, esters, etc.) [51]. Its fruit, root, and leaves are used in traditional medicine to treat various ailments such as gastrointestinal (colic, indigestion, loss of appetite, and diarrhea), respiratory (sore throats, coughs, and bronchial problems), and cardiovascular disorders and as anti-inflammatory and antispasmodic remedy [52, 53].

Saussurea costus

Saussurea costus is a historical herb that has been used in various ancient systems of medicine. The roots and root oil of S. costus have been sold out as an important drug in the international herbal markets [54]. It has been prescribed as neuroprotective, anticonvulsant, anti-cancer, anti-ulcer, antiarthritic, hepatoprotective, anti-viral, antiinflammatory herb and for treatment of cough and cold in old systems of medicines such as India, China and Iran [54]. Saussurea costus, is one of the main species of the genus Saussurea (Asteraceae family). The reported active ingredients of this well known medicinal plant are mainly terpenes, while different amounts of flavonoids, anthraquinones, alkaloids, tannins and inulin were reported in several studies from the plant [55-56]. Sesquiterpene lactones, such as costunolide and dehydrocostus lactone are the major components of S. costus with several pharmacologic effects [56].

Moringa oleifera

M. oleifera is known as a valuable food source because of its high nutritional content and physiological properties [57]. M. oleifera leaves contain many fatty acids including lauric acid, myristic acid, palmitic acid, arachidonic acid, and oleic acid [66] that have a similar molecular structure to 10-HDA. 10-HDA is a bioactive compound found in royal honey that has been shown to enhance wound healing in various extensive studies. This type of fatty acid triggers fibroblasts to induce various growth factors in the wound, in particular transforming growth factor-1 (TGF-1) and vascular endothelial growth factor (VEGF) [58]. It has also been reported that Moringa leaves contain many phytoconstituents such as flavonoids, alkaloids, steroids, saponins, glucosinolates, tannis, phenolic acids, and terpenes, etc. [57-59]. The Moringa oleifera leaves have been proven to have antioxidant, anti-inflammatory, anticancer, anti-hypertensive, hypolipi-

demic, hypoglycemic, antimicrobial, and hepatoprotective pharmacological activities [57-58]. Certainly, its numerous pharmacological effects are due to the diversity of its phytochemicals .

Matricaria chamomilla

Chamomile has been used in herbal remedies for thousands of years, known in ancient Egypt, Greece, and Rome [60]. The chamomile drug is included in the pharmacopoeia of 26 countries [61]. It is an ingredient of several traditional and homeopathy medicinal preparations [62]. As a drug, it finds use in flatulence, colic, hysteria, and intermittent fever [63]. Chamomile is used mainly as an anti-inflammatory and antiseptic, also antispasmodic and mildly sudorific. Sesquiterpenes, flavonoids, coumarins, and polyacetylenes are considered the most important constituents of the chamomile drug. The coumarins are represented in M. chamomilla by herniarin, umbelliferone, and other minor ones [63]. (Z)- and (E)-2--d-glucopyranosyloxy-4-methoxycinnamic acid (GMCA), the glucoside precursor of herniarin, were described as native compounds in chamomile [63]. In addition other phenolic compounds, such as chlorogenic acid and caffeic acid (phenylpropanoids), apigenin, apigenin-7-O-glucoside, luteolin and luteolin-7-O-glucoside (flavones), quercetin and rutin (flavonols), and naringenin (flavanone) were found in chamomile extract [63].

Allium cepa

Common onion (Allium cepa) is one of the oldest cultivated plants, utilized worldwide as both vegetable and flavouring. This species is known to contain sulphur amino acids together with many vitamins and minerals. Many epidemiological studies confirmed that dietary consumption of onions is associated with a reduced risk of developing many forms of cancer and cardiovascular and neurodegenerative diseases [64]. Their beneficial effect on health is attributed to high contents of biologically active phytomolecules, such as phenolic compounds, especially flavonoids, and several organosulfur compounds [64]. The most abundant flavonoids found in onions are quercetins, namely quercetin-40 -monoglucoside and quercetin-3,40 -diglucoside, which account for more than 85% of the total flavonoid content [64]. In addition to flavonoids, onions, especially the red varieties, are a rich source of anthocyanins. The most frequently reported anthocyanins in red onions are cyanidin derivatives, although minor amounts of peonidin, petunidin, and delphidin derivatives have also been identified [64]. Different biological properties, such as antioxidant, antimicrobial and antidiabetic, have been reported [64].

Artemisia herba alba

Artemisia herba-alba belongs to the Asteraceae family; it is known for its therapeutic and medicinal properties. In traditional medicine A. herba alba is used as an antispasmodic and in treatment of diabetes mellitus [65-66]. Its essential oil is known for its antimicrobial, antioxidant, insecticidal, and antispasmodic activities [66]. Various secondary metabolites have been isolated from A. herba-alba : Sesquiterpene lactones are among the prominent natural products found in Artemisia species and are largely responsible for the importance of these plants in medicine and pharmacy. It contains also phenolic acids such as

chlorogenic acid, caffeoylquinic acid and caffeic acid derivatives, and flavonoids such as quercetin and pultetin derivatives, hispidulin, cirsilineol, isovitexin, rutin, schaftoside, isoschaftoside, and vicenin-2. In Algerian essential oil, camphor, /β-thujones, 1,8-cineole and chrysanthenyl derivatives were the major components [67-68].

6 Conclusion

Phytotherapy is very widespread in Algerian society, we use many plants and their extracts in various therapy. The use of the reported natural remedies, traditionally used for treatment of respiratory problems, have increased considerably during the COVD-19 pandemic. A total of 14 species of plants belonging to 9 families were identified as commonly used ethno medicinal plants for the prevention and management of symptoms associated with Covid-19. The most important species according to their use frequency are Syzygium aromaticum, Mentha spicata, Origanum vulgare, Artemisia herba alba, Eucalyptus globulus, Zingiber officinale, Saussurea costus, Aloysia citrodora, Peganum harmala, Allium cepa, Ficus carica, Cinnamomum verum and Matricaria chamomilla. Moringa oleifera was used as dietary supplements to boost the immune system.These herbs were mostly administered with other ingredients such as sesame seed, black seed, lemon juice, olive oil and honey. In this study, Syzygium aromaticum, Mentha spicata, Origanum vulgare and Zingiber officinale, are in first position in relative importance. These findings can be used for complementary scientific research in the fields of pharmacology and phytochemistry. In the future, biological activities and related mechanisms of action should be further investigated.

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