



# Showcasing the Internationally Prioritized Medicinal Plants to Counteract the Pandemics – Potential Remedies for COVID-19 and other Forms of SARS

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**Abstract:** Indigenous communities throughout the globe respond to COVID-19 by their traditional medicinal systems as primary health care. Our lab was part of an international study that discusses the outcomes of a rapid response, preliminary survey during the first phase of the pandemic among social and community contacts in five metropolises heavily affected by the COVID-19 health crisis (Wuhan, Milan, Madrid, New York, and Rio de Janeiro) and in twelve rural areas or countries initially less affected by the pandemic (Appalachia, Jamaica, Bolivia, Romania, Belarus, Lithuania, Poland, Georgia, Turkey, Pakistan, Cambodia, and South Africa). Primarily, people have relied on teas and spices (“food-medicines”) to prevent and mitigate its symptoms. Urban diasporas and rural households seem to have repurposed homemade plant-based remedies that they use on daily basis to treat the flu and other respiratory problems and hence consider among the healthy foods. The most remarkable shift in many areas has been increased in the consumption of ginger and garlic, followed by onion, turmeric, lemon, chamomile, black tea, nettle, chili pepper, and apple. This study serves as a baseline for future systematic ethnobotanical studies countering COVID-19 and other vicious types of viruses. It aims to inspire in-depth research on how use patterns of plant-based foods and beverages, both “traditional” and “new,” are changing during and after the COVID-19 pandemic. Our reflections in this study call attention to the importance of ethnobiology, ethnomedicine, and ethno-gastronomy research into domestic health care strategies for improving community health. Some of these economically important plants are suggested to be extensively analyzed experimentally, for active ingredients, phytochemicals, and the precursor of vaccines and probable remedy of SARS including COVID-19.

**Keywords:** Ethno-medicines; COVID-19; Pandemic; Potential Remedies.

## 1. INTRODUCTION

The outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; COVID-19) in the city of Wuhan China in 2019 and its ubiquitous nature spread it worldwide and caused millions of deaths so far [1, 2]. On the 30<sup>th</sup> of January 2020, World Health Organization (WHO) declared an emergency of international concern for public health because of the SARS-CoV-2 [3]. Close contact with infected individuals is the main reason for the speedy propagation of COVID-19 [4, 5]. Facial protection, social distancing, increased hygiene, and avoiding

large gatherings are various measures to flatten the spread of the COVID-19 pandemic [6, 7], but these nonmedicinal precautions are inadequate for long-term management [8]. Researchers are working hard for the development of vaccines, nanomedicines, and other effective medications to prevent the fatal COVID-19 [9, 10]. Local communities throughout the globe use various homemade medicines to treat the coronavirus disease at indigenous levels [8]. The traditional societies living in villages are mostly economically marginalized, but they are wealthy in terms of biological resources [11]. They use homemade herbal medicines and natural

products for decades to prevent viral diseases [12] which shows great potential and efficiency. In the current era, it is undeniable that natural products and herbal medicine are still playing a crucial role in drug discovery [13, 14].

Plant species used as antiviral remedies have acceptable toxicity which makes it a potential prophylactic candidate to combat the SARS-COVID-19. *Magnolia officinalis* bark a combination of TCM and Western treatments is being used extensively in China to treat COVID-19 patients [15]. A study has screened 125 Chinese herbal medicines with the potential of direct inhibition on COVID-19. More than 125 species of plants are ingredients in these treatment formulations. These generally include *Glycyrrhiza* spp., *Panax* spp, and *Cibotium barometz*. Species used in more than five formulations are *Glycyrrhiza* spp., *Magnolia officinalis*, *Scutellaria baicalensis*, *Ephedra* spp., *Atractylodes macrocephala*, *Forsythia suspensa*, *Pogostemon cablin*. The main species found in the commercial trade of liquorice are *Glycyrrhiza glabra* and *Glycyrrhiza uralensis* [7].

Frequently used plants in SARS treatments include *Lonicera japonica*, *Glycyrrhiza uralensis*, *Astragalus membranaceus*, *Atractylodes macrocephala*, *Angelica sinensis*, *Scutellaria baicalensis*, *Schisandra chinensis*, and *Panax quinquefolius* [16]. Keeping in mind the importance of homemade medicines we have based our study on a recommendation proposed by [17]. They have mentioned the 10 most important plant species widely used across 17 case studies. We have gathered literature on these plant species for a respiratory disorders, viral disease in general, and COVID 19 in particular. This research aims to showcase the highly important plant species for taming and management of the pandemic days.

## 2. MATERIALS AND METHODS

The data generated by reviewing the current state of the knowledge and research articles on the perception and the use of medicinal plants as potential remedies against COVID-19. Relevant research articles were searched via different search engines such as “google scholar”, ISI web of knowledge, PubMed, without any restriction of the publication year using different combinations of

search terms; medicinal plants OR ethnomedicinal plant and (against COVID-19 and respiratory problems), phytochemical OR phytoconstituents, remedies OR recipes, globe OR worldwide. Through initial selection, 186 research articles were appraised addressing medicinal plants with antimicrobial properties. Further screening of these research articles by reading abstract, conclusion (results and discussion where needed) overall 124 published articles met the aim of the study.

## 3. RESULTS AND DISCUSSION

Plants have great therapeutic potential to cure various health disorders. Therefore, used all over the world against various diseases including viral infections. These are actively used in the form of herbal remedies and are preferred to encounter different diseases due to easy access, low cost, and least or no side effects. However, in this period of the unexpected viral outbreak with no possible treatment, people responded to COVID-19 preliminary with easily accessible plant species. Globally ten selected plants are reviewed for antiviral activity along with their action against respiratory disorders. These include common household plants i.e., *Zingiber officinale* Roscoe, *Allium sativum* L., *Allium cepa* L., *Curcuma longa* L., *Citrus limon* (L.) Osbeck., *Matricaria chamomilla* L., *Camellia sinensis* (L.) Kuntze., *Urtica dioica* L., *Capsicum annuum* L., and *Malus domestica* Borkh as shown in Table 1 and Figure 1.

### 3.1 *Zingiber officinale* Roscoe.

*Zingiber officinale* Roscoe, (Figure 1a) has been traditionally used for throat infections and broadly reported against many diseases. Many of the studies proved its activity against viral diseases in the form of potential extracts or other additives. According to [18], fresh ginger has an anti-viral activity that decreases plaque formation induced by the human respiratory syncytial virus (HRSV). Mishra et al., [19] reviewed that its extracts are involved in the modulation of inductive genes responsible for chronic inflammation while ginger’s rhizome isolates such as ingenol and 6-shogaol exhibit antiviral activity. According to these studies, *Z. officinale* was a highly cited plant species used against COVID-19 as shown in Figure 2. Relative importance value highlights the ten most important



Fig. 1. (a) Ginger (b) Garlic (c) Onion (d) Turmeric (e) Lemon (f) Black tea (g) Nettle (h) Apple

Table 1. Top ten globally prioritized medicinal plants exhibiting anti-viral and respiratory therapeutic activities

S. No.	Plant Species	Anti-microbial (anti-viral)	Respiratory Diseases
1.	<i>Zingiber officinale</i> Roscoe.	[42-46]	[42-44, 47, 48].
2.	<i>Allium sativum</i> L.	[49-53]	[49, 51, 54-56]
3.	<i>Allium cepa</i> L.	[57-61]	[62-66]
4.	<i>Curcuma longa</i> L.	[67-71]	[71-75]
5.	<i>Citrus limon</i> (L.) Osbeck	[76-80]	[81-85]
6.	<i>Matricaria chamomilla</i> L.	[86-91]	[88, 92, 93].
7.	<i>Camellia sinensis</i> (L.) Kuntze	[94-99]	[100-102]
8.	<i>Urtica dioica</i> L.	[103-109]	[108, 110, 111]
9.	<i>Capsicum annum</i> L,	[112-116]	[112, 117-119]
10.	<i>Malus domestica</i> Borkh.	[120-123]	[123,124]

taxa used among which ginger was the most significant of all, used as home remedies during the preliminary stage of pandemic (Figure 3). Ginger rhizome is the most vital part of the plant and is highly being used as a spice in cuisines, due to its high potential against throat infection dried or fresh ginger tea is the best remedy for its cure. Some, of the global evaluation of *Zingiber* showing anti-viral potential and therapeutic activity against respiratory disorders, are mentioned in Table 1. However, reported gingerol and zingerol extracted from ginger as active inhibitors of COVID-19 strain. Pakistan cost 71 million US\$ in 2017 for importing 79,000 tonnes of ginger (<https://pc.gov>.

[pk/uploads/report/Ginger\\_Cluster\\_Report.pdf](https://pc.gov/pk/uploads/report/Ginger_Cluster_Report.pdf)). Our neighboring country is the world-leading country having similar climatic conditions to our Punjab province. If we identify suitable zones in our country for ginger production, we can save such a huge amount.

### 3.2 *Allium sativum* L.

Our study reveals *Allium sativum* (Figure 1b) as the second most abundantly (3.8 RI value) used medical plant against COVID-19 around the globe. Sulphur-containing phytoconstituents such as allacin, alliin, vinyldithiins, ajoenes, and flavonoids

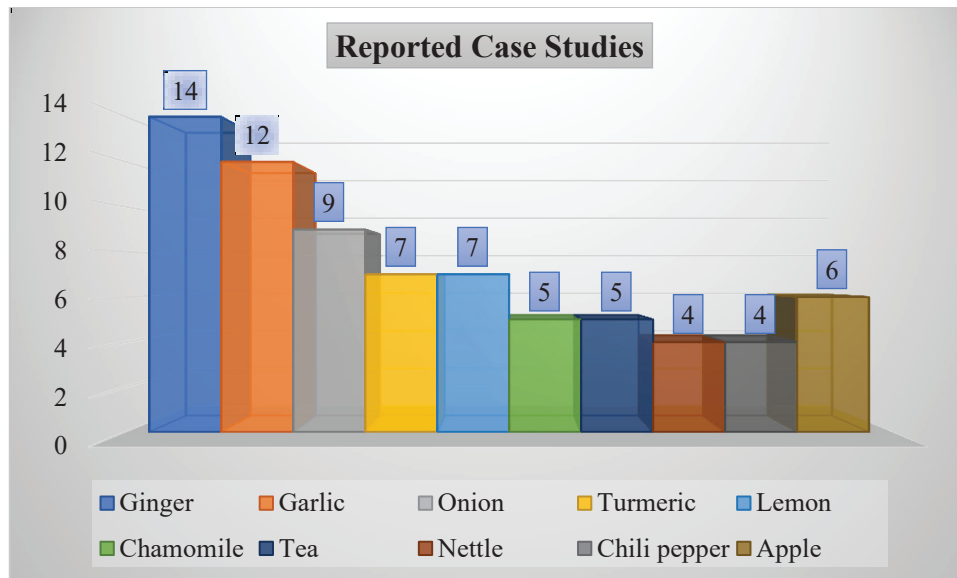


Fig. 2. Plant species reportedly used for the treatment of COVID-19

particularly quercetin have proven antimicrobial, antifungal, and antiviral properties [20]. Organic sulphur compounds have proven antiviral activities to human, animal, and plant viruses [21]. In Pakistan garlic is cultivated over 7973 hectares area in 2015 with a 72987 tonnes production [22]. Garlic is a very potential and economic crop and plays an important role in the livelihood of agricultural societies of the country.

### 3.3 *Allium cepa* L.

*Allium cepa* comes next to *A. sativum* against COVID-19 with a 3.7 RI value and is a rich source of polyphenols, flavonoids, saponins, organic sulphur along with other secondary metabolites [23]. Onion (ure 1c) is an economic and commercially important vegetable crop throughout the world. In Pakistan, it is cultivated over an area of 131.40 hectares. In 2018, the annual production of onion was 1.8 million tonnes (DOI: 10.13140/RG.2.2.11139.04647).

### 3.4 *Curcuma longa* L.

*Curcuma longa* is among the premier spices used in a variety of dishes due to its posed medicinal properties with a 2.9 RI value. Phytochemical profiling of turmeric seems to be dominated by curcumin and cyclocurcumin with anti-viral properties mainly by binding the active site of SRS CoV-2 protease [24, 25]. Turmeric (Figure

1d) is an important figure of condiments and spices throughout the country. It is cultivated in different areas of the country, but the district Kasur is the leading district with an 80% share of the annual production of 30569 metric tonnes [26]. The demand for turmeric consumption increases with time due to which its per kg price also increases. Therefore, its cultivation on broad scales is crucial for the development of the livelihood of agricultural societies.

### 3.5 *Citrus limon* (L.) Osbeck.

*Citrus limon* is a medicinally very important plant with a 2.7 RI value widely used in different preparations. Its photochemistry reveals the presence of phenolic acids such as synaptic, ferulic, and p-hydroxybenzoic acid and phenolic compounds such as limocitrin, diosmin, hesperidin making it suitable against various microbial diseases [27]. Citrus (Figure 1e) is grown in different areas of the country. The total citrus production from 2014-2015 was 2.4 million tonnes [28]. The trend for Citrus gardens development increases in the region which is considered an important step for the employment of traditional societies.

### 3.6 *Matricaria chamomilla* L.

Chamomile is the single ingredient most popular herbal tea prepared from dried and brewed flowers for multiple medicinal purposes. Potential medicinal



properties of *Matricaria chamomilla* accounted as out-turn of bioactive compounds. Phenolic compounds are the premier constituent of flowers essentially flavonoids such as quercetin, apigenin, luteolin, patuletin, and glucosides. Whereas terpenoids  $\alpha$ -bisabolol and azulenes to chamazulene are ruling components of its essential oil [29]. The existing fact, of phytoconstituents occurrence, made chamomile tea a suitable alternative against respiratory and viral diseases. Chamomile is a popular medicinal herb used at large scales as an herbal tea in the region. Another species *Matricaria recutita* is grown in the highlands for commercial purposes. Nowadays *Matricaria chamomilla* is grown in herbal medicines industries to produce homeopathic medicines, through the cultivation of this important species we can increase livelihood and employment chances in the region.

### 3.7 *Camellia sinensis* (L.) Kuntze

On the top of herbal teas comes green tea (*Camellia sinensis*) where dried leaves and flowers are used. *Camellia sinensis* (Figure 1f) brought to play against viral and respiratory diseases essentially due to diversified chemical compounds. Primarily polyphenolic constituents such as catechins, epicatechin gallate (ECG), epigallocatechin gallate (EGCG), and epigallocatechin (EGC) reported from previously studied literature of [30] against influenza virus by restricting or inhibiting replication and could be a possible reason for its recommendation against a broad spectrum of viral diseases. Polyphenol epigallocatechin-3-gallate found premier chemical compound against hepatitis B virus [31] and anti-HIV therapy. Pakistan imports tea from other countries like Kenya, Bangladesh, Brazil, etc. The government of Pakistan in 1986 established a national tea research station at Shinkiyari district Mansehra. A tea garden was established over 30 acres of land to enhance tea production in the country [32]. Unfortunately, tea production is still a challenge for Pakistan.

### 3.8 *Urtica dioica* L.

The stinging nettle possesses an Immuno-modulatory effect that helped native people in symptomatic cure of COVID-19. Almost the same number of case studies were reported as that of *Capsicum* but, *Urtica dioica* L. (Figure 1g) is

relatively much important than chilli and Apple having RI value greater than that of *Capsicum annuum* L. and *Malus domestica* Borkh as illustrated in Figure 3 & Figure 4. Nettle help in covid-19 mortality as reported by [33], 2020. It reduces pain and has anti-inflammatory therapeutic activity and can be used in the form of tea and food [34]. Leaf of *Urtica dioica* L. was used effectively as an anti-asthmatic agent and against lung diseases worldwide and initially at hospitals to relieve fever pain due to viral infection [35] (Table. 1). *Urtica dioica* is widely distributed in the temperate zones of both hemispheres. In Pakistan, the species is distributed in the Himalayan and few regions of the Karakoram and Hindukush mountainous ranges.

### 3.9 *Capsicum annuum* L.

Among the ten most potential plant species used in the primary phase of the pandemic, *Capsicum annuum* L. was also one of them. It is a common plant used globally as a spice in most cuisines. Its bio-active compounds are used to target the COVID-19 main protease (Mpro) but before it was utilized in the form of remedies to overcome the symptoms of this novel virus [36]. The global studies reported *Capsicum* as one of the widely used plants with an RI value of 1.2, in the first phase of the pandemic. It has been experimentally reported to possess antimicrobial i.e., anti-viral, anti-inflammatory, and effectively used against respiratory disorders (Table .1). The capsicum fruit is the food additive as well as traditionally it has been used to combat several disorders. Capsaicin is the most active alkaloid present in pepper that exhibits the binding affinity of COVID-10 protease [37] that made it capable of combating the pandemic. Sindh province of Pakistan is very popular for chilli production. The country contributes 2 lac tons of chillies. Unfortunately, with the increase in climatic changes, chillies production decreases in the region [38]. The introduction of suitable and potential varieties can lead to more significance in chilli production in the region.

### 3.10 *Malus domestica* Borkh.

*Malus domestica* (Figure 1h) is also documented as an important plant against antimicrobial activities. It contains a rich content of polyphenols both in its pulp and peels comparatively in more concentration

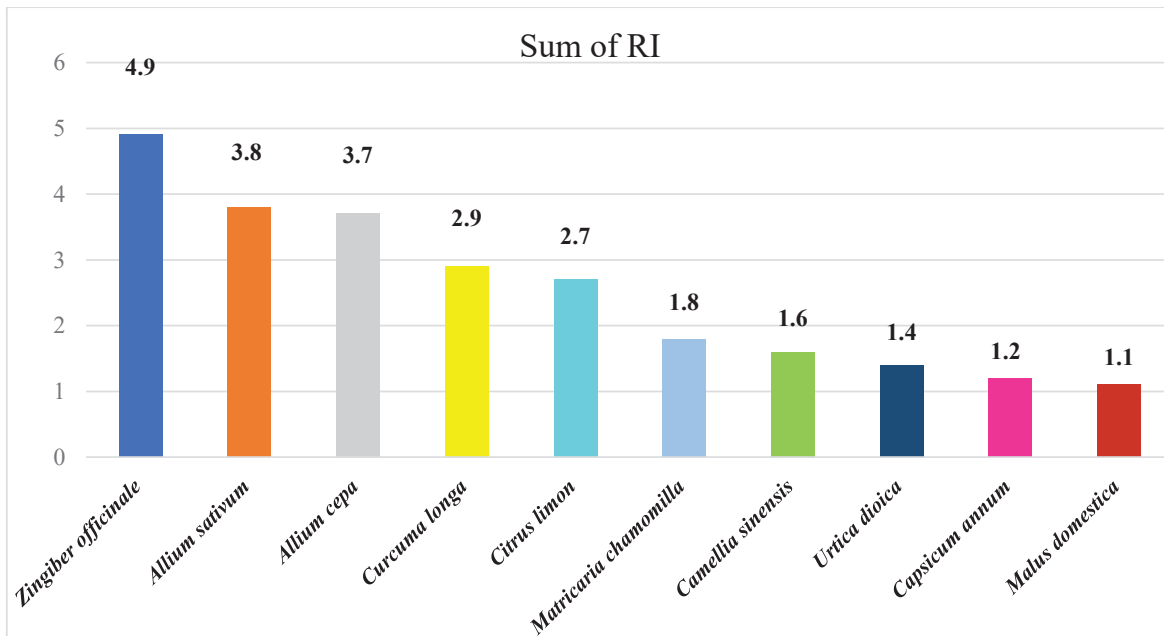


Fig. 3. Sum of the Relative importance of potential plants used during a pandemic

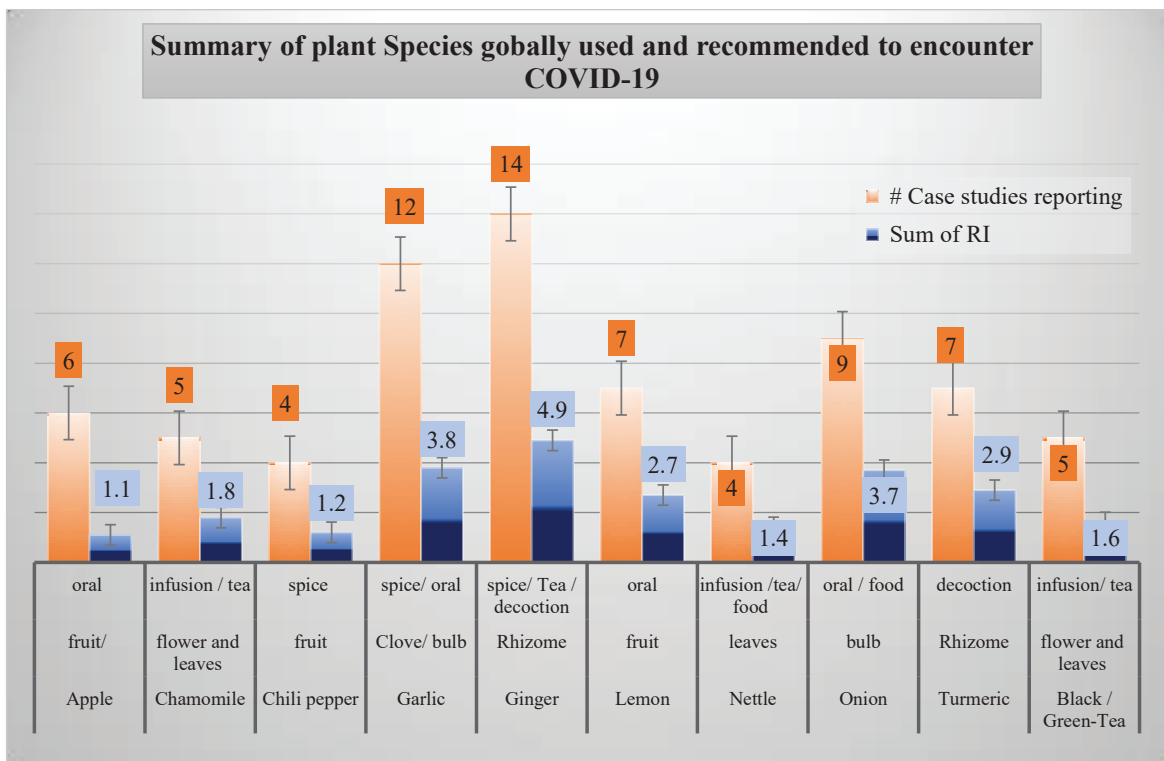


Fig. 4. Summary of globally utilized plant species and its mode of administration.

in organic than conventionally grown apples. The phenolic compound composition might be a possible reason for the recommendation against COVID-19 [39, 40]. Furthermore, genistein is found as the best phytoestrogen against a broad spectrum of viral diseases as reviewed by [41]. These medicinal

plants could be acceptable as preventive measures against COVID-19 primarily by boosting the immune system and suppressing growth. Annual apple production in Pakistan was 620.0 thousand tonnes in 2016 from a land of 97,000 hectares. Apples are cultivated in Baluchistan, Khyber-

Pakhtunkhwa, Gilgit-Baltistan over 1000-meter elevation. Apple contributes significantly to livelihood and employment in the region.

#### 4. CONCLUSION

The studies on internationally prioritized medicinal plants against the pandemic were evaluated. We have found that *Zingiber officinale* Rosc, *Allium sativum* L, and *Allium cepa* L. were the potentially effective medicinal plants used in households to encounter the pandemic COVID-19. These species have anti-septic, anti-viral, and other therapeutic potentials that aid in the cure of diseases. These contain active secondary metabolites which can be the primary precursor in the drug discovery development against COVID-19. In case of any new variant of COVID 19 or a new pandemic, a country should think about the self-sufficiency in the nutraceutical products as lockdown may cause a severe problem in this connection. Therefore, we recommend further research on these plants to be evaluated which will lead to yield effective outcomes.

#### 5. CONFLICT OF INTEREST

The authors declare no conflict of interest.

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