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Cultural belief and medicinal plants in treating COVID 19 patients of Western Colombia

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ABSTRACT

The main background of this study is that corona virus (COVID-19) has caused a global chaos where there was a complete lockdown of the whole planet as well as the collapse of the health system in many developed, developing and under-developed countries. This situation has caused a public health system and till date no decisive treatment is being confirmed so far. The present study from western Colombia focuses on the importance of traditional, cultural and generations history with reference to the use of importance and significance of medicinal plants, especially to find out a strategy to fight the new virus. The study was designed based on three major novel ethno-environmental strategies based on infusion, hot drinks, fresh baths and jelly types were identified. Based on the generated results, the calculated highest used species in the present pandemia indicates *Zingiber officinale* Roscoe (1.0), *Eucalyptus globulus* Labiil. (0.86), *Citrus x limon* (L.) Osbeck (0.80), *Gliricidia sepium* (Jacq.) Walp (0.56) and *Matricaria recutita* L. (0.52) were the species with the highest use. No significant difference was observed between men and women for the level of knowledge on these traditional medicinal plants. Moreover, many of the scientific information demonstrate their effectiveness in treating the respiratory infections caused due to the corona virus. The results infer the importance of traditional medicine, knowledge which needs more attention and research to counter attack the outbreak especially in medically weak health systems.

1. Introduction

The new corona virus outbreak “COVID-19” is a respiratory disease that has affected the whole planet and it is recorded as one of the fastest spreading disease in the modern times with a high death rate (<http://covid19.who.int>). The disease was detected in late December 2019, but it gained attention World-wide during mid-March 2020 when the whole planet went into a complete lock down with all human movements stopped as per the advice of World Health Organization [1,2]. Specifically, the outbreak of the disease was traced to Wuhan, China in late 2019 early 2020 and it spread around exponentially in a

roaring manner [3]. The most important symptoms are high fever, cough and fatigue and in the worst case it affected the respiratory system where the patient ultimately dies [4,5]. According to updated data on 2nd November, 2021, nearly 248,039,551 confirmed cases are reported world-wide and 5,024,445 persons have lost their lives due to this deadly pandemic (<https://worldmeters.info/coronavirus/coronavirus-death-toll/>). The main attraction in this pandemia is the mortality rate which prompted the scientific community go on a war footing in search of vaccines and medications that can stop the spread of the disease and most importantly to arrest the control the mortality rate [6].

In the present scenario, the interest in putting into practice on the

Abbreviations: E, Eucaliptus; HIV, Human immuno deficiency virus; MZ, Manzanilla; RPL, Relative Popularity Level of Plants; STU, Significant Tramil Use (STU); SUT, Significant Use of Tramil; WHO, World Health Organization.

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traditional knowledge associated with the use of medicinal plants in particular as a strategy to mitigate the impacts of COVID-19 was identified [7,8]. Recent report indicates that in the world 390,000 plant species are identified, where approximately 60,000 have been exclusively used as medicinal plants and around 26,000 of those have direct scientific evidence and confirmed through cultural practice in different geographical regions [9,10]. More importantly, the use of medicinal plants and trade has raised in recent decades internationally with a net revenue that has tripled over time 1.3 (in 1998) to 3.3 billion USD (in 2018) [10]. The growth on use of the medicinal plants has responded very well recently to meet the economic challenge of many recently during the current pandemia [11].

1.1. Worldwide scenario

Recently, in China a study indicates that the *Radix glycyrrhizae* rhizome [12,13] is an option that is important for its healing properties. Moreover, according to Chinese guidelines it can be used as a guide for treatment of COVID-19 patients. However, it is still in clinical process to produce the evidences [14,15]. Another specific case that attracts the attention of plants, is the amount of amino acids (L21) that these lectin (griffithsin) contains which are produced by the red algae of the genus *Griffithsia*. This also acted as an inhibitory agent for many viruses including the HIV virus, ebola virus and some corona viruses [14,16]. On a world-wide scenario, plant species like *Myristica fatua* Houtt, *Glycyrrhiza glabra* L. and *Psidium guajava* L. was used to control the spread of the deadly virus dengue, influenza (H1N1) and HIV respectively [17–20]. Moreover, important diseases like diabetics and obesity has been treated with *Salvia leucantha* Cav., liver based problems with *Cymbopogon citratus* (DC.) Stapf [21,22]. Based on historical evidences, the plants open up important possibilities to efficiently control the COVID-19 pandemic in the absence of effective regular treatments [6]. Hence the importance of rescuing the society and in managing the economy during the health emergency period can be directly linked to the concept of “socio-environmental intelligence”.

The main aim of this study is to describe the role of cultural belief, society, its contribution with the use of medicinal plants to counteract the health emergency. This was done where a balance was achieved in the local community through knowledge, sensitiveness and behavioral act of humans which contributed to find some sought of remedial measures in the Western Colombia. In addition, other purpose of the study was to evaluate the level of knowledge between men and women considering the number of plants reported by each participant.

2. Materials and methods

2.1. Patient search and data generation

Based on experience and with reference to the subject to assess the relevance of the study, a survey was applied using the Google Drive tool and a general questionnaire was prepared and distributed to patients with possible symptoms in the Chocó Department of Western Colombia during June/July 2020 (Fig. 1). The questionnaire was distributed in two different manner: 1) through emails and 2) through whatsapp messages as these are the widely used online messaging softwares/ programs used in this region of Colombia. The questionnaire was focused on just six different easy enquiry which will brought the answers for: 1) Place of residence; 2) Gender; 3) What are medicinal plants he/ she used during the COVID-19 treatment; 4) How/ ways of using the medicinal plants; 5) How they got the recipe for treating the COVID-19 virus and 6) Did you or have any symptoms associated with COVID-19 patients? (Supplementary Table T1). Moreover, the participation in this survey was made as voluntary without restriction of racial ethnicity, age, gender or sexual orientation [7]. The whole survey was applied in the Colombian Pacific region which has traditional history of knowledge of medicinal plants dominated by the Afro-Colombian race community people. In addition,

the purpose of the study was to know the level of knowledge for local men/women who are considering or using the medicinal plants for the treatment of the COVID-19 virus. The survey was closed as soon as it reached a total of one hundred participants ($n = 100$) (Supplementary Table T2). The number of participants was also not pre-fixed, but due to the low response of participants the response was very low and it was decided to close the questionnaire, which was also statistically sufficient for any general analysis. Moreover, based on ethnobiological concepts has been applied in the present study and due to the present limitations 100 participants has only been presented [23].

The plants used during the treatment were recognized by photographs and the description of the diagnostic characteristics of the participants. The plants were also identified using the list of plants (<https://www.theplantlist.org>) and the virtual herbarium of the Universidad Nacional de Colombia (<https://www.biovirtual.unal.edu.co/nombrecomun/es/en>) were consulted to corroborate scientific names assigned to each species [24,25]. Herbarium data information was extracted from the already published data and was compared with the ethnobotanical data [25]. In addition, the plant species was also identified based on the herbarium list in Universidad Tecnológica del Chocó, Colombia in Department of Chocó, Colombia, which was validated with all available scientific names. The whole data was organized based on genus and species as categorized along with the WHO International Classification of Diseases 10, where the mode of application, parts used and mode of application was recorded [26].

2.2. Type and approach of study

The present study was approached in a mixed way which was focused on ways to measure the qualitative and quantitative variables of data collection on usage of medicinal plants. This was done based on the information related to traditional knowledge associated with the use of medicinal plants during this time of pandemic. Mostly, the native and introduced plants were included for the analysis [27] and the formulas associated with industrial drugs were rejected because it was not considered as an ethnobotanical study.

2.3. Data analysis

The collected information was tabulated in an Excel spreadsheet and was purified until obtaining the necessary information for our analysis. The use value index that refers to the importance of use that a given species has according to its reporting frequency in the sampling was applied and is obtained through the following process explained in Eq. (1).

$$UV_{is} = \frac{\sum \text{species frequency, } is}{\text{maximum value of the most used species}} \quad (1)$$

Where, UV is the use of value index of the species usage. The maximum value is calculated by the most species used that obtained the highest report in the entire individual sample (i.e the most used). Moreover, it can be a same species or a different species. The UV_{is} varies between 0 and 1, where 1 being the species with higher values which is highly sought for and used regularly. Significant differences were evaluated between men and women with respect to the level of knowledge in relation to the number of plants reported through a t-student test (0.05) [28].

Additionally, the relative popularity level of each species was determined to assess its sociocultural importance applying the formula below (Eq. (2)) [29]. The level of significant tramil use (STU) that values a species with frequencies greater than or equal to 20% is a subject of scientific validation. This is calculated by dividing the number of use or citation of species by the number of respondents surveyed (Eq. (3)) [30].

$$RPL = \frac{nif}{n} \quad (2)$$



Fig. 1. Study area map of Western Colombia, Colombia.

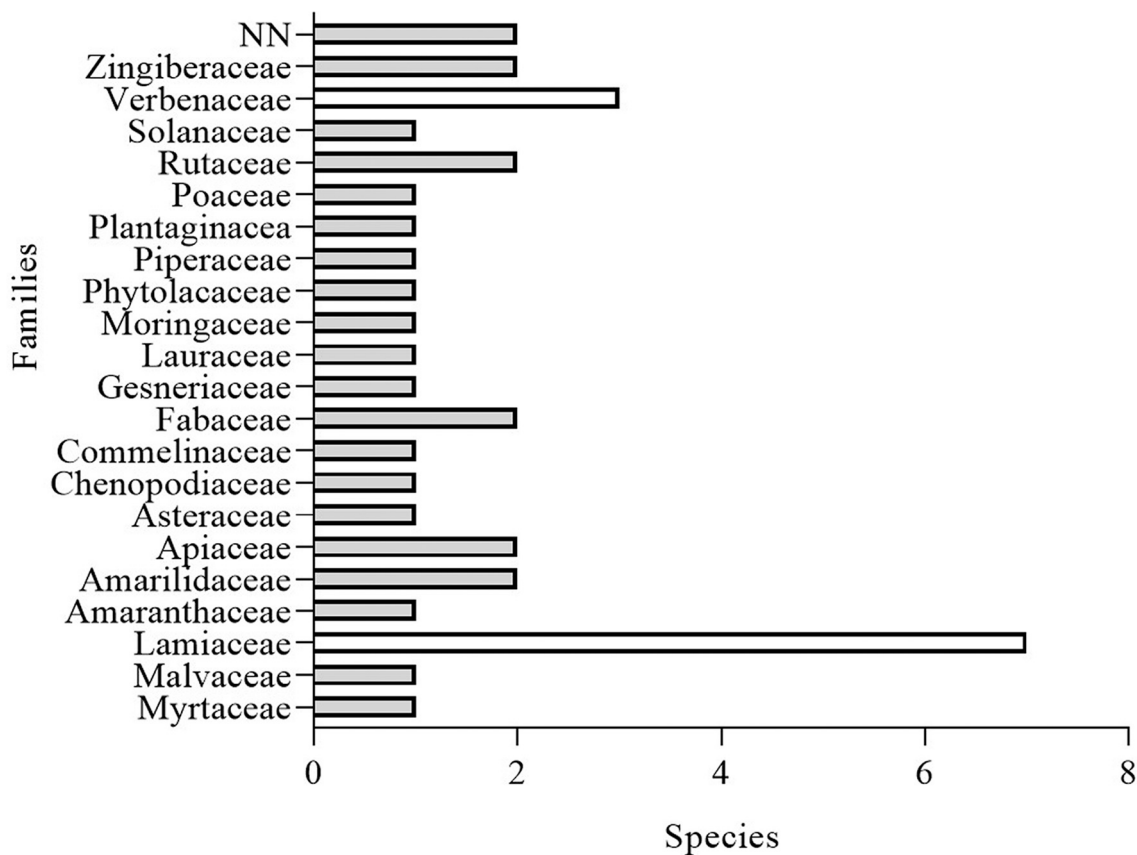


Fig. 2. Distribution of botanical families by number of species. Lamiaceae encompasses a significant number of species with high potential and applicability in the pharmaceutical industry because they have chemical compounds capable of inhibiting microbial activities.

Where, *nif* is equal to the number of informants citing the species, and *n* equal to the total number of informants.

$$SUT = \frac{\text{species } (s)}{nis} \times 100 \quad (3)$$

Where, use of species (*s*) is equal to the number of citations for each species and (*nis*) number of people surveyed.

2.4. Patient evidences

In a direct attempt to understand the use of medicinal plants, direct interviews were video recorded on the experience undergone during the treatment and only willing COVID-19 patients who wished to share the direct evidence of the process involved in using the traditional medicinal plants are presented in this study.

3. Results

3.1. Botanical composition and use value

Based on the results from the questionnaire the results generated in this study are presented based on botanical importance and its use with reference to cultural heritage.

The list yielded a total of 37 plant species comprised 22 families and 32 genus. Two of the species were unidentified in the present group. The families best represented by the number of species were Lamiaceae with

seven species (19%) and Verbenaceae (8%). The other families were represented by one to seven species respectively (Fig. 2). According to the use during the COVID-19 treatment process the following species obtained the highest use values within the various mixtures: *Zingiber officinale* (1.0), *Eucalyptus globulus* (0.86), *Gliricidia sepium* (0.56), *Citrus x limon* (0.80) and *Matricaria recutita* (0.52) (Table 1). Based on the Pearson's correlation analysis, the results indicate a positive linear relationship ($r^2 = 1$, $p < 0.01$) between the values that identifies the difference indexes of sociocultural importance and the number of citations of the species within a particular sample (Fig. 3).

3.2. Traditional knowledge

Based on the results, the participants were divided into 75 women and 25 men. The t sudden test (men $n = 25$, 2.420 ± 1.782 and women $n = 75$, 2.947 ± 1.902 ; $p > 0.005$) indicates that there are no statistically significant differences between men and women regarding the level of knowledge of medicinal plants used for treatments by different patients. The differences among the use of species is measured from the number of plants reported by each participant.

The thirty-seven species, three different patterns of formulas associated with the treatment of COVID-19 were identified. They were seen as: infusion / or hot drinks (56%), cool bath (33%) and jelly/ or syrup (11%). According to the information reported by the participants, the acquisition of the botanical formulas obtained were of the following order: Cultural beliefs (64%) > Recommended (24%) Other

Table 1
Quantitative analysis of medicinal species used in the prevention and treatment of COVID-19.

Sl.Nos.	Local name (in Spanish)	Local name (in English)	Families	Scientific name	n	UV	RPL	SUL
1	Ajo	Garlic	Amarilidaceae	<i>Allium sativum</i> L.	7	0.14	0.07	2.57*
2	Albahaca	Basil	Lamiaceae	<i>Ocimum sp</i>	2	0.04	0.02	0.74
3	Amaranto	Amaranth	Amaranthaceae	<i>Amaranthus sp</i>	1	0.02	0.01	0.37
4	Anamú	–	Phytolacaceae	<i>Petiveria alliacea</i> L.	1	0.02	0.01	0.37
5	Apio	Celery	Apiaceae	<i>Apium graveolens</i> L.	2	0.04	0.02	0.74
6	Canela	Cinnamon	Lauraceae	<i>Cinnamomum verum</i> J.Presl	2	0.04	0.02	0.74
7	Cebolla morada	Red Onion	Amarilidaceae	<i>Allium cepa</i> L.	2	0.04	0.02	0.74
8	Celedonia	–	Piperaceae	<i>Peperomia pellucida</i> Kunth	2	0.04	0.02	0.74
9	Cien picito	–	UI	UI	1	0.02	0.01	0.37
10	Cilantro	Coriander	Apiaceae	<i>Eryngium foetidum</i> L.	1	0.02	0.01	0.37
11	Coca	–	UI	UI	1	0.02	0.01	0.37
12	Cúrcuma	–	Zingiberaceae	<i>Curcuma longa</i> L.	2	0.04	0.02	0.74
13	Espabonilla	–	Gesneriaceae	<i>Glossoma panamense</i> (C.V. Morton) J.L. Clark	1	0.02	0.01	0.37
14	Eucaliptus	Eucalyptus	Myrtaceae	<i>Eucalyptus globulus</i> Labill.	43	0.86	0.43	15.81*
15	Galve	–	Fabaceae	<i>Senna reticulata</i> (Willd.) H.S.Irwin & Barneby	1	0.02	0.01	0.37
16	Guácimo	–	Malvaceae	<i>Luehea seemannii</i> Triana & Planch	1	0.02	0.01	0.37
17	Hierbabuena	Peppermint	Lamiaceae	<i>Mentha x piperita</i> L.	4	0.08	0.04	1.47
18	Jengibre	Ginger	Zingiberaceae	<i>Zingiber officinale</i> Roscoe	50	1.0	0.5	18.38*
19	Limón	Lemon	Rutaceae	<i>Citrus x limon</i> (L.) Osbeck	40	0.80	0.4	14.71*
20	Limoncillo	Lemongrass	Poaceae	<i>Cymbopogon citratus</i> (DC.) Stapf	14	0.28	0.14	5.15
21	Llantén	–	Plantaginaceae	<i>Plantago major</i> L.	1	0.02	0.01	0.37
22	Manzanilla	Chamomile	Asteraceae	<i>Matricaria recutita</i> L.	26	0.52	0.26	9.56
23	Mataratón	–	Fabaceae	<i>Gliricidia sepium</i> (Jacq.) Walp.	28	0.56	0.28	10.29*
24	Menta	Mint	Lamiaceae	<i>Mentha rotundifolia</i> (L.) Huds.	1	0.02	0.01	0.37
25	Moringa	–	Moringaceae	<i>Moringa olifera</i> Lam.	5	0.1	0.05	1.84
26	Naranja	Orange	Rutaceae	<i>Citrus x aurantium</i> L.	4	0.08	0.04	1.47
27	Orégano	–	Lamiaceae	<i>Origanum vulgare</i> L.	3	0.06	0.03	1.10
28	Orozul	–	Verbenaceae	<i>Phyla dulcis</i> (Trevir.) Moldenke	1	0.02	0.01	0.37
29	Paíco	–	Chenopodiaceae	<i>Chenopodium ambrosioides</i> L.	1	0.02	0.01	0.37
30	Poleo	–	Lamiaceae	<i>Clinopodium brownei</i> (Sw.) Kuntze	1	0.02	0.01	0.37
31	Prontoalivio	Soon-relief	Verbenaceae	<i>Lippia alba</i> (Mill.) N.E.Br. ex Britton & P.Wilson	5	0.1	0.05	1.84
32	Romero	–	Lamiaceae	<i>Rosmarinus officinalis</i> L.	2	0.04	0.02	0.74
33	Santamaría	–	Piperaceae	<i>Piper peltatum</i> L.	1	0.02	0.01	0.37
34	Sauco	–	Solanaceae	<i>Solanum sp</i>	12	0.24	0.12	4.41
35	Siempreviva	–	Commelinaceae	<i>Tripogandra serrulata</i> (Vahl) Handlos	1	0.02	0.01	0.37
36	Toronjil	Lemon balm	Lamiaceae	<i>Melissa officinalis</i> L.	1	0.02	0.01	0.37
37	Verbena	–	Verbenaceae	<i>Stachytarpheta cayennensis</i> (Rich.) Vahl	1	0.02	0.01	0.37

n = citations number; UV: use value; RPL: relative popularity level; SUL: significant usage level (tramil); UI: Unidentified.

* = species with greater value of use and cultural acceptance (>20%). These potential plants are recommended as per the government guidelines for the treatment of covid-19.

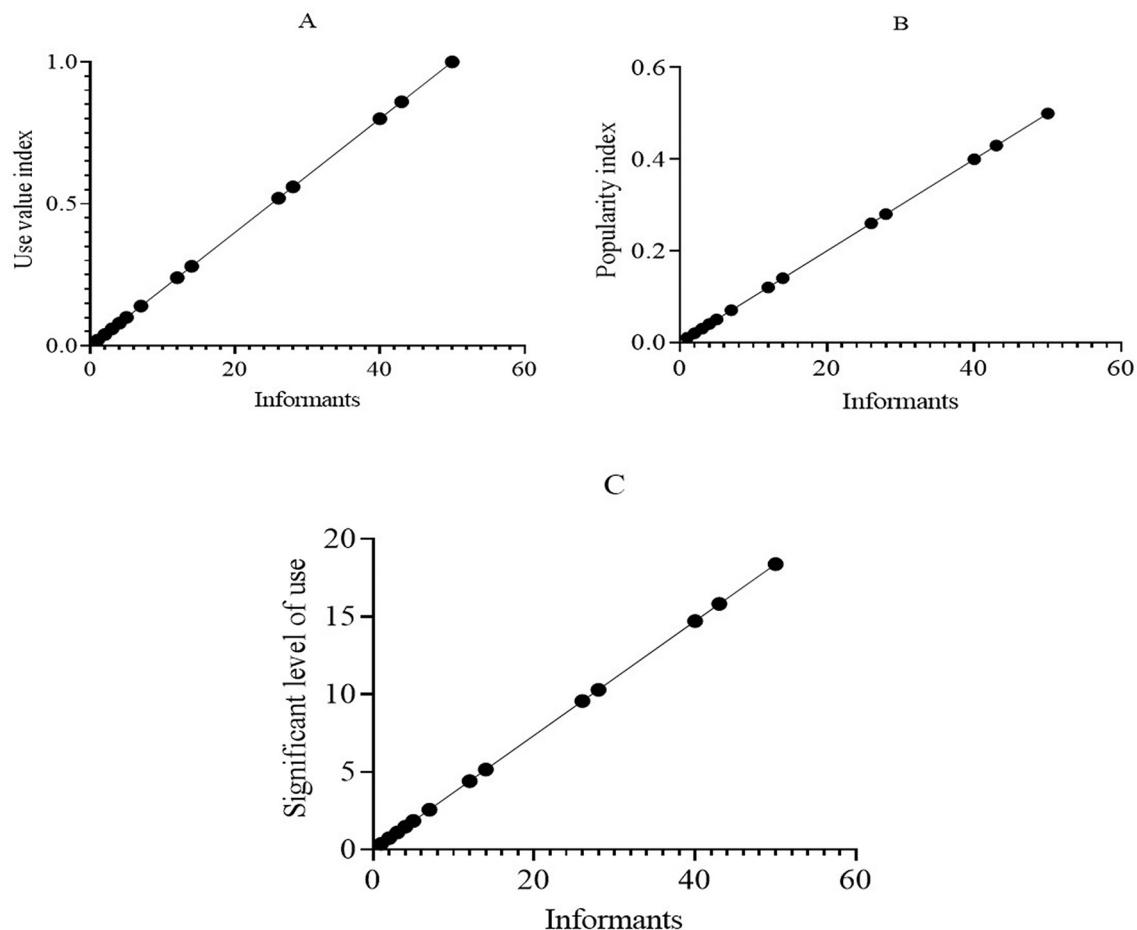


Fig. 3. a–c Linear relationship between the values that a species takes in the different indexes of sociocultural importance based on the number of citations within the sample. The number of informants has an important incidence when it comes to quantitatively evaluating the uses of plants.

(7%) > Acquired from internet (5%) respectively (Suppl. Fig. 1).

Overall, 19 persons reported having been infected with the disease and have described in detail on how they used the medicinal plants the formulas they adopted during the treatment process (Table 2). The main observation in the formulas documented were accounted as cooked (various medicinal plants), fresh bathing (using leaves), mixing the aromatics with lemon (to drink), fermented drinks (based on different mixtures) and inhalations (steam vapor generation).

4. Discussion

The traditional knowledge associated with medicinal plants nowadays is taking on wide spread importance worldwide, possibly due to the appearance of the new disease of COVID-19 [13]. Traditional medicine reveals the exclusivity of many plants used for the treatment based on health problems. During these treatments, notable differences are observed between one botanical family and another based on its distribution and sociocultural importance [31,32].

4.1. Importance of species in medicinal use

Importance of some species has to be taken into account as some of them have often significantly reached the applicability in the pharmaceutical industries [31,33].

One important species family that played a role in the present pandemic is Lamiaceae where genus *Rosmarinus* [34], *Occimum sp.*, [35,36] and *Mentha sp.*, dominated the general usage (Fig. 2). Lamiaceae for example is one of the families with a wide distribution throughout the

world with at least 200 genus and 4000 species many of them are medicinal [32,37]. This also makes it as one of the representative families in the diversity of the medicinal plants around the world [38,39] with special socio-cultural importance to the Afro-descendant communities located in this region. Additionally, the curative effectiveness is attributed to the contents of carnosic acid, carnosol, betulinic acid, camphor and rosmarinic acid [33,40,41] and phenolic compounds, di- and tri-terpenes and essential oils [42]. These components have the ability to inhibit actions of microorganisms harmful to human health [43].

During the present treatment process, mostly *C. citratus* (Lemon-grass) was used as an ancestral medicine in communities of this region and this is well supported by its use in the southwest Asian countries [44]. Its healing potential is attributed to the presence of essential oils which includes terpenes, alcohol esters, aldehydes and ketones [21,45]. Likewise, *Z. officinale* one of the most valued species in the chocono tropic in the midst of the pandemia currently has a high demand for use and commercialization, mainly due to the effectiveness in the treatment of COVID-19 patients as evidenced in the present study. Its rhizome represents an importance in food and in practical medicine which is linked to the transfer of traditional knowledge from generation to generation [46]. Phytochemical reactions during the treatment process indicate its effectiveness which is related to the presence of monoterpene and sesquiterpenic hydrocarbon content especially α -zingiberene, ar-curcumene, β -bisabolene and β -sesquiphellandrene [47,48].

Gliricidia sepium is another species which is being widely used during the present pandemia (Table 1). The phytochemical potential is related to the concentration of phenol (1.7 mg/ml) and flavonoids (0.46 mg/ml), in addition the alkaloid and saponins contents have the power to

Table 2
Medicinal formulas for the treatment of COVID-19 and participants account.

Plant codes	Mixing formula used
E	The leaves are cooked and taken in hot aromatics and infusion
MZ	The plant is cooked and lemon juice is added and it is taken hot
PCS	Several leaves are cooked, lemon is added and it is drunk in hot aromatics
AMG	Leaves are cooked and fresh baths are given from head to toe
MT	Leaves are crushed in water, then strained and fresh baths are prepared
JLE	Cook a piece of the rhizome, add lemon to taste and drink hot
AC	Crush several cloves of garlic, chop the onion, then mix and take a tablespoon three times a day
NLCJMZ	Three oranges, four lemons, two cinnamon sticks, a fist of chamomile, a piece of ginger are squeezed, then all the ingredients are cooked in two liters of water and taken hot in the mornings and nights
HA	The leaves are cooked and taken in hot aromatics and infusion
JEMZLI	In a liter of boiling water, add three centimeters of ginger, three cross-cut lemons, seven lemongrass leaves, add honey and drink hot
MGSES	The leaves are crushed in water and left to serene for a day. Then fresh baths are given for after days in the mornings, then several days are allowed to pass and the elderberry with santamaria is added. Subsequently, hot drinks and infusion of garlic, lemon, ginger, lemongrass are taken during the treatment
EJ	1/4 of panela, a piece of ginger rhizome, a crushed garlic clove, onion juice, lemon and chamomile juice and zest, boil the ingredients for half an hour. Then inhalations are made and a cup is taken three times a day for a week

Code: E = Eucaliptus; MZ = Manzanilla; PCS = Prontoalivio + Celedonia + Saucó; AMG = Anamú + Matarratón + Guácimo; MT = Matarratón; JLE = Jengibre + Limón + Eucaliptus; AC = Ajo + Cebolla; NLCJMZ = Naranja + Limón + Canela + Jengibre + Manzanilla; HA = Hierbabuena + Albahaca; JEMZLI = Jengibre + Eucaliptus + Manzanilla + Limoncillo; MTGSES = Matarratón + Galve + Saucó + Espabonilla; EJ = Eucaliptus + Jengibre. (Note: Do not drink hot drinks during treatment.)

inhibit infectious microorganisms [49]. Other observations report a value of 3.94 mg/g of flavonoids, which makes this species an important resource to alleviate health problems caused by pathogens [50]. The species continues to be promising in ethnomedicine and biomedicine because twelve important bioactive compounds are currently presumed to be present to address health problems [51,52]. Recent studies report the natural phytoconstituents (alliin, ajoenes, flavonoids, allicin and vinylthiethines) of *A. sativum* decrease the expression of proinflammatory cytokines and strengthen the immune system, where it becomes a very useful resource to counteract COVID-19 virus infections [53,54].

4.2. Popularity of medicinal plants based

Based on the acceptance of medicinal plant in the recent treatment process the following plants ranked higher in the order based on the significant usage level (only reported upto above 1%): Ginger (18.8) > Eucalyptus (15.81) > Lemon (14.71) > Matarratón (in Spanish) (10.29) > Chamomile (9.56) > Lemon grass (5.15) > Saucó (in Spanish) (4.41) > Garlic (2.57) > Moringa (in Spanish) (1.84) ≥ Prontoalivio (in Spanish) (1.84) > Orange (1.47) ≥ Peppermint (1.47) > Orégano (1.10) respectively (Table 1).

Twelve distinct medicinal formulas were reported by various respondents and the results have been documented to understand the usage way in which, traditional, cultural generational practices played a role in treating the COVID-19 virus (Table 2; Fig. 4; Video 1).

Generally, the leaves were cooked and taken along with hot aromatics and infusion (Code: E = Eucaliptus). In some cases, the plant is cooked and lemon juice is added to be taken hot (Code: MZ = Manzanilla). Several leaves (Prontoalivio + Celedonia + Saucó) (Anamú + Matarratón + Guácimo) were cooked garden-fresh and fresh baths were given morning/evening two times a day (Code: PCS, AMG, MT). Rhizome pieces were taken along with lemon as hot liquid (Code: JLE). Likewise, cloves of garlic, onion chop are crushed and mixed for

ingestion thrice a day (morning/evening) (Code: AC).

In some of the cases, large volumes of oranges, lemons, cinnamon sticks, chamomile, ginger were all cooked together and taken hot in morning and night time (Code: NLCJMZ). A combination of hierbabuena and albahaca was cooked and mixed with hot aromatics and taken (Code: HA). In boiling water, ginger, cross-cut lemons, lemongrass were mixed with honey and drunk hot (Code: JEMZLI). A combination of leaves (matarratón, galve, saucó, espabonilla) was crushed and left (soaked) for a complete day, then in the subsequent days, daily morning baths are given based on this water (Code: MGSES). Inhalations were made through boiling water vaopur where panela, ginger rhizome, garlic, clove, onion juice, lemon, chamomile juice were boiled and it was taken for a week continuously (Code: EJ) [55].

5. Human evidences and the application

Based on the questionnaire and information collected, nine patients are presented as evidences through direct interviews (Video 1). The information has been translated from the native Spanish language used in this region. All the patients presented as evidences were tested positive for COVID-19 and they have shared their knowledge on the use of medicinal plants and the particular formulas used based on their cultural traditional knowledge. The results on the confirmation of COVID-19 positive test by most of the patients has been reported by the Institute for National Health, Colombia.

5.1. Importance of ethnobotanical study

Ethnobotanical studies have increased widely during the present COVID-19 pandemic especially in underdeveloped and smaller countries [56]. This type of treatment process confirms that medicinal plants are one of the alternatives to prevent, treat and halt the spread of COVID-19 virus [13]. Moreover, the knowledge associated with medicinal plants can lead to the development of environmental awareness to face future challenges on human health [57]. However, many studies are required to help validate the effectiveness of these medicinal plants [58]. In the present situation, government guidelines can be advanced to promote public health policies linked to traditional medicine (based on medicinal plants) that can save some live around the world [9,56]. In addition, computational (*in silico*) studies, drug repurposing and genetic engineering will be a good ally in finding a safe and effective treatment against COVID-19 [59].

6. Historical evidences on use of medicinal plants

Historical evidences evaluated during the 20th and 21st century suggest that during various pandemic, the medicinal plants have played a role in the treatment process before the arrival of major vaccine (Supplementary Table T3).

In the 20th century 1957–58 “Asian Flu” outbreak, species like Garlic Red, Spider lily, and la equinaceae was used. During the 1960s when the “Dengue virus” arrived various species related to Papaya, Mint, Eucalyptus, Lemon grass, Mat grass were widely [60] used. In the 21st century “Influenza (H1N1)” virus spread during 2009–10 various evidences of Elder, Garlic Red, Spider Lily, Coconut, Chamomile, Eupatoria, La Equinaceae, Mint, Tulsi, Guduchi, Eucalytus, Yashtimadhu, Indian Goose berry, were used [61–65]. In the “Ebola virus” season during 2013 Tabaco, Benthí was the only reported species used [66,67]. In 2015 season during the spread of “Zika virus” Garlic Red, Coconut, Chamomile, Pina, Papaya and limon was used [68–71].

Recently during the COVID-19 spread, till date the use of Garlic Red, Spider Lily, Chamomile, Eucalyptus, limon, Mat grass, Ginger, Jengibre has been reported through various interviews. Commonly, in the present scenario during the ongoing pandemia the common medicinal plants which are popular in medically weak country like Colombia are: garlic, chamomile, eucalyptus, lemongrass, lemon, soon-relief, curcuma and

ginger [72]. This is very well supported by the four principal medicinal plants with strong pharmacological activity in garlic, which is rich in sulfur containing phytoconstituents such as allicin, ajoenes, vinyl-dithiols and flavonoids such as quercetin [55,75]. Likewise, ginger has the primary agents like phenylalkketones or Vanillyl ketones [73]. Presence of 1,8-cineole, spathulenol, α -terpineol, α -pinene, limonene, tricyclene, camphene, globulol, o-cimene, cisocymene, α -terpinyl acetate, ρ -cymene, β -myrcene, solanone, β -pinene, α -pinene, o-cymene, limonene, 1,8-cineole in *E. globulus* (eucalyptus) does contain strong pharmacological activity [74]. High contents of phenolic compounds mainly flavonoids (eg. Diosmin, hesperidin, limocitrin) and phenolic acids (eg. Ferulic, synaptic, p-hydroxybenzoic acids) are present in lemon [75]. The extracts are directly related to the treatments like antibacterial, antiviral, antifungal, anti-inflammatory, antiparasitic, respiratory diseases, common cold and sinus congestion problems [76–80].

7. Conclusion

The results generated from this cultural and traditional based study for treating COVID-19 patients justify the role of society and how it has been helpful in counteracting the outbreak to some extent. Generally, the study also suggests the commonly used plants that garlic, ginger, eucalyptus, lemon, lemon grass, chamomile and papaya were used during most of the pandemia that has spread during the 20th and 21st centuries. The plants were used in different mixtures in diverse conditions and considerable recovery has also been attained mostly in the rural regions (during different pandemia) which are strongly based on ethnic and cultural values.

However, phytochemical studies are also recommended and it needs to be validated for the efficacy of the chemical components not only from the popular plants, but also from the species that are invisible in the scientific world. The results also justify the need on the importance to improve the research on ethno-cultural knowledge and the significance of medicinal plants in treating various patients in under developed and medically weak countries worldwide which will often save many human lives.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.chnaes.2021.10.011>.

Ethical approval

This article does not contain any studies with human samples (only direct interviews) performed by the authors.

Declaration of Competing Interest

The authors declare no conflict of interest.

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