

Emergence of Ethnomedical COVID-19 Treatment: A Literature Review

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Abstract: The emergence of COVID-19 as a new pandemic in the modern era has led the public to a new perspective of health. In the earlier days of the COVID-19 pandemic, many factors made people go on their own ways in finding its supposed “cure”. With conventional medicines’ limited availability and access, traditional medicines become more appealing due to its widespread availability and increased perception of safety. Several herbal medicines are then believed to be able to alleviate or cure COVID-19 and its symptoms. Similarities and patterns in herbal medicines being used show local wisdom of the respective communities regarding their knowledge of diseases and its treatment, known as ethnomedicine. Despite not being approved yet by regulatory bodies as a definitive guideline in COVID-19 management, the application of ethnomedicine results in several herbal medicine candidates that show a promising result regarding its efficacy in managing COVID-19. This literature review aims to study how a society and its knowledge of medicine responds to a new and currently developing disease, and whether if that knowledge merits further study in search of a cure for the pandemic. Furthermore, the narrative aspect in this review also explores socio-politics and public health aspects and considerations of non-conventional COVID-19 treatment.

Keywords: COVID-19, SARS-CoV-2, ethnomedicine, herbal medicine

Plain Language Summary

COVID-19 pandemic poses new challenges to the clinical field. Research is done to find its treatment. Meanwhile, people are also looking for its alternatives. Several herbal medicine candidates appear as the result that might be beneficial in treating COVID-19. Nevertheless, the lack of knowledge and research of those candidates hinders its public adoption as COVID-19 treatment. Therefore, ethnomedicine, a field studying traditional medicine and the culture around it, might have the potential in guiding researchers in finding COVID-19 treatment from traditional herbal medicine. This paper reviews:

- Traditional herbal medicines used as alternative COVID-19 treatment.
- Herbal medicines’ potential for wider adoption in treating COVID-19.
- Social and political climate surrounding herbal medicine use.
- Precautions needed for the use of herbal medicine.

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Background

The emergence of the COVID-19 pandemic has led the public to a shock due to its unprecedented nature and wide scope. Ever since its declaration as a global pandemic by the World Health Organization on March 11, 2020,¹ many aspects of modern society are brought to a halt in an attempt to slow down its spread by acts

such as lockdown, restriction on events and gatherings, etc. While being effective in preventing COVID-19 spread,^{2,3} several shortcomings of COVID-19 control protocol still led the public into a panic.

In the United States, for example, disruption of supply chain due to lockdown protocol hindering corporation activities as well as increased demand caused medicine shortages.⁴ Similar phenomena also happened in other parts of the world due to unprecedented increase in demand and disruption in production line and supply.⁵ These drug shortages are further aggravated by misinformation among people that certain drugs can cure or alleviate COVID-19, such as chloroquine/hydroxychloroquine (HCQ).⁶ Misinterpretation of scientific research behind it caused people to stockpile HCQ as an anticipatory purchase, believing its capability of curing COVID-19. This further contributes to HCQ scarcity, as well as other medicines.

Lack of resources for conventional modern medicines forces people to look for its alternatives; one of them is herbal medicines. Despite some preliminary study of available herbal medicine preparations and its curative effects of COVID-19, such as the traditional Chinese medicine *Lianhua Qingwen*,^{7,8} experts still fear the misguided use of such medicines could do more harm towards people by reliance on unproven alternatives with questionable effectivity.⁹ Regional Office for Africa of the World Health Organization shared a similar sentiment regarding the use of traditional herbal medicine for COVID-19.¹⁰

Nevertheless, as patterns of similarity emerge in traditional medicines being used for COVID-19,¹¹ ethnomedicine can be used as a knowledge basis to “guide” the scientific community in search of specific plants or herbal preparation as a potential cure for COVID-19, amidst the vast number of plants or herbal preparations available in the world. The ethnomedicinal approach also allows representation of local wisdom and knowledge in the modern scientific community, therefore giving such knowledge the scientific reputation and confirmation as its modern counterparts, allowing further utilization of the underrepresented knowledge.

It can be then concluded that, despite the veil of skepticism, the scientific community receives such an approach in search of cures for COVID-19 with open hands.¹² While knowledge discrepancy of herbal medicine among clinicians poses problems in regards to its adoption,^{13–17} exhibiting mainly in forms of skepticism towards it, herbal medicine remains a potential resource of COVID-19

treatment. Therefore, an adequate amount of research should be given to back up the use of traditional or herbal treatments.

The current situation regarding the COVID-19 pandemic also proves the growing urgency of finding treatment options available for COVID-19 patients. As Chaturvedi et al argued, failure of adapting to the current needs of finding a cure for COVID-19 might pose an ethical dilemma where potentially available treatments are rendered unavailable.¹⁸

Furthermore, critical and scientific study of traditional treatments for COVID-19—and in general, other ailments—may also act as the basis of counternarrative and education in response to the growing number of misinformation surrounding alternative COVID-19 treatment. As Grimes argued, experts should intervene in the process of information propagation.¹⁹ Therefore, shifting the conversation to a scientific realm with evidence backup should be an effective way of correcting these inaccurate claims on a theoretical basis.

This study is conducted to understand how local wisdom reacts to a modern phenomenon—in this case, the COVID-19 pandemic—in terms of considerations made in choosing available traditional medicines to be considered able to cure or alleviate COVID-19. The goal is to understand the rationale of herbal medicines used in COVID-19 treatment based on its indication before COVID-19.

However, local wisdom will be taken “as-is” and not be explored further in terms of its specific history, inception, nor propagation. This research will also focus solely on medicines without considering nonpharmacological interventions such as lifestyle changes, physical therapies, and other parts of holistic treatment commonplace in traditional medicine.

Method

This research is conducted through a literature review based on publicized scientific research regarding traditional or herbal medicines used or potentially used in COVID-19 treatment. Medicines found to be used for COVID-19 are then used to find other supporting publications regarding its indicated use before the emergence of COVID-19. Novel medicines with no previous use aside from COVID-19 cases are excluded from this study.

These collected data will then be interpreted to understand the justification or indication of use in treating COVID-19. Furthermore, these medicines’ mechanism of action will also be gathered and interpreted to determine

whether if the decision of its use for COVID-19 is warranted and whether if there are similarities across these medicines. These findings are also used to classify these medicines to symptomatic treatment—ie, these medicines alleviate COVID-19 symptoms; causative treatment—ie, these medicines, similar to antiviral medicines, can stop SARS-CoV-2 replication; or neither—ie, inconclusive or unproven. Further commentaries regarding the general condition and use of COVID-19 traditional treat measures are also added.

This research is mainly conducted through online databases such as Google Scholar, PubMed, and ScienceDirect. The keywords used in the search include “COVID-19”, “SARS CoV-2”, “traditional medicine”, and/or “herbal medicine”. Subsequent research regarding individual medicines will include either its Latin, local, or brand name to explore its medicinal use before COVID-19. Furthermore, other relevant publications are also referenced in the narrative section of this article to help describe the condition of herbal medicine use in general as well as other aspects surrounding it.

Result

After conducting the research, information gathered from various publication are compiled into a table in alphabetical order as seen in [Table 1](#).

Discussion

Data and Interpretation

Of 21 medicines listed and studied, 11 (55%) of them consist of preparations originating from China as TCM, 7 (33%) from India as Ayurvedic formula, and 3 (14%) from various other locations, as illustrated in [Figure 1](#). Indeed, such distinction based on geographic location and/or can be unclear due to the plants' spread in multiple regions and cultural similarity and/or adoption. *Zingiberis* and *Curcuma*, for example, can be found spanning within bigger parts of Asia in terms of its availability and use.

Such statistics, however, can be inferred to indicate the number of research and publications made from each country and their respective culture. In this case, one can see that TCM is extensively researched and evaluated alongside its Western medicine counterpart, indicating differences in approach to traditional medicine where Chinese culture arguably embraces their heritage and successfully synthesizes it with new perspectives of Western medicine. This phenomenon, indeed, warrants further

research in anthropology, history, or related fields, preferably with a postcolonial perspective. Authors, however, hypothesize that extensive codification of TCM⁸⁷ and Ayurveda⁸⁸ contributes to its prominence in scientific research.

In terms of effectivity, all studied herbal medicines show a degree of effectivity in treating COVID-19 through symptomatic mechanism, causative, or both, as illustrated in [Figure 2](#). This might owe to most of its established use as treatments for respiratory infection based on various of its underlying ethnomedical approach (n = 13; 62%), being the hallmark of SARS-CoV-2 infection symptoms.

Unfortunately, the variety of mechanisms through which these medicines, or its constituent herbs, work prevents its interpretation in finding common mechanisms through which these herbal medicines work in alleviating COVID-19. Future studies are warranted in this aspect to optimize its use in COVID-19 as well as, where applicable, replace rare herbs used in some formulations for ecological and accessibility considerations.

Appeals of Herbal Medicine

Despite not being adopted yet into any clinical guidelines and, furthermore, being generally faced with skepticism with much of conventional medicine practitioners (ie, clinicians),^{89,90} perception is going on a positive trend and is generally improving.⁹¹ Several beneficial aspects of herbal medicine contribute to its current use and may be further used in clinical settings.

The cultural proximity of ethnomedicine and its herbal-derived medicines also play a key role in its use. Firstly, despite being an ill-advised notion, the majority of people use herbal medicine with belief that its natural origin contributes to its safety.^{92–94} Furthermore, as access to conventional medicine might be lacking in several circumstances, traditional medicine—more specifically, herbal medicine—serves as an alternative.⁹⁵ Its cultural root uses readily available resources in each geographic area, making herbal medicine more widespread for the given area. Further elaborations, especially regarding its impact, are available in the ‘Prospect and Outlook’ section.

Challenges of Herbal Medicine

Despite offering interesting appeals, the wider use of herbal medicine remains a long journey that requires a methodical approach to overcome its shortcomings. As mentioned previously, many factors hinder the wider use and adoption of herbal medicine in clinical settings.

Table I Research Result

Medicine Name	Use in COVID-19	Use Before COVID-19	Mechanism of Action	Interpretation
<i>Allium sativum</i> (garlic). ²⁰ Origin: India	Indicated for the prevention of COVID-19 infection through its immunomodulatory and antibacterial properties. ^{20,21}	Indication of antibacterial, antifungal, antiviral, antioxidant, anti-inflammatory effects, etc. ²²	Lectin, as the active compound in <i>Allium sativum</i> , inhibits viral attachment in the early replication cycle and end of viral cycle. ²³	Symptomatic, as common consensus. ²⁰
<i>Artemisia afra</i> (African wormwood). ²⁴ Origin: African countries.	Claimed by several people to cure COVID-19, ²⁵ with some evidence in its in vitro efficacy. ²⁶	Used in malarial infection. ²⁷	Artemisinin and its derivatives can bind any of SARS-CoV-2 target proteins (ie its glycoprotein, spike ectodomain structural protein, main protease, or spike receptor-binding domain), preventing viral binding to the host's ACE2 receptor. ^{26,28}	Potentially causative.
<i>Asparagus racemosus</i> (shatavari). ²⁰ Origin: India	Indication of therapeutic effects through viral protein binding. ²⁹	Known as a part of rejuvenation medicine of Ayurveda (rasayana), with antitussive, antibacterial, immunomodulatory, immunoadjuvant effects, etc. ^{20,30,31}	In silico studies show phytochemical activities through binding of SARS-CoV-2 spike receptor-binding domain, attenuating the severity of COVID-19. ²⁹	Causative due to its effect in inhibiting viral activities as well as symptomatic due to its immunomodulatory and immunoadjuvant properties.
Bai He Gu Jin Tang decoction ³² of various herbs. Origin: PRC	Indicated for the treatment of severe COVID-19 infection. ³³	Treatment of cough on pregnant patients with indication of the expectorant activity of its ingredients. ³⁴	Suppression of viral-induced NF- κ B activation and expression of IL-6, IL-8, TNF- α , IP-10, and MCP-1. Impairment of viral RNP. ³³ Decreases the level of inflammatory cytokines in the early stages of infection.	Symptomatic through its effects on COVID-19 symptoms, ie coughing and difficulty in breathing.
<i>Curcuma longa</i> L. (turmeric). ^{20,35} Origin: India, as well as other countries.	Indication of symptomatic activity as well as therapeutic activity through in-silico study and its activity in similar viruses. ^{36,37}	Indication of gastrointestinal, respiratory, inflammatory, and cardiovascular disorders, as well as antidiabetic, hepatoprotective, neuroprotective, and chemoprotective effects. ³⁸	Several molecular mechanisms of curcumin may have potential in treating COVID-19, such as inhibitory effects on Toll-like receptors, NF- κ B, inflammatory cytokines and chemokines, and bradykinin, as well as its antioxidant, antiapoptotic, and antifibrotic properties. ³⁶	Possibly symptomatic, as despite without specific research in COVID-19 treatment, curcumin is thought to be able to alleviate its symptoms.
<i>Cyperus rotundus</i> Linn. rhizoma (nut-grass) decoction. ²⁰ Origin: India	Used as a warm decoction to alleviate symptoms, with further research indicating therapeutic effect by viral protease inhibition. ^{20,39}	Various symptomatic alleviation, including analgesic, antiallergic, antiemetic, etc. ⁴⁰	In silico study of its phytoconstituents, namely β -amyryn and stigmasta-5,22-dien-3-ol, indicated its capacity in inhibiting M ^{pro} of SARS-CoV-2. ³⁹	Possibly causative. ³⁹
Gancao Ganjiang decoction ⁴¹ of <i>Glycyrrhizae radix preparata</i> (licorice, yashtimadhu) and <i>Zingiberis rhizoma</i> (ginger). Origin: PRC	Indicated for treatment in the early phase of COVID-19 infection, indicates symptomatic relief. ⁴²	Licorice is indicated for use in respiratory diseases, as well as acting as a "complement" for other medicines. ^{43,44} Ginger has various symptomatic effects for various diseases, including antipyretic, antiemetic, antiinflammation, etc. ⁴⁵	At the membrane level, glycyrrhizic acid (GLR) induces cholesterol-dependent disorganization of lipid rafts used in SARS-CoV-2 entry. At the intracellular level, GLR traps HMGB1 and blocks its alarming functions. ⁴⁶	Symptomatic, as indicated by TCM. Licorice itself, however, may show causative effect due to its antiviral activity. ⁴⁴

(Continued)

Table 1 (Continued).

Medicine Name	Use in COVID-19	Use Before COVID-19	Mechanism of Action	Interpretation
Kaloba [®] tablets EPs 7630 ^{®47} of <i>Pelargonium sidoides</i> extract. Origin: Germany	Used to attenuate the severity of respiratory syndrome of human coronavirus infection. ⁴⁸	Registered in Germany since 2005 as a standardized extract for the treatment of acute bronchitis. ⁴⁹	Underlying immunomodulatory and cytoprotective effects through inhibition of enveloped virus replication—ie human coronavirus, inhibition of interactions between bacteria and host cells, and increment of ciliary beat frequency on respiratory cells. ⁴⁸	Causative, owing to its capability in inhibiting viral replication.
Lianhua Qingwen capsule ⁴² of various herbs and minerals. Origin: PRC	Indicated for treatment in COVID-19 patients, resulting in faster recovery from its symptoms. ^{7,8}	Indicated for respiratory diseases, particularly influenza. ⁵⁰	Inhibits decrement of CD4 ⁺ and CD8 ⁺ level and protects cellular immune response. ⁵¹	Symptomatic by most available publications, albeit several leads have indicated causative possibilities. ⁵²
Maxingshigan Tang decoction ³² of various herbs. Origin: PRC	Indicated for the treatment of severe COVID-19 infection. ³²	Treatment of H1N1 influenza, leading to a reduction in fever time. ⁵³	Suggested to interact with thrombin and Toll-like receptor signaling for its anti-inflammatory effects on COVID-19. ⁵⁴	Symptomatic.
Qingfei Paidu decoction ⁴¹ of various herbs and minerals. Origin: PRC	Indicated for treatment in COVID-19 patients through its immunomodulatory effects. ⁵⁵ It is also indicated for COVID-19 treatment. ⁴²	The complex nature of this preparation has limited its research. However, it is often indicated for respiratory problems related to “qi imbalances”. ⁵⁶	Targets human coronavirus as well as pneumonia and ACE2 co-expression proteins through miRNA (MIR183), kinase (CDK7), and TF (LXR). ⁵⁷	Causative, as indicated by its use in emergency COVID-19 guidelines issued by various authorities in PRC ⁵⁶ and by its capacity in viral replication interruption.
Sang Ju Yin ³² of various herbs. Origin: PRC	Indicated for the treatment of mild COVID-19 infection, particularly with heavy cough. ³²	Indication of immunomodulatory properties. ⁵⁸	<i>Forsythia suspensa</i> , a herb constituting Sang Ju Yin, demonstrates activity in the T-cell receptor cell pathway, inhibiting T-cell activation. ^{59,60}	Symptomatic, mainly due to its immunomodulatory effects. Further research regarding its specific mechanism to COVID-19 is still not found.
Shegan Mahuang ⁴¹ of various herbs. Origin: PRC	Indicated for COVID-19 treatment through its protective nature against viral infection damage. ^{42,61}	Indicated for respiratory diseases, particularly asthmatic airway restriction. ⁶²	Attenuation of asthmatic airway hyperresponsiveness through the inhibition of Th2 and Th17 differentiation; promotion of CD4, FOXP3, and Treg generation; and suppression of mTOR and NF-κB activities. ⁶³	Symptomatic, mainly due to its mechanism of action in modulation and suppression of various cytokines. ⁶³
Shuanghuanglian of various herbs. ⁶⁴ Origin: PRC	Indicated for COVID-19 treatment through its previous use treating SARS. ⁴²	Indication of use for acute upper respiratory tract infection, with clinical trials demonstrating its possible effectivity. ^{65,66}	Inhibition of SARS-CoV-2 3CLpro and PLpro, assumedly from its baicalin and baicalein content, resulting in viral replication inhibition. ⁶⁷	Causative.
<i>Solanum</i> sp. ⁶⁸ Origin: Congo, Africa	A pilot study indicates potential benefits to COVID-19. ⁶⁸	Indication for various effects depending on species, such as bronchodilator, antibacterial, antiviral, analgesic, hepatoprotective, cardioprotective, etc. ⁶⁸	Glycoalkaloids in <i>Solanum</i> sp. shows interaction with SARS-CoV-2 protease. ⁶⁸	Preliminary findings from similar viruses may indicate causative qualities.

(Continued)

Table I (Continued).

Medicine Name	Use in COVID-19	Use Before COVID-19	Mechanism of Action	Interpretation
<i>Tinospora cordifolia</i> (heart-leaved moonseed, guduchi). ²⁰ Origin: India	Indication of therapeutic effects through viral protein binding. ⁶⁹	Known as a part of rejuvenation medicine of Ayurveda (rasayana), with immunomodulatory, antidiabetic, antitoxic, anti-HIV, antibacterial, antioxidant activities, etc. ^{20,70}	Stimulation of proteolytic maturation of viral RNA into functional proteins, namely RNA polymerase, endoribonuclease, and exoribonuclease, hampering the host's intrinsic immune system response. ⁷⁰	Causative due to its effect in inhibiting viral activities as well as symptomatic due to its immunomodulatory properties.
<i>Vetiveria zizanioides</i> L. Nash (vetiver, khus) decoction. ²⁰ Origin: India	Indicated to restore bodily balance. ⁷¹	Indication of antibacterial activities. ⁷² Empirically used for mouth ulcer, fever, headache, etc. ⁷³	Potential capability in binding with spike protein of SARS-CoV-2, changing its affinity to ACE2 receptor, restricting viral entry to human cell. ⁷³	Possibly causative.
<i>Withania somnifera</i> (Indian ginseng, ashwagandha). ²⁰ Origin: India	Indication of therapeutic effects through viral activity suppression by viral protein binding. ^{69,74}	Known as a part of rejuvenation medicine of Ayurveda (rasayana), with antioxidant, immunomodulatory, antibacterial effects, etc. ^{20,75,76}	Withanone from <i>Withania somnifera</i> reduces the glycosylation of SARS-CoV-2 via interaction with Asn343, inhibiting viral replication. ⁷⁶	Causative due to its effect in inhibiting viral activities as well as symptomatic due to its immunomodulatory properties.
Xuebijing injection ³³ of various herbs. Origin: PRC	Indicated for the treatment of severe COVID-19 infection through inhibition of inflammatory cytokines. ^{33,77}	Treatment of rheumatoid arthritis through various cytokines downregulation, severe sepsis with disseminated intravascular coagulation, and pneumonia. ^{78–80}	Inhibition of IL-6, TNF- α , and other cytokines. ⁷⁷	Symptomatic, with remarks on its effects on downregulating inflammatory cytokines; playing a key role in its use for severe COVID-19 infection.
Yin Qiao San ³² of various herbs. Origin: PRC	Indicated for the treatment of mild COVID-19 infection, particularly with a high fever. ³²	Treatment of common cold or upper respiratory infection and fever in children. ^{81,82}	Improvement of lysozyme enzyme activity and enhancement of SIgA found in saliva. ⁸³	Symptomatic.
Yu Ping Feng San decoction ³² of <i>Astragali radix</i> , <i>Atractylodis macrocephale spora</i> , and <i>Saposhnikovia radix</i> . Origin: PRC	Indicated for the prevention of COVID-19 infection through the protection of lungs' "natural qi" against "pathogenic qi" and reduction of phlegm. ³²	Treatment of respiratory infection and disease, including COPD. ⁸⁴	Regulation of core pathways, such as AGE-RAGE, PI3K-AKT, TNF, apoptosis pathway, etc. ⁸⁵ Modulation of targets, such as PTGS2 (COX2), PTGS1 (COX1), IL-6, CASP3, NOS3, TNF, etc. ⁸⁵	Symptomatic, albeit with a possibility of being causative due to its antiviral activities. ⁸⁶

Abbreviations: PRC, People's Republic of China; TCM, traditional Chinese medicine.

Lack of study and profiling of herbal medicine poses uncertainty in evidence-based medicine practice. While some herbal medicines have undergone clinical trials, ie, human in vivo trials, plenty of others have only undergone preclinical trials, ie, in silico, in vitro, or animal in vivo trials, or even none. This use of clinically unproven medicine poses dangers to patients through the use of "placebo-based medicine", resulting in delayed proper care and loss of opportunity cost that may end up exacerbating the COVID-19 pandemic.^{9,96}

Furthermore, as herbal medicine often involves the use of whole plants, the lack of biomolecular profiling also raises an issue in its adoption. This raises problems

regarding its efficacy, safety, as well as interaction with other medicines, such as in the case with *Artemisia*.⁹⁷ While the effectivity of herbal medicine can be proven through a comparative study, Firenzuoli and Gori equate the lack of study of herbal medicines' chemical constituents and its mechanism of action as reliance on a "black box".⁹⁸ This owes to the plethora of variables affecting plants, which may result in a difference in each plants' chemical constituents and amount, leading to treatment inconsistency, adverse effects, as well as possible interaction with other medicines.

One of the examples signifying the importance of in vivo testing and biomolecular mechanism profiling can be seen in

the use of HCQ for COVID-19. Subsequent in vivo testing of HCQ fail to demonstrate its efficacy in treating COVID-19 despite promising in vitro results.^{99–101} Further researches indicated that HCQ only inhibits one of many pathways of SARS-CoV-2 infection to human lung cells that are not available in previously-used in vitro test cells.¹⁰² This finding can then conclude the importance of further research needed to justify the use of herbal medicine, especially regarding COVID-19.

Socio-Politics of COVID-19 Treatment

The politicization of COVID-19 treatment with the use of herbal, traditional, or generally unconventional medicine must be acknowledged. This is usually done to maintain public order to diminish panic among the society during the pandemic, oftentimes in place of more effective yet less appealing measures and regulations such as lockdown and quarantine. In these cases, medicines—particularly herbal medicine—are marketed by various people with exaggerated claims without adequate scientific research backing them.¹⁰³

A more prominent example of such an act is in Donald J. Trump's presidency of the United States, where he advocated what was yet-to-be proven HCQ, azithromycin, and remdesivir.¹⁰⁴ It has to be acknowledged that these acts exacerbate public distrust of the government and

scientific communities, which ends up undermining COVID-19's danger and measures taken to contain it.¹⁰⁵

Furthermore, people's political partisanship and lack of union in politician's stance regarding the COVID-19 pandemic further worsen the spread of misinformation and conspiracy theories surrounding it. The view of the COVID-19 pandemic as a political move further invalidates authoritative bodies' pandemic management measures, further worsening these people's health outcome.^{106,107}

In terms of herbal medicines, its use is often based on exaggerated claims regarding its curative effect exploiting its preconceived positive belief and outlook. Several herbal medicines have been used, despite lack of evidence, not only by pseudoscientific "alternative health advocate"¹⁰⁸ but also by politicians.^{25,109}

These issues end up fueling the misinformation havoc by adding inaccurate information that buries and dilutes accurate ones; making it harder to find correct information of the pandemic. As evidenced by Enders et al, the belief of misinformation regarding COVID-19 is linked with risky behaviors that would further propagate COVID-19.¹¹⁰ Furthermore, authors argue that—as the case of *Artemisia afra*'s use—exaggerated claims of herbal medicines can portray herbal medicine badly as "unscientific", etc.

Slippery Slopes

Appeals and challenges surrounding the use of herbal medicine, particularly within the context of the COVID-19 pandemic, puts it on a slippery slope of polar extremes in stances regarding it. On one side, traditional medicine is accepted as-is without further scrutiny of evidence-based medicine practice, leading to what is, at best, exaggerated claims or, at worst, pseudoscience. This approach to herbal medicine has unfortunately been exploited by parties, oftentimes in bad faith. On

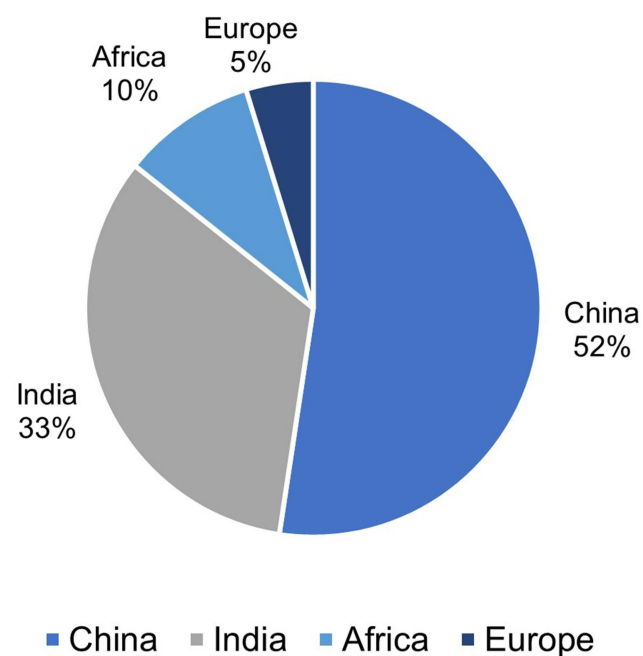


Figure 1 Geographic spread of studied herbal medicines.

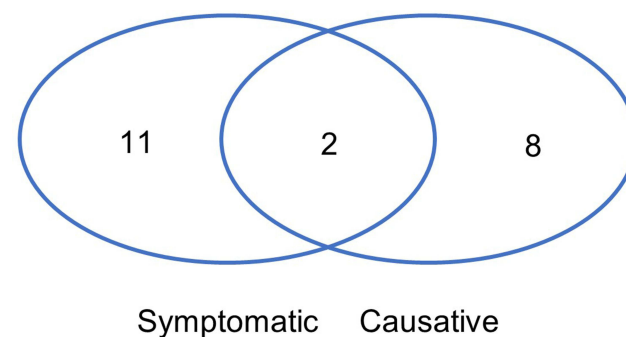


Figure 2 Effectivity of studied herbal medicines, numbers denoting n value.

the other side, the skeptical-borderline-cynical approach also comes with its risk of potentially hampering discoveries.

This phenomenon shows the delicacy of aspects related to the development of herbal medicine and its adoption among clinicians as well as people. For example, herbal medicines' perception of safety may be used in health promotion to increase people's trust,¹¹¹ while as well create an illusion of safety¹¹² and reliance on unproven medicine and further exacerbation of COVID-19 itself. Tabish described that reliance on unproven complementary and alternative medicine over traditional medicine is in and of itself reliance on placebo, which might result in loss of opportunity cost when patients end up foregoing effective treatments available for their ailments.⁹⁶

The juxtaposition between Western medicine and local traditional medicine oftentimes leads to a dichotomy between evidence-based scientific rigor and "mythical folklore" of unsupported claims. However, as evident in this research, such assumption cannot be held as true as all medicine shows some degree of correlation through symptomatic relief of its symptoms. This finding is further supported by some preliminary studies^{64,113} and meta-analysis^{11,114} showing promising theoretical basis as well as evidence regarding the use of herbal preparation. Some herbal preparations or plants used in traditional medicine, as stated above in Table 1, have also shown preliminary clinical evidence of its therapeutic effect, further supporting its use in COVID-19 treatment.

Significance and Capacity

As authors have elaborated before, it can be concluded that most problems arising from the use of herbal medicine in the present time are the social aspects that surround it; that is the problem revolves around how society perceives and treats its use in the context of contemporary knowledge. Therefore, change through regulation and education—to clinicians, patients, and people in general—should be able to shift the paradigm to bring herbal medicine use.

One example is the view of herbal medicine exclusively as complementary medicine, which hinders its research and leads to a loose regulation of its use. As of now, with most jurisdictions classifying herbal preparations as supplements, manufacturers can make claims that are not as rigorously proven as its conventional medicine counterparts.¹¹⁵ Societal view towards herbal medicine as the superior counterparts of conventional medicine also leads to reliance on subjective claims among its users.¹¹²

Looking into the history of pharmacy,¹¹⁶ one can also see its roots of drug discovery and use in plants. As many medicines—from antipyretic acetylsalicylic acid to chemotherapeutic paclitaxel are based on plant metabolites—have its origin as plant metabolites, and many other medicines are made based on these plant metabolites' mechanism of action, it is warranted to retrace and not forego the root of pharmaceutical science while also applying other knowledge built upon it. The possibility of novel active ingredients found in new medicinal plants may serve as a benefit and justification for further research.

Prospect and Outlook

Wider adoption of traditional medicine, and within itself herbal medicine, may bring several outcomes that might better the conventional medicine.

Demaio elaborated regarding the importance of appropriating health education to a society's particular culture.¹¹¹ Integration of local wisdom through ethnomedicine should work in health promotion and education in general. Regarding the COVID-19 pandemic, this approach also helps in terms of *partnership* and *adaptation of knowledge* through the involvement of local practitioners and their knowledge of both the medicine and people in the society, further leading to a *community-specific promotion*, as well as *empowerment of the community* using resources available to them.

The need for such a socio-cultural approach is further apparent in the COVID-19 pandemic due to the prevalent misinformation and distrust of science surrounding it, as mentioned before. A community-specific approach, which may or may not include ethnomedicine and herbal medicine, may help educate people and gain their trust in the healthcare system, therefore maximizing the efficacy of COVID-19 control. However, it is to be remembered that this approach should not be a way to coopt a culture, as also argued by Fofana.¹¹⁷

Furthermore, herbal medicine has also demonstrated its use as preventive medicine for various diseases, including the previous SARS epidemic.¹¹⁸ While no proper studies have been conducted in terms of the preventive role of herbal medicine in COVID-19 infection, its potential cannot be undermined.¹¹⁹ This use is further supported by traditional medicine's general paradigm that one's body can heal itself with medicines acting as an aid to reinforce it, which also includes the body's defense mechanism. General availability and accessibility of herbal medicine

also help its role as preventive measures, in conjunction with other measures such as mask-wearing and general hygiene.

While evidence-based medicine and ethnomedicine encounter issues in its reconciliation, Jonas highlighted this issue and proposed a new structure of thinking that might help approach ethnomedicine and complementary and alternative medicine.¹²⁰ Owing to the dynamic nature of local wisdom and its deep integration into society, local wisdom and its practice will remain in the society and can be used to respond to future diseases. Therefore, this analytical tool and framework can be used to approach more diseases to come.

Limitation

While authors strive for the accuracy of this study, several shortcomings should remain to be considered. Nevertheless, the authors hope that this article would serve as a reference and justification for future more in-depth research on this topic. Authors hope for future research from both medical science and social science researchers in this area.

The construction of this study as a literature review might impose a positive bias on its result due to the inherent publication bias of academic research. It also limits available data to medicines that have been published, which may pose selection bias and therefore might not present a complete view of ethnomedicine for COVID-19.

Conclusion

Traditional medicine proves to be an underexposed realm of medical knowledge. Its underrepresentation in the current medical field has been a loss in terms of opportunity cost, as its benefits have been masked by the problems that it continues to face. However, under the pressure of the COVID-19 pandemic, the medical field is forced to be able to adapt to a novel disease with its scale and burden. Therefore, in that regard, proposes for researchers to reconsider the potentials of ethnomedicine, particularly medicine, as a resource of potential treatments for COVID-19 as well as, possibly, other old or new diseases.

Among samples of ethnomedical COVID-19 herbal medicines used in this review ($n = 21$), all have demonstrated its potential in treating COVID-19 through various mechanisms, indicating ethnomedicine's capacity in adapting to novel diseases. This demonstrates ethnomedical herbal medicine's general capacity in responding to new

diseases—in this case, COVID-19—through adaptation of medicines used prior. While unsampled medicines in some cases may fail to demonstrate such efficacy, these failures should not be generalized as inadequacy of ethnomedicine itself; rather, a part of medicine discovery steps just like its conventional counterparts.

Furthermore, the intricacy of herbal medicine—especially in relation to ethnomedicine and, therefore, culture—gives a unique facet of medicine that can be a double-edged sword. While its cultural aspect can be used for clinicians to reach out to people and provide more widespread, inclusive, and accessible healthcare, it can also be misused as justification to undermine the scientific approach to medicine. A multidisciplinary approach is needed in this regard to not only study the medicines available in culture but to also “give back” the knowledge to its society to ensure its equitable access.

Regardless, ignoring the potential of what ethnomedicine has to offer would constitute an opportunity loss, especially in a condition as dire as the current pandemic. The pandemic, therefore, should catalyze the further research and codification of this field, as its capacity has been used in previous epidemics. The perpetually evolving nature of this field would make this analytical tool a substantial basis for use in studying the treatment of diseases of the present or future.

Acknowledgments

Authors express deep gratitude to Rizky Abdulah for his guidance in this research and grant through Universitas Padjadjaran, Atika, A. P., Kusumo, P. S., Indrajaya, R. M., and other friends of LPPMD Universitas Padjadjaran for the discussions and insights, and colleagues in the Faculty of Pharmacy, Universitas Padjadjaran. Funding for article processing charge (APC) is granted by Universitas Padjadjaran.

Author Contributions

All authors have contributed substantially to the creation process of this review through conception, design, drafting, revision, and analysis, and agreed on its publication and accountability.

Disclosure

Mr Kevin Aprilio reports grants from Universitas Padjadjaran, during the conduct of the study. The authors declared no other conflict of interests.

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