Medicinal Plants Used for Treating Mild Covid-19 Symptoms Among Thai Karen and Hmong

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Background: The COVID-19 pandemic is causing many severe problems globally, and it is not known for how long it will last. The only hope we have for dealing with the problem is to produce sufficient vaccines and administer them efficiently. However, the current demand for vaccines greatly exceeds the supply, and many people will suffer from the disease for still some time. Moreover, the period for immunity obtained by the vaccines remains unknown, and we cannot predict how long the world will suffer the COVID-19 infections. Therefore, there will be a continued demand for treatments of its symptoms. An alternative solution for providing such treatment is the use of traditional medicinal plants.

Aims: To document medicinal plants used by Hmong and Karen in Thailand to treat mild symptoms of COVID-19.

Methods: Traditional knowledge about ethnomedicinal plants used by Hmong and Karen in Thailand for treating mild symptoms listed by WHO as associated with COVID 19, was collected in field interviews and extracted from the literature.

Results: We identified 491 plant species used medicinally by both ethnic groups to treat fever, cough, diarrhea, muscle pain and ache, rash, headache, sore throat, and conjunctivitis. Of the 491 species 60 were mentioned at least five times in the literature or in our field data. Of these 60 species, we propose the most commonly used ones for treatments of mild COVID-19 symptoms. Ten of these most commonly mentioned species were used for treatments of fever, nine for treatment of cough, four for treatment of diarrhea, two for treatment of rash, and a single species was used to treat muscle pain and headache.

Conclusion: This study suggests alternative treatments for mild symptoms of COVID-19 with medicinal plants that are traditionally used by the ethnic minority groups of the Hmong and Karen in Thailand. Although COVID-19 is a new disease, its mild symptoms are shared with many other diseases. Traditional knowledge on medicinal plants used by the Thai Karen and Hmong could help in the treatments of these symptoms associated with COVID-19. Many of the proposed plants were used abundantly by both ethnic groups, and other studies on biological activities support their efficacy in such treatments.

Keywords: cough, diarrhea, fever, ethnobotany, headache, traditional knowledge
INTRODUCTION

In December, 2019, the emergence of a novel human virus caused respiratory system disorders in a population in Wuhan, China. Subsequently, the infection spread globally (Li et al., 2020; Zhu et al., 2020) and the virus was named SAR-CoV2 and the disease became known as COVID-19. The virus created havoc globally and it affected many people in all countries of the world. In mid-April, 2021, over three million people had died out of the 140 million who had contracted the disease worldwide and still, over 800,000 new cases are being reported daily (WHO, 2021b). The symptoms of COVID-19 vary. The most common symptoms are fever, dry cough, and fatigue. Less common symptoms are aches and pains, sore throat, diarrhea, conjunctivitis, headache, loss of taste or smell, skin rash, and discoloration of fingers and toes. The most serious symptoms are difficulty of breathing and shortness of breath, chest pain, and pressure, and loss of speech or movement (WHO, 2021a). The fear of this disease has led to the development of several vaccines, but many people are afraid of side effects from being vaccinated. It is worrying, that the current production rate of COVID-19 vaccines cannot meet the global demand. We are still learning about the COVID-19 vaccines and their efficacy in preventing new variants of the virus. Preliminary data show that some vaccines work against some variants but that they are less effective in preventing others (CDC, 2021). Another concern is that the duration of protection after getting vaccinated is not well documented. It is possible that vaccines could only protect for a short period and that vaccines would have to be given regularly, in the same way as vaccines that protect from other fevers and flues, hepatitis A and B, Tdap, and others. The worst-case scenario, even with effective vaccines that can prevent fatalities, is that the mild COVID-19 symptoms will remain a threat to our race for an unknown period of time.

In Thailand, even though there are few cases of COVID-19 infections and deaths compared to many other countries, the pandemic strongly affects cultures, economy, and happiness of the population. Thailand has only a few million doses of vaccines which is very low compared to the needs of approximately 70 million people. A similar excess in demand is found all over the world. According to UNICEF, 20% of the world population will be vaccinated by 2021 and vaccination of the entire world population might not be achieved until 2023 or later. Additional demands for vaccines depend on how long immunity will last (UNICEF, 2020). This leads to uncertainty about the time it will take to fight this disease, and especially to combat the mild symptoms of infections. Many people who have not been vaccinated are at risk of the infections and most infected people would suffer from the COVID-19 showing only mild symptoms. Therefore, we need medicines to treat such mild symptoms. Locally used medicinal plants could be one of the choices for patients infected, especially in developing countries that already extensively use medicinal plants in their primary health care (WHO, 2002). The demand for medicinal plants for medical treatment increased during the COVID-19, and the used plants were mostly associated with COVID-19 treatments (Khadka et al., 2021). However, because COVID-19 is a novel disease, there are no specific medicinal plants used to treat its symptoms. Uses of medicinal plants for the treatments is mostly based on medicinal plants used to treat symptoms related to the COVID-19. A study, that evaluated risk/benefits of medicinal plants used as adjuvant of COVID-19 treatments, found that many herbal species are safe to use (Silveira et al., 2020).

Ethnobotany is a young discipline in Thailand, but even so, the traditional medicinal plant knowledge of many of the ethnic minority groups has been studied in some detail (Phumthum et al., 2018; Phumthum, 2020). The Karen and the Hmong are the largest ethnic minorities in Thailand (HHDC, 2018). Both groups have vast traditional knowledge of medicinal plant uses (Phumthum, 2020; Phumthum et al., 2020). Traditional knowledge of medicinal plants used by these ethnic minorities is mostly unique to each group (Phumthum and Balslev, 2019). Uses of the same medicinal plants for the same treatments by people from different ethnic groups suggest efficacy of the plants (Saslis-Lagoudakis et al., 2011). Thus, cross-cultural comparison

FIGURE 1 | Locations of 56 Thai Hmong and Karen villages providing ethnomedicinal plant knowledge for treatments of symptoms related to mild Covid-19 symptoms in this study.
of the traditional knowledge of medicinal plants by the Hmong and the Karen in Thailand is useful for identifying medicinal plants that could be effective for treatments of mild COVID-19 symptoms. This leads to the aim of this study, which is to identify medicinal plants that can be proposed for treatments of mild COVID-19 symptoms. The proposal is based on traditional knowledge of Thai Hmong and Karen about the medicinal plants they use for treatments of symptoms similar to mild COVID-19 symptoms.

METHODS

Ethnomedicinal data from 31 Karen villages and 19 Hmong villages were derived from already published data and new data from six Hmong villages were collected in field studies by the authors.

Published Data

Available published data on ethnomedicinal plants used for treatments of mild COVID-19 related symptoms, such as fever, dry cough, fatigue, aches and pains, sore throat, diarrhea, conjunctivitis, headache, loss of taste or smell, skin rash, discoloration of fingers or toes (WHO, 2021a) were extracted from already published ethnobotanical studies. The inclusion criteria were: 1) The study must use accepted standard ethnobotanical methods (Martin, 1995) for collecting data; 2) all used species must be identified by their scientific names using standard botanical nomenclature; 3) the studies must have been conducted in Hmong and Karen villages in Thailand; 4) at least one species in the list must have been used for treatment of one of the mentioned mild COVID-19 symptoms; 5) the study must have been published between 1990 and 2020; 6) repeated data, such as data in a student thesis that was subsequently published in journal articles were combined. Using these criteria 33 publications were available as data sources and they originated from 19 Hmong villages and 31 Karen villages (Figure 1, Supplementary Data).

Field Study

To compensate for the smaller number of Hmong villages in the literature-based data, we conducted additional field studies to add information about traditional ethnomedicinal knowledge from six Hmong villages in Nan Province Thailand (Figure 1). Ethical approval was obtained from Chiang Mai University Research Ethics Committee with the certificate of approval number COA No. 020/61 (extended to April 19th, 2021). In the same way as the literature-based data, the data collected in the field covered plants used for treatments of the mentioned mild COVID-19 symptoms. Sixteen key respondents, who were local healers that used medicinal plants, were selected for semi-structured interviews using purposive and snow ball sampling. The studies were conducted from March 2020 to February 2021. The respondents were asked to show the plants that they used as medicine to treat the mentioned symptoms. The used plants were photographed and herbarium samples were collected for identification and documentation. The plants were identified by the authors using keys and plant descriptions in the Flora of Thailand and neighboring areas. Plant voucher specimens were deposited at the herbarium of the Department of Pharmaceutical Botany Mahidol (PBM) and Queen Sirikit Botanic Garden Herbarium (QBG).

Finally, scientific plant names and families from both published data and our field study were standardized to follow the World Checklist of Vascular Plants (WCVP) website (Kew, 2020).

Important Species

Important medicinal species for treatments of mild COVID-19 infections were evaluated by using species Use Value (UVs) (Phillips and Gentry, 1993). The Use Value is calculated using the following formula:

$$UVs = \sum_{i} \frac{Uis}{n}$$

where Uis is the number of use reports mentioned by each respondent (informant) i for a given species while n is the total number of interviewed respondents. In this study, we included both data from previous studies and the data from our recent field observation. It was difficult to identify that which respondent cited which use. We standardized the term “respondent”, which refer to a person citing a used species to “pseudorespondent” which refer to an area providing information of a used species (Phumthum et al., 2018). Therefore, the UV mentioned in this study is calculated form pseudorespondents. High UV indicates that the plants were frequently used by the pseudorespondent and implies that the plant would have potential for treatments.

RESULTS

Numbers of Use Reports

Our data include information from 56 villages (Hmong 25, Karen 31) (Figure 1) and 1230 use reports (Hmong 675, Karen 555) (Figure 2, Supplementary Table 1, supplementary materials) and 491 species (Hmong 269, Karen 297) that the people from these ethnic groups used for treatments of mild COVID-19 symptoms. Not all the above mentioned mild COVID-19 symptoms were covered in our data. We only found plants used for treatments of fever, cough, diarrhea, muscle pain, rash, headache, sore throat, and conjunctivitis, whereas the other mild COVID-19 symptoms were not treated with any plants. The number of use reports for different treatments were similar in the Hmong and Karen data. Fever was the most commonly treated symptom followed by cough, diarrhea, muscle pain, skin rash, headache, and sore throat, respectively. Treatment of conjunctivitis had the lowest numbers of use reports among both Hmong and Karen (Figure 2).

Most Used Species

Although the published and additional field studies of both ethnic groups together listed 491 species used for treatments of mild symptoms related to the COVID-19, sixty species had high use...
values (UVs) (Supplementary Table 1, supplementary materials). These 60 species accounted for almost half of the total number of use reports (Figure 2). *Psidium guajava* L. had the highest number of use reports (35) followed by *Phyllanthus emblica* L. (25), *Houttuynia cordata* Thunb. (24), *Plantago major* L. (22), and *Strobilanthes cusia* (Nees) Kuntze (21). Eleven species (*Zingiber officinale* Roscoe, *Blumea balsamifera* (L.) DC., *Elephantopus scaber* L., *Biancaea sappan* (L.) Tod., *Duhaldea cappa* (Buch.-Ham. ex D.Don) Pruski & Anderb., *Schima wallichii* (DC.) Korth., *Scoparia dulcis* L., *Teucrium viscidum* Blume, *Acorus calamus* L., *Leea indica* (Burm.f.) Merr.) had 10–20 use reports (Figure 2).

Hmong and Karen people had different ethnomedicinal knowledge about the 60 most used species. The Hmong reported 54 species of which 15 were not mentioned by the Karen. And the Karen reported 45 of the 60 most used species and six of them were not used by the Hmong. However, there were many species used by both the Hmong and the Karen that had abundant use reports for treatments of the same symptoms. *Psidium guajava* had one hundred percent of use reports for treatments of diarrhea by both Hmong and Karen people. Both ethnic groups also agreed that *Phyllanthus emblica* was useful for treating cough and fever. Approximately 94 percent of the use reports of *Strobilanthes cusia* from the Hmong and 100 percent from the Karen mentioned the use for treatment of fever. High percentages of uses from both ethnic groups presented many species for the same treatments, namely *Zingiber officinale* (cough), *Blumea balsamifera* (cough), *Elephantopus scaber* (cough), *Acorus calamus* (fever), *Zingiber ottensii* (diarrhea), and *Melicope glomerata* (fever) (Figures 2, 3).

Many species were used for treatments of specific symptoms. The Hmong used *Teucrium viscidum* to treat fever and cough, *Artemisia vulgaris* for treatment of diarrhea, *Verbena officinalis* and *Dichrocephala integrifolia* to treat rashes, *Aster indicus* and *Cassia fistula* to treat diarrhea, *Bidens biternata*, *Monosops parishii* and *Paederia pilifera* to treat fever, *Pseudoelephantopus spicatus* and *Hedyotis acutangula* to treat cough. The species that were commonly used only by the Karen for treatments of specific symptoms were *Teucrium viscidum*, *Acorus calamus*, *Zingiber officinale*, and *Melicope glomerata*.
symptoms were *Cyclea barbata* and *Alpinia malaccensis* that were used to treat cough, *Pothos scandens* used to treat muscle pain and *Mimosa pigra* which was used to treat fever (Figure 3).

**Species Used for Multiple Treatments**

Many species listed in this study were used for treatments of several symptoms, sometimes as many as five (Figure 2).
Plantago major was used by the Hmong to treat four symptoms and by the Karen to treat five different symptoms. Other species used for treatments of five symptoms included Artemisia verlotiorum (Hmong) and Tadchagi triquetrum (Karen). Many species were used to treat four symptoms by Hmong (Zingiber officinalis, Blumea balsamifera, Zingiber officinale, Ruscus communis, Tacca chantrieri) and Karen (Elephantopus scaber, Biancaca sappan, Scoparia dulcis, Cyclea barbata, Tinospora crispa, Celtis tetrandra, and Centella asiatica) (Figure 3).

**DISCUSSION**

Because COVID-19 is a new emerging disease, there are no records of medicinal plants specifically used to treat the disease. This study presents medicinal plants for which traditional knowledge in 31 Karen and 25 Hmong villages in Thailand show that they are used to treat disease with symptoms that are similar to mild COVID-19 symptoms. Although there are many mild symptoms of the COVID-19 (WHO, 2021a), we found traditional knowledge only for symptoms. Although there are many mild symptoms of COVID-19, we found traditional knowledge only for symptoms. Although there are many mild symptoms of COVID-19, we found traditional knowledge only for symptoms. Although there are many mild symptoms of COVID-19, we found traditional knowledge only for symptoms. Although there are many mild symptoms of COVID-19, we found traditional knowledge only for symptoms. Although there are many mild symptoms of COVID-19, we found traditional knowledge only for symptoms. Although there are many mild symptoms of COVID-19, we found traditional knowledge only for symptoms. Although there are many mild symptoms of COVID-19, we found traditional knowledge only for symptoms. Although there are many mild symptoms of COVID-19, we found traditional knowledge only for symptoms.

Because the Hmong and the Karen have different histories and cultures, some species were used by both groups but in totally different ways. The Hmong used Andrographis paniculata only to treat cough while the Karen used the same species only to treat fever (Figure 3). Interestingly, those species had high numbers of use reports for treatments of various symptoms. All use reports of Mimosa pigra were for treatment of fever by the Karen whereas the Hmong used Cassia fistula and Hedyotis acutangula for treatments of diarrhea and cough, respectively, (Figure 3). This suggests that these unique intensively used species could be effective medicinal plants for treatments of the mild COVID-19 symptoms.

We prioritized the species for potential further use by the following criteria: 1) plants commonly used by both ethnic groups for treatment of the most common mild COVID-19 symptoms; 2) plants commonly used by either ethnic groups for common symptoms; 3) plants commonly used by both ethnic groups for less common symptoms; and 4) plants commonly used for treatments of less common symptoms used by either ethnic group. Using these criteria, we could rank the top proposed species. Strobilanthes cusia and Acorus calamus ranked as the top species for treatments of fever. Other studies have shown that a mixture of medicinal plants with S. cusia extract inhibited influenza virus growth in a mice model (Cervi et al., 2006). Another study showed that tryptanthrin and indigodole B from S. cusia had bioactivity against human coronavirus (HCoV-NL63) (Tsai et al., 2020). Acorus calamus is also used to treat fever by other ethnic groups in Thailand and elsewhere (Sharma et al., 2014; Panyadee et al., 2019; Kyaw et al., 2021). Phyllanthus emblica has been used to treat cough and several symptoms in Ayurvedic, Turkish, Unani, and Tibetan medicines for centuries. The plant produces various kinds of secondary metabolites and the compounds act in various therapeutic treatments (Ahmad et al., 2021). Many anti-cough lozenge products from this plant are sold in Thailand. However, there is only limited scientific evidences that the plant is effective for treatment of fever. Zingiber officinale was evaluated as a medium benefit, medium overall safety, and promising benefit/risk herbal medicine as adjuvant COVID-19 symptomatic therapy.
Jiang et al., 2021). Other plants, such as an alternative choice of treatments would be suitable for COVID-19 symptoms. In the worst-case scenario, such as we medicinal plants for treatments of the mild COVID-19 symptoms. Here, we strongly emphasize that using these infected patients would have complex symptoms or serious COVID-19 is a new deadly emerging disease. Moreover, some traditional uses while others need more studies. However, the evidences that the plant produces large amounts of tannins (Anbuselvi and Rebecca, 2017), and that it is effective in the treatment of diarrhea (Hirudkar et al., 2020; Lu et al., 2020). Zingiber officinalis, a candidate for treatments of diarrhea, is much used in Thailand as a medicine for treatments of symptoms related to digestive system disorders (Phumthum and Balslev, 2020).

The medicinal plants used only by the Hmong or only by the Karen are also interesting candidates as medicinal plants for treating the mild COVID-19 symptoms. Andrographis paniculata is one of the important medicinal species in Thailand according to its use value (UV) (Phumthum et al., 2018). Although the plant is used by both ethnic groups in completely different ways (Figure 3), it provides a tremendous information on treatments of mild COVID-19 symptoms and it has antiviral activities, especially for coronaviruses (Shi et al., 2020; Bhattacharya et al., 2021; Jiang et al., 2021). Other plants, such as Mimosa pigra which is used for treatment of fever by the Karen, Hedychium acutangula and Pseudelephantopus spicatus which are used to treat cough by the Hmong, and Cassia fistula which is used to treat diarrhea by the Hmong, are interesting candidates because of their abundant uses in treatments of specific symptoms. However, pharmacological support for using these plants for treatments is rare. Further studies should focus on phytochemicals and biological activities of these plants used for treatments of the specified symptoms.

Thai Hmong and Karen traditional knowledge on ethnomedicinal plant uses provides interesting information on medicinal plant candidates for treatments of the mild COVID-19 symptoms. Several of the proposed species have substantial additional scientific evidences for pharmacological activities of these plants for treatment of mild COVID-19 symptoms. Psidium guajava was the most interesting plant for treatment of diarrhea which is a less common mild COVID-19 symptom. There is abundant scientific evidences that the plant produces large amounts of tannins (Anbuselvi and Rebecca, 2017), and that it is effective in the treatment of diarrhea (Hirudkar et al., 2020; Lu et al., 2020). Zingiber officinalis, a candidate for treatments of diarrhea, is much used in Thailand as a medicine for treatments of symptoms related to digestive system disorders (Phumthum and Balslev, 2020).

We propose several plant species for treatments of mild COVID-19 symptoms. In the worst-case scenario, such as we are currently experiencing in which we may have to stay with the disease for an unknown period of time, using these plants as an alternative choice of treatments would be suitable for many people, especially in developing countries. However, if it turns out that the vaccines have no strong side effects and are efficient to activate our immune system to protect us from the disease for a long time, we may not need to rely on these proposed medicinal plants for treatments of the mild symptoms. The traditional knowledge of the Hmong and the Karen documented in this study remains important for the development of medicines based on traditional knowledge. Although COVID-19 may disappear within a few years, fever, cough, diarrhea, muscle pain, and aches, rash on skin, headache, sore throat, and conjunctivitis are common symptoms that the majority of the world population experience annually. Therefore, studying medicines from these proposed plants is necessary and would save and may benefit the world.

CONCLUSION

We documented 1230 uses of 491 plants in treatments of mild COVID-19 symptoms as listed by WHO. The plants were mainly used to treat a subset of mild COVID-19 symptoms, including fever, cough, diarrhea, muscle pain, rash, headache, sore throat, and conjunctivitis. Sixty of the species were in common use. Strobilanthes cusia, Acorus calamus, Melicope glomerata, Andrographis paniculata, Teucrium viscida, Bidens biternata, Paederia pilfera, Mimosa pigra, Monosis parishii, Artemisia vulgaris, were used to treat fever; Zingiber officinalis, Blumea balsamifera, Elephantopus scaber, Andrographis paniculata, Teucrium viscida, Pseudelephantopus spicatus, Hedychium acutangula, Cyclea barbata, Alpinia malaccensis were used to treat cough; Psidium guajava, Zingiber officinalis, Cassia fistula, and Aster indicus were used to treat diarrhea; Verbena officinalis and Dichrocephala integripolia were used to treat skin rash; Artemisia vulgaris was used to treat headache, and Pothos scandens was used to treat muscle pain. Many of these commonly used species had additional scientific evidences that supported their ethnomedicinal uses among the Thai Hmong and Karen. However, because the COVID-19 is a new emerging disease and the symptoms have insufficient clinical data on treatments to support, we recommend that future studies should test the efficacy of these plants on treatments of the symptoms of the COVID-19. We may have to deal with COVID-19 for only a few years in the future. In this case, the plants may not be relevant for treatment of the mild COVID-19 symptoms. However, these symptoms are common and associated with many common negative health conditions. Scientific experiments need to be done to confirm their efficacy and safety. Finally, we hope that traditional knowledge from these ethnic groups would alleviate suffering of patients who have these symptoms, especially in rural communities who live on medicinal plants for their primary health care.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.
ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Chiang Mai University Research Ethics Committee 239 Huay Kaew Road, Suthep Sub-district, Mueang District, Chiang Mai Province 50200.

AUTHOR CONTRIBUTIONS

MP conceived the idea, collected data, did field studies, analyzed of the data, visualized the data, wrote and revised the manuscript, and coordinated of overall work. VN coordinated the field work and identified the species. HB wrote the manuscript, supported research expenses and critically reviewed and revised the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fphar.2021.699897/full#supplementary-material
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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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