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Potential traditional medicinal plants for COVID-19 management in Sri Lanka: A review

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Abstract

COVID-19 is a highly contagious respiratory illness caused by a novel coronavirus known as SARS-CoV-2. It has had a significant global impact on public health, economies, and daily life. Therefore, many researchers do their studies towards the finding of the different treatments to combat COVID-19. Indeed, Sri Lanka is known for its rich diversity of medicinal plants. Traditional medicinal approaches in Sri Lanka, have been explored as potential supportive measures in combating COVID-19. Among them locally produced Sri Lankan herbal products such porridge mixers, Kasaya, Asamodgam, Peyawa, and Paspanguwa are become very popular among people. Therefore, it is worth to study the scientific evidence and background of the medicinal plants used to treat COVID-19. This review summarizes the potential traditional medicinal plants in Sri Lanka that is used for the treatment of COVID-19 with having enough reliable and scientific supportive evidence of their action.

Keywords: COVID 19, Traditional, medicinal plants, treatment.

Introduction

The COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, is a global public health crisis that began in late 2019 in Wuhan, Hubei Province in China and continues to affect people around the world as of my last knowledge update in September 2021. This pandemic has had far-reaching and profound impacts on virtually every aspect of human life, including public health, economies, social interactions and daily routines ^[1, 2]. COVID-19 is caused by newly identified corona virus strain called as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) ^[3] that has spread more than 200 countries all over the world effecting to the public health. It is a member of the Coronaviridae family of the order Nidovirales, which is an enveloped single-strand RNA virus family containing four genera - Alpha, Beta, Delta, and Gamma ^[4]. The four structural proteins found in coronaviruses are spike (S), envelope (E), membrane (M), and nucleocapsid (N). Importantly, the S protein allows the virus to enter the host cell. The host protease divides it into two functional subunits, S1 and S2, which are responsible for attaching to the host cell and fusing the viral membrane, respectively ^[3]. According to the database of WHO, as of March 2023, 759 408 703 confirmed COVID-19 cases have been reported and among them, there have been 6 866 434 confirmed deaths. Fever, coughing, and shortness of breath are some of the signs and symptoms of COVID-19 ^[2]. Apart from respiratory symptoms, COVID-19 patients may undergo other conditions such as fatigue, myalgia, and diarrhea ^[2, 3, 4] and pneumonia may develop in severe cases, which might ultimately result in organ failure and even death ^[5]. Although there are other routes to spread the SARS-CoV-2 illness, contact with contaminated surfaces and respiratory droplets from infected people are the most common ^[2]. As a result, countries around the world have implemented a variety of public health and social measures to prevent and manage disease transmission, such as isolation, quarantine, social distancing, partial closure or closure of public gathering areas such as educational institutes and businesses, quarantine in specific geographic regions, and international travel restrictions ^[2].

COVID-19 in Sri Lanka

The first COVID-19 patient in Sri Lankan was a Chinese tourist and he was diagnosed on the 27th of January 2020. The first case of COVID-19 infection in Sri Lanka was reported in March 2020. After that, the Sri Lankan government encouraged the public health sector to be watchful and take the necessary precautions to stop the COVID-19 virus from spreading. However, arrival of tourists and returning of Sri Lankans from infected countries and

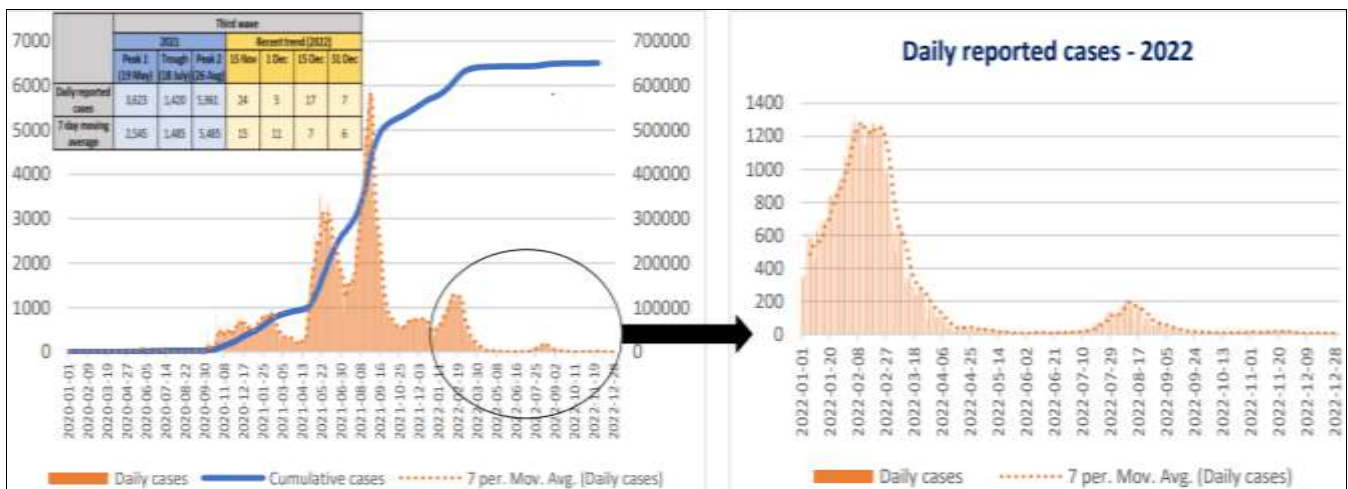
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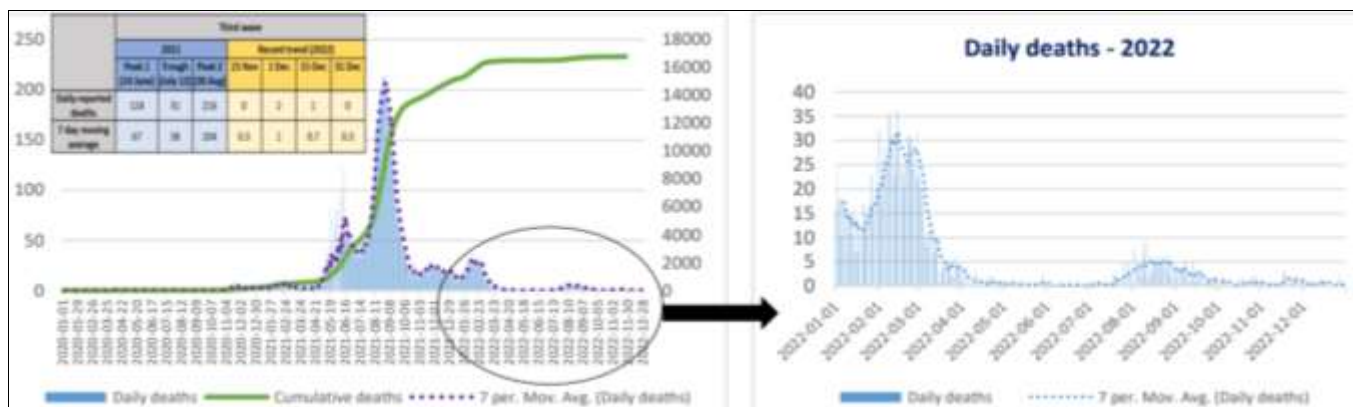
neglecting of control measures like quarantining impact to arise COVID-19 pandemic in Sri Lanka. Sri Lankan government was able to control first wave by imposing tight control measures and early precautionary steps like halting most of the activities in the country apart from essential services, isolating of persons arrival from abroad and imposing curfew for civil servants. Unfortunately, due to an

unexpected rise in infections, the second and third waves became more difficult. Clinical research revealed that Delta and Alpha variants were becoming more common, particularly in the third wave, which had a disastrous effect on all facets of life [6]. Figure 01 and Figure 02 describe the COVID-19 daily cases and death variation during 2020 -2022 in Sri Lanka respectively.



Source: Ministry of Health of Sri Lanka (Data updated until 31 December 2022)

Fig 1: Daily reported cases of COVID-19 from 2020-2022 in Sri Lanka



Source: Ministry of Health of Sri Lanka (Data updated until 31 December 2022)

Fig 2: Daily reported deaths due to COVID-19 in Sri Lanka

Table 1: Number of COVID-19 cases and deaths comparison in Sri Lanka during 2020-2022 years

	2020	2021	2022
Number of cases reported during the year	43299	543946	84646
Number of cumulative cases at the end of the year	43299	587245	671891
Number of deaths reported during the year	204	14775	1838
Number of cumulative deaths at the end of the year	204	14979	16817
Case fatality rate for the year	0.47%	2.71%	2.17%

Source: Ministry of Health of Sri Lanka (Data updated until 31 December 2022)

According to the above Fig: 1, Fig: 2 and Table 01, they conclude that a total of 671 891 cases and a total of 16 817 deaths have been reported in Sri Lanka as of 31 December. Approximately 56% of deaths were being for males and 76% of deaths were in age group of 60+.

Treatment Strategies

Due to increment of number of COVID-19 cases and death rate in the globe, most of the countries widely contributed to find possible treatment strategies to rescue from this global pandemic disease. The primary treatment strategy for COVID-19 is supportive care [2] and bed rest [4] However, broad-spectrum antibiotics [2]. Antivirals [2, 7]. Corticosteroids

[2], immune modulating therapy [8] and convalescent plasma [2]. Organ function support, respiratory support, bronchoalveolar lavage (BAL), blood purification and extracorporeal membrane oxygenation (ECMO) [9] were also introduced as treatments.

In addition, the creation of an effective and secure vaccination that is widely accessible, notwithstanding the importance of the treatment approach to the disease, is the primary method of stopping the spread of the virus. The development of vaccines meant to protect against the COVID-19 offered the entire globe a great deal of hope, and Sri Lanka similarly to other nations, planned for the immunization of its population starting from late January 2021. Astra Zeneca, Sputnik V,

Pfizer, Sinopharm, Moderna, and Sinovac vaccines have all received approval from the National Medicines Regulatory Authority (NMRA) based on a thorough examination of the quality, safety, immunogenicity, and safety data in Sri Lanka [7].

The long incubation period of the virus in humans complicates the development of effective treatments for SARS-CoV-2, making source and transmission routes elusive [10, 11]. Moreover, antiviral drugs also exhibit adverse side effects, directly and indirectly affecting human health. Since, the development of plant-based drugs and herbal treatments with minimal side effects is of utmost importance [2]. Recent studies from China report that, based on their experience in the treatment of previous respiratory syndromes such as SARS and MERS, both conventional medicine and traditional Chinese medicine can be used to treat COVID-19 patients [12].

Traditional medicinal approach as a treatment for the COVID-19

Herbal medicines are a diverse class of bioactive chemical substances derived from plants plant parts or unpurified plant extracts that frequently assumed that they work synergistically to prevent some diseases [2, 13]. They consist of various type of chemicals such as phenolic compounds, flavonoids, alkaloids, colour pigments like carotenoids and anthocyanins, plant terpenes and other sulphur-containing compounds, etc [2]. Several plant parts, including leaves, stems, flowers, roots, and seeds, as well as combinations of these, can contain these compounds [14]. There are many different types of herbal medications, including extracts, pills, mixtures, and dried plant parts [2]. Due to worries about the safety of synthetic pharmaceuticals, rising consumer demand for natural products, and a decrease in the use of chemical additives, there is an increase in the market for natural herbal drugs [13].

Use of Herbal drugs in Sri Lanka

Indigenous medicine is an age-old wisdom tradition that has been passed down by native people as a part of their distinct cultural history in Sri Lanka. Indigenous medical practices and knowledge are spread out over the nation and are a culture-bound archive of ancestors' knowledge that has endured for many generations [15]. Sri Lanka is endowed with a huge collection of medicinal plants that have been utilized in traditional medicine for millennia [14]. Around 3000 years ago, Sri Lankan plants were employed as medication by traditional medical systems, including the treatment of viral illnesses [16]. Because they are easily available and less expensive than contemporary medications, it is estimated that plant-based medications are essential in the treatment of more than 70% of Sri Lanka's population. According to reports, Sri Lanka grows 1430 different species of medicinal plants [16]. About 174 of them are endemic to Sri Lanka. These plants are often utilized alone or in conjunction with other plant sources as polyherbal formulae in Sri Lankan traditional medicine practice to treat a wide range of diseases [13, 17].

Sri Lanka has a strong track record of treating viral illnesses like influenza, the human immunodeficiency virus (HIV), herpes simplex virus (HSV), dengue, malaria, SARS, hepatitis, and coxsackievirus infections with traditional plant-

based formulations [17, 18]. Furthermore, conventional herbal remedies are also used to treat the symptoms of fever, cough, asthma, joint pain, etc [2]. The majority of the leaves including *Centella asiatica* (Gotukola), *Asparagus falcatus* (Hathavariya), *Cardiospermum halicacabum* (Wel-penela) and *Murraya koenigii* (Karapincha) used to make herbal porridge have been shown to have antiviral properties [2]. Also, there is a wide range of antiviral activity of substances identified in hot water extracts of coffee, green tea, black tea, and herbal teas against a variety of influenza viruses, minimizing lung damage by influenza viruses [2]. Before taking Western drugs, the majority of Sri Lankans turn to these herbal remedies during the early stages of illness. Few people take them along with other drugs at the same time. When all other forms of treatment have failed, another group frequently turns to herbal remedies [17].

Herbal medicine in controlling SARS-CoV

Herbal medicine has historically played an important role in the control of infectious diseases [1]. Many medicinal herbs may be employed for the management and prevention of SARS-CoV-2 infection, according to recently published literature [2]. Clinical evidence from a variety of studies of herbal medicine in the treatment of SARS coronavirus (SARS-CoV) has shown significant results [19] and favorable effects [20]. Supporting the idea that herbal medicine aids the treatment and prevention of epidemic diseases [19]. According to the previous studies, herbal medicine is regarded as one of the complementary methods for treating COVID-19 [1]. The medicinal plants have the potential to treat SARS-CoV-2 infections in two ways: either by boosting the patient's overall immunity or by acting directly against the virus by preventing its transcription and replication, which shortens the duration of illness, or by blocking viral signal transduction [21, 22, 23].

The data amply demonstrate Sri Lanka's strong position in the world rankings for COVID-19 recoveries due to controlling spread of COVID-19. Without a doubt, achieving this level of control was aided using our antiquated therapy procedures and household routines [15]. Traditional medical procedures and herbal remedies have been largely accepted by Sri Lankans in the COVID-19 pandemic [24]. As a result, locally produced Sri Lankan herbal products such as Perumkayam, Instant Kanji or porridge mixers, Kasaya, Asamodgam, Peyawa, and Paspanguwa are in high demand [2]. As coronavirus predominantly affects the lungs and respiratory system, ayurvedic treatments like herbal fumigation also known as "dhoomayanaya" may help patients breathe better and build up their immune systems, increasing their resistance to viral infections [2]. During the pandemic, Sri Lankans consumed the herbal remedy of coriander seeds – *Coriandrum sativum* (Koththamalli), ginger - *Zingiber officinale* with tea and *Conscinium fenestratum* (Veniwalgata) in a daily basis. The study's findings revealed that there were significant interactions between COVID-19 and these herbal remedies that aid to improve the immune system, reduce inflammation, and stop respiratory difficulties [15].

Following table summarized some of the traditional medicinal plants in Sri Lanka that have been explored for the potential activity against SARS-CoV-2 virus.

Table 2: Medicinal plants in Sri Lanka that have the potential activity against COVID-19

Medicinal plant	Plant part	Activity/Mechanism	Ref.
<i>Zingiber officinale</i> English: Ginger Sinhala: I guru Family: Zingiberaceae	Rhizome	Using a molecular docking approach, it was demonstrated that ginger's 6-gingerol could function as a viable treatment option for COVID-19.	25
<i>Glycyrrhiza glabra</i> English: Licorice Sinhala: Walmi Family: Fabaceae	Root	Glycyrrhizin, a component of this plant has been shown in <i>in vitro</i> and human investigations to have immunostimulatory and antiviral actions against a variety of viruses, including SARS-CoV. Giving symptomatic relief for the COVID-19 patients who are suffering shortness of breath.	26 27
<i>Citrus aurantifolia</i> English: Lime Sinhala: Delhi Family: Rutaceae <i>Citrus limon</i> English: Lemon Sinhala: Delhi Family: Rutaceae	Whole plant (seeds, bark, roots, leaves and ripe and un-ripe fruit)	Lemon essential oils and the chemicals derived from them are potent natural antiviral agents that may aid in preventing the entry of SARS-CoV-2 into the human body. Boosting the immune system by reducing cough and flu.	28
<i>Camellia sinensis</i> English: Tea Sinhala: The Family: Theaceae	Leaves	Polyphenol (Rutin) – Angiotensin Converting Enzyme (ACE) inhibition and that aids to inhibit SARS-CoV entry to its host cells. Phenol (theaflavin-3, 30 digallate, tannic acid, [-]-epigallocatechin gallate) - Chymotrypsin-like (SARS-3CLpro) inhibition that is significant to inhibit the SARS-CoV virus replication.	29
<i>Cinnamomum Zeylanicum</i> English: Cinnamon, Ceylon cinnamon, True cinnamon Sinhala: Kurudu Family: Lauraceae	Bark, leaves, oil	Inhibition of wild type SARS-CoV as cinnamon extract has antiviral effect on RNA viruses. Antiviral mechanism - blocking cell entry via endocytosis.	30
<i>Benincasa hispida</i> English: Winter Melon, White gourd Sinhala: Alu puhul Family: Cucurbitaceae	Fruit	Phytonutrients and prebiotics - attenuate the excessive immune response which may prove to be beneficial in preventing and mitigating COVID-19	31
<i>Withania Somnifera</i> English: Winter cherry Sinhala: Amukkara Family: Solanaceae	Tuber, leaves, berries, roots	Therapeutic adjuvant for prevention and treatment of COVID-19 due to its molecular and pharmacological characteristics. It also enhance the clinical results of the currently used pharmacotherapeutics in COVID 19. It was found the muscle-strengthening and organ protective properties of the recovered patients.	32 33 34
<i>Allium sativum</i> English: Garlic Sinhala: Sudulunu Family: Amaryllidaceae	Leaves and bulb	Garlic essential oil exhibits strong interactions with the amino acids of the Angiotensin-converting enzyme 2 (ACE2) proteins, which are critical for reducing the operability of the SARS-CoV-2 host receptor.	35
<i>Azadirachta indica</i> English: Neem Sinhala: Kohomba Family: Meliaceae	Leaves and bark	Nimbinol A, Nimocin and Cycloartanol – Neem compounds aid to prevent assembly of SARS-COV-2 particles leading to reduce the propagation of virus according to the in-silico binding study. Desacetylgedunin bioactive compound from neem recorded highest molecular docking score against SARS-Cov-2.	36
<i>Aloe vera</i> English: Aloe Sinhala: Komarika Family: Liliaceae	Leaves	Leaf extract has antiviral activity against coronavirus SARS-CoV-1 and presence of Zn mineral in <i>A. vera</i> effects on antiviral activity. Mechanisms - interaction of virus enzyme, breakdown of the viral envelope etc.	37
<i>Andrographis paniculata</i> English: Green chireta, Creat Sinhala: Heen bin Kohomba Family: Acanthaceae	Whole plant	Showing antiviral properties over SARS-CoV through immunomodulation. Andrographolide and dihydroxy dimethoxy flavone extracted from <i>A. paniculata</i> could be a potential inhibitor of SARS-CoV-2 main protease.	38
<i>Asparagus racemosus</i> English: Shatawari Sinhala: Heen hathawariya Family: Liliaceae	Leaves	Plausible antiviral agent in COVID-19 treatment according to in silico studies. Asparaoside-C and Asparaoside-F phytochemicals bind with SARS-COV-2 (S) and (N) proteins for inhibition.	39
<i>Tragia involucrata</i> English: Singhara nut Sinhala: Wel kahambiliya Family: Euphorbiaceae	Roots, seeds and leaves	Based on in silico studies, due to affinity towards spike protein of virus, it has a potential for COVID-19 therapy. Phytochemicals with activity - Stigmasterol and 3-(2, 4- dimethoxyphenyl)-6, 7- dimethoxy-2, 3- dihydrochromen-4-one.	40
<i>Curcuma longa</i> English: Turmeric Sinhala: Kaha Family: Zingiberaceae	Rhizome	Curcumin – Controlling cellular signaling pathways such as inflammation, apoptosis and RNA replication. Concealing the pulmonary edema and fibrosis associated pathways in COVID-19 infection. Modifying the different molecular targets that help SARS-CoV-2 adhering and internalization in a variety of organs, including the liver, cardiovascular system, and kidney.	41
<i>Echinacea purpurea</i>	extracts, tinctures,	Through direct virucidal activity, echinacea extract is an intriguing herbal anti-	42

English: Purple coneflower Family: Asteraceae	teas, and sprays	virus treatment for several viruses with a membrane. Being an enclosed virus, the human coronavirus may be a viable target for the action of <i>E. purpurea</i> that could result in a COVID-19 treatment.	
<i>Justicia adhatoda</i> English: Malabarnut Sinhala: Adhatoda Family: Acanthaceae	Structures of known alkaloids of the plant	Using molecular dynamic simulation studies it was revealed that anisotine has the potency to inhibit the pro-teolytic activity of SARS CoV-2 Mpro.	43

Conclusion

The National Health Commission of China has revealed that herbal medicine can use in conjunction with Western medicine as a treatment for COVID-19, and moreover it has issued numerous guidelines for herbal medicine therapy [44]. Ang *et al.* has discovered that combination therapy of herbal medicine with western medicine has shown significant effects in treating COVID-19 by assessing Randomized controlled trials (RCTs) and quasi-RCTs [1]. Despite the fact that herbal drugs are an important source of various bioactive compounds with antiviral properties, only a few systematic research studies on the antiviral potential of Sri Lankan herbal plants have been conducted [2]. Furthermore, there have been even fewer studies that have looked into herbal drugs for SARS-CoV-2 inhibition. In addition, further clinical trials should be conducted to investigate the potential efficacy of these herbal drugs against SARS-COV-2 infection. At the same time, during the experimental design for herbal drug development, several variables should be considered like geographical variation of the plant species, collection method, extraction procedure and also administration methods.

In conclusion, the use of medicinal plants in combatting COVID-19 holds promise for the future, but it requires rigorous scientific investigation and collaboration between traditional medicine practitioners and the broader medical community. While medicinal plants may not replace vaccines or established medical treatments, they could complement existing strategies and provide additional tools in the fight against the virus. Continued research, safety measures, and regulation are essential for the responsible and effective use of medicinal plants in addressing COVID-19 and other health challenges.

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