The antiviral properties of edible medicinal plants: potential remedies against coronaviruses

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Abstract

SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) is an unparalleled challenge for the international community. Subsequently, an extraordinary effort has been made to contain SARS-CoV-2. However, this has been largely limited to behavioral changes and vaccination. To make the containment strategies effective, behavioral changes and vaccination need to be complemented with alternative prevention methods and curative treatments. This work reports the antiviral properties of some of the commonly known edible medicinal plants that can be used as potential remedies to suppress coronaviruses. A growing body of evidence substantiates that edible medicinal plants with antiviral properties that have been proven effective against sibling coronaviruses likely contain the spread of SARS-CoV-2, and they may also suppress the fatality of COVID-19 (coronavirus disease 2019). The secondary metabolites found in herbal medicines do not cause pathogens to develop drug resistance, which is a common problem in conventional medicines. The use of edible medicinal plants is much safer and causes less panic, thereby avoiding the fear associated with the use of herbal medicines. Right dosages and mixtures of edible medicinal plants need to be rigorously investigated to circumvent unanticipated side effects and chronic health risks.

Introduction

Infections that are caused by pandemic contagions such as coronaviruses are imposing unprecedented challenges to global health.[1,2] For example, several coronaviruses have threatened public health; among these is SARS-CoV (severe acute respiratory syndrome coronavirus 2), which shares a significant portion of its genomic structure and etiology with SARS-CoV-2.[3] SARS-CoV-2 is highly infectious,[4] however, it is less fatal than SARS-CoV.[5] SARS-CoV-2 is rapidly transmitted through coughing, sneezing, respiratory droplets, or aerosols[4] and contagiously via infectious secretions.[6]

Hitherto, there is no effective treatment for COVID-19.[4,7] Therefore, the most reliable containment strategies are behavioral changes[8] – such as social distancing, enhancing hygiene, and the use of personal protection equipment. Tremendous efforts have been made to develop vaccines[5] and vaccination has commenced. However, vaccination needs to be supported by complementary preventive, suppressive, or curative treatments. Moreover, based on the epidemiology of COVID-19, SARS-CoV-2 may not last soon,[9] and given the recent bunch of contagions we have faced novel coronaviruses could instantly emerge; therefore, prevention and treatment efforts need to be intensified and supported by alternative and complementary medications. Although the impact of coronaviruses has been significantly decreased, Worldometers data for April 26, 2023[10] (https://www.worldometers.info/coronavirus/) shows that there are ~687 million registered cases and ~6.9 million coronavirus-related deaths. Still, a few new cases of coronavirus are registered daily in the Worldometers database. All-inclusive efforts need to be made to avoid the devastating impact of the coronavirus. Among the complementary strategies, the most environmentally friendly and safer one could be the use of edible medicinal plants.

In the history of mankind, plants have been used as key ingredients for nourishment. Paleontological evidence shows that the omnivorous modern-day human once in the course of his evolutionary history was herbivorous.[11] Consequently, plants make up the largest portion of the diet of modern humans. Accordingly, the digestive system microflora have developed symbiosis to digest and absorb plant-derived compounds.[12] This has made plants ubiquitously consumed healthy foods. Some of these plants are not exclusively used as food but also as medicine. For example, an extensive list of medicinal plants with antiviral properties of which some are edible was reviewed by Yasmin *et al.*[13] Moreover, a long list of edible medicinal plants was produced in the Traditional Chinese Medicine Systems Pharmacology Database,[14-16] the Encyclopedia of Traditional Chinese Medicine,[15] and SymMap.[16] Several edible medicinal plants have been also used to treat diseases in India.[17] Interestingly, Zhang *et al.*[18] have screened Insilco Chinese medicinal plant databases and have proposed several traditional medicines (some of them might be edible) that can be used to contain SARS-CoV-2 or to treat COVID-19. To increase the prudent use of medicinal plants, it is essential to compile relevant literature on the most recent advancements in the treatment of coronaviruses and sibling respiratory syndromes with edible medicinal plants as well as the ongoing debates regarding the use of conventional medicines versus traditional medicinal plants.

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Materials and Methods

While organizing this report, the pursued pieces of literature were looked through using Google Scholar, and the keywords "medicinal plants and coronavirus" were used as search items. As a result, the findings that identified medicinal plants that have been widely used for human consumption and have been used to treat coronaviruses and sibling respiratory syndromes were discussed in this report.

Results and Discussions

The unique importance of medicinal plants

Interestingly, medicinal plants have been validated and used for a long time to produce several drugs with potent antiviral properties.[19] Traditionally, plant substances have been used as medicine for more than 5000 years.[20] This shows that there is an enriching pool of traditional knowledge and wisdom aligned with the utilization of medicinal plants. Several studies have been conducted on the pharmacological properties of herbal medicines; however, the number of good quality clinical studies is limited (see for instance the review by Eng *et al.*[21] and the references listed in *Supplementary Table 1*),[22-44] which constrains the broader use of edible medicinal plants. However, Chinese and Koreans have developed guidelines for traditional medicines, for example, to treat COVID-19.[7] Medicinal plants possess several natural compounds with phytomedicinal properties, subsequently, they are usually broad-spectrum.[9,17] Therefore, they can be used to treat coinfections[9] and comorbidities that aggravate the fatality of the disease in question. Since the bioactive compounds of medicinal plants are readily absorbable, they can be used to prevent several infections affecting different parts of the body and related physiological functions.

Edible medicinal plants are safe to use

Besides affordability and being ubiquitous and highly diverse, edible medicinal plants with reasonable assumptions may not have side effects or long-lasting health risks, provided that the right dose and appropriate pharmacological procedures are adopted.[45] Edible medicinal plants could be wild and/or semi-domesticated types, commonly or rarely consumed. Since edible medicinal plants are part of our daily meals,[2,17] their basic characteristics are widely known by the general populace, which may then help to reduce the adverse impact of unforeseen effects. Therefore, the use of edible medicinal plants lowers the fear and skepticism prevailing against herbal medicines.

Interestingly, medicinal plants are less susceptible to drug resistance usually developed by pathogens that are repeatedly exposed to a conventional drug[17,] and when there is inappropriate (indiscriminate), irregular, and irrational (improper) use of antibiotics.[46,47] Medicinal plants have a lot of secondary metabolites and phytochemicals, and these substances provide medicinal plants with several therapeutic roles.[47] The activity of secondary metabolites (either in the intermediate or end-product form) found in the crude extracts of medicinal plants suppresses the development of drug resistance in the microbes.[46] This special attribute of medicinal plants and the side effect of using synthetic drugs may have conferred medicinal plants with broad-spectrum uses.

Medicinal plants are readily biodegradable; therefore, they do not cause environmental pollution. Herbal medicines are widely used[16], and their utilization is gaining importance.[45] For example, 80 percent of the world's population mainly relies on medicinal plants.[48] Interestingly, herbal medicines contain several active substances

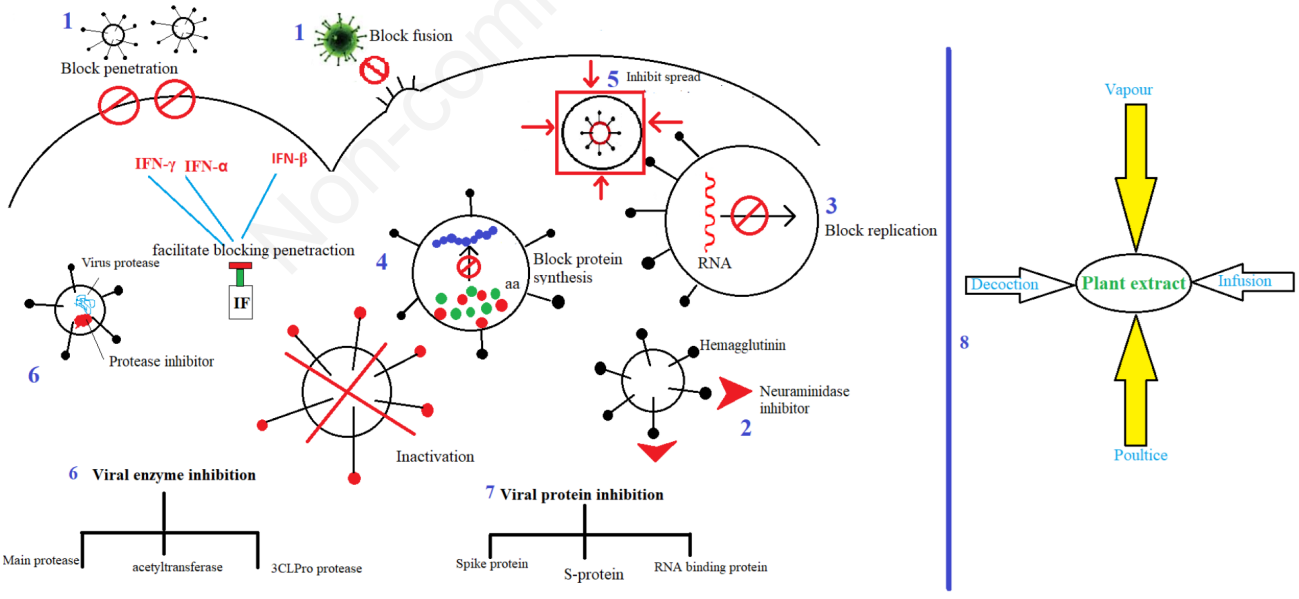

Figure 1. The mode of action of extracts of medicinal plants on viruses causing respiratory syndromes. Medicinal plant extracts can inhibit the invasion of viruses into the animal's cells, and the infected cells sensitize themselves against the entry of the virus (IFN-production) (1). Medicinal plant extracts may have viral hemagglutinin or neuraminidase activity (2). Medicinal plant extracts may inhibit the replication of viral RNA (3). Medicinal plant extracts may block the synthesis of viral proteins (4). Medicinal plant extracts may inhibit the spread of the virus in the host (5). Medicinal plant extracts may block the activity of viral proteins and enzymes (6, 7). Medicinal plants' phytochemicals can be extracted using various methods (8).

with therapeutic roles.[21-44] However, the interaction of these substances may sometimes produce undesirable consequences. Therefore, understanding the pharmacological properties, interactions, side effects, and underlying molecular mechanisms (docking effect) of edible medicinal plants is inevitable to enhance their utilization.[21]

Bioactive phytochemicals and their antiviral properties

Bioactive phytochemicals with antimicrobial properties possessed by edible medicinal plants are used to cure and/or induce/enhance/modulate the immune response.[17,49] The preventive and curative capacity of edible medicinal plants inhibits, attenuates, docks, or suppresses the entry and cellular fusion, replication, infectivity, or fatality of the pathogens (Figure 1).[50] It is, therefore, vital to understand where and how phytochemicals specifically interact with or interrupt the life cycle of viruses, such as at the point of entry, replication, assembly, or release.[45] However, the use of edible medicinal plants largely relies upon the knowledge and wisdom of traditional healers in the less developed world, and it is usually documented using the information retrieved from less rigorous field surveys and has not often been validated by clinical studies.[51] This shows that carefully managed clinical studies should be carried out to avoid potential risks associated with the use of medicinal plants.

Conclusions

This report suggests the cautious use of commonly available edible medicinal plants to acquire some level of immunity against SARS-CoV-2. However, it does not present an extensive list of medicinal plants and their mode of action. To enhance the safe use of edible medicinal plants extensive research needs to be conducted to unlock the active phytochemicals and secondary metabolites and their docking effect. Moreover, an extensive review of the available literature needs to be conducted to identify the prevailing research gaps.

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Online supplementary materials
Table 1.