Scope of Natural Plant Extract to Deactivate COVID-19

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Abstract
The outbreak of coronavirus disease 2019 (COVID-19) has emerged as a severe threat for public health and economy throughout the world. The structure of corona virus is composed of RNA based proteins that contains amino (-NH2) and carboxyl (-COOH) groups. It includes nucleocapsid protein (N-protein), spike protein (S-protein), envelope and hemagglutinin-esterase dimer (HE). These proteins affect adversely on human gastrointestinal system, heart, kidney, liver, and central nervous system leading to several organ damages. This investigation reveals that the extracted components of natural plants, especially hydroxyl (-OH) groups react chemically to deactivate the active components of the virus by esterification process. As a case study, using one of the natural resources, as for example, licorice (Glycyrrhiza glabra) which has the components of glycyrrhizin, glycyrrhetic acid, liquiritin and isoliquiritin that can be used to neutralize the activeness of COVID-19 and it can be used as an antiviral drug. The extracted licorice is further processed with PVA solution to form antiviral nano-membrane for potential application as wound dressing materials, musk, gloves and against skin infection by electrospinning. The morphology of the membrane is characterized using scanning electron microscope (SEM). The research suggests that the other plants having deactivate components against virus can be applicable to resolve the human health crisis of the globe.

1. Introduction
Yet now, researchers have been observed three different pathogenic human coronaviruses (CoVs), such as Middle East respiratory syndrome coronavirus (MERS-CoV), severe acute respiratory syndrome coronavirus (SARS-CoV), and a 2019 novel coronavirus (COVID-19) [1-3]. Among them, recently, the people of the world faces the biggest challenges of COVID-19 in relation to health issue. This COVID-19 has transmitting exponentially throughout the globe. Coronaviruses are relatively large in size occupying single-stranded positive-sense RNA genome enclosed in a membrane envelope. In fact, this coronavirus is composed of four structural proteins, including spike (S), envelope (E), asamembrane (M), and nucleocapsid (N) proteins [2, 4, and 5]. Spike (S) protein is very crucial in
connection of viral attachment, fusion and entry and this protein can be utilized to develop antibodies, entry inhibitors and vaccines [1, 6-12]. Human pathogenic coronaviruses (severe acute respiratory syndrome coronavirus [SARS-CoV] and SARS-CoV-2) bind to their target cells through angiotensin-converting enzyme 2 (ACE2), which is recognized by epithelial cells of the lung, intestine, kidney, and blood vessels [13]. Angiotensin-converting enzyme 2 (ACE2) is a membrane bound amino peptidase that effects on cardiovascular and immune systems [14]. Some literature [15, 16] mentioned that this virus effects in the lower respiratory system which is responsible for viral pneumonia. In addition to that, it may also deteriorate the conditions of the gastrointestinal system, heart, kidney, liver, and central nervous system leading to several organ damages. Following the adverse impact of a pandemic, researchers have been trying to realize nature of this new virus and the pathophysiology of this virus to seeking the probable treatment process and searching out the reasonable therapeutic agents and vaccines. There are several attempts have been taken to find out the recovery system even though, there are no SARS-CoV-2-specific antiviral agents [17].

In this study, research has been carried out to find out the possible mechanisms to save the lives of people and produce the vaccines and drugs for future prevention.

The practice of using medicinal plants to treat human skin including healing of wounds and burn injuries, antifungal, antiviral, antibacterial applications against skin infections has long history and is going on for primary healthcare even in the modern age [18-20].

Usages of metal nanoparticles like as silver, zing in the existing wound dressing materials is not environment friendly due to its toxicity effect [18]. The altrtrnative environment friendly similar materials such as licorice, neem, turmeric, honey, nigella etc. natural herbs have significant effect due to their inherent biomedicinal properties. As a result, the development of electrospun nanofibrous membrane by electrospinning technique from natural polymers is considered as novel approach in biomedical applications such as wound dressing, tissue engineering and drug delivery, leads to contemporary research field.

Synergistic effects of licorice on nanofibrous membrane have not yet been studied thoroughly. Thus, the newness of the present study is to fabricate nanofibrous membrane with licorice extract to
explore its antibacterial and antiviral medicinal properties also.

2. Methodology

2.1 Virus Deactivation Strategy

The structure of RNA based COVID 19 virus is depicted in Figure 1. This virus is composed of different distinct proteins. The chemical and molecular structure of these proteins are different in nature. The human body is badly affected by this virus. The common symptoms of this virus are mentioned in Figure 2. The process of this research is to understand the chemical structure of these proteins for analyzing their effects. These most of the proteins of COVID 19 are formed by the amine (-NH₂) and carboxyl (-COOH) functional groups. Some chemical reaction oriented strategies are developed to neutralize the effect of amine (-NH₂) and carboxyl (-COOH) functional groups to protect the adverse effect of corona virus on human body. The leaves of hydroxyl group and bio-ingredients are processed for reacting with the amino acid compound to neutralize the chemical and molecular bonding of functional groups of S, N and M proteins.

Fig. 1: Diagram of coronavirus virion structure showing spikes that form a "crown" like the solar corona, hence the name [21]

Fig. 2 Common symptoms and severe disease due to COVID-19 [22]

2.2 Preparation of PVA-Licorice Solution for Nanofibrous Membrane

The licorice roots were collected from the local area of Gazipur city, Dhaka, Bangladesh. Prior to extraction, licorice was checked to ensure that materials are free from dirt and impurities. Then, a small piece of licorice was oven-dried at 45°C and it was kept under water at ratio of 1:10 (w/v%) for 24hours. The crude extract of licorice was then filtered through nylon mesh three times.
On the other hand, 10gm polyvinyl alcohol (PVA) with molecular weight (MW) of 1, 15,000, DP of 1700-1800, viscosity: 26–32 cps, 99% hydrolyzed granules was sourced from Loba Chemical (India). PVA was mixed with 90mL deionized water to obtain 10wt % (w/v) solution. This mixture was stirred and heated to 80°C to get a clear and transparent solution. Finally, the prepared PVA solution was blended with licorice solution at 50:50 ratio. A magnetic stirrer was used to make uniform and homogenous solution for 1hour. The prepared solution is then transferred via a syringe (30mL) to the pump of electrospinning machine. Electrospinning machine (model TL-01, TONG Li TECH) shown in Fig. 3 was used to produce the nanofibrous membrane using PVA and licorice extract under optimized processing parameters.

Fig. 3 Electro-spinning machine for preparation of membrane

2.3 Morphological Analysis

The morphological analysis of nanofibrous membrane was observed by scanning electron microscopy (SEM) (SU 1510, Hitachi, Japan) at a magnification of × 1.5K and × 2.0K with a voltage of 10 kV to achieve actual images.

3. Results And Discussion

3.1 Mechanism of Deactivation COVID-19

Coronavirus disease 2019 (COVID-19) is a respiratory illness which is spread very rapidly from person to person. COVID-19 is a RNA based infected virus which is formed by nucleocapsid protein (N-protein), spike protein (S-protein), envelope and hemagglutinin-esterase dimer (HE). The nucleocapsid protein (N-protein) is a structural protein that binds to the coronavirus RNA genome, thus creating a shell (or capsid) around the enclosed nucleic acid. The spike protein performs two primary tasks that aid in host infection: 1) mediates the attachment between the virus and host cell surface receptors,
and 2) facilitates viral entry into the host cell by assisting in the fusion of the viral and host cell membranes.

The CoV envelope (E) protein is a small, integral membrane protein involved in several aspects of the virus’ life cycle, such as assembly, budding, envelope formation, and pathogenesis [23-25]. The active components of these proteins are amino (-NH2) carboxyl (-COOH) groups [26]. The natural plant extract can be used to deactivate the active components of this virus. As a case study, licorice was selected as a sample to neutralize the activity of virus proteins. Similar agreements are found in literature [27-30] that state “licorice root extract is effect against HIV, RSB, herpes viruses and severe acute respiratory syndrome-related corona virus which causes a serious type of pneumonia”. The contents of licorice are glycyrrhizin, glycyrrhetic acid, liquiritin and isoliquiritin [31] that are able to control the spreading of virus activity. Chemical structure of licorice components are illustrated in Fig. 5.

Fig. 5 Chemical structure of licorice components (a) glycyrrhizin, (b) isoliquiritin, (c) glabridin (d) glycyrrhetic acid and (e) liquiritin

Formation of licorice root extract in Fig. 6 can be effective to diminish the virus growth and having possibility to be used as antiviral drug.

Fig. 6 Formation of licorice extract solution.

All contents of licorice have hydroxyl groups that can attack the active group of virus. The mechanism is presented in Fig. 7.

Fig. 7 Mechanism of deactivation of COVID-19 using active component of plant extract

3.2 Characterization of Licorice Nanofibrous Membrane

The extraction solution of licorice was mixed with PVA solution at 50:50 ratio to form membrane by electrospinning machine. Voltage, pressure, heater power and collector distance and ambient condition were the parameters of electrospinning process. The optimum electrospinning conditions were reached by trial and error method at -12.3kV, +23 kV, 0.45 kW with a flow rate of 1.5 mL per hour, constant collector distance of 15 cm under ambient condition of 65% relative humidity and 27°C respectively. The scanning electron microscope (SEM) image of the developed samples are shown in
Fig. 8 which reflects the formation of smooth nanofiber having an average diameter of 245 nm.

**Fig. 8:** Morphology of electrospun PVA-licorice (a) natural image of membrane (b) SEM image at 10.0 kV, x1.00 k of front site view (c) SEM image at 10.0 kV, x1.00 k of back site view

4. Summary And Perspectives
RNA oriented COVID-19 virus is structured by some proteins which infect the internal parts of the human body adversely. As the amino and carboxyl groups are functional components of this virus, it causes infection human cells of respiratory. To deactivate the activity of this virus, hydroxyl group has significant role. As the artificial chemical ingredients have minor to severe side effects for human organs, this study proposed the extracted plants, as for example licorice, which can be used as a biochemical ingredients to diminish the effect of virus including reduced risk factor. The nano membrane produced from licorice having the antiviral characteristics and it can be used as wound dressing material. Some other supplementary bio-components can be added to improve the functional properties of the natural plant membrane. In future, how these hydroxyl groups related natural plants can be used to improve the immunity of human with proper drug delivery systems will be studied. The suggested some others nature plants are garlic, sambucus, astragalus, ginger, ginseng that can exhibit significant effect against COVID-19.

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Figures

![Diagram of coronavirus virion structure showing spikes that form a "crown" like the solar corona, hence the name [21]](image_url)
Figure 2

Common symptoms and severe disease due to COVID-19 [22]
Figure 3

Electro-spinning machine for preparation of membrane
Figure 4

Legend not available in this version
Figure 5

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