



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



# COVID-19: Disease, management, treatment, and social impact

Imran Ali<sup>a,b,\*</sup>, Omar M.L. Alharbi<sup>c</sup>

<sup>a</sup> Department of Chemistry, College of Sciences, Taibah University, Al-Medina Al-Munawara 41477, Saudi Arabia

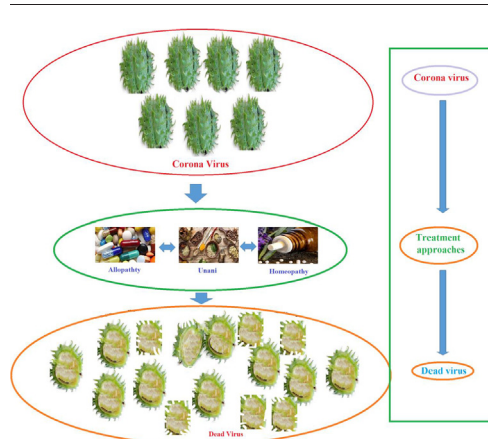
<sup>b</sup> Department of Chemistry, Jamia Millia Islamia, (Central University), New Delhi 11025, India

<sup>c</sup> Department of Biology, College of Sciences, Taibah University, Al-Medina Al-Munawara 41477, Saudi Arabia

## HIGHLIGHTS

- Detail information on COVID-19.
- Advanced methods of prevention and management.
- Various treatment strategies.
- Transmission routs.
- Article may be useful to prevent, manage and treat COVID-19.

## GRAPHICAL ABSTRACT



## ARTICLE INFO

### Article history:

Received 15 April 2020

Received in revised form 18 April 2020

Accepted 19 April 2020

Available online 22 April 2020

### Keywords:

SARS-CoV-2

COVID-19

Prevention and management

Treatment

Social impact

## ABSTRACT

COVID-19 was originated from Wuhan city of Hubei Province in China in December 2019. Since then it has spread in more than 210 countries and territories. It is a viral disease due to the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus. The patients show flu-like symptoms with a dry cough, sore throat, high fever, and breathing problems. The disease due to SARS-CoV-2 was named as COVID-19. About 2.2 million people have been infected with more than 0.15 million deaths globally. The United States of America is the most affected country with the highest patients of about 0.7 million. Despite great efforts, there is no treatment of this disease. However, prevention and management are the best options. This article describes SARS-CoV-2, disease, prevention and management, treatment and social impact on society. It was analyzed that a combination of antiviral drugs with hydroxyl-chloroquine and azithromycin (with the consultation of a medical practitioner) may be the best option to treat the patients, depending on the patient's conditions and symptoms. However, Unani therapy may be useful along with allopathic treatment. It is urgently advised and requested that all the persons should follow the preventive measures, managements and quarantine strictly without any religious discrepancy otherwise the situation may be the worst. Also, there is an urgent requirement to educate our new generation for science and technology to fight against any such disaster in future; if any. There is no need to be panic and proper prevention and management are essential to combat this disease. This article may be useful to create awareness among the public, to prevent, manage and treat COVID-19.

© 2020 Elsevier B.V. All rights reserved.

\* Corresponding author at: Department of Chemistry, College of Sciences, Taibah University, Al-Medina Al-Munawara 41477, Saudi Arabia.

E-mail addresses: [drimran.chiral@gmail.com](mailto:drimran.chiral@gmail.com), [drimran\\_ali@yahoo.com](mailto:drimran_ali@yahoo.com) (I. Ali).

## 1. Introduction

Coronaviruses belong to the *Coronaviridae* family and appear just like spiked rings when observed through an electron microscope. The surface looks with various spikes, which are helpful to attack and bind living cells. These are the viruses causing the simple common cold disease to severe illnesses like Middle East Respiratory Syndrome (MERS-CoV), Severe Acute Respiratory Syndrome (SARS-CoV). The source of these viruses is some animals including bats. The word coronavirus is a derivative of the Latin corona, which means crown or halo, that states to the typical look indicative of a crown or a solar corona around the virions. These viruses are having a positive-sense single-stranded RNA genome (27 to 34 kilobases) and helical symmetry nucleocapsid (Su et al., 2016; Sexton et al., 2016). Typically, the coronaviruses are of ~20 nm size draped with a large petal or club-shaped surface appearance. The first coronavirus was discovered in 1937 in the birds and later on in the 1960s in humans (*Coronavirus: Common Symptoms, Preventive Measures, and how to Diagnose it. Caringly Yours*, 2020). The various types of viruses, capable to infect human beings are 229E, OC43, HCoV-NL63, SARS-CoV, MERS-CoV, HKU1 and SARS-CoV-2. There are several outbreaks from time to time due to these viruses. The most notorious outbreaks were in 2003, 2012, 2015 and 2018 with 774, 400, 36 and 42 deaths, respectively. It is important to mention that the 2019–2020 outbreak is started in Wuhan, Hubei Province, China in December 2019 (*The Editorial Board*, 2020) when a new strain of coronavirus was detected on 31st December 2019 (WHO, 2020). World Health Organization (WHO) has given name to this virus as 2019-nCoV (*Novel Coronavirus 2019*, 2020) which was later renamed as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses. The diseases caused by this virus is called as coronavirus disease 2019 and abbreviated as COVID-19 [CO: corona, VI: virus, D: disease and 19: 2019 year]. This virus was found to have 86.9% resemblance to a bat coronavirus, and, hence, is suspected to develop from bats (Lu et al., 2020; Wan et al., 2020; Zhu et al., 2020). This virus is out broken in pneumonia type of disease with respiratory problems, leading to death due to respiratory failure. About 210 countries and territories have been reported to be infected with major outbreaks in the USA, China, South Korea, Italy, Iran, Japan, etc. tolling about 2.2 million patients with more than 0.15 million deaths globally. The United States of America is the most affected country with the highest patients of about 0.7 million and about 35,000 deaths. This article is dedicated to the recent outbreak of 2019–2020 describing the diseases, symptoms, spread, prevention, and treatment. This article may be useful to control the present outbreak and future spread.

## 2. Disease and symptoms

Coronaviruses infect the upper gastrointestinal and respiratory tract of the mammals (including humans) and the birds. These viruses cause many diseases in animals and human beings but we are limited in this article with SARS-CoV-2, leading to COVID-19 disease. The whole clinical picture of COVID-19 is not completely known. The occurrence of the illness ranged from mild to severe. SARS-CoV-2 propagate through RNA replication using RNA-dependent RNA polymerases enzyme. This virus can mutate slowly, posing a challenge for its treatment and control. The symptoms of COVID-19 may arise within 2 to 14 days after the infection. Besides, in some cases, the diseases prevail after 27 days. However, Chinese researchers mentioned 5.2 days as an average incubation period (Li et al., 2020). The duration of the survival of death is 6 to 41 days after infection of the coronavirus. It depends on the age, health and clinical conditions of the patients (Wan et al., 2020).

The common signs of infection are fatigue, muscle pain, sneezing, sore throat, dry cough, high fever, respiratory problems, etc. with some severe cases having pneumonia, serious respiratory syndrome,

kidney failure and even death (Huang et al., 2020; Hui et al., 2020; Ren et al., 2020). The COVID-19 risk is greater in older people, kids and the patients having other health problems like lung diseases, heart diseases, diabetes, and cancer. It is important to mention that it is not necessary to have COVID-19 if these symptoms are seen because such types of symptoms are also seen in the case of other virus infections, except breathing and diarrhea problems. The pathological conditions of coronavirus include greater counts of chemokines, cytokines, and leukocytes, and high levels of plasma pro-inflammatory cytokines and C-reactive protein. The chances are greater of COVID-19 if there is shortness of breath, dry cough, and a person comes in the contact with a COVID-19 patient or traveled with COVID-19 effected area. Under such a situation, the clinical test for COVID-19 is a must. However, some persons recover easily while others may take some time depending on the health conditions and the age of the patients. WHO categorized the COVID-19 virus as of  $\beta$ -CoV of group 2B (Carlos et al., 2020). The genome of this virus is identified and it resembles the SARS-CoV (80% similarity) and MERS-CoV (50% similarity) (Lu et al., 2020; Ren et al., 2020). It is interesting to note that both MERS-CoV and SARS-CoV have their origin in the bats (Cui et al., 2019).

## 3. Modes of transmission

During the last few decades, it was observed that coronaviruses can infect rats, mice, cats, dogs, horses, turkeys, cattle and pigs. Occasionally, these animals may communicate coronaviruses to humans. The coronavirus is spread by the sneezing, cough droplets and contact. Normally, this virus enters the body through the mouth, nose, and eyes (*Transmission of Novel Coronavirus (2019-nCoV)*, 2020). It has been reported that the virus may infect a person at a distance of about a 6 ft (1.8 m) radius. The virus can survive for 2 h to few days in cough and sneezing droplets lying on the surface or ground. An infection may be by touching an object or surface which has already a virus but it is not the major course of the infection. This virus has been detected in stools of the patients but no infection via stool has been reported.

The cellular infection model is very similar to SARS-CoV. The main target of this virus is lungs and the virus spikes (binding domains) get attached to the cell receptors of the lungs. These are known as angiotensin-converting enzyme 2 (ACE2) receptors (Jaimes et al., 2020; Wan et al., 2020). Belouzard et al. (2009) reported that a proteolytic cleavage occurs at SARS-CoV S protein at position (S2') interceded the membrane fusion and viral infectivity. The chances of the infection may arise if a person comes in contact with the infected person. Now, COVID-19 has become pandemic as per the WHO report. The data of the patients in the different countries at a different time was analyzed and the efforts are made to find out the routes of transmission globally. Consequently, the routes of COVID-19 pandemic in most of the effected countries are shown in flow chart (Fig. 1).

## 4. Prevention and the management

The prevention and management are very important issues to control COVID-19. Therefore, there is a great need for the collective efforts of the public and the government. The regular and the proper care of the homes and hospitals are very important to control this calamity. The regular recommendations to minimize the infection are cleaning of your area. The most important is to avoid sneezing and cough at the public place. The hand cleaning with soap and sanitizer, mouth and nose coverage with mask during sneezing and coughing are essential. Thoroughly washing foodstuff before cooking may help in this regard. The simple house-keeping disinfectants may kill the virus on the surfaces. Regularly cleaning of the surface by the disinfectants may control the virus outbreak. It is always better to avoid the interactions with anyone; suspecting respiratory problems symptoms like sneezing, coughing, breathing problem, etc. It is also advisable to stay at home if



Fig. 1. COVID-19 routs of transmission to the most effected countries.

anyone has flue and common cold-like symptoms. It is also better not to go to school, work and public places, not use public means of transport (aircraft, train, metro, bus, taxi, etc.). Some important suggestions may include avoiding travel, and collection at a particular place. The drinking of hot water after every hour may be helpful. Plenty of lukewarm water (~5 L per day) may help in this regard. The governments should provide facilities for the decontamination of the hands at the public places. The guidelines are available for healthcare providers, medical staff, researchers and public health individuals (Jin et al., 2020). They can use

to control COVID-19 globally. During the entire period of COVID-19, it was realized that this disease is spreading among those who are not taking it seriously and are not following the directions of WHO and the local government. Some people are trying to target one community for the spreading COVID-19 while this virus does not recognize and race, creed, sex, age, and religion. Therefore, it is urgently advised and requested that all the persons should follow the preventive measures, managements and quarantine strictly without any religious discrepancy otherwise the situation may be the worst.

## 5. Treatment

There is no precise treatment for coronavirus but prevention, management and supporting healthcare may provide relief in the outbreak of COVID-19. However, some approaches have been or may be used to control this disease. These approaches may be categorized in Allopathic, Unani and Homeopathic treatments. But before all this treatment, plenty of testing facilities should be available to the health care sectors.

### 5.1. Allopathic medicines

Allopathic treatment and management include oxygen therapy, intravenous fluid infusion with life support in dangerous cases. It is also advisable to contact a medicinal practitioner if the flue like symptoms prevails. Coronavirus may show comparable proteins for virus replication to human immunodeficiency virus (HIV). Therefore, HIV protease inhibitors and nucleoside analogs may be operative to treat COVID-19 (Lu, 2020). A combination of lopinavir and ritonavir, previously used for SARS-Cov and MERS-Cov, may be useful (Chu et al., 2004; Momattin et al., 2019). China is doing clinical trials of remdesivir, which was developed for the Ebola virus. Besides, other anti-viral medicines like oseltamivir, ganciclovir, ribavirin, favipiravir, nelfinavir, arbidol, remdesivir and galidesivir are being examined for COVID-19 treatment (Agostini et al., 2018; Chen et al., 2020; Guangdi and Clercq, 2020; Sheahan et al., 2020; Xu et al., 2020). Wang et al. (2020) reported that a combination of remdesivir and chloroquine may be effective to treat COVID-19 disease. Besides, the peptide (EK1), neuraminidase inhibitors, DNA synthesis inhibitors (tenofovir disoproxil and lamivudine) may be useful to control COVID-19. Also, 2 (ACE2)-based peptides (an angiotensin-converting enzyme), 3CLpro-1 (3CLpro inhibitor) and vinylsulfone protease inhibitors are known to show antiviral activities (Morse et al., 2020). Recently, an Italian patient of COVID-19 is treated in Sawai Man Singh (SMS) Hospital, Jaipur India by giving a combination of lopinavir (200 mg) and ritonavir (50 mg) twice a day. Besides, the patient was also given a combination of oseltamivir and chloroquine medicine. The patient test was found negative for COVID-19. Cheng et al. (2006) extracted some saikosaponins (a group of oleanane derivatives, usually as glucosides) and tested against the proliferation of some viruses. The authors reported that saikosaponin B2 (6  $\mu$ M) inhibited human coronavirus 229E effectively. In this way, the saikosaponin B2 along with other glucosides may be tested for COVID-19. The broad range of spectrum antibiotics may be used to control the additional bacterial infection after a virus attack. Some drugs are under clinical trial and results are still awaited. The best approach to fight with viruses is vaccination. Therefore, scientists are trying to develop a vaccine for this virus and probably may be available after some time.

### 5.2. Unani medicines

Generally, the Unani medicines (plant-based medicines) are non-toxic and without any side effects. Unani and Ayurvedic methods of the treatment are based on the plant materials. The different parts of the various plants are well known for a long time for their anti-viral activities (Li et al., 2005; Lin et al., 2014; Kim et al., 2010). The most important plants are *Glycyrrhiza glabra*, *Allium cepa*, *Allium sativum*, *Ocimum sanctum*, *Ocimum tenuiflorum*, *Piper nigrum*, *Cinnamomum verum*, *Daucus maritimus*, *Curcuma longa*, etc. An aqueous extract of these plants along with lemon juice and honey was found to be effective for flu and common cold virus infections. The ingredients present in this recipe have anti-viral properties (Bano et al., 2017; Chang et al., 2013; Bayan et al., 2014; Fatima et al., 2016; Ghoke et al., 2018; Hashemipour et al., 2014; Jiang et al., 2013; Konowalchuk and Speirs, 1978; Lee et al., 2012; Miladi et al., 2012; Omer et al., 2014; Pradiya et al., 2019; Weber et al., 1992). The root of Licorice (*Glycyrrhiza glabra*) is known to have a good antiviral potential (Wang et al., 2015a). This

plant is native of Asia and Europe and recognized as a weed. Fiore et al. (2008) carried out an in vitro study of *Glycyrrhiza glabra* plant and reported that this plant showed antiviral activities of several viruses including SARS related coronavirus, HIV-1, and respiratory syncytial virus. Asl and Hosseinzadeh (2007) presented a review of the antiviral activity of *Glycyrrhiza glabra*. The authors reported this plant active against SARS, HIV, varicella zoster, hepatitis A, B, C, cytomegalo virus herpes simplex type-1. Another review was from Anagha et al. (2014) on the antiviral activity of *Glycyrrhiza glabra* plant. The authors described the activity of this plant against various viruses like H1N1, H5N1, Influenza A virus (IAV), Hepatitis C virus, Rotavirus, HIV and SARS-associated coronavirus. Similarly, Wang et al. (2015b) also presented a review of the antiviral and antimicrobial activities of *Glycyrrhiza glabra*. The authors described the presence of more than 300 flavonoids and 20 triterpenoids in this plant. The authors summarized the active components and the most probable mechanisms of these constituents. Therefore, an aqueous extract of this plant along with other plants as mentioned above may be useful to control COVID-19. On January 29, 2020, the Government of India issued an advisory based on Indian traditional medicine practices Ayurveda, Homeopathy and Unani, New Delhi. The advisory includes the ways of preventive management and described a list of some Unani medicines. The interested persons may find these medicines at <https://pib.gov.in/PressReleasePage.aspx?PRID=1600895#> and can use after proper consultation with the Unani medical practitioners.

### 5.3. Homeopathy

In homeopathy, arsenic at very low concentration is considered beneficial for several diseases including viral infections. Recently, Directorate of AYUSH, New Delhi, India issued an order dated on January 30, 2020, to take prophylactic medicine to avoid coronavirus infection. The directorate suggested taking 4 pills of Arsenic Album-30 medicine once daily in empty stomach for 3 days. Arsenic Album-30 is highly diluted arsenic trioxide and work as homeopathic prophylaxis. It is important to mention here that there is no clinical evidence for Arsenic Album-30 medicine as an effective medicine. After that, a criticism for homeopathy came into existence and it was called as pseudoscience. An article is published in Taiwan Medical News on February 18, 2020 (<https://www.thailandmedical.news/news/india-slammed-for-proposing-usage-of-homeopathy-to-prevent-coronavirus>) and some people criticized homeopathy to manage COVID-19 infection. The persons who criticized are Dr. David Robert Grimes (Irish science writer) and Dr. Edzard Ernst (an emeritus professor, University of Exeter, UK and a critic of homeopathy). However, Dr. Mitchell Fleisher (second vice president, American Institute of Homeopathy) advised to carry out a comparative clinical study on the acute coronavirus infection by giving to homeopathic medicines to an individual and experimental group, and allopathic medicines to another, for 250 patients in each group. It was stated to confirm the scientific truth. But after this statement again Dr. David Robert Grimes criticized it as completely unethical and according to him, Homeopathy has no reasonable mechanism of action. Furthermore, he added that it is irresponsible to propose a trial for a serious pandemic. He also mentioned that many studies on homeopathy have indicated that it does not work. Also, the news director of Thailand Medical News Jakkapong Watcharachaijunta criticized the use of homeopathic medicine in controlling COVID-19. At this point, it is very important to mention the work of Dr. Robert T. Mathie et al. (2013) whose research work described that Arsenicum album medicine as effective to reduce fever, runny nose, headache, sore throat in the patients with swine flu symptoms. During writing this article under this section, it was realized that the subject matter is debatable and needs the scientific study to support the working of Homeopathic medicine for COVID-19. It is suggested that some research work should be funded by the government and the research should be carried out to make the situation clear. It is significant to add here that personally I (Prof. Imran



Ali) used some homeopathic medicine when living in India for some diseases and found them effective. Besides, I also observed that some homeopathic medicines are effective to treat a variety of diseases.

## 6. Immune system boosters

It is observed that early deaths were in older people, probably because of the poor immunity, which fosters faster progress of COVID-19 (Li et al., 2020; Wang et al., 2020). Therefore, it is significant to boost our immune system. It is important to suggest that people should use some supplements to boost their immune systems. Healthy people should take plenty of citrus fruits having various vitamins. Some dry fruits (almonds, walnuts, and dates) are also useful to improve the immune system. However, older people and the patients may take vitamins and zinc supplements with the consultation of medical practitioners. The important vitamins are A, C, D and E. It is also advisable to take zinc and iodine intakes. It is too wise not to smoke and take other narcotic products. Always an adequate sleep is essential to boost up the immune system. Avoid any stress and do proper and regular exercises.

## 7. Social impact

In the present scenario, COVID-19 has affected all the sectors of society. There is a big loss globally, and it cannot be estimated exactly. However, some aspects are discussed herein. Nowadays, the whole world is just like a family where everyone has to contribute to run the family. Similarly, the production of various items including medicines, machines, motor vehicles, computers, mobiles, etc. are controlled by many countries. Generally, the different components are being manufactured in various countries while these are assembled in other countries – Globalization. It is just like a chain process where the progress is stopped if even a single chain-link gets collapsed. It is a well-known fact that China is the biggest manufacturer of the various components, APIs and other raw materials while China is the most affected country due to COVID-19. And that is why the whole world is affected economically very badly due to a decrease in industrial production. The travel ban has been imposed by some countries resulting in millions of dollars loss to the airlines and tourism industry. There is a shortage of medicines, sanitizers, masks, and other commodities, which has hiked the prices of these items many times. The various functions, especially scientific conferences, business meetings, sports events, fashion shows, and the marriage parties are suggested to avoid, which is a big social impact on society. The Kingdom of Saudi Arabia has provisionally banned Umrah (pilgrimage) for the pilgrims to Mecca and Medina (the two holiest cities of the Islam religion). All these factors affected the local and global share markets badly. The USA big stock indexes such as S & P 500 Index, NASDAQ-100, Dow Jones Industrial Average, etc. have shown sharp fall since 2008. Many countries have banned to attend the classes in schools, colleges, and the Universities and millions of the student are not getting a good quality of education. It is very difficult to assess this loss in terms of money but has a big disadvantage to the students and their families. Briefly, there is a big loss to the worldwide economy and the expert assessed a loss of about 2.7 trillion US dollars (<https://www.bloomberg.com/graphics/2020-coronavirus-pandemic-global-economic-risk/>).

## 8. Future perspectives

As expected SARS-CoV is zoonotic and originated from the bats. It is observed that many people are consuming various animals as food-stuffs. Some animals like bats, snakes, cats, mice, rats, dogs, pigs, etc. should not be consumed as these may have dangerous microbes while the only safe animals should be consumed. Moreover, it is also advisable that we should consume vegetables and fruits as maximum as possible in our food. There is an urgent need to educate our new generation for

science and technology to fight against any such disaster in future; if any. Of course, the world is progressing towards advancement and even then we don't have highly specialized research centers. Therefore, there should be highly specialized research centers under the umbrella of WHO and funded by all the countries of the world. These centers should be located in the various parts of the world and be efficient, capable and specialized to control any calamity in the world in the future. The most important required research centers are for viral diseases, bacterial illnesses, mosquito, and insect-based diseases, cancer, etc. These centers are essential to combat any future calamity in the world if any. A paper was published by Casanova et al. (2010) and the authors studied the effect of temperature and humidity on the survival of gastroenteritis virus (TGEV) and mouse hepatitis virus (MHV) on the surface. The authors reported that the chances of the virus's survival are poor at 40 °C or high temperature with low humidity. Furthermore, the authors reported that TGEV and MHV could be used as conservative surrogates for modeling experience, transmission risk and control measurements for enveloped viruses like influenza virus and SARS-CoV virus on the surfaces. Therefore, it may be expected that the propagation of SARS-CoV-2 will decrease at high temperatures and low humidity. Now, we are at the end of April 2020 and progressing towards the summer. Therefore, it is expected that the coronavirus cases will decrease in the coming time; especially in the Middle East countries.

## 9. Conclusion

COVID-19 disease is originated from Wuhan city of Hubei Province in China in December 2019 and has become pandemic as per WHO. The disease has spread in 210 countries and territories with about 2.2 million patients and more than 0.15 million deaths globally. The United States of America is the most affected country with the highest patients of about 0.7 million. It is a viral disease due to the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus. The patients show flu-like symptoms with high fever and breathing problems. The disease due to SARS-CoV-2 was named as COVID-19. Still, there is no treatment of this disease. However, prevention and management are the best options. A combination of antiviral drugs with hydroxyl-chloroquine and azithromycin (with the consultation of a medical practitioner) may be the best option to treat the patients, depending on the patient's conditions and symptoms. However, Unani therapy may be useful along with allopathic treatment. Probably, the number of COVID-19 cases may decrease in the coming time as the summer is approaching and the rate of virus transmission may be low at high temperature and low humidity. It was realized that this disease is spreading among those who are not taking it seriously and are not following the directions of WHO and the local governments. Therefore, it is urgently advised and requested that all the persons should follow the preventive measures, managements and quarantine strictly without any religious discrepancy otherwise the situation may be the worst. Also, there is an urgent requirement to educate our new generation for science and technology to fight against any such disaster in future; if any. There is no need to be panic and proper prevention and management are essential to combat this disease. Briefly, there is a need for collective efforts globally without any religious discrepancy to fight against such diseases in the future.

## CRedit authorship contribution statement

**Imran Ali:** Conceptualization, Methodology. **Omar M.L. Alharbi:** Investigation, Writing - original draft.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgment

The authors are thankful to the administration of Taibah University, Al-Madinah Al-Munawarah and Government of Saudi Arabia for providing facilities and the encouragement to write this article.

## Funding source

No funding source for this work.

## References

- Agostini, M.L., Andres, E.L., Sims, A.C., 2018. Coronavirus susceptibility to the antiviral Remdesivir (GS-5734) is mediated by the viral polymerase and the proofreading exonuclease. *mBio* 9 221–218.
- Anagha, K., Manasi, D., Priya, L., Meera, M., 2014. Scope of *Glycyrrhiza glabra* (Yashtimadhu) as an antiviral agent: a review. *J. Curr. Microbiol. App. Sci.* 3, 657–665.
- Asl, N.N., Hosseinzadeh, H., 2007. Review of antiviral effects of *Glycyrrhiza glabra* L. and its active component, glycyrrhizin. *J. Med. Plants* 6, 1–12.
- Bano, N., Ahmed, A., Tanveer, M., Khan, G.M., Ansari, M.T., 2017. Pharmacological evaluation of *Ocimum sanctum*. *J. Bioequiv. Availab.* 9, 387–392.
- Bayan, L., Koulivand, P.H., Ali, G., 2014. Garlic: a review of potential therapeutic effects. *Avicenna J. Phytomed.* 4, 1–14.
- Belouzard, S., Chu, V.C., Whittaker, G.R., 2009. Activation of the SARS coronavirus spike protein via sequential proteolytic cleavage at two distinct sites. *Proc. Natl. Acad. Sci. U. S. A.* 106, 5871–5876.
- Carlos, W.G., Cruz, C.S.D., Cao, B., Pasnick, S., Jamil, S., 2020. Novel Wuhan (2019-nCoV) coronavirus. *Am. J. Respir. Crit. Care Med.* 201, 7–8.
- Casanova, L.M., Jeon, R.W.A., Weber, D.J., Sobsey, M.D., 2010. Effects of air temperature and relative humidity on coronavirus survival on surfaces. *Appl. & Environ. Microbiol.* 2712–2717.
- Chang, J.S., Wang, K.C., Yeh, C.F., Shieh, D.E., Chiang, L.C., 2013. Fresh ginger (*Zingiber officinale*) has anti-viral activity against human respiratory syncytial virus in human respiratory tract cell lines. *J. Ethnopharmacol.* 145, 146–151.
- Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., 2020. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* 395 (10223), 507–513.
- Cheng, P.W., Ng, L.T., Chiang, L.C., Lin, C.C., 2006. Antiviral effects of saikosaponins on human coronavirus 229E in vitro. *Clin. Exp. Pharmacol. Physiol.* 33, 612–616.
- Chu, C.M., Cheng, V.C.C., Hung, I.F.N., 2004. Role of lopinavir/ritonavir in the treatment of SARS: initial virological and clinical findings. *Thorax* 59, 252–256.
- Coronavirus: Common Symptoms, Preventive Measures, & How to Diagnose It. Caringly Yours. 28 January 2020. (Retrieved 28 January 2020).
- Cui, J., Li, F., Shi, Z.L., 2019. Origin and evolution of pathogenic coronaviruses. *Nat. Rev. Microbiol.* 17, 181–192.
- Fatima, M., Zaidi, N.U., Amraiz, D., Afzal, F., 2016. In vitro antiviral activity of *Cinnamomum cassia* and its nanoparticles against H7N3 influenza A virus. *J. Microbiol. Biotechnol.* 26, 151–159.
- Fiore, C., Eisenhut, M., Krausse, R., Ragazzi, E., Pellati, D., Armanini, D., Bielenberg, J., 2008. Antiviral effects of *Glycyrrhiza* species. *Phytother. Res.* 22, 141–148.
- Ghoke, S.S., Sood, R., Kumar, N., Pateriya, A.K., Bhatia, S., Mishra, A., Dixit, R., Singh, V.K., Desai, D.N., Kulkarni, D.D., Dimri, U., Singh, V.P., 2018. Evaluation of antiviral activity of *Ocimum sanctum* and *Acacia arabica* leaves extracts against H<sub>2</sub>N<sub>2</sub> virus using embryonated chicken egg model. *BMC Complement. Altern. Med.* 18, 174.
- Guangdi, Li., De Clercq, Erik, 2020. Therapeutic options for the 2019 novel coronavirus (2019-nCoV). *Nature Rev. Drug Discov.* 19 (3), 149–150.
- Hashemipour, M.A., Tavakolineghad, Z., Arabzadeh, S.A.M., Iranmanesh, Z., Nassab, S.A.H.G., 2014. Antiviral activities of honey, royal jelly, and acyclovir against HSV-1. *Wounds* 26, 47–54.
- Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., 2020. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 395 (10223), 497–506.
- Hui, D.S., IA, E., Madani, T.A., Ntoumi, F., Kock, R., Dar, O., 2020. The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health - the latest 2019 novel coronavirus outbreak in Wuhan, China. *Int. J. Infect. Dis.* 91, 264–266.
- Jaimes, J.A., Millet, J.K., Stout, A.E., Andre, N.M., Whittaker, G.R., 2020. A tale of two viruses: the distinct spike glycoproteins of feline coronaviruses. *Viruses* 12, 83.
- Jiang, Z.Y., Liu, W.F., Zhang, X.M., Luo, J., Ma, Y.B., Chen, J.J., 2013. Anti-HBV active constituents from *Piper longum*. *Bioorg. Med. Chem. Lett.* 23, 2123–2127.
- Jin, Y.H., Cai, L., Cheng, Z.S., Cheng, H., Deng, T., Fan, Y.P., 2020. A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus (2019-nCoV) infected pneumonia (standard version). *Mil. Med. Res.* 7, 4.
- Kim, H.Y., Eo, E.Y., Park, H., Kim, Y.C., Park, S., Shin, H.J., Kim, K., 2010. Medicinal herbal extracts of *Sophora radix*, *Acanthopanax cortex*, *Sanguisorba radix* and *Torilis fructus* inhibit coronavirus replication in vitro. *Antiviral Therap* 15, 697–709.
- Konowalchuk, J., Speirs, J.L., 1978. Antiviral effect of commercial juices and beverages. *Appl. & Envir. Microb.* 35, 1219–1220.
- Lee, J.B., Miyake, S., Umetsu, R.H.K., Chijimatsu, T., Hayashi, T., 2012. Anti-influenza A virus effects of fructan from welsh onion (*Allium fistulosum* L.). *Food Chem.* 134, 2164–2168.
- Li, S.Y., Chen, C., Zhang, H.Q., Guo, H.Y., Wang, H., Wang, L., Zhang, X., Hua, S.N., Yu, J., Xiao, P.G., Li, R.S., Tan, X., 2005. Identification of natural compounds with antiviral activities against SARS-associated coronavirus. *Antivir. Res.* 67, 18–23.
- Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., 2020. Early transmission dynamics in wuhan, China, of novel coronavirus-infected pneumonia. *N. Engl. J. Med.* 382, 1199–1207.
- Lin, L.T., Hsu, W.C., Lin, C.C., 2014. Antiviral natural products and herbal medicines. *J. Tradit. Complement. Med.* 4, 24–35.
- Lu, H., 2020. Drug treatment options for the 2019-new coronavirus (2019-nCoV). *Biosci. Trends.* 14, 69–71.
- Lu, R., Zhao, X., Li, J., Niu, P., Yang, B., Wu, H., 2020. Genomic characterization and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet* 395 (10224), 565–574.
- Mathie, R.T., Baitson, E.S., Frye, J., Nayak, C., Manchanda, R.K., Fisher, P., 2013. Homeopathic treatment of patients with influenza-like illness during the 2009 A/H<sub>1</sub>N<sub>1</sub> influenza pandemic in India. *Homeopath* 102, 187–192.
- Miladi, S., Abid, N., Debarnöt, C., Damak, M., Canard, B., Aouni, M., Selmi, B., 2012. In vitro antiviral activities of extracts derived from *Daucus maritimus* seeds. *Nat. Prod. Res.* 26, 1027–1032.
- Momattin, H., Al-Ali, A.Y., Al-Tawfiq, J.A., 2019. A systematic review of therapeutic agents for the treatment of the Middle East respiratory syndrome coronavirus (MERS-CoV). *Travel Med. Infect. Dis.* 30, 9–18.
- Morse, J.S., Lalonde, T., Xu, S., Liu, W.R., 2020. Learning from the past: possible urgent prevention and treatment options for severe acute respiratory infections caused by 2019-nCoV. *ChemBiochem* 21, 730–738.
- Novel Coronavirus 2019, Wuhan, China | CDC. [www.cdc.gov](http://www.cdc.gov). 23 January 2020. Archived from the original on 20 January 2020. Retrieved 23 January 2020.
- Novel Coronavirus Infection (Wuhan, China): Outbreak Update. [Canada.ca](http://Canada.ca). 21 January 2020.
- Omer, M.O., AlMalki, W.H., Shahid, I., Khuram, S., Altaf, I., Saeed, I., 2014. Comparative study to evaluate the anti-viral efficacy of *Glycyrrhiza glabra* extract and ribavirin against the Newcastle disease virus. *Pharm. Res.* 6, 6–11.
- Praditya, D., Kirchhoff, L., Brüning, J., Rachmawati, H., Steinmann, J., Steinmann, E., 2019. Anti-infective properties of the golden spice curcumin. *Front. Microbiol.* 10, 912.
- Ren, L.L., Wang, Y.M., Wu, Z.Q., Xiang, Z.C., Guo, L., Xu, T., 2020. Identification of a novel coronavirus causing severe pneumonia in human: a descriptive study. *Chinese Med. J. (In Press)*.
- Sexton, N.R., Smith, E.C., Blanc, H., Vignuzzi, M., Peersen, O.B., Denison, M.R., 2016. Homology-based identification of a mutation in the coronavirus RNA-dependent RNA polymerase that confers resistance to multiple mutagens. *J. Virol.* 90, 7415–7428.
- Sheahan, T.P., Sims, A.C., Leist, S.R., 2020. Comparative therapeutic efficacy of remdesivir and combination lopinavir, ritonavir, and interferon beta against MERS-CoV. *Nat. Commun.* 11, 222.
- Su, S., Wong, G., Shi, W., Liu, J., Lai, A.C.K., Zhou, J., Liu, W., Bi, Y., Gao, G.F., 2016. Epidemiology, genetic recombination, and pathogenesis of coronaviruses. *Trends Microbiol.* 24, 490–502.
- The Editorial Board, 29 January 2020. Is the world ready for the coronavirus? - distrust in science and institutions could be a major problem if the outbreak worsens. *The New York Times* Retrieved 30 January 2020.
- Transmission of Novel Coronavirus (2019-nCoV) | CDC. [www.cdc.gov](http://www.cdc.gov). 31 January 2020. Retrieved 1 February 2020.
- Wan, Y., Shang, J., Graham, R., Baric, R.S., Li, F., 2020. Receptor recognition by novel coronavirus from Wuhan: an analysis based on decade-long structural studies of SARS. *J. Virol.* 94, 31996437.
- Wang, L., Yang, R., Yuan, B., Liu, Y., Liu, C., 2015a. The antiviral and antimicrobial activities of licorice, a widely-used Chinese herb. *Acta Pharm. Sin.* B 5, 310–315.
- Wang, L., Yang, R., Yuan, B., Liu, Y., Liu, C., 2015b. The antiviral and antimicrobial activities of licorice, a widely-used Chinese herb. *Acta Pharm. Sin.* B 5, 310–315.
- Wang, M., Cao, R., Zhang, L., et al., 2020. Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019-nCoV) in vitro. *Cell Res.* 30, 269–271.
- Weber, N.D., Andersen, D.O., North, J.A., Murray, B.K., Lawson, L.D., Hughes, B.G., 1992. In vitro virucidal effects of *Allium sativum* (garlic) extract and compounds. *Planta Med.* 58, 417–423.
- WHO Statement Regarding Cluster of Pneumonia Cases in Wuhan, China, 9 January 2020n. [www.who.int](http://www.who.int) Archived from the original on 14 January 2020. Retrieved 10 January 2020.
- Xu, Z., Peng, C., Shi, Y., 2020. Nelfinavir was predicted to be a potential inhibitor of 2019-nCoV main protease by an integrative approach combining homology modelling, molecular docking and binding free energy calculation. *bioRxiv* (In Press).
- Zhu, N., Zhang, D., Wang, W., Li, X., Yang, B., Song, J., 2020. A novel coronavirus from patients with pneumonia in China. *N. Engl. J. Med.* 382, 727–733.