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.
Overview of Covid-19; its prevention and management in the light of Unani medicine

Sadia Nikhat a,1, Mohammad Fazil b,⁎

a Dept. of Ilaj bit Tadbeer, School of Unani Medical Education and Research, Jamia Hamdard, New Delhi 110062, India
b HAK Institute of Literary and Historical Research in Unani Medicine, CCRUM, Jamia Millia Islamia Campus, New Delhi 110025, India

HIGHLIGHTS

• Covid-19 is an ongoing pandemic caused by a new coronavirus named as SARS-CoV-2.
• SARS-CoV-2 has structural similarity with bat coronavirus and SARS-coronavirus.
• Researches are being done to develop effective vaccines and drugs for the disease.
• Unani medicine has effective preventative measures for epidemic diseases.
• Phytochemicals in herbal drugs can potentially help in reducing the disease burden.

GRAPHICAL ABSTRACT

ABSTRACT

Since December 2019, a respiratory pandemic named as coronavirus disease 2019 (Covid-19) caused by a new coronavirus named as SARS-CoV-2, has taken the world by storm. The symptoms are fever, malaise, and cough which resolve in a few days in most cases; but may progress to respiratory distress and organ failure. Transmission is through droplet infection or fomites, but other modes such as airborne transmission and oro-fecal transmission are also speculated. Research is underway to develop effective vaccines and medicines for the disease. In such a scenario, we present the measures described in Unani system of medicine for health protection during epidemics. Unani is a traditional system of medicine developed during the middle ages, which employs natural drugs of herbal, animal and mineral origin for treatment. In Unani medicine, during an epidemic, apart from isolation and quarantine, three measures are of utmost importance, (i) purification of surroundings using certain herbal drugs as fumigants or sprays, (ii) health promotion and immune-modulation, and (iii) use of health-protecting drugs and symptom-specific drugs. Drugs such as loban (Styrax benzoides W. G. Craib), sandroos (Hymenaea verrucosa Gaertn.) za'fran (Crocus sativus L.), vinegar etc. are prescribed in various forms. Scientific researches on these drugs reveal the presence of a number of pharmacologically active substances, which may provide a new insight into the management of infections and epidemics.

Abbreviations: SARS-CoV, severe acute respiratory syndrome coronavirus; MERS-CoV, Middle-East respiratory syndrome coronavirus; Covid-19, coronavirus disease 2019; WHO, World Health Organization; SARS-CoV-2, SARS coronavirus-2; NSAIDs, non-steroidal anti-inflammatory drugs; ACE2, angiotensin converting enzyme-2; AYUSH, Ayurveda, Yoga, Unani, Siddha, and Homeopathy; RNA, ribose nucleic acid.

⁎ Corresponding author.
E-mail addresses: sadianikhat@jamiahamdard.ac.in (S. Nikhat), fazilmd00@gmail.com (M. Fazil).

1 The authors contributed equally to the manuscript at all stages.
1. Introduction

Since the beginning of the 21st century, three coronaviruses have caused disastrous outbreaks of pneumonia in human beings: Severe acute respiratory syndrome coronavirus (SARS-CoV) in 2002–03 and Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012 (Čižjak et al., 2020). The ongoing Covid-19 (Coronavirus disease 2019) is the third coronavirus epidemic of zoonotic origin to occur in the present century (Sun et al., 2020), which spread from a single city in China to the entire country within 30 days (Wu and McGoogan, 2020); and spread to nearly 72 countries in less than three months (Chinazzi et al., 2020). In essence, it is known to have affected ‘all continents except Antarctica’ (Acharya, 2020). On 12th March 2020, Covid–19 was declared a pandemic by the World Health Organization (WHO) (Gautret et al., 2020). As of 17th April 2020, there have been 2,074,529 confirmed cases and 139,378 deaths worldwide due to Covid-19 as reported by the WHO (WHO, 2020).

In India, the first case of Covid-19 was a student who returned from Wuhan, China on 30th January 2020 (Saahasrananam and Kumar, 2020). By 14th April 2020, there have been a total of 13,387 cases and 437 deaths in the country. Although community transmission is not reported, clusters of cases have been identified (WHO, 2020).

The causative agent of Covid-19 was tentatively named as 2019-nCoV (2019 novel coronavirus) by WHO on 12th January 2020 (Sun et al., 2020). On 11th February 2020, it was officially named as SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) by the International Committee on Taxonomy of Viruses (Gautret et al., 2020; Rasmussen et al., 2020). It is now understood that SARS-CoV-2 has a 96.2% structural similarity with a bat coronavirus (CoV RaTG13) and 79.5% similarity with SARS-CoV. However, its spike (S) glycoprotein has a 10–20 times higher affinity to human ACE2 receptors as compared to SARS-CoV, leading to more chances of human–to–human transmission; though having a lesser mortality rate (average 3.4%) than that of SARS (9.6%) and MERS (3%) respectively (Guo et al., 2020).

The present control strategies of the disease include the reduction of secondary infections by early diagnosis and isolation of cases, providing optimal care to infected patients, and the development of effective diagnostic, preventive and therapeutic strategies, including vaccines (WHO, 2020). In the absence of any proven treatment option, many drugs are under investigation to control this disease with a potentially fatal outcome. Chloroquine is one of the widely used drugs, with in vitro evidence that it reduces viral replication (Deponti et al., 2017). A combination of hydroxychloroquine and azithromycin has also been found to have a significant synergistic effect in reducing viral load and early recovery (Gautret et al., 2020). For severe disease, the use of steroids, passive antibodies, and selective cytokine blockade is suggested (Mehta et al., 2020). The role of NSAIDs and corticosteroids, however, is still controversial and not advisable at present (Russell et al., 2020). Antivirals such as interferon-α, lopinavir/ritonavir, ribavirin, etc. are also being used as a tentative treatment for Covid-19 (Dong et al., 2020). Yet, as of now, there are no specific antiviral drugs or vaccines verified to be effective against SARS-CoV-2, hence the emphasis is being laid on preventive measures and symptomatic treatment (Jean et al., 2020).

In this context, traditional systems of medicine are being explored for providing preventive, supportive and rehabilitative care to patients. Although no direct evidence is available, some uncontrolled studies on traditional medicines suggest that they may have a direct efficacy on the virus. Unani medicine is one of the officially recognized traditional medicine systems of India, which are represented by the acronym AYUSH, i.e. Ayurveda, Yoga, Unani, Siddha and Homeopathy (Weeks, 2020). Unani also sometimes referred to as the Greco-Arabian system of medicine originated with the teachings of Hippocrates and was improved and systematized by Arabian physicians. It was introduced into India during the 11th–13th century in the Mughal period (Subbarayappa, 2001). Unani system of medicine has a detailed description of drugs that are utilized in many infectious diseases, including respiratory infections (Vohora, 1986). Some of these drugs have been demonstrated to have specific antiviral (Cagno et al., 2015) and immunomodulatory (Nigar and Itrat, 2013) activity in various scientific studies. In this paper, we present an overview of Covid-19 and SARS-CoV-2, Unani concept of infectious and epidemic diseases and their preventive measures, and a possible approach to the management of Covid-19 with Unani medicine.

2. Methodology

The authors searched the Unani medicine books available in Jamia Hamdard library for information related to epidemic diseases. Five important textbooks of Unani medicine were reviewed. Al-Qanoon fil Tib (The Law in Medicine) of Ibn Sina (980–1035 CE), Kitab al-Hawi (The Comprehensive Book of Medicine) of Zakariya Razi (865–925 CE), Kitab al-Kulliyat (The Complete Book on Medicine) by Ibn Rushd (1126–1198 CE), Kitab al-Mansoori (Book dedicated to Caliph Mansoor) by Zakariya Razi (865–925 CE), and Kitab al-Mukhtarat fil-Tib (The Book on Choice of Medicine) by Ibn Hubal Baghdadi (1121–1213 CE). Other published books and journals were also consulted for further details. For information on SARS-CoV-2 and Covid-19, we searched major scientific databases namely Pubmed, Science Direct and Springer for the most recent information regarding the pandemic. The search words used were ‘SARS-CoV-2’, ‘Covid–19’, ‘history’, ‘prevalence’, ‘symptoms’, and ‘transmission’. Internet search on the same search engines and also Google Scholar was also done to search for scientific evidence regarding Unani drugs prescribed during epidemics. For this search, we used the terms ‘air purification’, ‘influenza’, ‘epidemic’, ‘immunomodulatory’, and ‘bioactive compounds’ along with the names of drugs, according to their use. Time restriction was not made to extract the most useful information. The articles published during 2005–2020 were hence included in the final manuscript.

3. Coronavirus disease 2019

3.1. Causative agent

SARS-CoV-2 is a coronavirus belonging to the genus β-coronaviruses, sub-genus bat coronaviruses (Sun et al., 2020). It is the seventh in the family of coronaviruses which is known to infect humans (Andersen et al., 2020). Coronavirus are a group of enveloped viruses with a spherical shape, having a non-segmented, single-stranded RNA genome with club-like projecting spikes on their surface (Phan, 2020a). SARS-CoV-2 was first isolated from bronchoalveolar lavage samples from three patients suffering from pneumonia of unidentified cause (Zhu et al., 2020). Structurally, the genome of SARS-CoV-2 is similar to other β-coronaviruses. It has a long coding strand on which five ORFs are identified: including ORF1ab polyprotein, spike (S) glycoprotein, envelope protein, membrane protein, and nucleocapsid protein (Phan, 2020a). The S glycoprotein is the primary target of antibodies and vaccines as it is surface-exposed (Walls et al., 2020).

Two distinct features have been identified in the genome sequence: (i) Structural and biochemical studies have identified that SARS-CoV-2 receptor-binding domain (RBD) in the spike protein has a high affinity to human or human-like angioteins converting enzyme-2 (ACE2) receptors; and (ii) a second feature is a polybasic cleavage at the junction of sub-units S1 and S2 of the spike, which may determine the infectivity and host range of the virus (Andersen et al., 2020).

Mutations and deletions have also been identified in the genome sequence of virus samples isolated from patients across countries, which indicate genetic diversity and evolution of the virus (Phan, 2020b). Genetic analysis of 103 genomes has indicated that SARS-CoV-2 has evolved into two major types, designated as S and L. The L-type is more prevalent, found in about 70% of the cases in Wuhan (Tang et al., 2020).
3.2. Modes of transmission

In the earliest stage of the epidemic, as 55% of the patients were related to a seafood and wet animal market, a likely zoonotic origin was suggested (Sun et al., 2020). Researches have indicated that SARS-CoV-2 has close structural resemblance with bat coronaviruses, supporting the theory that SARS-CoV-2 was derived from bats. Snakes have also been suggested as a likely wildlife repository of the virus. However, there was an exponential rise in unrelated cases since late December 2019 (Sun et al., 2020). Since bats are a natural reservoir of various coronaviruses, a zoonotic angle is not entirely ruled out. But statistics reveal that the disease is spreading rapidly by human-to-human transmission (Guo et al., 2020).

SARS-CoV-2 has been detected in broncho-alveolar secretions, sputum, saliva, throat and nasopharyngeal secretions of infected persons (Phan, 2020b). About 50–80% transmission of the virus is from asymptomatic carriers, hence transmission through speech droplets is considered as a significant mode of transmission of the disease. The virus can be transmitted directly through speech droplets, or through fomites (Anfinrud et al., 2020). Based on reports, it is estimated that 44% of the transmission can occur before the onset of symptoms (He et al., 2020). SARS-CoV-2 binds to the ACE2 receptors, which are present in abundance in the lungs and gastrointestinal tract. Viral RNA has also been detected in feces. Hence, an oro-fecal route of transmission is also considered. Air-borne transmission is not completely ruled out (Ling et al., 2020). There is also evidence that the virus can be transmitted through tears and body fluids if they come into contact with the mucosa of eyes, mouth or nose. Depending on the route of entry, the virus binds to ACE2 receptors and infects type-2 pneumocytes, ciliated bronchial epithelium of lungs (Rodriguez-Moraes et al., 2020), or enterocytes of the small intestine. The virus has also been isolated in blood, indicating more routes of transmission (Guo et al., 2020).

3.3. Disease spectrum

The incubation period of Covid-19 ranges from 1 to 14 days, averaging 5–6 days in most patients. Though an incubation period of up to 24 days has been reported in some cases (Jean et al., 2020). The disease affects males and females equally, although a slight male predominance has been observed (Guo et al., 2020). The initial symptoms are fever with chills, dry cough, and malaise in 83–98% of cases. Sputum production is seen in about one-third. Other symptoms include shortness of breath, abdominal pain, diarrhea, headache and vomiting in a few cases (del Rio and Malani, 2020). If pulmonary inflammation worsens, hypoxemia occurs which may lead to cardiac arrest. Elderly patients and those with underlying diseases such as chronic obstructive pulmonary disease, cardiovascular disease, hypertension, etc. have a more chance of developing acute respiratory distress syndrome, organ failure or other conditions leading to death (Guo et al., 2020).

Most patients have a good prognosis, with mild flu-like symptoms (del Rio and Malani, 2020). However, a small percentage, particularly the elderly and those with underlying diseases may develop complications such as arrhythmia, shock, acute renal failure, acute cardiac injury, acute respiratory distress syndrome, etc. (Guo et al., 2020). Overall, the case fatality rate is estimated to be 2–3% (Rodriguez-Moraes et al., 2020), while it is as high as 8–15% in older adults (del Rio and Malani, 2020).

Laboratory findings include a decreased white cell count in 70% patients, prolonged prothrombin time in 58% patients, and elevated lactate dehydrogenase in about 40% of the patients (del Rio and Malani, 2020). Interleukin-6 (IL-6), Interleukin-10 (IL-10), Tumor necrosis factor-α (TNF-α) are increased. Bilateral patchy infiltrates are seen on chest radiograph and ground-glass opacities are seen on chest CT scan (del Rio and Malani, 2020). Histopathological examination of biopsy tissues has demonstrated the desquamation of pneumocytes, formation of hyaline membrane and bilateral diffuse alveolar damage in lung, liver and cardiac tissue (Rodriguez-Moraes et al., 2020).

4. Infectious and epidemic diseases in Unani medicine

4.1. A brief introduction to Unani System of Medicine

Unani system of medicine has its roots in ancient Greece, in the teachings of Hippocrates (460–377 BCE). The name Unani reflects its Hellenistic origin and is derived from the Yunan, the ancient name of Greece (Husain et al., 2010). Unani medicine flourished to its zenith during medieval ages (500–1500 CE) in the Muslim world, mostly in the Arabian peninsula, Persia, Egypt, Syria, ancient Mesopotamia, etc. Ero it is also referred to as Greco-Arabian medicine and Persian medicine in different parts of the world (Islam, 2018). In India, it is integrated into the national healthcare system and officially named as Unani medicine (Subbarayappa, 2001). Unani medicine is based on the Hippocratic concepts of misaj (temperament) and akhlat (humors) (Husain et al., 2010). Famous scholars of Unani medicine include Ibn Sina (Latinized as Avicenna, 980–1035 CE), Zakariya Razi (Latinized as Rhazes, 865–925 CE), Ibn Rushd (Latinized as Averroes, 1126–1198 CE), and many more (Islam, 2018).

4.2. Concept of infectious diseases and epidemics in Unani medicine

The ‘germ theory of disease’ was established as late as 1683 CE with the development of the first microscope (Foster, 1970). For obvious reasons, the concept of microbes as disease-causing agents does not find a direct reference in Unani medicine. However, there is an adequate understanding that certain ajsam-i-khabitha (literally translated as ‘bad substances’) can migrate from the diseased to healthy persons, and may cause diseases (Sina, 1878). This theory of contagion is advocated by a number of Unani scholars. According to Jalinoos (Latinized as Galen, 131–199 CE), ‘a physician should always keep an eye on changes of weather and air’ (Qadeer, 2001). A treatise of Zakariya Razi (865–925 CE), Kitab al-jadari wa-al-hasbah (Book on Smallpox and Measles) describes the modes of spread of the two diseases and their differential diagnosis. In May 1970, it was regarded as “the first scientific treatise on the subject” by WHO (Islam, 2018). According to Ibn Sina (980–1035 CE), ‘air and water are contaminated only after admixture of ajsam-i-khabitha, which does not happen otherwise’. He further states, ‘such contamination can also be brought about if the dead bodies of people dying due to an epidemic are not disposed of properly’ (Sina, 1878). Evidently, he had knowledge of microbes being present in the body even after death, which could potentially infect others.

During the 14th-century plague pandemic, Spanish scholar Ibn Khatima (1364–1369 CE) mentioned in his treatise Tahsil garad al-qasid fi-taafsil al-marad al wafid (succeeding in clarifying pest disease) that ‘I have observed that a person who comes in close contact with a patient of plague will start suffering from the same symptoms’ (Cambra, 2018; Rehman, 1991), indicating a good understanding of disease transmission.

Epidemics, referred to as waba in Unani medicine, are thought to occur if such contagion or ajsam-i-khabitha, as they are referred to, find a place in air and water (Sina, 1878). Zakariya Razi (865–925 CE) states in Kitab al-Mansoori (Book dedicated to Caliph Mansoor), most epidemics spread in the autumn season, especially if the preceding summer season was humid, and the wind is still (Razi, 1991). In this context, the direction of winds is given utmost significance. As Ibn Hubal Baghdadi (1121–1213 CE) mentioned in his treatise Kitab al-Mukhtarat fil-Tib (The Book on Choice of Medicine), if southern winds are replaced by northern winds, then catarrhal illnesses will occur in abundance (Baghdadi, 2004). Because, as stated by Razi in the 15th volume of his treatise Kitab al-Hawi (The Comprehensive Book of Medicine), southern winds are warmer while the northern winds are colder, and this change...
of temperature makes people more susceptible to respiratory infections (Razi, 2008).

Furthering the view, Ibn Sina (980–1035 CE) stated that epidemics spread from one person to another, and one city to another ‘like a message’ (Sina, 1878). Zakariya Razi (865–925 CE) stressed this fact and stated that ‘there will always be something common in patients of epidemics, whether a place, food, drink or travel history’ (Razi, 2008). During the 14th-century plague pandemic, Arabian scholar Ibn Khatib (1313–1374 CE) stressed that ‘most of the people who come in contact with a plague victim will die’. In the same context, he states, ‘the disease spreads through clothes, utensils and jewelry’ (Ober and Aloush, 1982; Rehman, 1991), thus stressing on transmission through fomites. In the same vein, this statement stresses on social distancing and isolation, two important aspects of prevention in the current pandemic.

The 13th-century Persian scholar Najeebuddin Samarqandi (d. 1222 CE) mentioned about a type of epidemic influenza in his treatise Al-asbab wa-Alamat (the book of causes and symptoms). In the translated version of the book, published by the name of Sharah Asbab, the disease is mentioned by the name of Nazla-e-Wabaiya (epidemic influenza) in the chapter on Anaf al-Anza (Influenza). About Nazla-e-Wabaiya, Samarqandi states that it is associated with fever, sneezing, sore throat, nasal irritation and malaise. Specifically, weakness sets in early in the disease. He further states that a patient of nazla-e-wabaiya may also suffer from cough, diarrhea, and delirium. Pleurisy and pneumonia, if present, worsens the prognosis (Samarqandi, 2010).

It is evident that despite the inability to observe microbes, Unani scholars could envision and comprehend their sources and reservoirs, modes of transmission of infections, and potential causes of infections turning into epidemics. The theories and observations closely resemble the contemporary knowledge of infections, which reinforce the fact that Unani medicine can play a significant role in combating current health problems.

4.3. General preventive measures during epidemics

The preventive measures for epidemic diseases are collectively aimed towards the improvement of immunity, prevention of spread of infection, hygiene and anti-secit measures and promotion of general health. Host defenses are given particular importance (Rushd, 1987). According to Razi (865–925 CE), people who remain physically active and exercise regularly have a lesser susceptibility to epidemic diseases (Razi, 2008). Patients having a weak constitution and those suffering from underlying diseases are said to be more susceptible during epidemics (Sina, 1878).

The basic measure advised is to avoid places where an epidemic is spread. In case it is not avoidable, then a person advised to stay at a well-ventilated place, preferably distant from the ground. When interacting with a patient, care should be taken that the air currents may not be directed from a patient to a healthy person (Razi, 1991). During epidemics, it is also advised to avoid unnecessary physical exertion (Razi, 2008; Sina, 1878) and to stay in properly ventilated places with optimum temperature, neither too hot nor too cold (Rushd, 1987).

4.4. Sanitization of surroundings

Immense stress is placed on purification and sanitization of surroundings during epidemics because it is the primary medium which facilitates the spread of infections. Before the era of chemical-based air purifiers, Unani physicians employed medicinal herbs as decoction or distillate for spray, or as fumigants to keep the air free of contaminants.

Homes should be sprayed with diluted vinegar to keep the air clean. It may be mentioned here that in Unani texts, vinegar implies the one made from sugarcane (Saccharum officinarum L., Poaceae) unless specified otherwise. Arq-e-Gulab (Rosa damascena Herrm.) should be applied on the body and curtains etc. If the air smells foul, then fumigation with sandal (Santalum album L.) and camphor is also advisable. Fumigation with herbs like Qust (Saussurea costus (Falc.) Lipsch.), kundur (Boswellia serrata Roxb. ex Colebr.), ood (Paroemia emodi) and Murr (Commiphora myrrha Nees Engl.) is also advisable (Rushd, 1987). According to Zakariya Razi, some aromatic drugs can destroy infectious agents and should be used as fumigants during epidemics. For instance amber (Liquidambar acalychna H. T. Chang), loban (Styrax benzoides W. G. Craib), sandroos (Hymenaea verrucosa Gaertn.) za’far (Crocus sativus L.), aboobos (Diospyros ebenum J. Koenig ex Retz.), mastagi (Pistacia lentiscus L.), mushik (Moschus moschiferus L.), izkhr (Cymbopogon jwarancusa (Jones) Schult.), abhal (Juniperus communis L.), zanjabeel (Zingiber officinale Roscoe), sibr (Aloe vera L.), olive gum, etc. (Razi, 2008). Mushik however, is now banned for use, as the Musk deer is an endangered species in many parts of the world, including India (Bhat, 2016). Information about these drugs is presented in Table 1.

It is pertinent mentioning here that in the contemporary world, herbal fumigants and sprays are rarely used for the purpose specified in traditional medicine. Sporadic researches have been published on the efficacy of herbal drugs as fumigants (BhatwalKar er al., 2019), but much of the potential is yet to be discovered. Also, we could not find any clinical trials on the health effects of herbal fumigants. Probably, for this reason, the studies, if at all conducted, report the effect of these drugs as insecticidal, acaricidal, etc. For some drugs such as H. verrucosa, O. europaea, etc., no studies were found where the drugs have been used for fumigation, although many herbal drugs are used as household incense in some countries (Lemenih et al., 2003). Hence, we rely on the information that they contain volatile oils rich in alcohol (J. Kim et al., 2016), terpenoids (Ludwiczuk et al., 2017), etc. which may offer an anti-microbial effect on fumigation. However, the health effects of fumigation, along with quality control of drugs is needed before reaching a conclusion.

4.5. Dietary modifications

During epidemics, it is advised to avoid meat, sweets, and fruits with high water content. If meat has to be taken, then that of birds found on mountains may be preferred over animal meat. Fish should be entirely avoided (Rushd, 1987). These restrictions were placed probably because the zoonotic spread of infections was speculated, and fish and animals living near the ground were more likely to be infected than those living at higher altitudes. It is also advised to consume citrus and sour fruits, especially grapes, apples, lemon, etc. Oxymel prepared with Arq-e-Gulab is believed to provide effective protection during epidemics (Razi, 1991; Rushd, 1987). Overeating and under-eating both are considered harmful as they have adverse effects on the bodily constitution. Staying thirsty was also known to be detrimental (Sina, 1878).

4.6. Health protecting drugs

Unani scholars have prescribed certain drugs that may be used as health protecting drugs during epidemics. Both single herbs and compound formulations have been prescribed in this regard. Imit (Tamarindus indica L.), revand chini (Rheum australe D. Don), gul-e-banafsa (Viola odorata L.), halela (Terminalia chebula Retz.), amattas (Cassia fistula L.), turanjabeen (Alhagi pseudalhagi (M. Bieb.) Desv. ex B. Keller & Shap.), and aab-e-anar (Punica granatum L.) are said to afford protective effects during epidemics. According to Ibn Rushd, these drugs have a cleansing effect on body humors (Rushd, 1987). Vinegar may also be taken orally, as part of diet or salad, etc. (Razi, 1991). Since the dosage and dosing pattern of these drugs is not specified in classical textbooks of Unani medicine, we suggest that they may be used according to the guidelines of Unani pharmacopeias (Anonymous, 2009).

Some important compound formulations are also prescribed during epidemics. Ibn Rushd (1126–1198 CE) has given a description of a medicine, about which he made a curious claim, ‘whoever has used this formulation during an epidemic remained protected from it’. The composition is as follows: Sibr (Aloe vera L.) and Murr makki (Commiphora...
such as alcohols, terpenes, etc. (mentioned in the table) which may provide air-purifying effects on fumigation. Hence, these

Drugs prescribed for the protection of health during epidemics.

| S. no. | Botanical name & family | Unani name | Part used | Method of use in Unani medicine | Mode of Action/rationale for use |
|--------|--------------------------|------------|-----------|-------------------------------|---------------------------------|
| 1.     | Acetic acid (vinegar)    | Sirka      | Whole     | Spray                         | Antimicrobial                    |
| 2.     | Boswellia serrata Roxb. ex Colebr., Styracaceae | Kundur | Oleo-gum resin | Fumigation | Reduction of airborne bacteria |
| 3.     | Cinnamomum camphora (L.) J. Presl., Lauraceae | Kafoor | Essential oil | Fumigation | Insecticidal, acaricidal |
| 4.     | Crocus sativus L., Iridaceae | Ze'faran | Stamen | Fumigation | Contains volatile oils with anti-microbial activitya |
| 5.     | Cymbopogon jwarancusa (Jones) Schult., Poaceae | Izkar | Root | Fumigation | Insect repellent |
| 6.     | Diospyros eburnum Koenig ex Retz., Ebenaceae | Aubnoos | Wood | Fumigation | Contains essential oilsa |
| 7.     | Hymenaea verrucosa Gaertn., Leguminosae | Sandroos | Resin | Fumigation | Contains diterpenoidsa |
| 8.     | Juniperus communis L., Cupressaceae | Abhal | Berry | Fumigation | Volatile oil contains terpenesa |
| 9.     | Liquidambar acyclinno H. T. Chang, Altingiaceae | Amber | Gum | Fumigation | Contains diterpenoids and triterpenoidsa |
| 10.    | Olea europaea L., Oleaceae | Zaitoon, Olive | Gummy exudate from tree | Fumigation | Leaves and oil contain triterpenoidsa |
| 11.    | Paonia emodi Roy., Paoniaceae | Mastagi | Gum-resin | Fumigation | Contains essential oil having salicylaldehyde, trans-myrtanol etc.a |
| 12.    | Pistacia lentiscus L., Anacardiaceae | Arq-e-Gulab | Distillate of petals | Application on curtains etc. | Fumigation | Insecticidal |
| 13.    | Rosa damascena Herrm., Rosaceae | Santalum album L., Santalaceae | Sandal safaid | Heartwood | Fumigation | Insecticidal |
| 14.    | Sausseea costus (Falc.) Lipsch., Compositae | Styrax benzoides W. G. Craib, Styracaceae | Loban | Resin | Fumigation | Reduction of air-borne bacteria |
| 15.    | Zingiber officinale Roscoe, Zingiberaceae | Zanjabeel | Rhizome | Fumigation | Insecticidal and insect repellant |

Mode of action/rationale for use

Antimicrobial, anti-oxidant, anti-obesity
Anti-microbial, anti-oxidant, hepatoprotective, anti-pyretic
Antimicrobial, anti-oxidative, anti-inflammatory
Antibacterial against oral bacteria
Antioxidant; contains alcohols
Anti-microbial, anti-fungal
Anti-microbial, anti-fungal, anti-viral, anti-inflammatory
Anti-microbial, anti-oxidative, anti-inflammatory
Antibacterial
Antioxidant; contains alcohols
Analgesic, anti-inflammatory
Anti-bacterial
Anti-microbial, anti-fungal

References

(a) Studies about these drugs as fumigants were not found on any of the search engines. However, researches have shown that they contain volatile oils with biologically active substances such as alcohols, terpenes, etc. (mentioned in the table) which may provide air-purifying effects on fumigation. Hence, these findings provide a rationale for future research.

Table 2

Drugs prescribed for the protection of health during epidemics.

| S. no. | Botanical name & family | Unani name | Part used | Method of use in Unani medicine | Mode of action/rationale for use |
|--------|--------------------------|------------|-----------|-------------------------------|---------------------------------|
| 1.     | Acetic acid (vinegar)    | Sirka      | Whole     | Spray                         | Antimicrobial, antioxidant, anti-obesity |
| 2.     | Alhagi pseudalhagi (M. Bieb.) Desv. ex B. Keller & Shap, Leguminosae | Turanjabeen | Resinous exudates from fruit and stem | Oral | Anti-microbial, anti-fungal, anti-inflammatory |
| 3.     | Cassia fistula L., Leguminosae | Amaltes | Pulp | Oral | Anti-microbial, anti-oxidant, hepatoprotective, anti-pyretic |
| 4.     | Crocus sativus L., Iridaceae | Zafran | Stamen | Oral | Antimicrobial, anti-oxidative, anti-inflammatory |
| 5.     | Juglans regia L., Juglandaceae | Jauz | Jam made of fruits | Oral | Neuroprotective, cardioprotective |
| 6.     | Morus nigra L., Moraceae | Toot | Jam made of fruits | Gargle | Anti-inflammatory, antimicrobial |
| 7.     | Punica granatum L., Lythraceae | Anar | Fruit juice | Oral | Anti-microbial, anti-fungal, anti-viral, anti-inflammatory |
| 8.     | Rhus coraria L., Anacardiaceae | Revand Chini | Rhizome | Oral | Antimicrobial, anti-oxidative, anti-inflammatory |
| 9.     | Rosa damascena Herrm., Rosaceae | Arq-e-Gulab | Distillate of petals | Gargle | Antioxidant; contains alcohols |
| 10.    | Tammarindus indica L., Leguminosae | Imli | Pulp | Oral | Analgesic, anti-inflammatory |
| 11.    | Terminalia chebula Retz., Combretaceae | Halela | Fruit | Oral | Anti-bacterial |
| 12.    | Viola odorata L., Violaceae | Banafsha | Flowers | Oral | Anti-microbial, anti-fungal |

References

(a) Studies about these drugs as fumigants were not found on any of the search engines. However, researches have shown that they contain volatile oils with biologically active substances such as alcohols, terpenes, etc. (mentioned in the table) which may provide air-purifying effects on fumigation. Hence, these findings provide a rationale for future research.
myrrha (Nees Engl.), one part each, za'fran (Crocus sativus L.), 2 parts. The drugs should be finely powdered and taken in a dose of 2.4 g per day (Rushd, 1987). For epidemics involving respiratory diseases, gargling with a solution of sumaq (Rhus coriaria L., decoction), rub-e-toot (Morus nigra L.), rub-e-jauz (Juglans regia L.) and arq-e-gulab (Rosa damascena Herrm.) before sleep is advised (Razi, 1991). Information about the use of these drugs is provided in Table 2.

5. Possible approach to prevention and management of Covid-19 in the light of Unani medicine

In light of the above-summarized information, the symptoms of Covid-19 closely resemble those of nazla-e-wabaiya described in Unani books. Fever, malaise, cough, etc. are the initial symptoms, which may be associated with diarrhea (del Rio and Malani, 2020). Similar symptoms have been described by Unani scholars regarding nazla-e-wabaiya (Samarqandi, 2010). People with an underlying disease or a weak constitution have been described by Ibn Sina (980–1035 CE) as being more susceptible to epidemic diseases and having a poor prognosis (Sina, 1878). Besides, the modes of transmission of infection, importance of quarantine and air purification have also been outlined in sufficient detail (Rushd, 1987).

With this information, we suggest the following preventive measures and management options in the light of Unani medicine:

5.1. Preventive measures

General measures of isolation, quarantine, and distancing must be followed. Transmission through fomites is highly likely, so care should be taken in handling and disposing of the same. Health care workers, family members and caretakers of the patients should take due precautions. Stay in well-ventilated places reduces the chances of contracting the infection. Razi’s advice of avoiding airflow from the patient to a healthy person is remarkable. For this purpose, the patient should face away from healthy people while coughing, sneezing or talking, as the virus may also be excreted through saliva (Razi, 1991).

Sanitization of the environment should always be given special importance as it serves as the medium for lodging and dissemination of the virus. Several drugs (Table 1) have been prescribed for spray, for application on curtains, as sanitizers on the body, and for fumigation. In the light of Unani medicine, primary focused on air-borne respiratory infections. Concepts of sanitation, isolation, air purification and immune-modulation described in Unani medicine remain the basis tenets of infection containment in the contemporary preventive medicine (Chinazzi et al., 2020). This necessitates a keen observation to uncover more treasure of knowledge from this ancient medicine system. Presently, in the absence of any decisive treatment available for Covid-19, stress is being laid on traditional medicine systems. Unani physicians were aware of the immunomodulatory effects of citrus fruits. Besides, other measures of health promotion during epidemics include having a wholesome diet, avoiding starvation, avoiding meat and fish, and staying hydrated (Razi, 2008; Sina, 1878). Certain drugs have also been prescribed as for the purpose of health promotion (summarized in Table 2), such as revand chini (Hymenaea verrucosa Gaertn.) za’fran (Crocus sativus L.), Rose water, vinegar, etc. which provide a relaxing aroma and are also said to have a clearing effect on microbes (Razi, 1991). Although the clinical effects of most drugs are not published as yet, as they have a long history of cultural use, their importance cannot be denied abruptly. In the future, herbal drugs may potentially provide a cost-effective and safer alternative to chemical disinfectants (Bhatwarkar et al., 2019).

Health protective measures need a special mention. Unani physicians are aware of the immunomodulatory effects of citrus fruits. Besides, other measures of health promotion during epidemics include having a wholesome diet, avoiding starvation, avoiding meat and fish, and staying hydrated (Razi, 2008; Sina, 1878). Certain drugs have also been prescribed for the purpose of health promotion (summarized in Table 2), such as revand chini (Hymenaea verrucosa Gaertn.) za’fran (Crocus sativus L.), Rose water, vinegar, etc. which provide a relaxing aroma and are also said to have a clearing effect on microbes (Razi, 1991). Although the clinical effects of most drugs are not published as yet, as they have a long history of cultural use, their importance cannot be denied abruptly. In the future, herbal drugs may potentially provide a cost-effective and safer alternative to chemical disinfectants (Bhatwarkar et al., 2019).

Health protective measures need a special mention. Unani physicians were aware of the immunomodulatory effects of citrus fruits. Besides, other measures of health promotion during epidemics include having a wholesome diet, avoiding starvation, avoiding meat and fish, and staying hydrated (Razi, 2008; Sina, 1878). Certain drugs have also been prescribed for the purpose of health promotion (summarized in Table 2), such as revand chini (Hymenaea verrucosa Gaertn.) za’fran (Crocus sativus L.), Rose water, vinegar, etc. which provide a relaxing aroma and are also said to have a clearing effect on microbes (Razi, 1991). Although the clinical effects of most drugs are not published as yet, as they have a long history of cultural use, their importance cannot be denied abruptly. In the future, herbal drugs may potentially provide a cost-effective and safer alternative to chemical disinfectants (Bhatwarkar et al., 2019).

6. Conclusion

Human civilization has been marred with the occurrence of epidemics, often threatening to have disastrous effects on humankind. Just when we thought we had conquered microbes (Abedeji, 2016; Mohr, 2016), three viruses, belonging to a family hitherto considered less virulent, took the 21st century by storm (Čivljak et al., 2020). The newest of them, SARS-CoV-2, is, fortunately, lesser on virulence than its two recent predecessors, namely SARS-CoV and MERS, but higher in infectivity (Vellingiri et al., 2020). This simply implies that it has more chances of reaching the susceptible population and causing higher mortality. There is also speculation that close to two-thirds of Covid-19 cases from China may have gone undetected (Menkir et al., 2020). Going by the present trends, the cases are likely to increase in the near future (Vellingiri et al., 2020). This is going to place a huge economic burden, especially on developing and under-developed countries (McKibbin and Fernando, 2020).

An important aim of this paper was to apprise the readers about the concept of epidemic diseases in Unani medicine, and also how the theories built largely on observation and clinical experiences aptly provide a comprehensive description of preventive and protective measures for infectious and epidemic diseases. Concepts of sanitation, isolation, air purification and immune-modulation described in Unani medicine remain the basis tenets of infection containment in the contemporary preventive medicine (Chinazzi et al., 2020). This necessitates a keen observation to uncover more treasure of knowledge from this ancient medicine system. Presently, in the absence of any decisive treatment available for Covid-19, stress is being laid on traditional medicine systems for providing the necessary protection (Vellingiri et al., 2020). Herbal medicines have several bioactive compounds such as phenols, vitamins, several antioxidants, etc. with important pharmacological activity. Hence they can play a significant role in reducing the disease burden in the contemporary world (J. Kim et al., 2016; Zeinali et al., 2019).

Intriguingly, it was noticed that among all epidemics, the textbooks of Unani medicine primarily focused on air-borne respiratory infections. Although at some places epidemics involving food and water-borne diseases, and plague, etc. have also been discussed (Razi, 2008; Sina, 1878), but most of the literature is dedicated to air-borne diseases which affect the respiratory system. It is possible because the most prevalent epidemics in the Muslim world during the medieval ages were plague, smallpox, chickenpox, etc. which are transmitted through fomites or respiratory route (Islam, 2018). The methods of air purification, and the
Table 3
Drugs prescribed in Unani medicine for naza-e-wabe'iyah (epidemic influenza).

| S. no. | Botanical name & family | Unani name | Part used | Method of use in Unani medicine | Active ingredients | Mode of action | References |
|--------|-------------------------|------------|-----------|---------------------------------|-------------------|---------------|------------|
| 1. | Cydonia oblonga Mill., Rosaceae | Behidana | Berry | Decoction for oral use | Hydroxycinnamic derivatives | Anti-oxidant | (Baghdadi, 2004; 
Hamazu et al., 2005) |
| 2. | Ziziphus jujube Mill., Rhamnaceae | Unnab | Fruit | Decoction for oral use | Betulinic acid | Anti-proliferative on some influenza viruses, anti-inflammatory | (Hong et al., 2015; 
Samarqandi, 2010) |
| 3. | Cordia dichotoma G. Forst., Boraginaceae | Sapistan | Fruit | Decoction for oral use | Hydroquinones, terpenoids, steroids, flavonoids | Anti-microbial, antioxidant, antiulcer on gastric mucosa Anti-bacterial | (Oza and Kulkarni, 
2017; Sina, 1878) |
| 4. | Sisyrium adenosporhum (Wooton & Standl.) Tidestr., Brassicaceae | Khaksi | Seeds | To be mixed after preparing decoction | | | (Al-Massarani et al., 
2017; Sina, 1878) |
| 5. | Myrtus communis L., Myrtaceae | Habb-ul aas | Berry | Decoction for oral use | Tannins, flavonoids (anthocyanin, gallic acid, quercetin, etc.) | Intestinal motility, anti-oxidant | (Jabri et al., 2016; 
Sina, 1878) |
| 6. | Bambusa bambos (L) Voss, Poaceae | Tabasheer | Manna | Decoction for oral use | Coumaran, palmitic acid, adipic acid ester, α-ethylol | Anti-helminthic, anti-inflammatory, anti-diarrheal Anti-inflammatory, anti-diabetic, nutritive Anti-inflammatory | (Samarqandi, 2010; 
Vairappan et al., 2015) |
| 7. | Lactuca sativa L., Compositae | Tukhm-e-Kahu | Seeds paste | For oral use | Folate, (β-carotene, lutein, phenolics, vitamins, iron Anthrones, anthraquinones, mannans | | (M. J. Kim et al., 
2015) |
| 8. | Aloe vera (L) Burm.f., Xanthorrhoeaceae | Elha | Leaf sap | For local application on chest wall | | | (Arain et al., 2016; 
Sina, 1878) |
| 9. | Crocus sativus L., Iridaceae | Ze'fran | Stamen | For local application on chest wall | Safranal, crocin | Antioxidant | (Bukhari et al., 2018; 
Samarqandi, 2010) |

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.

Acknowledgments

None.

References

Acharya, K.P. 2020. Resource poor countries ought to focus on early detection and containment of novel corona virus at the point of entry. Clin. Epidemiol. Glob. Heal. https://doi.org/10.1016/j.cUGH.2020.03.001.

Adedeji, W.A. 2016. The treasure called antibiotics. Ann. ibadan Postgrad. Med. 14, 56–57. Al-Massarani, S.M., El Gamal, A.A, Alam, P., Al-Sheddi, E.S., Al-Oqail, M.M., Farshor, N.N., 2017. Isolation, biological evaluation and validated HPTLC-quantification of the marker constituent of the edible Saudi plant Sisyrium ivo L. Saudi Pharm. J. 25, 750–759. https://doi.org/10.1016/j.sjpj.2016.10.012.

Annamalai, M., Meenakshi, V., Jeevanesan, P., Venkatesan, V. 2015. Ficus religiosa L. bark extracts inhibit human rhinovirus and respiratory syncytial virus replication. J. Ayurveda Integr. Med. 10, 203–206. https://doi.org/10.1016/j.jaim.2019.05.002.

Amini, M., Chorannevis, M., Abdijaddid, S., 2017. Effect of cold plasma on crocin esters and volatile compounds of saffron. Food Chem. 235, 290–293. https://doi.org/10.1016/j.foodchem.2017.05.067.

Anonymous. 2009. The Unani Pharmacopedia of India. Part-1st. VI. Ministry of Health and Family Welfare, Govt. of India, New Delhi.

Anonymous. 2006. National Formulary of Unani Medicine. 1st ed. Ministry of Health and Family Welfare, Govt. of India, New Delhi.

Anonymous. 2010. The Unani Pharmacopoeia of India. Part-1st. VI. Ministry of Health and Family Welfare Department of Ayush. Ministry of Health and Family Welfare, Govt. of India, New Delhi.

Arain, I.U., Hussain, A., Talat, A., 2016. Effects of aloe vera in local massage oils in alternative medicine for the treatment of joint pains: a double blind study. Ann. King Edward Med. Univ. 22, 8. https://doi.org/10.21649/akemu.v22i1.789.

Bassiri-Jahromi, S., 2018. Punica granatum (pomegranate) juice as a potential antiviral for SARS-CoV-2. Food Chem. 235, 290–293. https://doi.org/10.1016/j.foodchem.2017.12.090.

Bhat, G.A., 2016. Mush deer trade and worldwide depletion. Environ. Policy Law 46, 137–148.

Bhattacharjee, S.R., Shukla, P., Srivastava, R.K., Mondal, R., Anupam, R., 2019. Validation of environmental disinfection efficacy of traditional Ayurvedic fumigation practices. J. Ayurveda Integr. Med. 10, 203–206. https://doi.org/10.1016/j.jaim.2019.05.002.

Bukhari, S.I., Manzoor, M., Dhar, M.K., 2018. A comprehensive review of the pharmacological potential of Crocus sativus and its bioactive apopacoretiolids. Biomed. Pharmacother. https://doi.org/10.1016/j.biopha.2017.12.090.

Cambra, L.M.A., 2018. The causes of the black death described by Ibn Khitam in his work Tahsil Al-Garad. Am. Res. J. English Lit. 4. https://doi.org/10.21694/2378-9026.18015.

Cagno, V., Civra, A., Kumar, R., Pradhan, S., Donalisio, M., Sinha, B.N., Ghosh, M., Lembo, D., 2015. Ficus religiosa L. bark extracts inhibit human rhinovirus and respiratory syncytial virus infection in vitro. J. Ethnopharmacol. 176, 252–257. https://doi.org/10.1016/j.jep.2015.10.042.

Chaudhry, M.B., 2013. Biological activities of Zingiber officinale (Zingiberaceae) and Piper cubeba (Piperaceae) essential oils against pulse beetle, Callosobruchus chinensis (Coeloptera: Bruchidae). Pakistan J. Biol. Sci. 16, 517–523. https://doi.org/10.3923/pjbs.2013.517.523.

Chen, T., Davis, J.T., Ajeli, M., Gioannini, L., Litvinova, M., Merler, S., Pastore y Piaggio, A., Kaushik, R., Rossi, L., Sun, K., Viboud, C., Xiong, X., Yu, H., Halloran, M.E., Longini, I.M., Vespignani, A., 2020. The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. Science (80-.), eaab9757 https://doi.org/10.1126/science.abab4757.
