Review Article

Persian medicine recommendations for the prevention of pandemics related to the respiratory system: a narrative literature review

Maryam Iranzadasl a, Yasin Karimia, Fatemeh Moadeli a, Mehdi Pasalarb,*,1

a Department of Traditional Persian Medicine, School of Medicine, Shahed University, Tehran, Iran
b Research Center for Traditional Medicine and History of Medicine, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran

A R T I C L E   I N F O

Article history:
Received 20 May 2020
Received in revised form 2 July 2020
Accepted 12 July 2020
Available online 25 July 2020

Keywords:
COVID-19
Pandemic
Persian medicine
Respiratory
Prevention

A B S T R A C T

Background: Pandemics of infectious diseases have long been regarded as societal challenges. This study aimed to summarize the theories of Persian medicine for controlling respiratory disease-related pandemics and to compare these theories with the findings of modern medicine.

Methods: We searched the classic medical reference books of the 9th to 19th centuries for the terms 'polluted air' and 'pandemic', and we searched 4 databases (PubMed, Google Scholar, Science Direct, and Scopus) with the keywords 'COVID-19', 'pandemic', 'history', and 'prevention programs'. The results were collected and subjected to content analysis.

Results: From the point of view of traditional Iranian physicians, disease prevention is primarily possible by avoiding pathogenic factors. As a secondary solution, reducing one’s susceptibility to the disease is crucial; this can be achieved through cleansing the body and strengthening the mood, reducing food intake, decreasing the internal humidity, disinfecting the house with herbal fumigation, and making use of pleasant aromas. Some of these recommendations are reaffirmed by modern research.

Conclusion: Persian medicine techniques may be preventive during respiratory, influenza-like disease pandemics. However, rigorous studies are needed to confirm this hypothesis.

© 2020 Korea Institute of Oriental Medicine. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Throughout history, many reports of pandemics have been recorded, with respiratory infections such as influenza being among the most notorious and common.1,2 In the earliest documents, historians reported the occurrence of an influenza-like pandemic in Greece in approximately 412 BC.2,3 In each of the recent centuries, an average of two to three influenza pandemics have occurred worldwide.4

The geographic and political conditions of Iran have led to its involvement in a range of pandemics throughout its history.5 Due to Iran’s involvement in most global pandemics, related topics, especially respiratory infectious diseases, have remained prominent aspects of Persian medicine (PM). Accordingly, Persian physicians are familiar with respiratory, influenza-like pandemics, discussed under the title 'polluted air' (PA; háwā-y-e vābdā) in reference books.6 Avicenna considered vābdā to mean a general disease, i.e., the pandemic-like spread of a disease.7 In fact, under PA conditions, various diseases such as smallpox, typhoid, plague, and various fevers and abscesses arise: symptoms such as fever, dyspnea, palpitations, and syncope results in a considerable number of deaths in the community.8 Regarding pandemic respiratory infections with specific symptoms, terms such as ‘polluted wind’, ‘postnasal drip related to common disease’, ‘fever related to common disease’, and ‘cough related to common disease’ have been used in the Persian references.9,10

The coronavirus disease 2019 (COVID-19) pandemic has affected most countries across the world. The symptoms induced by SARS-CoV-2 virus are vastly similar to those of other viral infections of the respiratory tract (e.g., influenza).11 The person-to-person transmission of this virus has facilitated the rapid, global spread of the disease.12,13 Considering the fact that an effective modality of treatment for this newfound ailment has yet to be discovered, there is a significant need for preventive policies and the utilization of experiences from traditional medicine.14

The present study aimed to review the theories, experiences, and views of Persian medicine scholars and compare them with the findings of modern medicine for controlling respiratory disease pandemics.

https://doi.org/10.1016/j.imr.2020.100483
2213-4220 © 2020 Korea Institute of Oriental Medicine. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

* Corresponding author at: Center for Traditional Medicine and History of Medicine, School of Medicine, Zand St., Shiraz 71348-45794, Iran.
E-mail address: pasalar@sums.ac.ir (M. Pasalar).
1 ORCID: https://orcid.org/0000-0003-2458-2626.
2. Methods

In this narrative systematic review, the credible books of Persian medicine published between the 9th and 19th centuries AD, including The Canon of Medicine (Avicenna), Al-Mansûrî on Medicine (Al-Mansûrî Fi al-Tibb; Rhazes), A Guide to Medical Learners (Hidayat al-Mute’allemin Fi al-Tibb; Al-Akhawyni), Zakhireye Khwarazmshahi (Gorgan), The Book of Experiences (Kitab al-tajariib; Rhazes), The Greatest Elixir (Exir Azam; Hakim Azam Khan), Tohfat Al-mo’menin (Hakim Mu’min), Summary of Wisdom (Kholasah al-Hekmah; Aghili Shirazi), and Mofarah Al-Gholoob (Hakim Arzani), were searched for the terms ‘pandemic’ (Persian: وباً) and ‘polluted air’ (Persian: هوای آلوده وباً) and all their equivalents in the Persian and Arabic languages.

In addition, the main medical databases, i.e., PubMed, Science Direct, Scopus, and Google Scholar, were searched for the terms ‘COVID-19’, ‘pandemic’, ‘history’, and ‘prevention programs’. Data published prior to April 2020 were collected, and modern and traditional information was analyzed and compared.

First, we gathered all notes and documents to form a comprehensive file on a computer. Then, we reviewed the findings several times and made notes about relevant information. We made some initial codes to categorize the data into historical, preventive and incoherent groups. Subsequently, the recurring codes and items were combined into cohesive themes presented in text and tables.

3. Results

We gathered relevant data from the historical references and from a total of 1342 papers indexed in the electronic databases to form a one hundred twenty-three-page Microsoft Word document. After a thorough review of the searched material, we finally reached a six-page dataset composed of the most applicable information from both the classical books and 64 novel articles.

In PM references to control PA conditions or the occurrence of pandemics, numerous recommendations have been issued for health preservation management via the six essential principles as well as the nonessential principles.15,16 However, Persian physicians consider distancing from the disease area and self-quarantining at home to comprise the first and foremost preventive strategy.15 Subsequent to the six essential principles, other factors, such as showering and oiling the body, are considered nonessential principles that also have significance in pandemic disease prevention.15

The first and foremost method to prevent the incidence of disease during pandemics is to move from the focus of the disease to healthy regions. However, as a secondary solution, it is necessary to self-quarantine in closed environments such as the house and to correct the internal environment.17 Among the principles of correcting the internal environment is the removal of moisture using the incense of plants such as purple nutedge (Cyperus rotundus), frankincense (Boswellia carterii), myrtle (Myrtus communis), Damask rose (Rosa damascena), sandalwood (Santalum spp.), and vinegar.7,17 Another measure to correct the internal environment is to dissolve the Ferula asafoetida in vinegar and spray it several times inside the house and at its entrances (e.g., doors and windows).17 Avicenna also introduced the use of vinegar as a deterrent of PA.15

Hunger and thirst are harmful to both healthy people and those afflicted with pandemic disease, as they augment the effect of PA.15 On the other hand, drinking plenty of fluids is not recommended in PM.15 In addition to reducing food intake (as the most prominent food strategy), measures such as increasing the number of meals, reducing the size of each meal, and consuming easily digestible foods should be considered.18-20 Eating sour and drying foods such as sour grape soup, pomegranate soup, sumac soup, and vinegar soup is also beneficial.17,19 Another recommendation is to consume fragrant fruits such as apples (Pyrus malus) and quinces (Cydonia oblonga) as well as sour/astringent fruits such as pomegranates (Punica granatum).3,18,19

In PM, during epidemics, high-intensity exercise or activities that result in shortness of breath are considered harmful and are therefore prohibited.15 The balance of evacuation (excretion of waste products) and retention (preservation of beneficial substances) should be maintained in such a way that while excess moisture is eliminated, weakness and reduction of vital force do not occur. Generally, sleep should be considered in terms of two aspects. The first is the sleep duration, which should be moderate, i.e., between 6 and 10 hours per day. The second is the timing of sleep, such that one should refrain from remaining awake through the night, sleeping late, or sleeping during the day. Avoiding mental conditions such as sadness, anxiety, emotional stress and anger can be effective in preventing the incidence of disease during PA.18 Refraining from obsession is also essential and necessary.19

It is highly remarkable that, as evident in Table 1, the PM recommendations maintain a high level of agreement with the WHO guidelines for dealing with COVID-19.

There is some current evidence in support of the anti-infective properties of the Persian medications recommended for preventing PA in traditional resources (see Table 2). Current sleep research and guidelines also confirm the beneficial effects of adequate sleep on the immune system.27 The necessity of social distancing during the peak of a pandemic, which includes restrictions on exercise (particularly team sports), has been reaffirmed recently.28

Furthermore, the incidence of agents such as vinegar and sandalwood can minimize ambient humidity. Research has shown that the COVID-19 spreads more prominently in areas with a humidity of 47–49%.28 The positive impact of reduced fear, stress and anxiety on the body's immunity and physical strength has also been confirmed in recent studies.29

4. Discussion

After examining and analyzing the findings of the present study, it can generally be inferred that PM considers the issue of prevention in the context of pandemics from two perspectives. First, it considers the etiological agent of the disease and recommends its avoidance by refraining from the area of outbreak or self-quarantining at home. In fact, this is the first and foremost recommendation of Persian physicians. The second substantial factor that should be considered is the background and susceptibility of individuals to the disease, with the risk of affliction being largely minimized if the suggested measures are taken. It should be noted that this susceptibility is broader than the issue of comorbidities mentioned in modern medicine because, from the perspective of PM, individuals who appear to lack any underlying conditions can be quite susceptible to infectious diseases. This is consistent with recent studies that have reported healthy subjects becoming severely affected by COVID-19.

Among the six essential principles, Persian physicians have placed greater emphasis on nutrition, air, and the excretion of waste products from the body, causing weight loss. Hence, obesity can increase the risk of acquiring influenza disease in the community.46 Novel studies have demonstrated that calorie restriction (CR) affects various parts of the immune system and improves its function.47 Currently, many studies have hypothesized that the olfactory system influences the immune system.48 Accordingly, essential oils are also used in aromatherapy given their antimicrobial, anti-inflammatory, and immune system-enhancing properties.49-51 Garlic is one agent that boosts the functioning of the immune system in such a way.44 Another example is the onion,
Table 1
Comparison of the Persian Medicine Recommendations for the Prevention of Pandemics with the Guidelines of the World Health Organization Related to COVID-19

| Persian medicine recommendations | World Health Organization guidelines |
|----------------------------------|--------------------------------------|
| Essential principles             |                                      |
| **Air**                          | Distance oneself from the disease area; |
|                                  | self-quarantine\(^1\); eat things like the |
|                                  | purple nutseed and frankincense\(^2\); |
|                                  | spray vinegar and sour grape juice at |
|                                  | home\(^3\); make the house smell |
|                                  | pleasant with rose water and |
|                                  | sandalwood.\(^6\)                      |
| **Eating and drinking**          | Reduce food intake\(^4\); consume |
|                                  | antidotes\(^5\); eat garlic, onion, and |
|                                  | vinegar\(^7\); consume sour foods\(^7\) |
|                                  | and fragrant fruits such as apples and |
|                                  | quinces.\(^8\)                         |
| **Activity and rest**            | Avoid relatively high-intensity |
|                                  | exercise\(^9\); avoid excessive |
|                                  | rest/immobilization.\(^8\)            |
| **Evacuation and retention**     | Consume stool softeners such as the |
|                                  | Terminalia chebula and *Cassia fistula*\(^10\); |
|                                  | avoid excessive sexual intercourse.\(^8\) |
| **Sleep and wakefulness**        | Moderate sleep duration; sleep early at |
|                                  | night and wake up early; avoid |
|                                  | daytime sleep.\(^11\)                   |
| **Psychological and mental**     | Avoid harmful mental states such as |
|                                  | sadness, fear, anxiety, stress and |
|                                  | obsession.\(^12\)                      |
| **Olfaction**                    | Use perfume\(^13\); vapor bath and inhale |
|                                  | the fragrances of vinegar, garlic, onion, |
|                                  | and bergamot.\(^17\) | – |
| **Showering**                    | Avoid excessive showering with hot |
|                                  | water.\(^25\)                          |
| **Embrocation**                  | Apply suitable oils to the body.\(^19\) |

| Nonessential principles          |                                      |

Table 2
Therapeutic effects of some Persian herbal medicines recommended in the prevention and treatment of infectious diseases and the supporting evidence

| Scientific name | Common name   | Traditional name | Route of consumption | Supporting evidence |
|-----------------|---------------|------------------|-----------------------|---------------------|
| *Cyperus rotundus* | Purple nutsedge | Sâd | Fumigation | Antimicrobial effect against six important pathogens\(^15\); suppression of Influenza virus (H1N1) infectivity by essential oil in a dose-dependent manner in vitro\(^31\) |
| *Boswellia carterii* | Frankincense | Kondor | Fumigation | Antimicrobial activity of oil against a large number of Gram positive and Gram negative bacteria, yeast and filamentous fungi\(^11\) |
| *Myrtus communis* | Myrtle | Mûrd | Fumigation | Treatment of herpes simplex infection by essential oil in animal model\(^25\) |
| *Rosa damascene* | Damask rose | Vârd | Fumigation | Antimicrobial activity against Gram-negative strains in vitro\(^9\) |
| *Santalum spp.* | Sandalwood | Sandal | Fumigation | Antibacterial activity against *Vibrio cholerae* and *Escherichia coli* diarrhea; possible use as a mild expectorant during the treatment of chronic airway diseases\(^10\) |
| *Ferula asafted* | Asafteda | Heltît | Inhalation | Antimicrobial activity against five different bacterial strains in vitro\(^5\) |
| *Berberis vulgaris* | Barberries | Zereshk | Oral | Effect against *Vibrio cholerae* and *Escherichia coli* diarrhea; possible use as a mild expectorant during the treatment of chronic airway diseases\(^10\) |
| *Pyrus malus* | Apple | Sîb | Oral | Anti-inflammatory effect on mucous membranes, esp. of the nose or throat (Anticatarrhal)\(^7\) |
| *Cydonia oblonga* | Quinces | Beh | Oral | Antibacterial effect of quince extracts in vitro and in vivo\(^36\) |
| *Punica granatum* | Pomegranates | Ânär | Oral | In vitro and in vivo antibacterial activity of the peel\(^29\) |
| *Rheum ribes* | Syrian rubarb | Rîvâs | Oral | Antibacterial activity of the ethanol, aqueous, and organic extracts of the root\(^40\) |
| *Cinnamomum camphora* | Camphor | Kâfûr | Oral | Reducing effect on nosocomial infections in a hospital setting\(^41\) |
| *Terminalia chebula* | Myrobalan | Hâfälleh | Oral | Inhibiting effect on influenza A virus infections\(^42\) |
| *Cassia fistula* | Amaltas | Folûs | Oral | Antibacterial and antifungal activity\(^43\) |
| *Allium sativum* | Garlic | Sîr | Inhalation | Antimicrobial and immune system-enhancing properties\(^44\) |
| *Allium cepa* | Onion | Pîyâz | Oral/Inhalation | Decreases obesity and subsequently reduces obesity-related immune disorders\(^45\) |
which should be eaten or inhaled during steam therapy according to a PA-related recommendation of PM.

As a novel finding, the cardiac symptoms in COVID-19 patients\textsuperscript{52} may be related to the PM theory of cardiac involvement during PA. Such issues must be examined in detail to be proven or disproven in future research. Furthermore, the loss of the smell and taste senses in many patients with COVID-19\textsuperscript{18,19} may be related to PM physicians’ emphasis on the use of fumigation therapy with fragrant plants; this can form the basis of studies on the effects of these substances on stimulating the olfactory system and recovering the senses of patients, which is a promising sign during treatment.

In the current pandemic, due to the ease of person-to-person transmission and the rapid, global spread of COVID-19 in the absence of definitive treatment and vaccination, the World Health Organization’s key policies are the observation of personal hygiene and the establishment of social distancing through quarantining cities and limiting crowding or attendance in public places. By comparing the strategies of PM in encountering all kinds of pandemics (especially those of respiratory infections) with the current policies and actions of the health systems in countries affected by the pandemic, no contradictory matters of great significance were seen. Furthermore, PM places distinctive emphasis on the lifestyle of the individual, with various suggestions in the form of the six essential principles as well as the nonessential principles. These recommendations can increase the body’s ability to deal with the pathogen by strengthening its temperament through the use of appropriate natural medicines and products, providing complementary and effective solutions to scientists and health policymakers in the fight against the COVID-19 pandemic.

The main limitation of the current study is the difficulty of exploring causality because it is based on beliefs and judgments rather than outcomes. Additionally, the statistical representation of findings is not applicable here, rendering this work difficult to replicate. Some mentioned medicines and practices such as fumigation and embrocation seem safe to be utilized for decreasing the chance of infection in respiratory outbreaks. We also suggest conducting pilot clinical trials assessing the effectiveness of the fruits introduced in the PM literature (apples, quinces, and pomegranates) in treating antibacterial infections given adequate in vivo and in vitro evidence.

In conclusion, no significant contradictions were found in this study between current guidelines for the control of pandemics and those of traditional Persian physicians. Therefore, it is essential to pay attention to factors that may currently be overlooked (e.g., nutrition, body cleansing, strengthening the temperament) and to assess the multifactorial and cumulative effects of these factors.

Acknowledgments

The authors would like to thank Dr. Seyed Ali Hosseini of Shiraz University of Medical Sciences for editing the English language of this manuscript.

Data availability

Conceptualization: MI, YK, FM and MP. Methodology: FM, MI and MP. Data Curation: FM, MI and MP. Formal Analysis: MI and YK. Investigation: MP, FM and MI. Software & resources: FM. Writing – Original Draft: MI, YK and MP. Writing – Review & Editing: FM, MI and MP. Supervision: MP and MI. All authors read and approved the final manuscript. The authors have no conflicts of interest to declare. None.

Not applicable for this manuscript as this work did not involve human subjects or laboratory animals.

Data will be made available upon request.

References

1. Maurice J. Cost of protection against pandemics is small. Lancet 2016;387:e12, http://dx.doi.org/10.1016/S0140-6736(16)00156-2.

2. Rewar S, Mirdha D, Rewar P. Treatment and prevention of pandemic H1N1 influenza. Ann Glob Health 2015;81:645–53, http://dx.doi.org/10.1016/j.aogh.2015.08.014.

3. Voudoukis E, Pappas A, Panoutopoulos A, Xynos K, Rozi F, Giannakopoulou K, et al. Novel influenza A (H1N1) infection vs. common influenza-like illness: a prospective study. Med Sci Monit 2011;17:CR185–4, http://dx.doi.org/10.12659/msm.881713.

4. Potter CW. A history of influenza. J Appl Microbiol 2001;91:572–9, http://dx.doi.org/10.1046/j.1365-2672.2001.01492.x.

5. Salahu-Moghaddam A, Khoshdeli A, Habibi-Nokhandan M, Sedaghat M. Medical Climatology of Iran. J Army Uni Med Sci 2012;2:49–56.

6. Ahmadian Attarria M. A new look to chapter of “Vabaie Weather” in Iranian Traditional medicine. J Islam Iran Trad Med 2013;3:406–23.

7. Sina HA, Dafee Al Mazar Al Koliat An Al Abdan Al Erian; Tehran: Almiali; 2008.

8. Aksheinevi. Hedayat al-Motelemin fi al-Teb. Mashhad: Ferdousi University of Mashhad Publication; 1992.

9. Schleimmer J. Terminologie Médico-Pharmaceutique et Anthropologique française-Persane. Tehran: Tehran University Press; 1970.

10. Chashiti MAK. Exir-e Azam Great Elixir). Tehran: The Institute for Medical History-Islamic and Complementary Medicine, Iran University of Medical Sciences; 2004 [in Persian].

11. Chan JF, Yuan S, Ko KH, To KK, Chu H, Yang Y, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. Lancet 2020;395:514–23, http://dx.doi.org/10.1016/S0140-6736(20)30154-5.

12. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. JAMA 2020;323:1239–42.

13. Phan LT, Nguyen TV, Luong QC, Nguyen TV, Nguyen HT, Le HQ, et al. Importation and human-to-human transmission of a novel coronavirus in Vietnam. N Engl J Med 2020;382:872–4, http://dx.doi.org/10.1056/NEJMc2001722.

14. Chen Y, Liu Q, Guo D. Emerging coronaviruses: genome structure, replication, and pathogenesis. J Med Virol 2020;92:418–23, http://dx.doi.org/10.1002/jmv.25681.

15. Sina HA, Al-Qanun fi al-Tebb. In: The canon of medicine. Beirut, Lebanon: Alaalam Library; 2005.

16. Rezaeizadeh H, Alizadeh M, Naseri M, Arakdani M. The traditional iranian medicine: a point of view on health. Iran J Publ Health 2009;38:169–72.

17. Razi B, Khosaiat Al Tajarok. Tehran: Tehran University Press; 2011.

18. Aghihi Shirazi MH. Khosaiat al hekmah. Quom: Esmailian; 2006 [in Persian].

19. Arzani MA. Mofareh Al-Cholub. Lahor: Salim Lahor; 1915.

20. Razi M. Al-Mansouri fi al-Tebb. Kuwait: Al-Monazzamat al-Tarbiat va al-Saghafat va al-Oloom; 1987.

21. Organization WH. Rational use of personal protective equipment (PPE) for coronavirus disease (COVID-19): interim guidance, 19 March 2020. Jena: World Health Organization; 2020.

22. Hellewell J, Abbott S, Gimma A, Bosse NJ, Jarvis CI, Russell TW, et al. Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. Lancet Glob Health 2020;8:e488–96, http://dx.doi.org/10.1016/S2214-109X(20)30074-7.

23. Sohrabi C, Alsafz Z, O’Neill N, Khan M, Kerwan A, Al-Jabir A, et al. World Health Organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19). Int J Surg 2020.

24. Tonkaboni MM. Tahafel al-Momenin. Tehran: Shahid Beheshti University of Medical Sciences; 2007 [in Persian].

25. Jorjani E, Zakhireh Khorazm Shali. In: Treasure of Khurazm Shali. Tehran: Iranian Medical Academy; 2001.

26. Elgued C. Iran medical history and the regions of eastern caliphate. Tehran: AmirKabir; 1992.

27. Ali T, Choe J, Awah A, Wagener TL, Orr WC. Sleep, immunity and inflammation in gastrointestinal disorders. World J Gastroenterol 2013;19:9231–9, http://dx.doi.org/10.3748/wjg.v19.i48.9231.

28. Feng Y, Marshall T, Serry T, Yi H. Influence of wind and relative humidity on the social distancing effectiveness to prevent COVID-19 airborne transmission: a numerical study. J Aerosol Sci 2020;105585, http://dx.doi.org/10.1016/j.jaerosci.2020.105585.

29. Ponderleak N, Lugovic-Milic L. Stress-induced interaction of skin immune cells, hormones, and neurotransmitters. Clin Ther 2020, http://dx.doi.org/10.1016/j.clinthera.2020.03.008.

30. Sharma SK, Singh AP. Antimicrobial investigations on rhizomes of Cyperus rotundus Linn. Der Pharmacialett 2011;4:427–31.

31. Wu S, Patel KB, Booth LJ, Metcalf JP, Lin HC. Wu W. Protective essential oil attenuates influenza virus infection: an in vitro study in MDCK cells. BMC Complement Altern Med 2010;10:69, http://dx.doi.org/10.1186/1472-6882-10-69.
32. Oulm P, Saderi H, Aghaei H, Yaraee R, Zaei F. The effect of Myrtus communis L. essential oil on treatment of herpes simplex infection in animal model. Iran J Med Aroma Plant 2007;23.

33. Mahboubi M, Kazempour N, Khamechian T, Fallah MH, Kermani MM. Chemical composition and antimicrobial activity of Rosa damascena Mill. essential oil. J Biol Active Prod Nature 2011;1:19–26, http://dx.doi.org/10.1080/22311866.2011.10719069.

34. Kalantar E, Deopurkar R, Kapadnis B. Antimicrobial activity of indigenous strains of aureobasidium isolated from sanatalum album leaves. Iran J Phamaeut Res 2006;5:59–64.

35. Bhatnager R, Rani R, Dang AS. Antibacterial activity of Ferula asafoetida: a comparison of red and white type. J Appl Biol Technol 2015;3:18–21.

36. Imanshahidi M, Hosseinionzadeh H. Pharmacological and therapeutic effects of Berberis vulgaris and its active constituent, berberine. Phytother Res 2008;22:999–1012, http://dx.doi.org/10.1002/ptr.2399.

37. Rigat M, Valles J, Iglesias J, Garnaitte T. Traditional and alternative natural therapeutic products used in the treatment of respiratory tract infectious diseases in the eastern Catalan Pyrenees (Iberian Peninsula). J Ethnopharmacol 2013;148:411–22, http://dx.doi.org/10.1016/j.jep.2013.04.022.

38. Alizadeh H, Rahnama M, Semnani SN, Hajizadeh N. Detection of compounds and antibacterial effect of quince (Cydonia oblonga Miller) extracts in vitro and in vivo. J Biol Active Prod Nature 2013;3:303–9.

39. Choi JG, Kang OH, Lee YS, Chae HS, Oh YC, Brice O0, et al. In vitro and in vivo antibacterial activity of Punica grumitsum peel ethanol extract against salmonella. Evid Based Complement Alternat Med 2011;090518, http://dx.doi.org/10.1093/ecam/nep105.

40. Aladin AM, Al-Khateeb EH, Jäger AK. Antibacterial activity of the Iraqi Rheiurn rubes. Root. Phannaceucz Biol 2008;45:688–90, http://dx.doi.org/10.1080/13880200701575049.

41. Blanchard J-M. Cinnamomum camphora à cinéole (rauvintsara), une plante au service de la prévention des infections nosocomiales en milieu hospitalier? Phytothérapie 2007;5:15–20.

42. Ma H, Diao Y, Zhao D, Li K, Kang T. A new alternative to treat swine influenza A virus infection: extracts from Terminalia chebula Retz. Afr J Microbiol Res 2010;4:497–9.

43. Duraisundar V, Ignacimuthu S. Antibacterial and antifungal activity of Cassia fistula L.: an ethnomedicinal plant. J Ethnopharmacol 2007;112:590–4, http://dx.doi.org/10.1016/j.jep.2007.04.008.

44. Schepetkin IA, Kirpotina LN, Khlebnikov AI, Balasubramanian N, Quinn MT. Neutrophil immunomodulatory activity of natural organosulfur compounds. Molecules 2019;24:1809, http://dx.doi.org/10.3390/molecules24091809.

45. Marrelli M, Amodeo V, Statti G, Conforti F. Biological properties and bioactive components of Allium cepa L.: focus on potential benefits in the treatment of obesity and related comorbidities. Molecules 2019;24:119.

46. Dixit VD. Adipose-immune interactions during obesity and caloric restriction: reciprocal mechanisms regulating immunity and health span. J Leukoc Biol 2008;84:882–92, http://dx.doi.org/10.1189/jlb.0108028.

47. Nikolich-Zugich J, Messoudi I. Mice and flies and monkeys too: caloric restriction rejuvenates the aging immune system of non-human primates. Exp Gerontol 2005;40:884–93, http://dx.doi.org/10.1016/j.exger.2005.06.007.

48. Alves GJ, Vismari L, Lazzarini R, Merusse JL, Palermo-Neto J. Odor cues from tumor-bearing mice induces immunomune changes. Behav Brain Res 2010;214:357–67, http://dx.doi.org/10.1016/j.bbr.2010.06.003.

49. Ali B, Al-Wabel NA, Shams S, Ahamad A, Khan SA, Anwar F. Essential oils used in aromatherapy: a systemic review. Asian Pac J Trop Biomed 2015;5:601–11.

50. Edris AE. Pharmaceutical and therapeutic potentials of essential oils and their individual volatile constituents: a review. Phytother Res 2007;21:308–23.

51. Gandhi GR, Vasconcelos ABS, Haran GH, Calisto VKDs, Joho G, Quintans JDSS, et al. Essential oils and its bioactive compounds modulating cytokines: a systematic review on anti-asthmatic and immunomodulatory properties. Pymomedicine 2019;15:2854, http://dx.doi.org/10.1016/j.phymed.2019.152854.

52. Huang L, Zhao P, Tang D, Zhu T, Han R, Zhan C, et al. Cardiac involvement in recovered COVID-19 patients identified by magnetic resonance imaging. JACC: Cardiovasc Imaging 2020, http://dx.doi.org/10.1016/j.jcmg.2020.05.004.

53. Xydakis MS, Dehghani-Mobaraki P, Holbrook EH, Geisthoff UW, Bauer C, Hautefort C, et al. Smell and taste dysfunction in patients with COVID-19. Lancer Infect Dis 2020, http://dx.doi.org/10.1016/S1473-3099(20)30293-0.