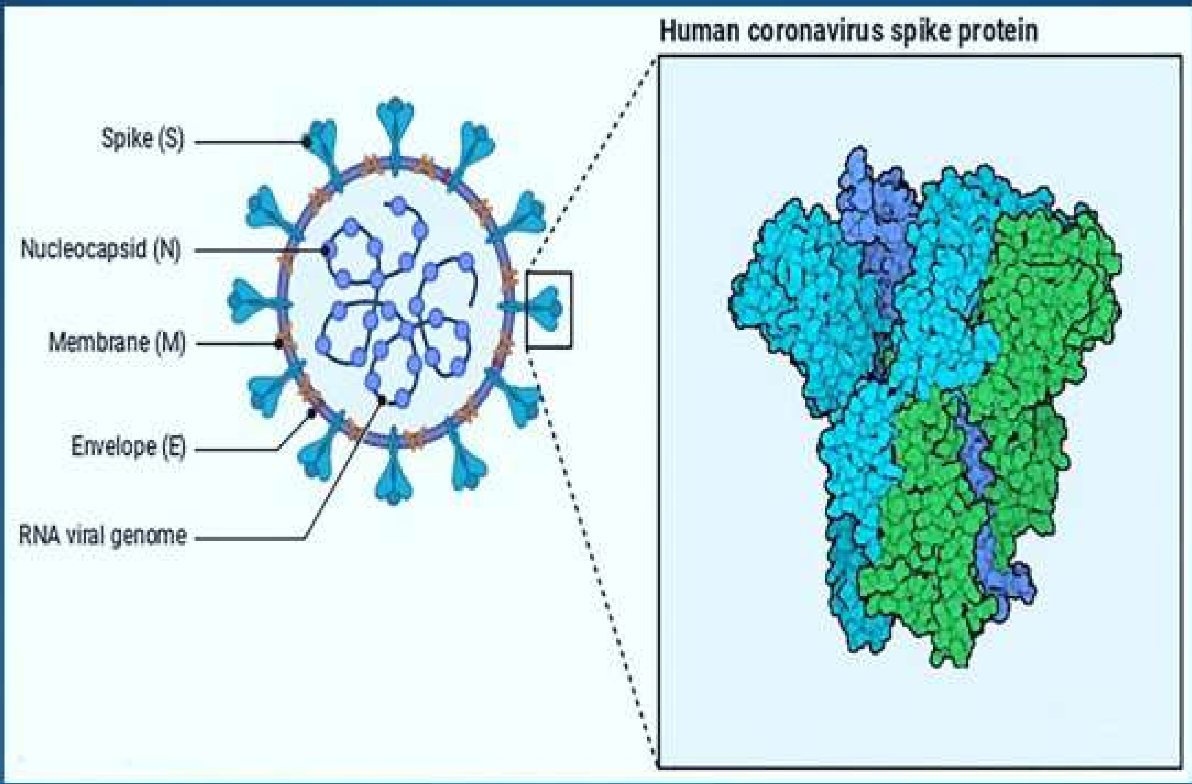
Pharmaceutical Sciences

- Journal of Faculty of Pharmacy, Tabriz University of Medical Sciences
- ISSN: 1735-403X eISSN: 2383-2886

2020, Volume 26, Suppl 1, S1-S93



Pharmaceutical Sciences

COUNTRY

Iran

Universities and research institutions in Iran

SUBJECT AREA AND CATEGORY

Pharmacology, Toxicology and Pharmaceutics

- Pharmacology, Toxicology and Pharmaceutics (miscellaneous)

PUBLISHER

Tabriz University of Medical Sciences

Tabriz University of Medical Sciences in Scimago Institutions Rankings

H-INDEX

17

PUBLICATION TYPE

Journals

ISSN

1735403X, 23832886

COVERAGE

2009-2020

INFORMATION

Homepage

How to publish in this journal

garjania@tbzmed.ac.ir

SCO

Pharmaceutical Sciences provides a forum for the publication of original research articles, reviews, short communications, and editorials (by invitation only) in all areas of pharmaceutical sciences, including these topics: Clinical Pharmacy Medicinal and Pharmaceutical Chemistry Pharmaceutical Analysis Pharmaceutics Pharmacognosy Pharmacology and Toxicology Pharmaceutical Biotechnology Pharmaceutical Nanotechnology Pharmacoeconomy Radiopharmacy Water, Food, Drug and Cosmetic Control.

Join the conversation about this journal

Quartiles

FIND SIMILAR JOURNALS

1
Brazilian Journal of Pharmaceutical Sciences
BRA
52%
similarity

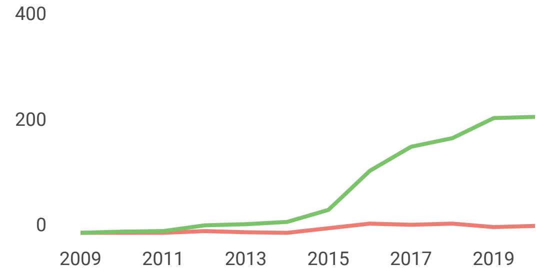
2
Indian Journal of Pharmaceutical Sciences
IND
51%
similarity

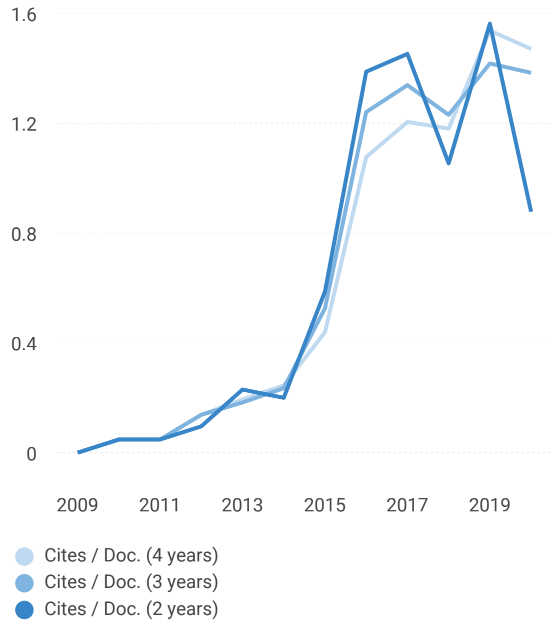
3
Journal of Research in Pharmacy
TUR
51%
similarity

4
Journal of R Pharmaceut
IRN
4
s

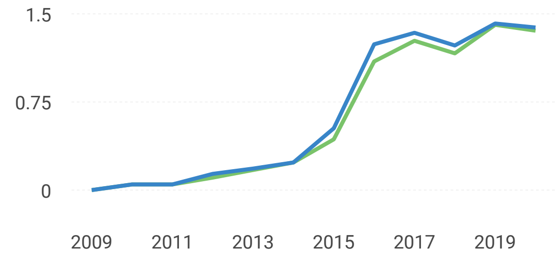
SJR

Total Documents

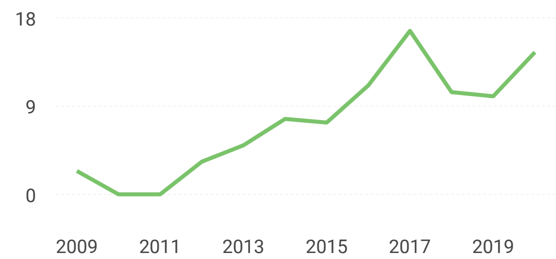




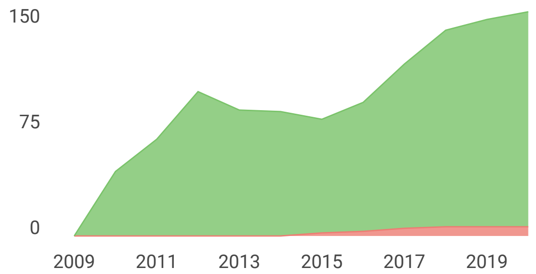
External Cites per Doc   Cites per Doc



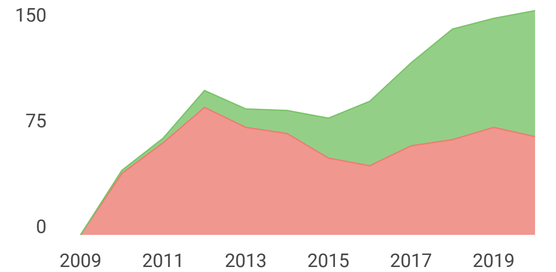
% International Collaboration



Citable documents   Non-citable documents



Cited documents   Uncited documents



← Show this widget in your own website

Just copy the code below and paste within your html code:

<a href="https://www.scimag

SCImago Graphica

Explore, visually communicate and make sense of data with our **new free tool**.

Get it

Metrics based on Scopus® data as of April 2021

Pharmaceutical Sciences

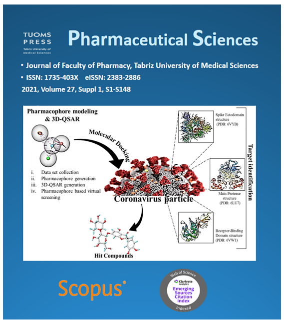
(/)

Title

Title

Search

ISSN: 1735-403X (https://portal.issn.org/resource/ISSN/1735-403X) **eISSN**: 2383-2886 (https://portal.issn.org/resource/ISSN/2383-2886)



November 2021, Vol 27, (Suppl 1)

Pharmaceutical Sciences is peer-reviewed, and quarterly journal providing a forum for basic to clinical issues related to all areas of pharmaceutical sciences. It is the official journal of Faculty of Pharmacy (https://pharmfac-en.tbzmed.ac.ir/), published by TUOMS PRESS (https://publications.tbzmed.ac.ir/), Tabriz University of Medical Sciences (https://www.tbzmed.ac.ir).

- Platinum Open Access (no processing or publication fees)

- Indexed in ESCI (Web of Science Core Collection) and Scopus

- Average time to first decision in 2020: 23 Days

- Acceptance rate in 2020: 18%

Current Issue (/Current) In Press (/InPress) Editor's Choice (/EditorsChoice) Most Viewed (/MostViewed)

Most Downloaded (/MostDownloaded) Most Cited (/MostCited)

Review COVID-19

The Impact of Vitamin D Supplementation on Mortality Rate and Clinical Outcomes of COVID-19 Patients: A Systematic Review and Meta-Analysis

(/Article/ps-34133)

Leila Nikniaz (https://orcid.org/0000-0003-2951-936X), Mohammad Amin Akbarzadeh (https://orcid.org/0000-0002-9589-104X), Hossein Hosseinifard (https://orcid.org/0000-0003-1308-1244), Mohammad-Salar Hosseini* (https://orcid.org/0000-0003-2765-5018)

Pharm Sci. 2021;27(Suppl 1): S1-S12. **doi:** 10.34172/PS.2021.13 (https://doi.org/10.34172/PS.2021.13)

Scopus ID: 85115423983 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85115423983&origin=inward)

Article logoArticle (/Article/ps-34133)

PDF (/PDF/ps-27-S1.pdf)

Supplementary 1Suppl 1 (/Suppl/ps-27-S1-s001.jpg)

XMLXML (/XMLs/ps-34133)

Pharmaceutical Sciences

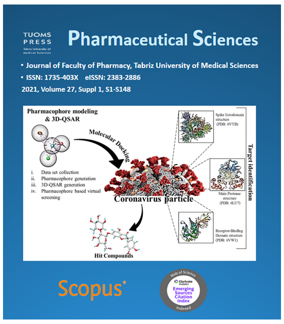
(/)

Title

Title

Search

ISSN: 1735-403X (https://portal.issn.org/resource/ISSN/1735-403X) **eISSN**: 2383-2886 (https://portal.issn.org/resource/ISSN/2383-2886)



November 2021, Vol 27, (Suppl 1)

Pharmaceutical Sciences is peer-reviewed, and quarterly journal providing a forum for basic to clinical issues related to all areas of pharmaceutical sciences. It is the official journal of Faculty of Pharmacy (https://pharmfac-en.tbzmed.ac.ir/), published by TUOMS PRESS (https://publications.tbzmed.ac.ir/), Tabriz University of Medical Sciences (https://www.tbzmed.ac.ir).

- Platinum Open Access (no processing or publication fees)

- Indexed in ESCI (Web of Science Core Collection) and Scopus

- Average time to first decision in 2020: 23 Days

- Acceptance rate in 2020: 18%

Aim and scope

Pharmaceutical Sciences provides a forum for the publication of original research articles, reviews, short communications, commentary, and editorials (by invitation only) in all areas of pharmaceutical sciences, including these topics:

- Clinical Pharmacy
- Food, Drug and Cosmetic Control
  Medicinal and Pharmaceutical Chemistry
- Pharmaceutical Analysis
- Pharmaceutics
- Pharmacognosy
- Pharmacology and Toxicology
- Pharmaceutical Biotechnology
- Pharmaceutical Nanotechnology
- Pharmacoeconomy
- Radiopharmacy

Open Access and charges

All articles published by *Pharmaceutical Sciences* are made free, permanent, immediate and online availability upon publication. The authors are required to sign an exclusive license form for open access publication of their work in the journal under the Creative Commons license 4.0 (CC-BY-NC). The authors retain the copyright to their work.

Free of charge publication

Currently, there are no publication charges applicable to the articles published in *Pharmaceutical Sciences,* the open access publication of which is supported by the Department of Research Vice Chancellor for Research & Technology at Tabriz University of Medical Sciences.

Indexing services

Pharmaceutical Sciences is indexed/covered by:

- ISI (ESCI) (http://mjl.clarivate.com/cgi-bin/jrnlst/jlresults.cgi?PC=MASTER&Full=*Pharmaceutical%20Sciences)
- Scopus (https://www.scopus.com/source/sourceInfo.uri?sourceId=19700189400&origin=resultslist)
- Chemical Abstract (CAS) (https://cassi.cas.org/search.jsp)

- Embase (https://www.elsevier.com/solutions/embase-biomedical-research/embase-coverage-and-content)
- Proquest (https://search.proquest.com/?accountid=41307)
- DOAJ (https://doaj.org/toc/2383-2886)
- Google Scholar (https://scholar.google.dk/citations?user=58ljPBIAAAAJ&hl=en)
- ISC (https://isc.ac/en)
- Magiran (https://www.magiran.com/)
- SID (https://www.sid.ir/En/Journal/)

Editorial policies

All manuscripts submitted to *Pharmaceutical Sciences* should adhere to Editorial policies (http://publications.tbzmed.ac.ir/Page/5/Editorial-polices.html) of journals published by Tabriz University of Medical Sciences.

Human and animal rights and informed consent

In cases where a study involves the use of live animals or human subjects, the author should include a statement that all experiments were performed in compliance with the relevant laws and institutional guidelines, and also state the institutional committee(s) that has approved the experiments. They should also include a statement that informed consent was obtained for any experimentation with human subjects.

For more information on ethical considerations, see our publisher's (http://publications.tbzmed.ac.ir/Page/5/Editorial-polices.html)Editorial policies (http://publications.tbzmed.ac.ir/Page/5/Editorial-polices.html).

Competing interests

All authors must declare all competing interests in their covering letter and in the "competing interests" section upon submission. Where authors have no competing interests, the statement should read "The author(s) declare(s) that they have no competing interests with regards to authorship and/or publication of this article." The Editor may ask for further information relating to competing interests.

Reviewers of *Pharmaceutical Sciences* are also required to declare any competing interests and they will be excluded from the peer review process if a competing interest exists.

Editors and advisory board of *Pharmaceutical Sciences* dec are no competing interests and any financial relationship with any biomedical company and they were excluded from peer review process whenever submitting a manuscript to the journal.

For more information on ethical considerations, see our publisher's (http://publications.tbzmed.ac.ir/Page/5/Editorial-polices.html)Editorial policies (http://publications.tbzmed.ac.ir/Page/5/Editorial-polices.html).

Peer review

All research articles, and most other article types, published by *Pharmaceutical Sciences* undergo a thorough double-blind peer review process. This usually involves review by two independent peer reviewers. The following scheme illustrates the editorial workflow of *Pharmaceutical Sciences*:

Complaint Policy

No specific policy regarding all manuscripts – we handle complaints on a case-by-case basis; Email: Pharm.sci@tbzmed.ac.ir; Pharm.sci.tabriz@gmail.com

Archiving

This journal publishes articles provides unrestricted access to the published content through its website and open access repositories.

Journal History

Pharmaceutical Sciences continues the title published from 1994 to 2012 in Persian (Ulum-i Daroei).

Submit Your Paper (/Login)
Editorial Board (/EditorialBoard)
Instructions for Authors (/InstructionsforAuthors)
Contact Us (/ContactUs)
Peer Review & for Reviewers (/ForReviewers)
Editorial Policies (/EditorialPolicies)
Archive (/Archive)

Indexing & Abstracting:

Director-in-Charge:

Prof. Parvin Zakeri-Milani (https://pharmfac-en.tbzmed.ac.ir/?PageID=86&ID=6&BasesID=45)

(https://publications.tbzmed.ac.ir/)

(https://publicationethics.org/members/pharmaceutical-sciences)

Follower of ICMJE (http://www.icmje.org/journals-following-the-icmje-recommendations/#P)

Powered by:

Pharmaceutical Sciences

(/)

Title

Title

Search

ISSN: 1735-403X (https://portal.issn.org/resource/ISSN/1735-403X) **eISSN**: 2383-2886 (https://portal.issn.org/resource/ISSN/2383-2886)

Submit Your Paper (/Login)

Editorial Board (/EditorialBoard)

Instructions for Authors (/InstructionsforAuthors)

Contact Us (/ContactUs)

Peer Review & for Reviewers (/ForReviewers)

Editorial Policies (/EditorialPolicies)

Archive (/Archive)

Indexing & Abstracting:

Pharmaceutical Sciences

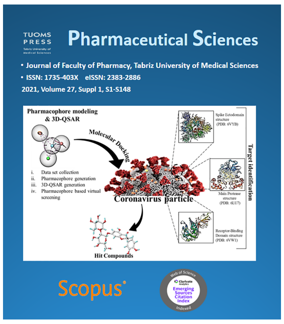
(/)

Title

Title

Search

ISSN: 1735-403X (https://portal.issn.org/resource/ISSN/1735-403X) **eISSN**: 2383-2886 (https://portal.issn.org/resource/ISSN/2383-2886)



November 2021, Vol 27, (Suppl 1)

Pharmaceutical Sciences is peer-reviewed, and quarterly journal providing a forum for basic to clinical issues related to all areas of pharmaceutical sciences. It is the official journal of Faculty of Pharmacy (https://pharmfac-en.tbzmed.ac.ir/), published by TUOMS PRESS (https://publications.tbzmed.ac.ir/), Tabriz University of Medical Sciences (https://www.tbzmed.ac.ir).

- Platinum Open Access (no processing or publication fees)

- Indexed in ESCI (Web of Science Core Collection) and Scopus

- Average time to first decision in 2020: 23 Days

- Acceptance rate in 2020: 18%

Peer Review Process:

All manuscripts submitted to Pharmaceutical Sciences are subject to rigorous review. This review consists of the following steps:

1. Initial submissions are reviewed by internal staff to ensure adherence to policies of TUOMS Press, including ethical requirements for human and animal experimentation.

2. Submissions are then assigned to an Editor for evaluation.

3. The Editor decides whether reviews from additional experts are needed to evaluate the manuscript. The majority of submissions are evaluated by two external reviewers, but it is up to the Editor to determine the number of reviews required.

4. After evaluation, the Editor chooses between the following decisions:

I. Accept

II. Minor Revision

III. Major Revision

IV. Reject

5. If the decision is Minor Revision or Major Revision, authors have 60 days to resubmit the revised manuscript. Authors may contact email address if they require an extension.

6. Upon resubmission, the Editor may choose to send the manuscript back to external reviewers, or may render a decision based on personal expertise.

Instruction for Reviewers:

The invitation letter will be sent including information about the title and abstract of the manuscript and the time limit expected for review. Following reviewer acceptance, the manuscript will be accessible to reviewer through his or her registration and then will be given access to download the entire manuscript. After reviewer, she/he may put her/his comments on website.

Special comments on the manuscripts could be sent to editors if they are inappropriate to be declared to authors.

A review in dedicated time will benefit the entire scientific community.

Reviewers should decline refereeing the manuscripts is the financial interest of him or her, is a field that reviewer is now working on, or if the reviewer has contacted the author recently. This information is uttered in the "request for review" e-mail sent to reviewer; otherwise after receiving the manuscript, the reviewer should inform the editor in order to inhibit subjective reviewing.

Information in manuscripts should be held confidential till the time of publication.

In the case of accepting reviewing a manuscript, this is a request of the reviewers to re-review the future revisions of the manuscript. Of course, reviewing revisions will be handled by editorial board as it is possible in order to restrict extra burden on reviewers.

Reviewers should assess the novelty and technical accuracy of the paper first draft and give specific comments and suggestions, including about layout and format, title, abstract, introduction, graphical abstracts and/or highlights, method, statistical errors, results, conclusion/discussion, language and references.

If reviewer suspect plagiarism, fraud or have other ethical concerns, raise your suspicions with the editor, providing as much detail as possible.

According to COPE guidelines, reviewers must treat any manuscripts they are asked to review as confidential documents. Since peer review is confidential, they must not share the review or information about the review with anyone without the agreement of the editors and authors involved. This applies both during and after the publication process.

Any suggestion that the author includes citations to reviewers' (or their associates') work must be for genuine scientific reasons and not with the intention of increasing reviewers' citation counts or enhancing the visibility of reviewers' work (or that of their associates).

Indexing & Abstracting:

(https://mjl.clarivate.com:/search-results?issn=1735-403X&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-these-results)

(https://www.scopus.com/sourceid/19700189400?origin=resultslist)

Pharmaceutical Sciences

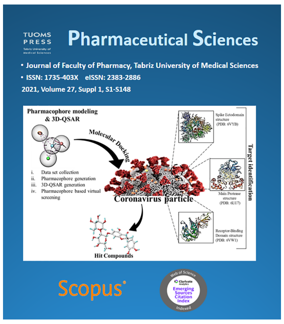
(/)

Title

Title

Search

ISSN: 1735-403X (https://portal.issn.org/resource/ISSN/1735-403X) **eISSN**: 2383-2886 (https://portal.issn.org/resource/ISSN/2383-2886)



November 2021, Vol 27, (Suppl 1)

Pharmaceutical Sciences is peer-reviewed, and quarterly journal providing a forum for basic to clinical issues related to all areas of pharmaceutical sciences. It is the official journal of Faculty of Pharmacy (https://pharmfac-en.tbzmed.ac.ir/), published by TUOMS PRESS (https://publications.tbzmed.ac.ir/), Tabriz University of Medical Sciences (https://www.tbzmed.ac.ir).

- Platinum Open Access (no processing or publication fees)

- Indexed in ESCI (Web of Science Core Collection) and Scopus

- Average time to first decision in 2020: 23 Days

- Acceptance rate in 2020: 18%

Editorial Policies

Policies on Human and Animal Rights and Informed Consent

Pharmaceutical Sciences endorse the guidelines of the Committee on Publication Ethics (COPE) (http://publicationethics.org/), the World Association of Medical Editors (WAME) Policy Statement on Geopolitical Intrusion on Editorial Decisions (http://www.wame.org/policy-statements#Geopolitical%20Intrusion), the Council of Science Editors' White Paper on Promoting Integrity in Scientific Journal Publications (http://www.councilscienceeditors.org/wp-content/uploads/entire_whitepaper.pdf) and the International Committee of Medical Journal Editors (ICMJE) Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals (http://www.icmje.org/recommendations/).

In cases where a study involves the use of live animals or human subjects, the author should include a statement that all experiments were performed in compliance with the relevant laws and institutional guidelines, and also state the institutional committee(s) that has approved the experiments. They should also include a statement that informed consent was obtained for any experimentation with human subjects.

For more information on ethical considerations, see our publisher's Editorial policy (https://publications.tbzmed.ac.ir/EditorialPolicies).

Policies on Conflict of Interest

All authors must declare all competing interests in their covering letter and in the "competing interests" section upon submission. Where authors have no competing interests, the statement should read "The author(s) declare(s) that they have no competing interests with regards to authorship and/or publication of this article." The Editor may ask for further information relating to competing interests.

Reviewers of *Pharmaceutical Sciences* are also required to declare any competing interests and they will be excluded from the peer review process if a competing interest exists.

Editors and advisory board of *Pharmaceutical Sciences* declare no competing interests and any financial relationship with any biomedical company and they were excluded from peer review process whenever submitting a manuscript to the journal.

Data Sharing

Pharmaceutical Sciences encourages authors to share the data and any other material associated with methodology and the results of the submitted articles, in an appropriate public repository, or as open access supplementary to the article. In line with ICMJE recommendations, a data sharing statement is required for manuscripts reporting the results of clinical trials, on whether and how the data will be available. For more information, please consult ICMJE recommendations (http://www.icmje.org/recommendations/browse/publishing-and-editorial-issues/clinical-trial-registration.html#two (http://www.icmje.org/recommendations/browse/publishing-and-editorial-issues/clinical-trial-registration.html#two))

For more information about other policies, see our publisher's Editorial policy (https://publications.tbzmed.ac.ir/EditorialPolicies)

- Ethics and consent (https://publications.tbzmed.ac.ir/EditorialPolicies#ethics-and-consent)
- Trial registration (https://publications.tbzmed.ac.ir/EditorialPolicies#trial-registration)
- Standards of reporting (https://publications.tbzmed.ac.ir/EditorialPolicies#standards-of-reporting)
- Competing interests (https://publications.tbzmed.ac.ir/EditorialPolicies#competing-interests)
- Authorship (https://publications.tbzmed.ac.ir/EditorialPolicies#authorship)
- Unique identifiers (https://publications.tbzmed.ac.ir/EditorialPolicies#unique-identifiers)
- Citations (https://publications.tbzmed.ac.ir/EditorialPolicies#citations)
- Duplicate publication (https://publications.tbzmed.ac.ir/EditorialPolicies#duplicate-publication)
- Text recycling (https://publications.tbzmed.ac.ir/EditorialPolicies#text-recycling)
- Peer review (https://publications.tbzmed.ac.ir/EditorialPolicies#peer-review)
- Confidentiality (https://publications.tbzmed.ac.ir/EditorialPolicies#confidentiality)
- Misconduct (https://publications.tbzmed.ac.ir/EditorialPolicies#misconduct)
- Corrections and retractions (https://publications.tbzmed.ac.ir/EditorialPolicies#corrections-and-retractions)

Indexing & Abstracting:

(https://mjl.clarivate.com:/search-results?issn=1735-403X&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-these-results)

(https://www.scopus.com/sourceid/19700189400?origin=resultslist)

Pharmaceutical Sciences

(/)

Title

Title

Search

ISSN: 1735-403X (https://portal.issn.org/resource/ISSN/1735-403X) **eISSN**: 2383-2886 (https://portal.issn.org/resource/ISSN/2383-2886)

Address: Faculty of Pharmacy, Tabriz University of Medical Sciences, Daneshgah St, Tabriz, Iran.

P.O.Box: 14766-51664

E-mail: Pharm.sci@tbzmed.ac.ir and Pharm.sci.tabriz@gmail.com

First Name

Last Name

Email Address

Contact Text

Pharmaceutical Sciences

ISSN: 1735-403X (https://portal.issn.org/resource/ISSN/1735-403X) **eISSN**: 2383-2886 (https://portal.issn.org/resource/ISSN/2383-2886)

Editorial COVID-19

Higher Education System in Light of Covid-19

(/Article/ps-33518)

Jalal Hanaee* (https://orcid.org/0000-0002-0417-9381), Mohammad Reza Rashidi (https://orcid.org/0000-0001-9206-9336)

Pharm Sci. 2020;26(Suppl 1): S1-S2. **doi:** 10.34172/PS.2020.45 (https://doi.org/10.34172/PS.2020.45)

Scopus ID: 85097264895 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097264895&origin=inward)

Article (/Article/ps-33518)

PDF (/PDF/ps-26-S1.pdf)

XML (/XMLs/ps-33518)

Review COVID-19

COVID-19: A Devastating Pandemic

(/Article/ps-33397)

Punet Kumar* (https://orcid.org/0000-0001-6047-6615), Md Iftekhar Ahmad (https://orcid.org/0000-0003-0308-197X), Sangam Singh (https://orcid.org/0000-0002-1341-4451)

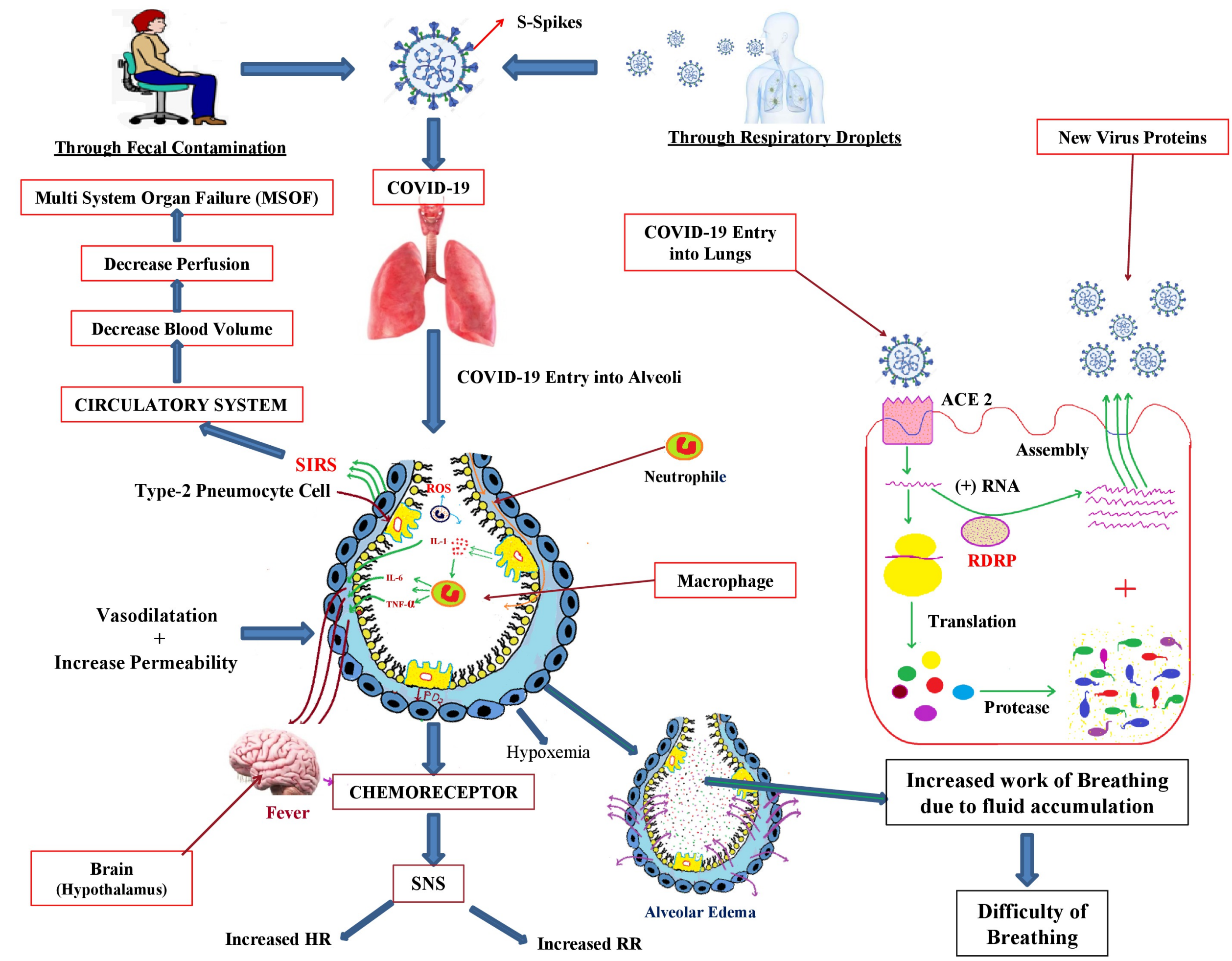
Pharm Sci. 2020;26(Suppl 1): S3-S11. **doi:** 10.34172/PS.2020.34 (https://doi.org/10.34172/PS.2020.34)

Scopus ID: 85097274657 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097274657&origin=inward)

Article (/Article/ps-33397)

PDF (/PDF/ps-26-S3.pdf)

XML (/XMLs/ps-33397)



Review COVID-19

COVID-19: Clinical Characteristics and Molecular Levels of Candidate Compounds of Prospective Herbal and Modern Drugs in Indonesia

(/Article/ps-33390)

Robert Tungadi* (https://orcid.org/0000-0003-2141-2402), Teti Sutriyati Tuloli, Widysusanti Abdulkadir, Nurain Thomas, Madania Madania, Ani Mustapa Hasan, Zulfiayu Sapiun

Pharm Sci. 2020;26(Suppl 1): S12-S23. **doi:** 10.34172/PS.2020.50 (https://doi.org/10.34172/PS.2020.50)

Scopus ID: 85097264531 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097264531&origin=inward)

Article (/Article/ps-33390)

PDF (/PDF/ps-26-S12.pdf)

XML (/XMLs/ps-33390)

Review COVID-19

A Summary of Coronavirus Disease 2019: What We Should Know?

(/Article/ps-33602)

Ysrafil Ysrafil (https://orcid.org/0000-0002-5980-7525), Indwiani Astuti* (https://orcid.org/0000-0001-7008-9192), Rosdiana Mus, Noviyanty Indjar Gama, Dwi Rahmaisyah, Riskah Nur'amalia

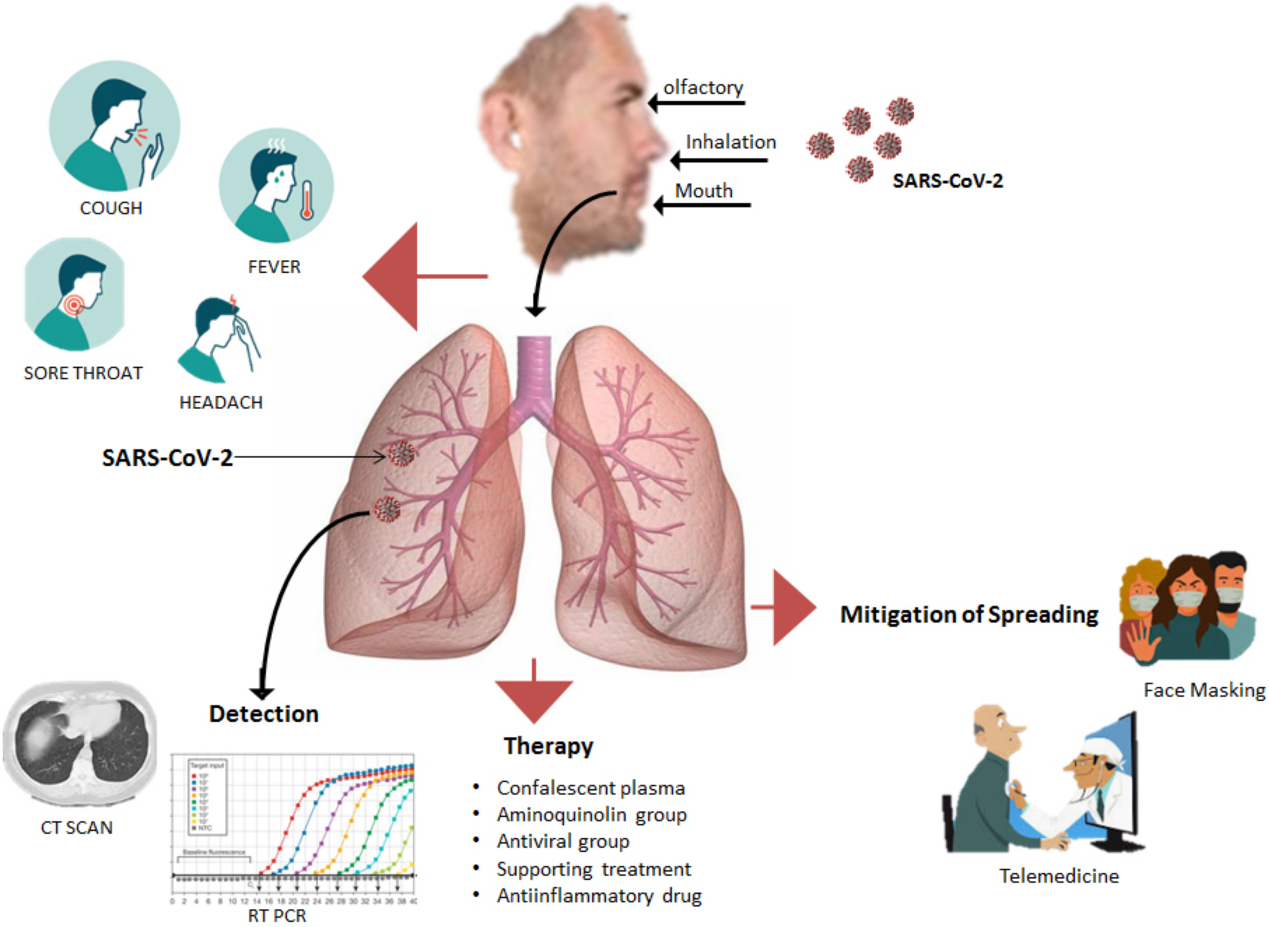
Pharm Sci. 2020;26(Suppl 1): S24-S35. **doi:** 10.34172/PS.2020.82 (https://doi.org/10.34172/PS.2020.82)

Scopus ID: 85097275654 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097275654&origin=inward)

Article (/Article/ps-33602)

PDF (/PDF/ps-26-S24.pdf)

XML (/XMLs/ps-33602)


olfactory
Inhalation
Mouth
SARS-CoV-2
COUGH
FEVER
SORE THROAT
HEADACH
SARS-CoV-2
Mitigation of Spreading
Face Masking
Telemedicine
Detection
CT SCAN
RT PCR
Therapy
• Confalescent plasma
• Aminoquinolin group
• Antiviral group
• Supporting treatment
• Antiinflammatory drug

Review COVID-19

Investigational Drugs for the COVID 19 Pandemic – A Concise Review

(/Article/ps-33526)

Reena Sherin Parveen (https://orcid.org/0000-0003-2147-8962), Sherya Hegde, Veena Nayak* (https://orcid.org/0000-0002-9372-2680)

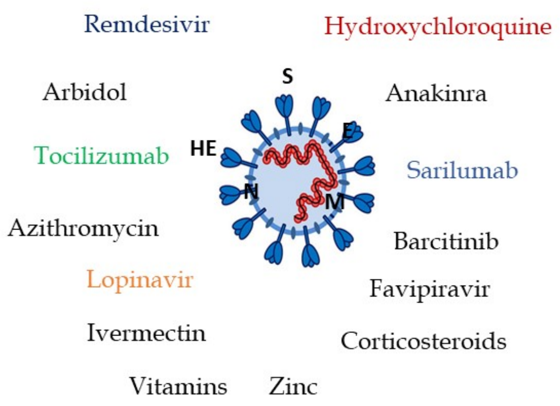
Pharm Sci. 2020;26(Suppl 1): S36-S48. **doi:** 10.34172/PS.2020.80 (https://doi.org/10.34172/PS.2020.80)

Scopus ID: 85097283168 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097283168&origin=inward)

Article (/Article/ps-33526)

PDF (/PDF/ps-26-S36.pdf)

XML (/XMLs/ps-33526)



Mini Review | COVID-19

NSAIDs and COVID-19: A New Challenging Area

(/Article/ps-33389)

Hananeh Baradaran (https://orcid.org/0000-0002-5836-5681), Hadi Hamishehkar, Haleh Rezae* (https://orcid.org/0000-0002-4808-6179)

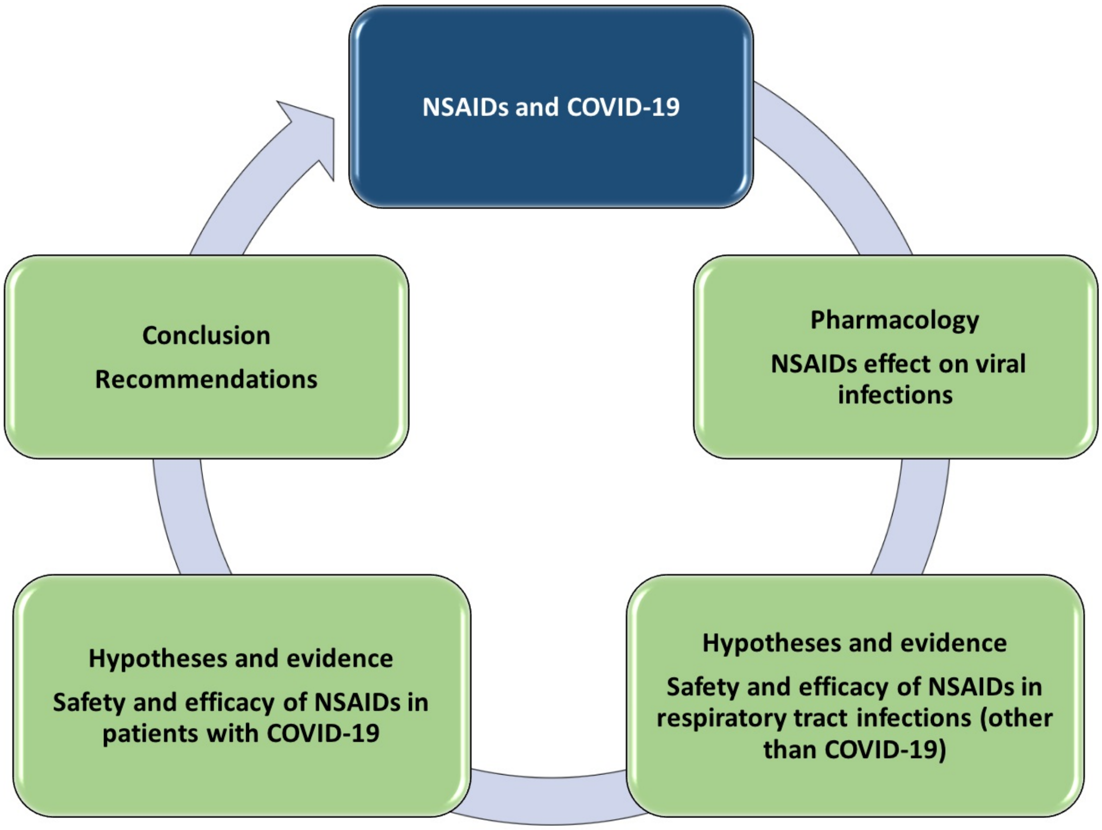
Pharm Sci. 2020;26(Suppl 1): S49-S51. **doi:** 10.34172/PS.2020.41 (https://doi.org/10.34172/PS.2020.41)

Scopus ID: 85097290006 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097290006&origin=inward)

Article (/Article/ps-33389)

PDF (/PDF/ps-26-S49.pdf)

XML (/XMLs/ps-33389)



Research Article | COVID-19

In Silico Drug Repurposing of Penicillins to Target Main Protease M^{pro} of SARS-CoV-2

(/Article/ps-33464)

Baby Krishnaprasad (https://orcid.org/0000-0002-1753-2332), Swastika Maity (https://orcid.org/0000-0001-5772-0883), Chetan Mehta (https://orcid.org/0000-0002-1895-8562), Akhil Suresh (https://orcid.org/0000-0001-8184-5125), Usha Y Nayak (https://orcid.org/0000-0002-1995-3114), Yogendra Nayak* (https://orcid.org/0000-0002-0508-1394)

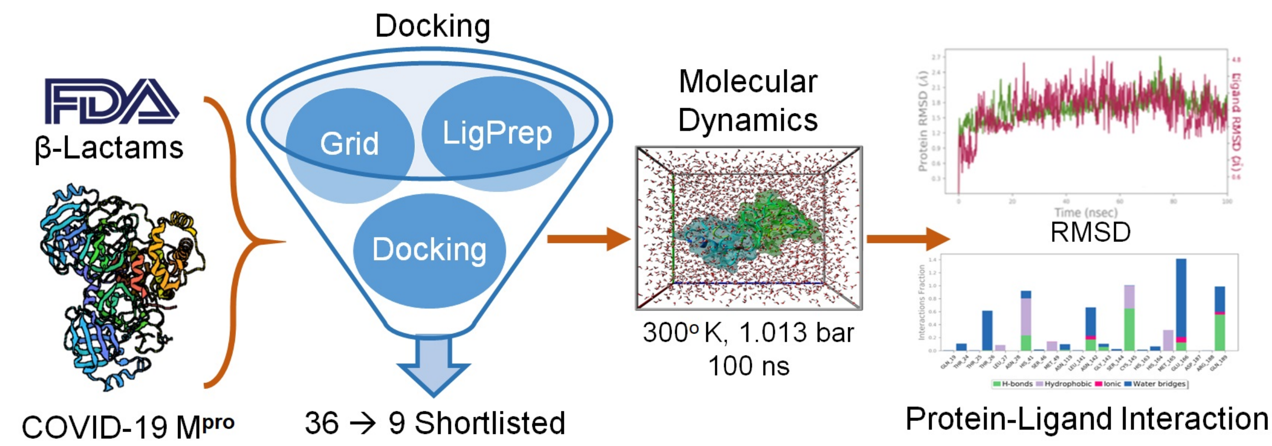
Pharm Sci. 2020;26(Suppl 1): S52-S62. **doi:** 10.34172/PS.2020.44 (https://doi.org/10.34172/PS.2020.44)

Scopus ID: 85097296158 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097296158&origin=inward)

Article (/Article/ps-33464)

PDF (/PDF/ps-26-S52.pdf)

XML (/XMLs/ps-33464)



Research Article COVID-19

Molecular Docking of Novel 5-O-benzoylpinostrobin Derivatives as SARS-CoV-2 Main Protease Inhibitors

(/Article/ps-33462)

Mohammad Rizki Fadhil Pratama (https://orcid.org/0000-0002-0727-4392), Hadi Poerwono (https://orcid.org/0000-0002-9241-9161), Siswandono Siswodihardjo* (https://orcid.org/0000-0002-9579-8929)

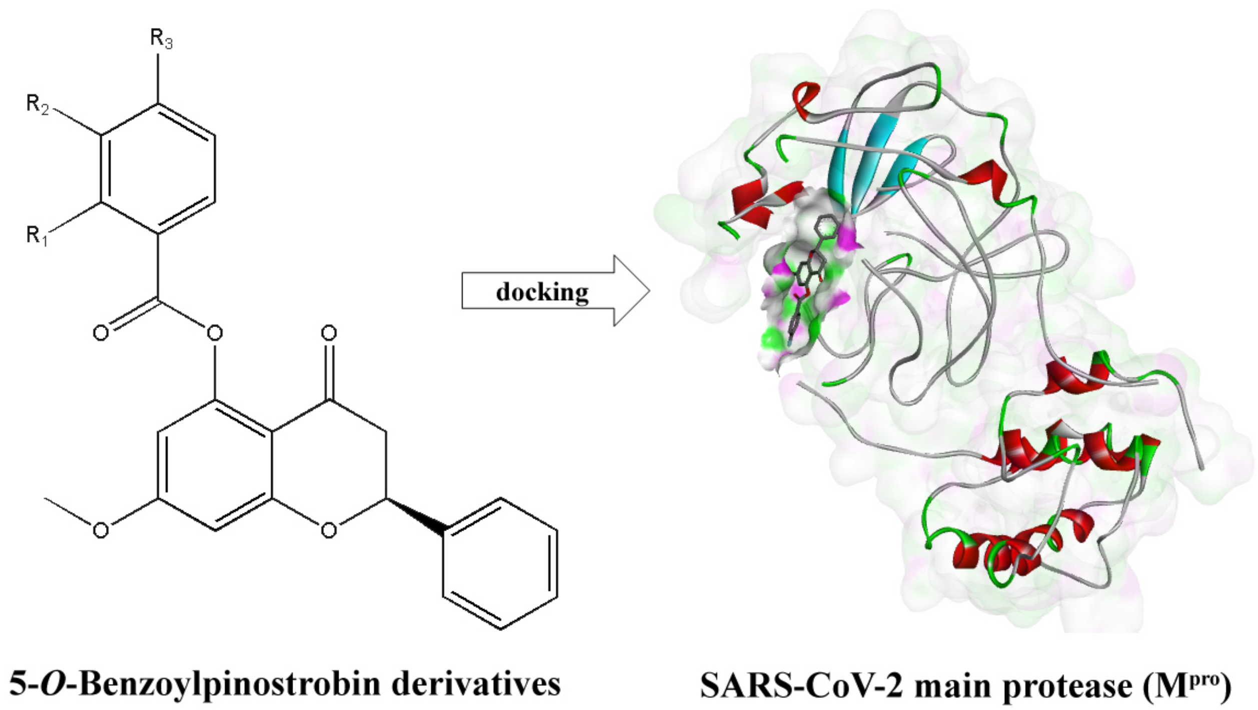
Pharm Sci. 2020;26(Suppl 1): S63-S77. **doi:** 10.34172/PS.2020.57 (https://doi.org/10.34172/PS.2020.57)

Scopus ID: 85097303712 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097303712&origin=inward)

Article (/Article/ps-33462)

PDF (/PDF/ps-26-S63.pdf)

XML (/XMLs/ps-33462)



Commentary | COVID-19

Prophylactic Use of Chloroquine May Impair Innate Immune System Response against SARS-Cov-2 (/Article/ps-33403)

Hamid Soraya* (https://orcid.org/0000-0003-0602-230X)

Pharm Sci. 2020;26(Suppl 1): S78-S79. **doi:** 10.34172/PS.2020.29 (https://doi.org/10.34172/PS.2020.29)

Scopus ID: 85086764367 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85086764367&origin=inward)

Article (/Article/ps-33403)

PDF (/PDF/ps-26-S78.pdf)

XML (/XMLs/ps-33403)

Commentary | COVID-19

Dexmedetomidine: An All Sedation-in–One Drug in Critically Ill Patients with COVID-19 (/Article/ps-33559)

Ata Mahmoodpoor, Elyad Ekrami, Hassan Soleimanpour* (https://orcid.org/0000-0002-1311-4096)

Pharm Sci. 2020;26(Suppl 1): S80-S81. **doi:** 10.34172/PS.2020.53 (https://doi.org/10.34172/PS.2020.53)

Scopus ID: 85097267928 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097267928&origin=inward)

Article (/Article/ps-33559)

PDF (/PDF/ps-26-S80.pdf)

XML (/XMLs/ps-33559)

Commentary COVID-19

Plasmapheresis: A New Strategy in the Treatment of COVID-19

(/Article/ps-33562)

Punet Kumar* (https://orcid.org/0000-0001-6047-6615), Md Iftekhar Ahmad (https://orcid.org/0000-0003-0308-197X), Sangam Singh (https://orcid.org/0000-0002-1341-4451)

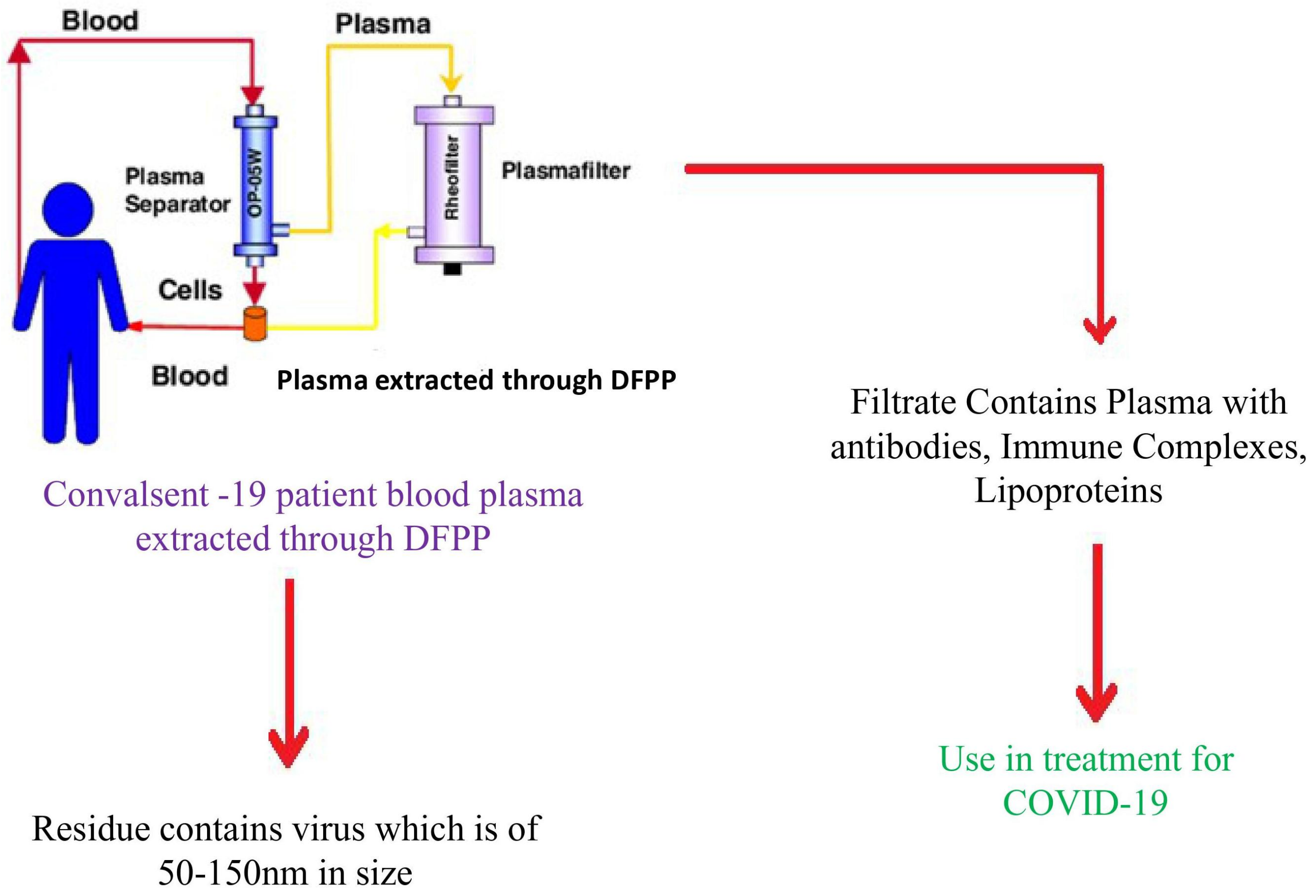
Pharm Sci. 2020;26(Suppl 1): S82-S83. **doi:** 10.34172/PS.2020.55 (https://doi.org/10.34172/PS.2020.55)

Scopus ID: 85097299809 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097299809&origin=inward)

Article (/Article/ps-33562)

PDF (/PDF/ps-26-S82.pdf)

XML (/XMLs/ps-33562)



Commentary COVID-19

Persistence of SARS-Cov-2 on the Beauty Products, Their Containers' Surfaces, and the Possibility of Secondary and Cross-Contamination

(/Article/ps-33571)

Zahra Jannatdoust, Sara Shamekhi, Jalal Hanaee, Somaieh Soltani* (https://orcid.org/0000-0002-0102-2960), Alireza Garjani*

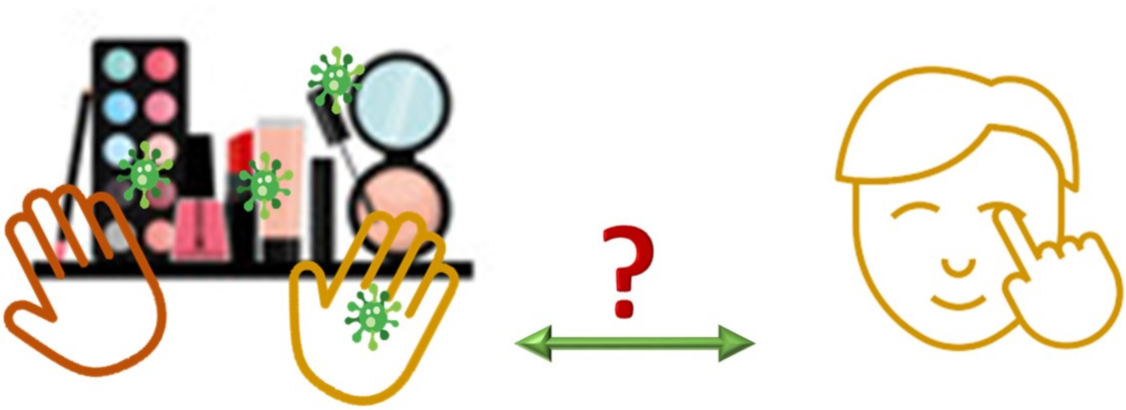
Pharm Sci. 2020;26(Suppl 1): S84-S86. **doi:** 10.34172/PS.2020.68 (https://doi.org/10.34172/PS.2020.68)

Scopus ID: 85097293410 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097293410&origin=inward)

Article (/Article/ps-33571)

PDF (/PDF/ps-26-S84.pdf)

XML (/XMLs/ps-33571)



Commentary COVID-19

Diabetes and the COVID-19 Pandemic: What Should the Diabetes Patients Know?

(/Article/ps-33649)

Moyad Shahwan* (https://orcid.org/0000-0001-8367-4841), Nageeb Hassan, Sahab Alkhoujah, Ammar Jairoun (https://orcid.org/0000-0002-4471-0878), Samer Zyoud, Sudhir Varma

Pharm Sci. 2020;26(Suppl 1): S87-S90. **doi:** 10.34172/PS.2020.75 (https://doi.org/10.34172/PS.2020.75)

Scopus ID: 85097277524 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097277524&origin=inward)

Article (/Article/ps-33649)

PDF (/PDF/ps-26-S87.pdf)

XML (/XMLs/ps-33649)

(/)
Title
Title
Search
ISSN: 1735-403X (https://portal.issn.org/resource/ISSN/1735-403X) **eISSN**: 2383-2886 (https://portal.issn.org/resource/ISSN/2383-2886)

Pharm Sci. 2020;26(Suppl 1) (/Archive/26/Covid-19): S12-S23.
doi: 10.34172/PS.2020.50 (https://doi.org/10.34172/PS.2020.50)

Scopus ID: 85097264531 (https://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85097264531&origin=inward)

Check for updates (https://crossmark.crossref.org/dialog?doi=10.34172%2FPS.2020.50&domain=ps.tbzmed.ac.ir&uri_scheme=https%3A&cm_version=v2.0)

COVID-19
Review

COVID-19: Clinical Characteristics and Molecular Levels of Candidate Compounds of Prospective Herbal and Modern Drugs in Indonesia

Robert Tungadi [1*] (https://orcid.org/0000-0003-2141-2402), Teti Sutriyati Tuloli [1], Widysusanti Abdulkadir [1], Nurain Thomas [1], Madania Madania [1], Ani Mustapa Hasan [2], Zulfiayu Sapiun [3]

[1] Department of Pharmacy, Faculty of Sport and Health, State University of Gorontalo, Gorontalo, Indonesia.
[2] Department of Biology, Faculty of Mathematics and Natural Sciences, State University of Gorontalo, Gorontalo,

Indonesia
[3] Department of Pharmacy, Health Polytechnic of Gorontalo, Gorontalo, Indonesia.

Abstract

A recent outbreak of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) disease also called Coronavirus disease 2019 (COVID-19) in China, has rapidly spread to other countries of the world. The medical and scientific communities are working tirelessly to produce a vaccine due to the lethal nature of this virus. COVID-19 is a novel virus that requires immediate emergency therapy, thereby leading to massive fear of infection, social problems in the community, and an increase in the number of infected people. Therefore, scientists and researchers need to determine the epidemiological cases of the virus, such as its mode of transmission, effective preventive measures, and the nature of the life cycle. In addition, there need to be current literature advances

in diagnostic development such as reverse transcription polymerase chain reaction (RT-PCR), computed tomography san (CT-Scan), ELISA as well as clinical researches on modern and herbal drugs for the treatment of infected patients. This treatment technique is classified from antiviral drugs such as entry, replication, nucleosides, nucleotides, and protease inhibitors, along with

the use of heterocyclic drugs, monoclonal antibodies therapy, vaccine development and herbal formulations that have been pre-clinically tested in vitro and molecular docking. Chemical drug molecules with prospective applications in the treatment of COVID-19 have been included in this review.

Keywords: COVID-19, Antiviral, Infection, Herbal, Modern drugs, Pandemic

Pharmaceutical Sciences, 2020, 26(Suppl 1), S12-S23
doi:10.34172/PS.2020.50
https://ps.tbzmed.ac.ir/

Review Article

COVID-19: Clinical Characteristics and Molecular Levels of Candidate Compounds of Prospective Herbal and Modern Drugs in Indonesia

Robert Tungadi[1*], Teti Sutriyati Tuloli[1], Widysusanti Abdulkadir[1], Nurain Thomas[1], Madania[1], Ani Mustapa Hasan[2], Zulfiayu Sapiun[3]

[1]*Department of Pharmacy, Faculty of Sport and Health, State University of Gorontalo, Gorontalo, Indonesia.*

[2]*Department of Biology, Faculty of Mathematics and Natural Sciences, State University of Gorontalo, Gorontalo, Indonesia*

[3]*Department of Pharmacy, Health Polytechnic of Gorontalo, Gorontalo, Indonesia*

Article Info

Article History:
Received: 31 March 2020
Accepted: 16 June 2020
ePublished: 30 November 2020

Keywords:
-COVID-19
-Antiviral
-Infection
-Herbal
-Modern drugs
-Pandemic

Abstract

A recent outbreak of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) disease also called Coronavirus disease 2019 (COVID-19) in China, has rapidly spread to other countries of the world. The medical and scientific communities are working tirelessly to produce a vaccine due to the lethal nature of this virus. COVID-19 is a novel virus that requires immediate emergency therapy, thereby leading to massive fear of infection, social problems in the community, and an increase in the number of infected people. Therefore, scientists and researchers need to determine the epidemiological cases of the virus, such as its mode of transmission, effective preventive measures, and the nature of the life cycle. In addition, there need to be current literature advances in diagnostic development such as reverse transcription polymerase chain reaction (RT-PCR), computed tomography san (CT-Scan), ELISA as well as clinical researches on modern and herbal drugs for the treatment of infected patients. This treatment technique is classified from antiviral drugs such as entry, replication, nucleosides, nucleotides, and protease inhibitors, along with the use of heterocyclic drugs, monoclonal antibodies therapy, vaccine development and herbal formulations that have been pre-clinically tested in vitro and molecular docking. Chemical drug molecules with prospective applications in the treatment of COVID-19 have been included in this review.

Introduction

In December 2019, the Chinese city of Wuhan experienced a rapid spread in an infectious disease, which affected the respiratory system, thereby leading to a high mortality rate. This virus, known as Coronavirus disease 2019 (COVID-19), soon spread to other countries and was declared a pandemic by the World Health Organization (WHO).[1] Infected people show symptoms of pneumonia, which is similar to SARS (Severe Acute Respiratory Syndrome). This disease is caused by a lethal virus in nature and is currently the highest leading cause of mortality all over the world.[2] The first reported case was in China, and within a few months, it has spread to almost all countries and continents in the world.[2] According to studies, the most significant numbers of cases of infected people are in South Korea, Italy, Iran, South Africa, the USA, and Indonesia. In a recent update by WHO, over 90,000 people all over the world are infected with approximately 3,000 deaths. China alone recorded 2,500 deaths by the end of February 2020.[3]
The WHO declared the virus a pandemic due to its rapid spread in various countries. It is speculated that this virus originated from different animals consumed as food in China. Early transmission studies reported that it originated from local fish and wild animal markets with possible transmission from animals to humans and vice versa. However, this speculation has not been proven. This disease has led to a very high increase in mortality all over the world.[4]

In Indonesia, the virus was not in existence till the end of April 2020, based on data from the Ministry of Health. Since its inception, there has been a rapid increase in the mortality rate due to the high number of infected people.[5] Therefore, based on these data, the Indonesian government quickly responded and took preventive measures to reduce the spread of this virus. Before now, no drug or vaccine has been proven to kill or inhibit the COVID-19 virus. However, WHO announced that over 20 countries and pharmaceutical companies around the world are developing vaccines and drugs to fight the virus.[6] Unfortunately, this development is going to take at least a year before completion. Meanwhile, several types of modern and herbal COVID-19 treatments have been clinically tested, such as Remdesivir and Chloroquine, as well as curcumin (in vitro study).

The emergence and rapid spread of this virus have hastened

*Corresponding Author: Robert Tungadi, E-mail: robert.tungadi@ung.ac.id

the development of diagnosis and medicines for the treatment of this infectious disease. In Indonesia, doctors have used several existing modern and herbal medicines, with national and international health institutions, to understand the mechanism, virulence, and pharmacology of the virus to develop possible drugs and vaccines. This review discusses the literature report on progress regarding diagnostic methods and developmental therapies with the possible use of candidate compounds of modern and herbal medicines for COVID-19 infectious diseases in Indonesia.

The Coronaviruses

Coronavirus, a genus of the Coronaviridae family, is a positive-strand and the most significant viral genome of all RNA viruses (27–32 kb), causing a wide range of diseases related to the respiratory system. The symptoms may vary from the common cold, dry cough to more severe respiratory diseases.[7] Furthermore, it consists of 80 to 160 nm particles, 4 or 5 structural spike (S), membrane (M), hemagglutinin-esterase (HE), nucleocapsid (N), and small envelope € proteins.[8] In addition, the virion structure consists of S glycoprotein, which forms petal-shaped spikes on the surface with 180 to 200 KDa molecule that is cotranslationally glycosylated in the endoplasmic reticulum as shown in Figure 1.[8] SARS-CoV-2 was an new strain of the current virus,[9,10] which was transmitted from animals to human[11], however, the new coronavirus infects humans.

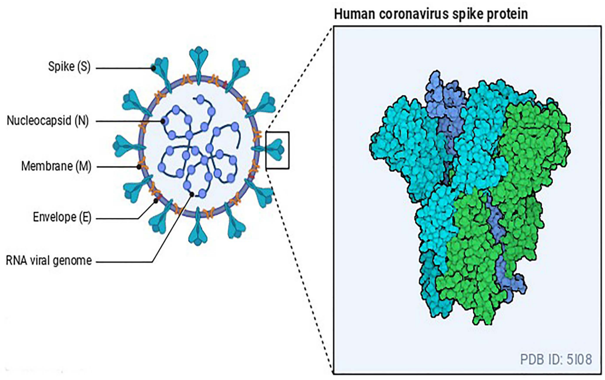


Figure 1. Structure of new coronavirus and protein visualization, now designated severe acute respiratory syndrome coronavirus-2, (SARS-CoV-2)

COVID-19 Transmission

COVID-19 spreads rapidly amongst humans with symptoms and asymptomatic carriers. The virus is easily spread when the liquid droplet of an infected person drops on surfaces when the patient coughs or sneezes. Transmission in certain cases is usually through the air, by staying close to an infected person.[12] Meanwhile, asymptomatic patients are hidden carriers of the virus and contribute to a greater transmission of the virus. This manual transmission also spread, assuming the patient has symptoms.[3] In addition, vertical transmission of the virus from mother to child has not been observed according to research conducted by Chen H et al. in a small group of pregnant women. They stated that the virus is vertically intrauterine and non-transmittable from mothers to unborn babies. The emergence and the spread of this new virus is due to the increase in human populations which causes proximity.[13,14]

Symptoms and Mortality of COVID-19

Symptoms of COVID-19 are indicated by the occurrence of respiratory distress similar to acute respiratory distress syndrome (ARDS), which marked respiratory infections on COVID-19 patients. These include runny nose, fever, cough, shortness of breath, sore throat, and mild to moderate upper respiratory tract illness. In severe cases, patients experience pneumonia, SARS, kidney failure, and even death. An infected patient shows full signs of the virus within two to seven days. However, the median incubation duration of infection development changed to 4 days with an interquartile variety of 2 to 7 days in all patients.[15] This is known as the incubation period which progresses for four days with an interquartile range.[16]

Study conducted by Guan et al. showed the middle-aged were more prone to infection compared to other categories of people.[17] Approximately 41.9% of the total number of patients were women, therefore, there are gender differences in the spread of the virus. The report also stated that the primary composite endpoint occurred in 6% of patients. In Wuhan city, there was no gender difference in people infected with COVID-19 with the highest mortality rates of 8.4% by 20 March 2020.[18,19] However, research shows that the elderly and young children are most at risk from the infection. This is similar to SARS, though it appears nCoV-2019 is less lethal compared to SARS and MERS, this is because approximately 15 to 20% of cases become severe within a limited timeframe. According to doctors, the lethal rate is about 1 in 10 which caused by enveloped virus meaning that it is protected by a glycoprotein shell, thereby, making it difficult to treat.[20,21]

Preventive Measures

All countries, including Indonesia, need preventive measures to overcome the spread of COVID-19, which currently has no known cure and vaccines. Therefore, handling infected patients has been recommended as one of the steps to control the rampant spread of the virus among people. However, it is difficult to force the isolation of infected patients because this causes many social problems. Like many reports in the Indonesian media, the practice of forced confinement of infected people at home is very difficult for health workers and the police. The isolation of infected individuals supported the provision of complete hospital treatment is one of the moral control methods.[22] Therefore, appropriate research studies need to be conducted to understand the best approach in infection prevention including assessing the country's ability to slow the spread of infected people.[23]

In Indonesia, the standard procedures recommended for preventing the spread of infection are more effective in controlling the spread and keeping things safe. The most crucial strategies include washing of hands after visiting public places and frequent exercises.[24,25] Other practices involve overlaying mouth and nostrils when coughing and sneezing to prevent the spread of the virus, assuming the person is asymptomatic or in preliminary degrees of contamination.[26,27] Also, proper cooking of foods such as meat, eggs, and animals helps to destroy the virus. In practice, one needs to avoid close contact with anyone showing symptoms of respiratory illnesses such as cough, flu, asthma, pneumonia, and tuberculosis. Therefore, this simple precaution can be effectively carried out in controlling the spread and containing the virus.

The Life Cycle of SARS-CoV-2 and Infection

Novel Coronavirus 2019 (COVID-19) has a life cycle mechanism divided into 3 parts, namely entry, replication, and release, as shown in Figure 2. Firstly, the infection starts when the viral spike (S) glycoprotein attached to the complementary host cell receptor. After attachment, a protease of the host cell cleaves and activates the receptor-attached spike protein. Depending on the availability of the host cell protease, cleavage and activation allow cell entry by endocytosis or direct fusion of the viral envelop with the host membrane.[28]

On entry into the host cell, the virus is uncoated, and its genome enters the cell cytoplasm.[29] The coronavirus RNA genome has a 5'-methylated cap and a 3'-polyadenylated tail, which allows the RNA to attach to the host cell's ribosome for translation, and translates the initial overlapping of the virus genome and forms a long polyprotein.[30] The polyprotein consists of proteases which cleaves it into multiple nonstructural proteins.[29]

Secondly, coronaviruses replicates and transcripts RNA from the strand by using the SARS-CoV-2 replication mechanism, which binds cell surface molecules such as metalloprotease amino peptidase with hemagglutinin esterase (HE-protein) and N-acetyl neuraminic acid as co-receptor. Furthermore, the virus goes into the host cell by fusion of viral and cell membranes or through the receptor-mediated endocytosis incorporated via an endosome, which is subsequently acidified by proton pumps. Meanwhile, the virus produces direct proteins and new genomes in the cytoplasm, particularly single positive-stranded RNA gen. Otherwise, the negative strand serves as a template used to transcribe smaller subgenomic positive RNAs used to synthesize all other proteins. After binding, assembled nucleocapsids with twisted helical RNA, it enters into the endoplasmic reticulum (ER) lumen and is encased with the membrane as shown in Figure 2.[31] Thirdly, the replicated positive-sense of genomic RNA becomes the genome of the progeny viruses. The mRNAs are gene transcripts after the initial overlapping reading frame translated by the host's ribosomes into the structural proteins.[32] RNA translation occurs inside the endoplasmic reticulum, which consists of S, E, and M proteins that move along the secretory pathway into the Golgi intermediate compartment. Therefore, the M proteins are required to assemble and bind the virus into the nucleocapsid.[33] Progeny viruses are released from the host cell by exocytosis through secretory vesicles.[29]

Diagnosis

The proper diagnosis characteristics used to manage COVID-19 is the first line of control and a deciding factor in the initiation of the course of treatment. This is different from the common cold, which is properly treated with

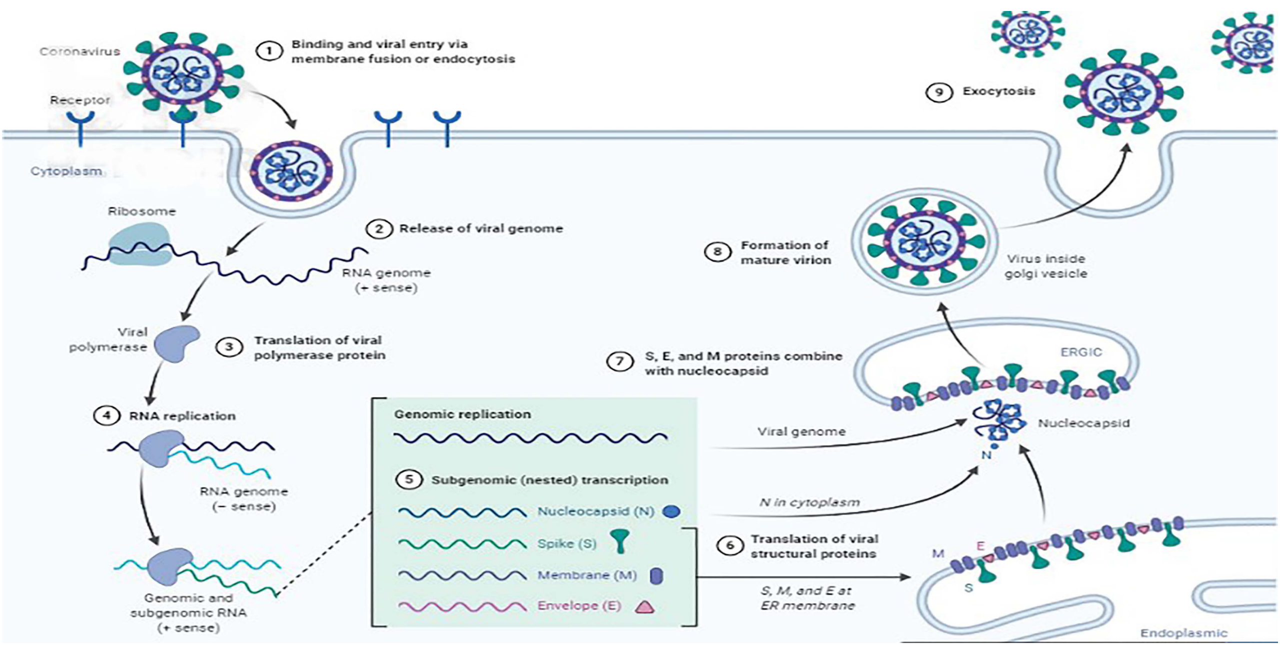


Figure 2. The life cycle of coronavirus including the viral spike (S) glycoprotein attach to the complementary host cell receptor via membrane fusion or endocytosis then release of viral genome, translation of viral polymerase protein, RNA replication, subgenomic transcription and translation of viral structural proteins. S, E, and M protein combine with nucleocapsid forming mature virion and exocytosis.

the right drugs. Sometimes the results of preliminary examinations in infected people do not provide a clear diagnosis of the infection, therefore, doctors tend to ask the patient to provide a detailed and accurate diagnosis of their disease such as cough, flu, fever, and so on. The identifying and providing effective support, sputum examination, and other diagnostic tests help to determine the infection early. Also, the number of days from the infected date is noted at the laboratory to recommend individual diagnostic tests as follows:

Reverse transcription-polymerase chain reaction (RT-PCR)

This is a standard technique for determining the virus by rRT-PCR from a nasopharyngeal swab. A sputum sample is used to obtain the required results within hours to 2 days.[32] Sample measurements (Swab test) consist of some steps using RT-PCR, as shown in Figure 3.

Enzyme-linked immunosorbent assay (ELISA)

Antibody assays are used to test infected people using their blood serum sample, with the results released with few days.[33]

Computerized-Tomography (CT-Scan)

The contamination is analyzed from a mixture of side effects, chance elements, and a chest CT scan demonstrating highlights of pneumonia.[34] The fundamental diagnosis reports from medical clinics in China show that majority of COVID-19 infected patients were determined using pneumonia and trademark CT imaging patterns.[35] Furthermore, radiological assessments have become imperative in early determination and appraisal of disease course.[36] CT scan of various COVID-19 contaminated patients differed in pattern[37], and almost 50% of patients were discovered from pictures. On admission to emergency clinics, the ground-glass haziness was the most widely recognized radiologic finding on chest figured tomography (CT)[37] of 56.4% of patients.[38] The longitudinal CT discovered infected patients with pneumonia with follow up checks over the course of treatment. Besides that, it was seen that numerous patients did not have strange radiologic findings.[39]

Treatments of COVID-19

The mechanism of viral infection is the entry of the virus into cells and multiplication using a host cellular method characterized by damages to the host cell as a key for the development of new drug compound therapies. Currently, there is no definitive and recommended therapy for COVID-19 because it is a new virus, and making a vaccine required numerous clinical analyses and tests. One of examples of treatment therapy i.e. convalescent plasma therapy which is the administration of plasma from a recovered COVID-19 patient to a Covid-19 patient who is still suffering from illness, so antibodies (immunity) in the plasma of the cured patient can help patients who are still ill to cope with the disease.[3,39] However, all antivirals used in COVID-19 therapy in almost all countries are still in the form of trial and error. Some countries have referred to the antiviral therapy used during the occurrence of

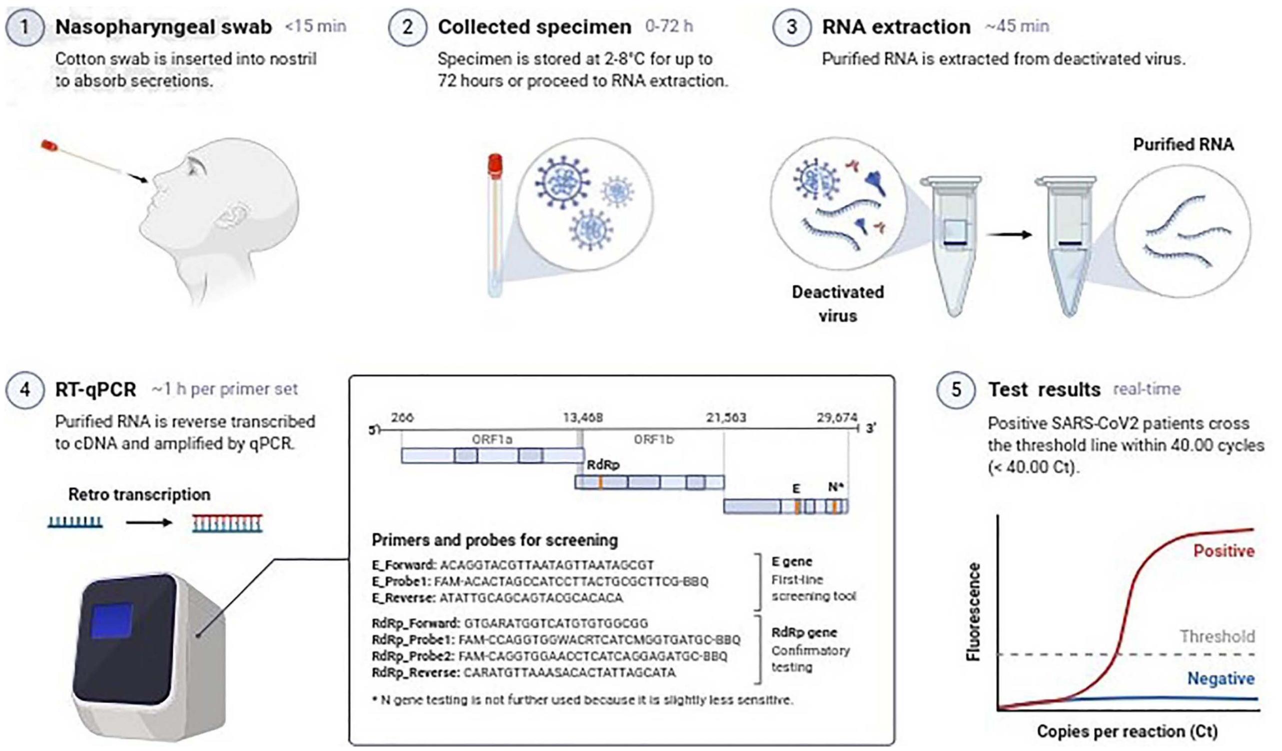


Figure 3. The steps of coronavirus disease 2019 (COVID-19) diagnostic test through reverse transcription polymerase chain reaction (RT-PCR) by nasophangeal swab using cotton swab, collecting specimen, extracting RNA, operating RT-PCR, and showing positive or negative results.

the SARS and MERS epidemic several years ago, such as lopinavir, ritonavir, ribavirin, oseltamivir, etc. These drugs have been used and were quite effective in dealing with SARS and MERS during the epidemic.[3] Similarly, there are no definitive guidelines for dealing with COVID-19 in Indonesia, as the country also relies on an existing drug such as oseltamivir. Indonesia has tried reaching out to China regarding the drugs used to treat their infected citizens, including the purchase of Chloroquine and Avigan. Some prospective drugs are considered to direct current applications or the development of new therapeutic drugs, including modern and herbal medicines.

Entry inhibitors

The SARS-CoV-2 infects the respiratory system and alveoli cells in the lung sacs would be the host for viral infection. In general, viruses enter the host cell by forming complex projections such as spikes or lobes with receptors. However, the exact structure or lobe of SARS-CoV-2 is not fully determined,[40] although prior experience of coronavirus (β-family), shows it has similarities with the receptor of host cells of SARS.[41] Recently it has been found that Angiotensin-converting enzyme 2 (ACE2) is a cellular receptor for SARS coronavirus, (SARS-CoV) and (SARS-CoV-2).[42] ACE2 has some homology with an angiotensin-converting enzyme (ACE) although it is not inhibited by ACE inhibitors.[3] A previous SARS case was characterized by an infection that was started by the transmembrane (S) spike in the glycoproteins binding the host receptor and combines viruses to cell membranes. The identification of the viral / spikes lobes molecular structure is time-consuming, while the development of facilitated heterocyclic drug molecules or existing heterocyclic screening has the ability to bind the entry inhibitor drug.[43]

Replication inhibitors

COVID-19 is an RNA virus that utilizes host cells for genomic replication by encoding the RNA-dependent RNA polymerase (RdRp), which allows the viral genome to be transcribed into new RNA copies using the host cell's machinery. The viral genome replication mechanism serves potential targets for the control of viral infections, while antiviral drugs (Figure 4) such as Remdesivir and Favipiravir (Avigan)[44] has the ability to potentially affect SARS-CoV-2 as shown in Figures 4A and B. The nucleotide adenosine analogue antiviral for Ebola and RNA viruses have shown some promising results in the clinical control of this virus.[45] However, further evaluation is needed for potential applications with more patients. The action mechanism of Remdesivir as antiviral drug as shown in Figure 5.

Favipiravir is the brand name for Avigan, also known as T-705, which is an antiviral drug developed by Toyama Chemical, a Fujifilm group, located in Japan with activity against many RNA viruses. In Japan, this drug was originally developed to treat influenza, however, in February 2020, Favipiravir was used in China for trials of emerging COVID-19 (novel coronavirus) disease. The action mechanism of favipiravir can inhibit replication and translation of virus by the RNA-dependent RNA polymerase (RdRp) of RNA viruses, as shown in Figure 6.[46] Further studies have shown that favipiravir induces mutant

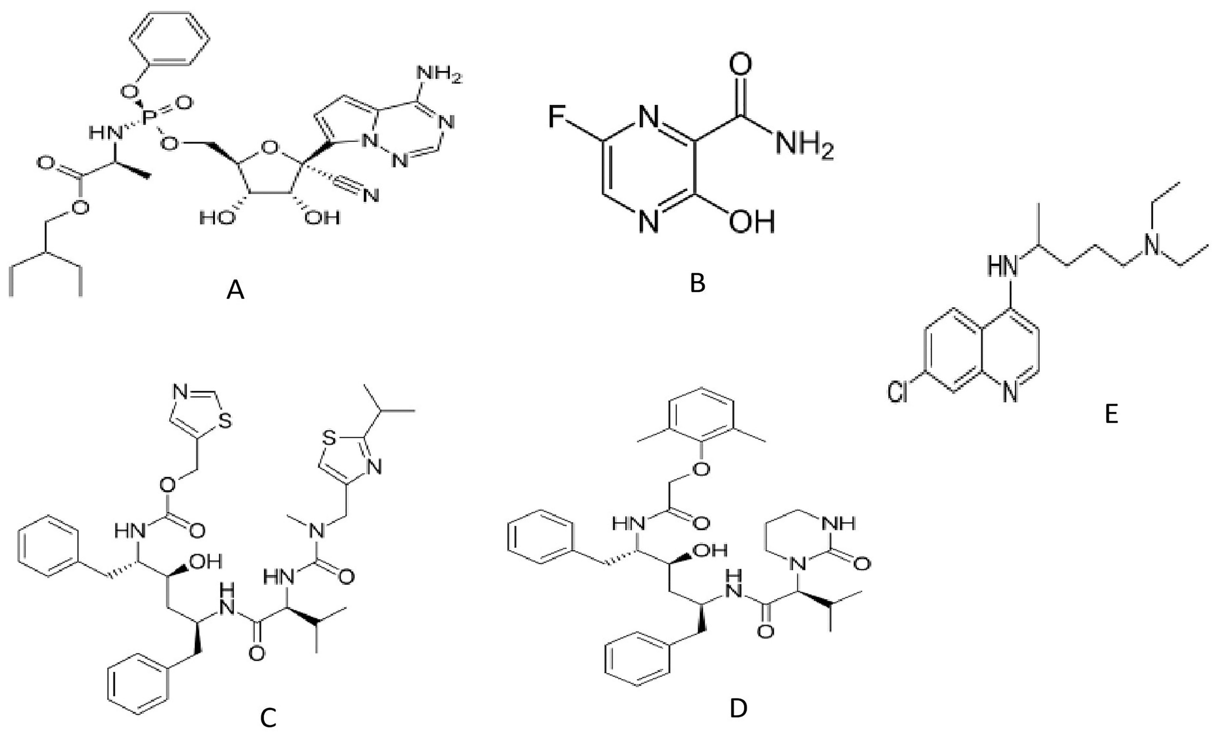


Figure 4. Chemical structures of Remdesivir (A), Favipiravir (B), Ritonavir (C), Lopinavir (D), Chloroquine (E)

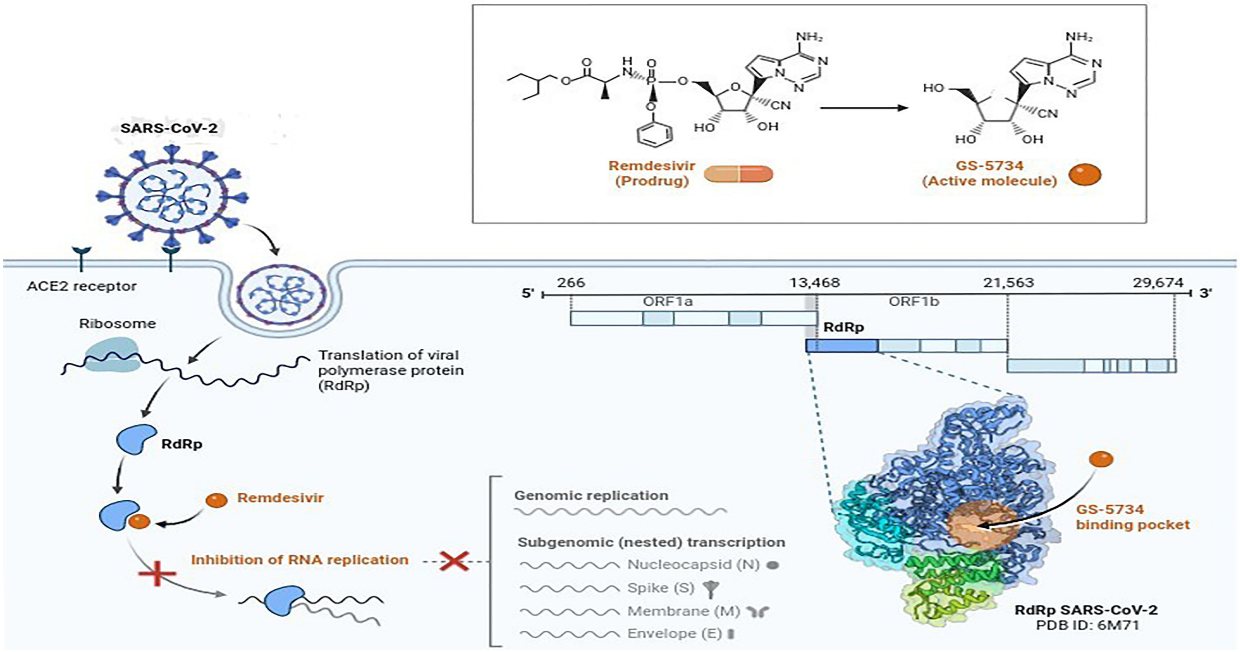


Figure 5. The action mechanism of Remdesivir against coronavirus by changing Remdesivir as prodrug into active molecule GS-5734, binding drug target molecule (RdRp), and inhibiting RNA replication in membrane cell.

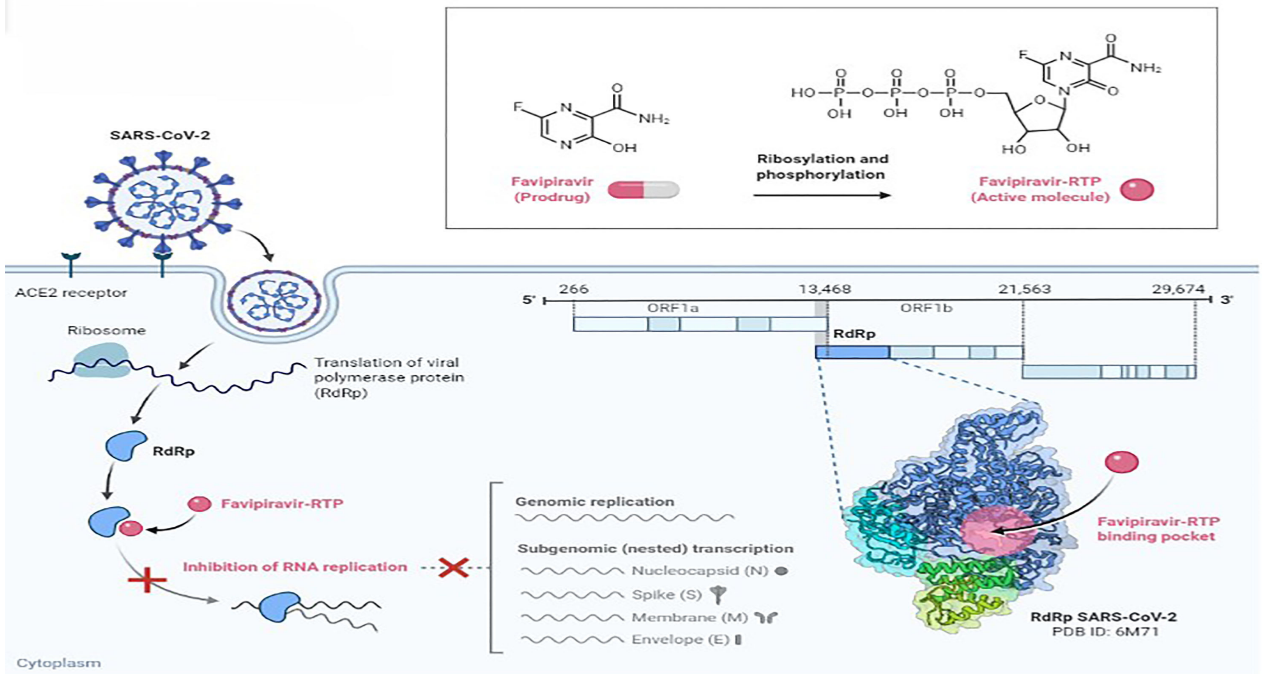


Figure 6. The action mechanism of Favipiravir as a potential repurposed drug candidate for COVID-19 which can inhibit replication and translation of virus by the RNA-dependent RNA polymerase (RdRp) of RNA viruses.

of RNA transversion, resulting in a viable viral phenotype. This product is metabolized by human hypoxanthine-guanine phosphoribosyltransferase (HGPRT) known as favipiravir-ribofuranosyl-5-triphosphate (favipiravir-RTP). During this COVID-19 pandemic, in a limited clinical trial with 80 subjects, favipiravir showed an antiviral potential for SARS-CoV-2 that was better than lopinavir/ritonavir.[47] Many other nucleoside analogues including DNA synthesis such as tenofovir, disoproxil, lamivudine, and other antivirals have the potential to inhibit the multiplication of SARS-CoV-2 and are being evaluated through molecular docking studies and testing in infected cell culture.[48]

Protease inhibitors

Protease enzymes are involved within the maturation stage of virus replication inside the host cell and related to protein or peptide translation. Figures 4C and D, shows that Lopinavir and ritonavir are approved anti-HIV drugs, and a combination of both aids in the inhibition of SARS-

CoV-2.[49,50] A research carried out by Lim J et.al.[51] on the remedy used to treat persons affected with COVID-19 in Korea indicated that the administration of lopinavir/ritonavir (Kaletra, AbbVie) extensively reduced the virus.This means that a detailed analysis is needed for the recommendation of this drug and the formation of new drug compounds. Molecular docking of potential inhibitors provide clear information because detailed docking simulation results have shown essential input in previous SARS cases and other viral infections.[51-53] However, a lot of clinical data needs to be conducted to prove the efficacy and safety of the human body.

Heterocyclic antiviral

Over the decades, many heterocyclic drug molecules have been used in the treatment of viral infections, and these drugs are thought to be probably slightly effective in inhibiting SARS-CoV-2. An example is Chloroquine, which was originally an antiplasmodium used to treat malaria. This drug contains a quinoline group as shown in Figure 4E and inhibits the activity of the enzyme heme polymerase into hemozoin. This accumulation kills the Plasmodium parasite responsible for malaria.[54] However, with the decrease in malaria and the emergence of plasmodium resistance to Chloroquine, this drug is no longer used. Also, Chloroquine and hydroxychloroquine are used for antiviral therapy. Gao et al. (2020) stated that Chloroquine has a strong antiviral effect against the virus in primate cells. This inhibitory effect is observed when cells are treated with Chloroquine both before and after exposure, which shows that it has a preventive and therapeutic effect. In addition, Chloroquine and hydroxychloroquine are weak bases that are known to elevate the pH of acidic intracellular organelles, such as endosomes/lysosomes, essential for membrane fusion inhibiting SARS-CoV-2 entry through changing the glycosylation of ACE2 receptor and spike protein, shown in Figure 7.[55-57] This inhibits the receptor which prevent infection and spread of the SARS-CoV-2 at concentrations that cause clinical response. In the SARS-CoV-2 pandemic in China, Chloroquine was used at a dose of 500 mg for adult 2 times a day, for 10 days.[56] Chloroquine and hydroxychloroquine are also currently being tried in Malaysia at the same dosage used in China and Indonesia. There are several heterocyclic antiviruses previously used as antivirals such as HIV, H1N1, H1N5, and SARS, which are further examined for the treatment of COVID-19. Oseltamivir (Tamiflu) has been widely used as a neuraminidase inhibitor for the treatment of influenza was also recommended.[57] In addition, other candidate compounds evaluated with antiviral activity against SARS-CoV-2 are heterocyclic based on ACE2 peptides namely 3C-like protease (3CLpro and 3CLpro-1) inhibitors and vinysulfone protease inhibitors.[58]

Nano Drug Delivery Systems

Drug delivery systems in the form of nanoparticle preparations have been widely used to improve the bioavailability in the blood and enhance the transport and efficacy antiviral drugs especially nucleoside analogues on conjugation with potential delivery systems that have been proven in drug-resistant HIV infection.[59-62] The wide variety of available nano delivery system can be used with the new developed drug formulation which could be efficacious in delivering the drugs with faster therapeutic indices for COVID-19.[62-66]

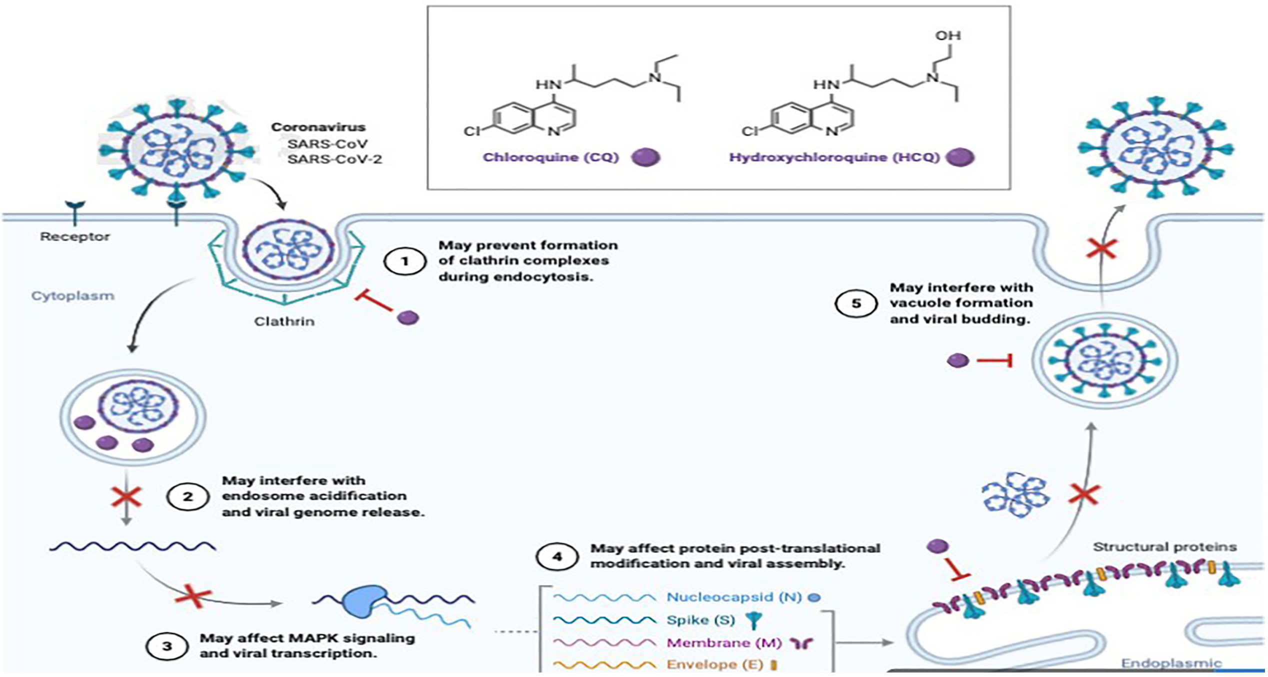


Figure 7. The molecular mechanism of chloroquine in membrane cell by preventing the formation of clathrin complexes in the cytoplasm during endocytosis, interfering with endosome acidification and viral genome release, affecting MAPK signaling and viral transcription, affecting protein post-translational modification, and interfering vacuole formation and viral budding.

Biological Therapeutics

Antibody therapy can be used for the treatment of COVID-19 infections. However, this vaccine still requires approximately 1 year before it can be globally utilized to prevent the spread of the virus. According to Tian et al. specific human monoclonal antibodies such as CR3022 are intended to bind strongly to SARS-CoV-2 receptor binding domain[= (RBD) (KD 6.3 nM) and overlap the ACE2 binding site.[67] These unique results indicate the possibility of developing a therapeutic vaccine with a combination of other antibodies. However, *in vitro* trials and clinical studies are needed to obtain accurate clinical data for the prevention and treatment of COVID-19 infections.[67]

In developing a new vaccine one must pay attention to the similarity of immunogenic structural proteins similar to SARS, MERS for SARS-CoV-2.[68] Ahmed et al. used a set of B and T cell epitopes derived from spikes (S) and nucleocapsid proteins (N) to identically map the SARS-CoV-2 protein.[69] Reports suggested that the identified epitope has no available mutase sequence. Therefore, this target immune epitope has the potential to be explored in the fight against the SARS-CoV-2. However, the final results depend on *in vitro* and future clinical trials.[69]

Herbal drugs

The herbal formulations used as alternative medication has been a success in presenting the remedy to a number of infections in conjunction with symptom specific remedy using herbs.[70-72] The initial lead from herbal medicinal drug has been successful in developing final applicable formulations like Praneem (a natural extract of neem tree) as microbicide for HIV therapy.[73] Therefore, various studies have been conducted on the use of herbal drugs to test the active compounds of some herbal in Indonesia by molecular docking in silico (Table 1).

According to University of Indonesia (UI) and Institute of Bogor Agriculture (IPB) researchers, they stated that some chemical compounds which originated from several plants in Indonesia have the potential ability to prevent COVID-19 infection in the form of molecular docking in silico. Based on the results of prediction models with machine learning methods, namely SVM (support vector machine), random forest, and MLP (multilayer perceptron) neural network is associated with 20,644 interactions of protein compounds. The results are 31 herbal compounds with 5 target proteins 3CLPro (Chymotripsin-like protease), PLPro (Papain-like protease), Spike-ACE2, EIF4 (Eukaryotic initiation factor-4), and RdRp. Modeling of structure and ligand based pharmacophores was used to carry out virtual screening with 1,377 compounds from the HerbalDB database.[74] The results of compound hit from machine learning, and pharmacophore mapping was confirmed using molecular docking.

Table 1. Active compounds having the potential as antiviral SARS-CoV-2[81]

Target	Compounds	Sources
3CLpro	Rhamnetin 3-mannosyl-(1-2)-alloside	*Cassia alata*
	Kaempherol 3,4'-di-O-methyl ether (Ermanin)	*Tanacetum microphyllum*
	Cyanidine 3-sophoroside-5-glucoside	*Brassica oleracea, Ipomoea batatas, Raphanus sativus*
	Casuarinin	*Psidium guajava*
	Quercetin 3-(2G-rhamnosylrutinoside)	*Clitoria ternatea*
	Peonidine 3-(4'-arabinosylglucoside)	*Ipomoea fistulosa*
	Hesperidine	*Psidium guajava, Citrus aurantium*
PLpro	Platycodin D	*Platycodon grandiflorus*
	Baicalin	*Scutellaria baicalensis*
	Sugetriol-3,9-diacetate	*Cyperus rotundus*
	Phaitanthrin D 2,2-di(3-indolyl)-3-indolone	*Isatis indigotica*
	(-)-epigallocatechin gallate	*Camellia sinensis*
	2,4-Dihydroxyphenyl)-2-[2-(3,4-Dihydroxyphenyl)-3,4-dihydro-5,7-dihydroksi-2H-1-benzopyran-3-yl]-3,4-dihydro-2H-1-benzopyran-3,4,5,7-tetrol	*Vitis vinifera*
RdRp.	Betulanol	*Cassine xylocarpa*
	Gnidicin	*Gnidia lamprantha*
	2-β-dihydroxy-3,4-seo-friedelolactone-27-lactone	*Viola diffusa*
	14-deoxy-11,12-didehydroandrographolide	*Andrographis paniculata*
	1,7-dihyroxy-3-methoxyxanthone	*Swerti apseudochinensis*
	Theaflacin 3,3'-di-O-gallate	*Camelia sinensis*
	2-(3,4-dihydrophenyl)-2-[(2-3,4-dihydroxyphenyl)-3,4-dihydro-5-7-dihydroxy-2H-1-benzopyran-3-yl]oxy]-3,4-dihydro-2H-1-benzopyran-3,4,5,7-tetrol	*Vitis vinifera*
	Hesperidine	*Psidium guajava, Citrus aurantium*

Guava (*Psidium guajava*) with pink flesh contains active compounds including myricetin, quercetin, luteolin, kaempferol, isorhamnetin[75], and hesperidin.[76] Luteolin is a furin protein inhibitor[77] and assumed as one of the enzymes that breakdown the Coronavirus S (spike) protein in MERS into units of S1 and S2.[78,79] In the S1 unit, there is a receptor-binding domain (RBD) where the ACE2 peptidase binds the virus in the host cell.[79] The Hesperidin/hesperitin compound in the silico study inhibits the RBD of the SARS-COV-2 Spike protein which is also known as luteolin having a neuramidase inhibitor as well as oseltamivir which is currently one of the drugs used in the CDC protocol.[80] Hesperidin a form of hesperidin aglycone and Quercetin is also known to act as inhibitors of 3CLpro virus proteins.[81,82] Other compounds in guava such as myricetin act as SARS coronavirus helicase inhibitors.[83] The kaempferol has the potential to be a non-competitive inhibitor of 3CLPro and PLpro as well as quercetin.[84] It also acts as a autophagy modulator, inducer and inhibitor, of the virus.

Meanwhile, Indonesia is also famous for its variety of cooking condiments which are derived from plants. One of the commonly used condiments for cooking or herbal medicine in Indonesia is empon-empon consisting of ginger, turmeric, galangal, curcuma and lemongrass. Furthermore, animals such as snakehead fish also improve immune system in the body due to high protein and amino acids.[85-87] According to UNAIR (University of Airlangga) researchers stated that the approach that can be taken in the public by consuming empon-empon to boost the immune system to avoid COVID-19.[78]

Turmeric containing curcumin have been consumed and proven by people for centuries and beneficial to health. For example it is used to maintain fitness vitality, liver, and digestive systems based on empirical experimental evidence. Various studies have been carried out in vitro and preclinical tests showing that curcumin is anti-inflammatory, antiviral, antibacterial, antifungal, and antioxidant based on scientific evidence.[88, 89]

One of the benefits of curcumin obtained from clinical trials is to increase the body's immune system. Recent research on curcumin against the virus shows that the SARS-CoV-2 receptor is an enzyme ACE2 found in host cells of human especially alveolus lungs. However, the cell entry of the virus depends on the binding of the spike virus protein, the receptor on the host cell (ACE2) and pad priming protein spike (TMPRSS2).[89]

Conclusion

The surging spread of the virus through human-to-human transmission has created a change in human life that must meet health protocol standards including therapy protocols to combat COVID-19. Few existing drugs had been evaluated for the remedy of SARS-CoV-2 and shown promising good effects in clinical applications. The chemical and herbal drugs for the management of viral infection symptoms have been on the frontline to mitigate this novel viral infectious disease and have helped the number of patients in safe healing from COVID-19. Several drugs have been clinically evaluated for the treatment of COVID-19, which showed promising results and assisted a number of patients to recover safely. There is continuous research on the potential of therapeutics in evaluating the existing antiviral drugs such as modern and herbal medicines.

Conflict of Interest

The authors claim that there is no conflict of interes

References

1. Kumar S, FNU P, Rathi B. Coronavirus Disease COVID-19: A New Threat to Public Health. Curr Top Med Chem. 2020;20(8):599-600. doi:10.2174/1568026620999200305144319
2. Wu F, Zhao S, Yu B, Chen YM, Wang W, Song ZG, et al. A new coronavirus associated with human respiratory disease in China. Nature. 2020;579:265-69. doi:10.1038/s41586-020-2008-3
3. Chhikara B.S, Brijesh R, Jyoti S, Poonam. Corona virus SARS-CoV-2 disease COVID-19: Infection, prevention and clinical advances of the prospective chemical drug therapeutics. Chem Biol Lett. 2020;7(1):63-72.
4. Bogoch II, Watts A, Thomas-Bachli A, Huber C, Kraemer MUG, Khan K. Potential for global spread of a novel coronavirus from China. J Travel Med. 2020;27(2):taaa011. doi:10.1093/jtm/taaa011
5. Adyatama E, Persada S. [BNPB extends the corona emergency period to May 29], 2020. Tempo magazine. Online 17 March 2020. Jakarta. Indonesian
6. Cohen J, Normile D. New SARS-like virus in China triggers alarm. Science. 2020 367(6475):234-235. doi: 10.1126/science.367.6475.234
7. Chang FR, Yen CT, Ei-Shazly M, Lin WH, Yen MH, Lin KH, et al. Anti-human coronavirus (anti-HCoV) triterpenoids from the leaves of Euphorbia neriifolia. Nat Prod Commun. 2012;7(11):1415-7.
8. Masters PS. The molecular biology of coronaviruses. Adv Virus Res. 2006;66:193-292. doi:10.1016/S0065-3527(06)66005-3
9. Badawi A, Ryoo SG. Prevalence of comorbidities in the Middle East respiratory syndrome coronavirus (MERS-CoV): a systematic review and meta-analysis. Int J Infect Dis. 2016;49:129-33. doi:10.1016/j.ijid.2016.06.015
10. Vijayanand P, Wilkins E, Woodhead M. Severe acute respiratory syndrome (SARS): a review. Clin Med (Lond). 2004;4(2):152-60. doi: 10.7861/clinmedicine.4-2-152
11. Wang LF, Shi Z, Zhang S, Field H, Daszak P, Eaton BT. Review of bats and SARS. Emerg Infect Dis. 2006;12(12):1834-40. doi:10.3201/eid1212.060401
12. Kam KQ, Yung CF, Cui L, Tzer Pin Lin R, Mak TM, Maiwald M, et al. A Well Infant With Coronavirus Disease 2019 With High Viral Load. Clin Infect Dis. 2020;71(15):847-849. doi:10.1093/cid/ciaa201

13. Chen H, Guo J, Wang C, Luo F, Yu X, Zhang W, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. Lancet. 2020;395(10226):809-15. doi:10.1016/S0140-6736(20)30360-3
14. Chan JFW, Yuan S, Kok KH, To KKW, Chu H, Yang J, 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(10223):514-23. doi:10.1016/s0140-6736(20)30154-9
15. Pan X, Chen D, Xia Y, Wu X, Li T, Ou X, et al. Asymptomatic cases in a family cluster with SARS-CoV-2 infection. Lancet Infect Dis. 2020;20(4):410-11. doi:10.1016/S1473-3099(20)30114-6
16. Goldsmith CS, Tatti KM, Ksiazek TG, Rollin PE, Comer JA, Lee WW, et al. Ultrastructural characterization of SARS coronavirus. Emerg Infect Dis. 2004;10(2):320-6. doi:10.3201/eid1002.030913
17. Guan WJ, Ni ZY, Hu Y, Liang WH, OU CQ, He J, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med. 2020;382:1708-20. doi:10.1056/NEJMoa2002032
18. Wu J, Liu J, Zhao X, Liu C, Wang W, Wang D, et al. Clinical Characteristics of Imported Cases of Coronavirus Disease 2019 (COVID-19) in Jiangsu Province: A Multicenter Descriptive Study. Clin Infect Dis. 2020;71(15):706-12. doi:10.1093/cid/ciaa199
19. Jiang X, Rayner S, Luo MH. Does SARS-CoV-2 has a longer incubation period than SARS and MERS? J Med Virol. 2020;92(5):476-8. doi:10.1002/jmv.25708
20. Ribeiro LZ, Tripp RA, Rossi LM, Palma PV, Yokosawa J, Mantese OC, et al. Serum mannose-binding lectin levels are linked with respiratory syncytial virus (RSV) disease. J Clin Immunol. 2008;28(2):166-73. doi:10.1007/s10875-007-9141-8
21. Falzarano D, de Wit E, Rasmussen AL, Feldmann F, Okumura A, Scott DP, et al. Treatment with interferon-α2b and ribavirin improves outcome in MERS-CoV-infected rhesus macaques. Nat Med. 2013;19(10):1313-7. doi:10.1038/nm.3362
22. Lu D. Inside Wuhan's lockdown. New Scientist. 2020;245(3268):7. doi:10.1016/S0262-4079(20)30234-7
23. Chen P. Study on the virus transmission based on data analysis of confirmed cases of 2019-nCoV coronavirus in China (II). 2020. doi:10.31219/osf.io/uaq69
24. Leung CC, Lam TH, Cheng KK. Mass masking in the COVID-19 epidemic: people need guidance. Lancet. 2020;395(10228):945. doi:10.1016/S0140-6736(20)30520-1
25. Zhang S, Diao MY, Duan L, Lin Z, Chen D. The novel coronavirus (SARS-CoV-2) infections in China: prevention, control and challenges. Intensive Care Med. 2020;46:591–3. doi:10.1007/s00134-020-05977-9
26. Plourde AR, Bloch EM. A literature review of Zika virus. Emerg Infect Dis. 2016;22(7):1185-92.
27. Gostin L, Phelan A, Coutinho AG, Eccleston-Turner M, Erondu N, Filani O, et al. Ebola in the Democratic Republic of the Congo: time to sound a global alert? Lancet. 2019;393(10172):617-20. doi:10.1016/S0140-6736(19)30243-0
28. Simmons G, Zmora P, Gierer S, Heurich A, Pöhlmann S. Proteolytic activation of the SARS-coronavirus spike protein: cutting enzymes at the cutting edge of antiviral research. Antiviral Res. 2013;100(3):605-14. doi:10.1016/j.antiviral.2013.09.028
29. Fehr AR, Perlman S. Coronaviruses: an overview of their replication and pathogenesis. Methods Mol Biol. 2015;1282:1-23. doi:10.1007/978-1-4939-2438-7_1
30. Fehr AR, Perlman S. Coronaviruses: An Overview of Their Replication and Pathogenesis. In: Maier H, Bickerton E, Britton P. (eds) Coronaviruses. Methods in Molecular Biology, vol 1282. New York, NY: Humana Press;2015. doi:10.1007/978-1-4939-2438-7_1
31. Lai MM, Cavanagh D. The molecular biology of coronaviruses. Adv Virus Res. 1997;48:1-100. doi:10.1016/S0065-3527(08)60286-9
32. Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W, et al. Correlation of Chest CT and RT-PCR Testing for Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. Radiology. 2020;296(2):E32-40. doi:10.1148/radiol.2020200642
33. Li M, Jin R, Peng Y, Wang C, Ren W, Lv F, et al. Generation of antibodies against COVID-19 virus for development of diagnostic tools. medRxiv; 2020. doi:10.1101/2020.02.20.20025999
34. Fang Y, Zhang H, Xie J, Lin M, Ying L, Pang P, et al. Sensitivity of Chest CT for COVID-19: Comparison to RT-PCR. Radiology. 2020;296(2):E115-117. doi:10.1148/radiol.2020200432
35. Li X, Zeng X, Liu B, Yu Y. COVID-19 Infection Presenting with CT Halo Sign. Radiol Cardiothorac Imaging. 2020;2(1):e200026. doi:10.1148/ryct.2020200026
36. Zu ZY, Jiang MD, Xu PP, Chen W, Ni QQ, Lu GM, et al. Coronavirus Disease 2019 (COVID-19): A Perspective from China. Radiology. 2020;296(2):E15-E25. doi:10.1148/radiol.2020200490
37. Liu T, Huang P, Liu H, Huang L, Lei M, Xu W, et al. Spectrum of chest CT findings in a familial cluster of COVID-19 infection. Radiol Cardiothorac Imaging. 2020;2(1),e200025. doi:10.1148/ryct.2020200025
38. Wu Y, Xie Y, Wang X. Longitudinal CT findings in COVID-19 pneumonia: Case presenting organizing pneumonia pattern. Radiol Cardiothorac Imaging. 2020; 2(1):e200031. doi:10.1148/ryct.2020200031
39. Kong W, Agarwal PP. Chest Imaging Appearance of COVID-19 Infection. Radiol Cardiothorac Imaging. 2020;2(1):e200028. doi:10.1148/ryct.2020200028
40. Wrapp D, Wang N, Corbett KS, Goldsmith JA, Hsieh CL, Abiona O, et al. Cryo-EM structure of the 2019-

nCoV spike in the prefusion conformation. Science. 2020;367(6483):1260-1263. doi:10.1126/science.abb2507
41. Letko M, Marzi A, Munster V. Functional assessment of cell entry and receptor usage for SARS-CoV-2 and other lineage B betacoronaviruses. Nat Microbiol. 2020;5(4):562-569. doi:10.1038/s41564-020-0688-y
42. Yan R, Zhang Y, Li Y, Xia L, Guo Y, Zhou Q. Structural basis for the recognition of SARS-CoV-2 by full-length human ACE2. Science. 2020;367(6485):1444-8. doi:10.1126/science.abb2762
43. Tortorici MA, Walls AC, Lang Y, Wang C, Li Z, Koerhuis D, et al. Structural basis for human coronavirus attachment to sialic acid receptors. Nat Struct Mol Biol. 2019;26(6):481–9. doi:10.1038/s41594-019-0233-y
44. Yuan Y, Cao D, Zhang Y, Ma J, Qi J, Wang Q, et al. Cryo-EM structures of MERS-CoV and SARS-CoV spike glycoproteins reveal the dynamic receptor binding domains. Nat Commun. 2017;8:15092. doi:10.1038/ncomms15092
45. Singh J, Chhikara BS. Comparative global epidemiology of HIV infections and status of current progress in treatment. Chem Biol Lett. 2014;1(1):14-32.
46. Chang YC, Tung YA, Lee KH, Chen TF, Hsiao YC, Chang HC, et al. Potential Therapeutic Agents for COVID-19 Based on the Analysis of Protease and RNA Polymerase Docking. Preprints. 2020, 2020020242. doi:10.20944/preprints202002.0242.v1
47. Li G, De Clercq E. Therapeutic options for the 2019 novel coronavirus (2019-nCoV). Nat Rev Drug Discov. 2020;19(3):149-150. doi:10.1038/d41573-020-00016-0
48. Wang M, Cao R, Zhang L, Yang X, Liu J, Xu M, et al. Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019-nCoV) in vitro. Cell Res. 2020;30(3):269-71. doi:10.1038/s41422-020-0282-0
49. Dong L, Hu S, Gao J. Discovering drugs to treat coronavirus disease 2019 (COVID-19). Drug Discov Ther. 2020;14(1):58-60. doi:10.5582/ddt.2020.01012
50. Yao TT, Qian JD, Zhu WY, Wang Y, Wang GQ. A systematic review of lopinavir therapy for SARS coronavirus and MERS coronavirus-A possible reference for coronavirus disease-19 treatment option. J Med Virol. 2020;92(6):556-63. doi:10.1002/jmv.25729
51. Lim J, Jeon S, Shin HY, Kim MJ, Seong YM, Lee WJ, et al. Case of the Index Patient Who Caused Tertiary Transmission of COVID-19 Infection in Korea: the Application of Lopinavir/Ritonavir for the Treatment of COVID-19 Infected Pneumonia Monitored by Quantitative RT-PCR. J Korean Med Sci. 2020;35(6):e79. doi:10.3346/jkms.2020.35.e79
52. Behera DK, Behera PM, Acharya L, Dixit A. Development and validation of pharmacophore and QSAR models for influenza PB2 inhibitors. Chem Biol Lett. 2017;4(1):1-8.
53. Sharma D, Pathak M, Sharma R, et al. Homology modeling and docking studies of VP24 protein of Ebola virus with an antiviral drug and its derivatives. Chem Biol Lett. 2017;4(1):27-32.
54. Bindu P.J, Naik T.R.R, Mahadevan K.M, Krishnamurthy G. Synthesis, DNA photo-cleavage, molecular docking and anticancer studies of 2-methyl-1,2,3,4-tetrahydroquinolines. Chem Biol Lett. 2019;6(1):8-13.
55. Slater A, Cerami A. Inhibition by chloroquine of a novel haem polymerase enzyme activity in malaria trophozoites. Nature. 1992;355:167-9. doi:10.1038/355167a0
56. Al-Bari MAA. Targeting endosomal acidification by chloroquine analogs as a promising strategy for the treatment of emerging viral diseases. Pharmacol Res Perspect. 2017;5(1):e00293. doi:10.1002/prp2.293
57. Gao J, Tian Z, Yang X. Breakthrough: Chloroquine phosphate has shown apparent efficacy in treatment of COVID-19 associated pneumonia in clinical studies. Biosci Trends. 2020;14(1):72-3. doi:10.5582/bst.2020.01047
58. Morse JS, Lalonde T, Xu S, Liu WR. Learning from the Past: Possible Urgent Prevention and Treatment Options for Severe Acute Respiratory Infections Caused by 2019-nCoV. Chembiochem. 2020;21(5):730-8. doi:10.1002/cbic.202000047
59. Gautret P, Lagier JC, Parola P, Hoang VT, Meddeb L, Mailhe M, et al. Hydroxychloroquine and azithromycin as a treatment of COVID-19: results of an open-label non-randomized clinical trial. Int J Antimicrob Agents. 2020;56(1):105949. doi:10.1016/j.ijantimicag.2020.105949
60. Agarwal HK, Chhikara BS, Doncel GF, Parang K. Synthesis and anti-HIV activities of unsymmetrical long chain dicarboxylate esters of dinucleoside reverse transcriptase inhibitors. Bioorg Med Chem Lett. 2017;27(9):1934-1937. doi:10.1016/j.bmcl.2017.03.031
61. Agarwal HK, Chhikara BS, Quiterio M, Doncel GF, Parang K. Synthesis and anti-HIV activities of glutamate and peptide conjugates of nucleoside reverse transcriptase inhibitors. J Med Chem. 2012;55(6):2672-87. doi:10.1021/jm201551m
62. Agarwal HK, Buckheit KW, Buckheit RW, Parang K. Synthesis and anti-HIV activities of symmetrical dicarboxylate esters of dinucleoside reverse transcriptase inhibitors. Bioorg Med Chem Lett. 2012;22(17):5451-4. doi:10.1016/j.bmcl.2012.07.037
63. Chhikara BS. Prospects of Applied Nanomedicine. J Mater Nanosci. 2016;3(1):20-1.
64. Chhikara BS. Current trends in nanomedicine and nanobiotechnology research. J Mater Nanosci. 2017;4(1):19-24.
65. Chhikara BS, Varma RS. Nanochemistry and Nanocatalysis Science: Research advances and future perspective. J Mater Nanosci. 2019;6(1):1-6.

66. Hu TY, Frieman M, Wolfram J. Insights from nanomedicine into chloroquine efficacy against COVID-19. Nat Nanotechnol. 2020 r;15(4):247-9. doi:10.1038/s41565-020-0674-9
67. Tian X, Li C, Huang A, Xia S, Lu S, Shi Z, et al. Potent binding of 2019 novel coronavirus spike protein by a SARS coronavirus-specific human monoclonal antibody. Emerg Microbes Infect. 2020;9(1):382-5. doi:10.1080/22221751.2020.1729069
68. Prompetchara E, Ketloy C, Palaga T. Immune responses in COVID-19 and potential vaccines: Lessons learned from SARS and MERS epidemic. Asian Pac J Allergy Immunol. 2020;38(1):1-9. doi:10.12932/AP-200220-0772
69. Ahmed SF, Quadeer AA, McKay MR. Preliminary Identification of Potential Vaccine Targets for the COVID-19 Coronavirus (SARS-CoV-2) Based on SARS-CoV Immunological Studies. Viruses. 2020;12(3):254. doi:10.3390/v12030254
70. Groneberg DA, Poutanen SM, Low DE, Lode H, Welte T, Zabel P. Treatment and vaccines for severe acute respiratory syndrome. Lancet Infect Dis. 2005;5(3):147-55. doi:10.1016/S1473-3099(05)01307-1
71. Haagmans BL, Osterhaus AD. Coronaviruses and their therapy. Antiviral Res. 2006;71(2-3):397-403. doi: 10.1016/j.antiviral.2006.05.019
72. Stockman LJ, Bellamy R, Garner P. SARS: systematic review of treatment effects. PLoS Med. 2006;3(9):e343. doi: 10.1371/journal.pmed.0030343
73. Cinatl J, Michaelis M, Hoever G, Preiser W, Doerr HW. Development of antiviral therapy for severe acute respiratory syndrome. Antiviral Res. 2005;66(2-3):81-97. doi:10.1016/j.antiviral.2005.03.002
74. Yanuar A, Mun'im A, Bertha A, Lagho A, Syahdi R.R, Rahmat M, et al. Medicinal Plants Database and Three Dimensional Structure of the Chemical Compounds from Medicinal Plants in Indonesia. Int J Comput Sci. 2011;8(5):180-3.
75. Musa KA, Abdullah A, Subramaniam V. Flavonoid profile and antioxidant activity of pink guava. ScienceAsia. 2015;41(3):149-54. doi:10.2306/scienceasia1513-1874.2015.41.149
76. Trujillo-Correa AI, Quintero-Gil DC, Diaz-Castillo F, Quiñones W, Robledo SM, Martinez-Gutierrez M. In vitro and in silico anti-dengue activity of compounds obtained from Psidium guajava through bioprospecting. BMC Complement Altern Med. 2019;19(1):298. doi:10.1186/s12906-019-2695-1
77. Peng M, Watanabe S, Chan KWK, He Q, Zhao Y, Zhang Z, et al. Luteolin restricts dengue virus replication through inhibition of the proprotein convertase furin. Antiviral Res. 2017;143:176-85. doi:10.1016/j.antiviral.2017.03.026
78. Kleine-Weber H, Elzayat MT, Hoffmann M, Pöhlmann S. Functional analysis of potential cleavage sites in the MERS-coronavirus spike protein. Sci Rep. 2018;8(1):16597. doi:10.1038/s41598-018-34859-w
79. Wu C, Liu Y, Yang Y, Zhang P, Zhong W, Wang Y, et al. Analysis of therapeutic targets for SARS-CoV-2 and discovery of potential drugs by computational methods. Acta Pharm Sin B. 2020;10(5):766-788. doi: 10.1016/j.apsb.2020.02.008
80. Lin CW, Tsai FJ, Tsai CH, Lai CC, Wan L, Ho TY, et al. Anti-SARS coronavirus 3C-like protease effects of Isatis indigotica root and plant-derived phenolic compounds. Antiviral Res. 2005;68(1):36-42. doi: 10.1016/j.antiviral.2005.07.002
81. Nguyen TT, Woo HJ, Kang HK, Nguyen VD, Kim YM, Kim DW, Ahn SA, Xia Y, Kim D. Flavonoid-mediated inhibition of SARS coronavirus 3C-like protease expressed in Pichia pastoris. Biotechnol Lett. 2012 May;34(5):831-8. doi:10.1007/s10529-011-0845-8
82. Yu MS, Lee J, Lee JM, Kim Y, Chin YW, Jee JG, et al. Identification of myricetin and scutellarein as novel chemical inhibitors of the SARS coronavirus helicase, nsP13. Bioorg Med Chem Lett. 2012;22(12):4049-54. doi:10.1016/j.bmcl.2012.04.081
83. Park JY, Yuk HJ, Ryu HW, Lim SH, Kim KS, Park KH, et al. Evaluation of polyphenols from Broussonetia papyrifera as coronavirus protease inhibitors. J Enzyme Inhib Med Chem. 2017;32(1):504-515. doi:10.1080/14756366.2016.1265519
84. Tungadi R, Abdulkadir W, Ischak NI, Rahim BR. Liposomal formulation of snakehead fish (*Ophiocephalus striatus*) powder and toxicity study in zebrafish (*Danio rerio*) model. Pharm Sci. 2019;25(2):145-53. doi:10.15171/PS.2019.22
85. Tungadi R. Potential of Snakehead Fish (*Ophiocephalus striatus*) in Accelerating Wound Healing. Universal Journal of Pharmaceutical Research. 2019;4(5):40-4. doi:10.22270/ujpr.v4i5.316
86. Tungadi R, Imran AK. Formulation development and characterization of snakehead fish powder in oral double emulsion. International Journal of Applied Pharmaceutics. 2018;10(2):70-5. doi:10.22159/ijap.2018v10i2.24175
87. Erlina L, Paramita RI, Kusuma WA, Fadilah F, Tedjo A, Pratomo IP, et al. Virtual Screening on Indonesian Herbal Compounds as COVID-19 Supportive Therapy: Machine Learning and Pharmacophore Modeling Approaches. Research Square; 2020. doi:10.21203/rs.3.rs-29119/v1
88. Mounce BC, Cesaro T, Carrau L, Vallet T, Vignuzzi M. Curcumin inhibits Zika and chikungunya virus infection by inhibiting cell binding. Antiviral Res. 2017;142:148-57. doi:10.1016/j.antiviral.2017.03.014
89. Fazal Y, Fatima SN, Shahid SM, Mahboob T. Effects of curcumin on angiotensin-converting enzyme gene expression, oxidative stress and anti-oxidant status in thioacetamide-induced hepatotoxicity. J Renin Angiotensin Aldosterone Syst. 2015;16(4):1046-51 doi:10.1177/1470320314545777