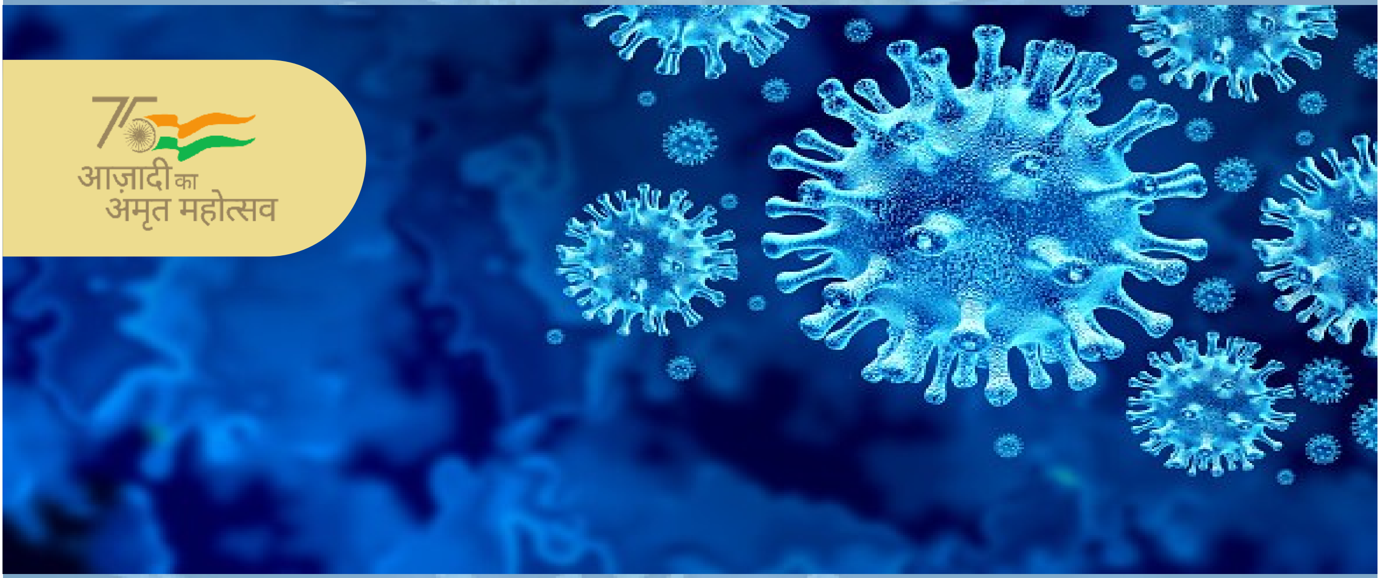
Proceedings of International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology

Strategies to Combat COVID-19, Zoonoses and Other Communicable Diseases

MAHARISHI MARKANDESHWAR
ॐ श्री मारकण्डेश्वराय नमः
कर्मण्येवाधिकारस्ते
MULLANA-AMBALA



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5th Annual Meeting of International Association of Zoologists

&

2nd International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology

Strategies to Combat COVID-19, Zoonoses and Other Communicable Diseases

(December 12-18, 2021)

Organized by

Department of Biotechnology, M.M. Engineering College
Maharishi Markandeshwar (Deemed to be University)
Mullana-Ambala (Haryana), India

In Association with

International Association of Zoologists (IAZ)
Siddhi Artha Group of Education (SAGE)
Sharda Institute of Science Technology Education & Research (SISTER)
Organization for Conservation of Environment and Nature (OCEAN)

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About Department of Biotechnology, MM(DU), Mullana-Ambala

Located on the "tapobhoomi" of Maharishi Markandeshwar beside the river bed of the sacred Markanda with magnificent building and world class infrastructural facilities, the Maharishi Markandeshwar (Deemed to be University) is the first self-financing University established under aegis of Maharishi Markandeshwar University Trust to integrate education and research. All the institutions of the University in the area of Medical Sciences, Dental Sciences, Physiotherapy, Nursing, Pharmacy, Engineering & Technology, Management, Hotel Management, Computer Technology and Law offering graduate, postgraduate and research degree programmes are already known for excellence in impartingvalue based, highly career oriented professional education.

Biotechnology is the research-oriented science including a fusion of biology and technology. The Department of Biotechnology, MM(DU) was established in 2008 and has been significantly contributing in terms of enhancing the knowledge and practical exposure of students, providing them with ample employment opportunities, and development of more advanced technologies. Department has progressed exceedingly well in the focused research areas including Drug Resistance, Cancer Biology, Medical Microbiology, Natural Products, Plant Biotechnology, Environmental Biotechnology, Industrial Microbiology, Medical Microbiology, Nano-Biotechnology and Computational Biology.

With vast number of specialties and courses, the biotechnology courses at MMEC have emerged as the youth's preference. The Department offers courses for all, i.e. everyone a spiring to enroll in Biotechnology right from an undergraduate student to a Ph.D aspirant. The success stories of students are a testimony to the faculty's commitment and appropriate research environment across all the interdisciplinary areas of biotechnology. Our focus is to prepare the students as per the Industry requirement; hence we also trainour students on Bio-Safety, Regulatory and Intellectual Property related issues in broader social context and sustainable development.

Department has progressed exceedingly well in the focused research areas including Drug Resistance, Cancer Biology, Medical Microbiology, Natural Products, Plant Biotechnology, Environmental Biotechnology, Industrial Microbiology, Medical Microbiology, Nano-Biotechnology and Computational Biology.

About Sharda Institute of Science Technology Education & Research (SISTER)

The Sharda Institute of Science Technology Education & Research (SISTER) is a collegiate academic cum research institute in Sultanpur (UP, India) since last five years. There is an evidence of societal service and education among girls and women empowerments through skill development by training and self-help groups, making it more interesting than the other organizations. The institute itself along with its associated wings are self-funded and self-governed with its own controlling membership, internal structure and activities as deciphered by-laws. All the teaching at this instate is organised around weekly small group tutorials, supported by class lectures, seminars, hands on training under the mission of 'Earn as you Learn' and vision 'Lab to land transfer technology for self-employment' to grab the slogan of 'AtmNirbhar Bharat, a mssion very close to the heart of our Hon'ble Prime Minister of India'. The key objectives of the SISTER are as follows:

i. To illuminate society in the advancement of the social science, art and science as well as the dissemination of knowledge and human values to all at grass root level.

ii. To provide a venture for the sharing of information, experiences and opinions in the matters of common or particular interest to society members for eco-societal development and mankind.

iii. To establish luminous and global repute education venture, institutions, and standards as well as to set, approve and maintain quality for the delivery of skilled education, professional development program for employability and sustainable development.

iv. To providing world class learning experience and light up each and every candidate not to become an engineer, scientists or professional only but also a responsible citizen and national asset.

v. To develop international links and collaboration with similar organizations already contribution in nation building and women empowerment.

About International Association of Zoologists (IAZ)

Animals are one of the most exciting creatures in the history of Life Sciences. The pace of discoveries is being stepped up across all the corners life sciences fields. To accomplish this tempo of discoveries, it was essential for scientists to use the same molecular tools and learn to speak the same scientific language: biochemists, cell biologists, developmental biologists, geneticists, medical researchers, immunologists, microbiologists, molecular biologists, bioinformaticians, mathematicians, physicists, neurobiologists, clinical researchers, medical informaticians, computer scientists, engineers, pharmacologists and more. To increase the future rate of discoveries it will be necessary to address the large gaps in knowledge, technology, computational algorithms and high-performance computing, data capture and analysis, and systems-level integration.

Achieving whole systems sympathetic of animal life, the International Association of Zoologists (IAZ) was established in 2017 to capture and sponsor the excitement that this generation of scientists is experiencing the opportunity to provide a scientific foundation for solving urgent problems in human diseases, and effect of global climate changes on animal life. The IAZ's objective is to provide platform for the exchange of scientific knowledge in all areas of animal and allied life sciences. It does this through the scholarly dissemination of research at its Annual Meeting in December and in its various workshops, online training and publications.

Furthermore, IAZ is collaborating with scientific organizations to bring a stronger voice in communicating the significance of the animal sciences to the larger scientific community. We are in contact with Wildlife Crime Control

Bureau (WCCB), Sharda Institute of Science Technology Education & Research (SISTER), Organization for Conservation of Environment and Nature (OCEAN), Zoological Society of India (ZSI), International Science Congress Association (ISCA), Helminthological Society of India (HSI), Indian Society for Parasitology (ISP), Jan Jaiv Welfare Society (JJWS), International Society for Biology and Applied Sciences (ISBAR) to share about the importance of scientific research in current scenario for animal and human welfare. The IAZ keeps the life sciences community informed on government science policies and provides guidance for standards. The IAZ brings together fields that were once considered disparate, thus supporting the next generation of scientists that are defining entirely new ways of doing science and engineering. For more details please visit www. iazindia.in.

The International Association of Zoologists (IAZ) is constituted to spread and emphasise the cause of animal science and other related subjects at international level through:-

a. Providing a venture for interactions with expert international scientific, academic and student's community.

b. Screening the eminent scholars of the field and encouraging them through Hon. Membership and Hon. Fellowship of the Association as a token of appreciation.

c. Organizing international conferences and workshops to bring worldwide intellectual people on a common platform.

d. Exploring scientific and academic efforts from all over the globe and appreciate them through international awards.

e. Floating worldwide information and news related to academics and research.

About Siddhi Artha Group of Education (SAGE)

The key objectives of the SAGE are as follows:

a. The SAGE will provide a common platform for distinguished postgraduate and undergraduate students to understand, discuss and debate over the new developments and scientific advancements that will impact future strategies to intervene with various debilitating human diseases, ranging from a mechanistic understanding to prevention, diagnosis, treatment, prognosis, therapy, response monitoring and eradication.

b. Organizing national conferences and workshops to bring together intellectuals from all over the world.This SAGE will unfold before the scientific community the latest research trends in a repertoire of areas related to diseases that plague humanity.

c. Screening the eminent scholars of the field and encouraging them through Hon. Membership and Hon. Fellowship of the Association as a token of appreciation.

d. To develop international links and collaboration with similar organizations already contribution in scientific building and research empowerment.

Beyond Science

Mythology is the backbone of science.
Is the backbone of spiritual, mythology.
Meditation is the backbone of the spiritual.
And, these three forms the basis of the universe.
If there were no Mythology then,
Science would have been impossible.
And it is difficult to understand mythological,
without spiritual.
So, these three are a pillar of our life.
If science wants to develop technology further,
it has to respect mythology
The spiritual must be connected to science in such a way,
that only the soul's rule in our universe.
Spiritual will swallow you,
Up on the day you-
Neglectful about mythology and careless about science.
Therefore, by going against nature,
neither you can win science nor
can you handle spiritual.

-Siddhartha Dan

About International Virtual Seminar

Erasmus Darwin (12 December 1731 – 18 April 1802) was an English physician. He was also a natural philosopher, physiologist, slave-trade abolitionist, inventor, and poet. His poems included much natural history, including a statement of evolution and the relatedness of all forms of life. He was a member of the Darwin–Wedgwood family, which includes his grandsons Charles Darwin and Francis Galton. Darwin was a founding member of the Lunar Society of Birmingham, a discussion group of pioneering industrialists and natural philosophers.

Every historian of evolutionary ideas dutifully acknowledges Erasmus Darwin's distinguished right to be included in the roll of those who anticipated The Origin of Species in some way; even his grandson includes him in a footnote to his prefatory Historical Sketch. It was curious how largely his Grandfather, Dr. Erasmus Darwin, anticipated the views and erroneous grounds of opinion of Lamarck in his "Zoonomia" (vol. I, pp. 500-510), published in 1794.

Darwin's most important scientific work, Zoonomia (1794–1796), contains a system of pathology and a chapter on 'Generation'. In the latter, he anticipated some of the views of Jean-Baptiste Lamarck, which foreshadowed the modern theory of evolution. Erasmus Darwin's works were read and commented on by his grandson Charles Darwin the naturalist. Erasmus Darwin based his theories on David Hartley's psychological theory of associationism.

Erasmus Darwin also anticipated survival of the fittest in Zoönomia mainly when writing about the "three great objects of desire" for every organism: "lust, hunger, and security." A similar "survival of the fittest" view in Zoönomia is Erasmus' view on how a species "should" propagate itself. Erasmus' proposed idea that "the strongest and most active animal should propagate the species, which should thence become improved". Today, this is called the theory of survival of the fittest. His grandson Charles Darwin, much less libidinous and who led more of an invalid life, and who is not known to have illegitimately fathered children, or fathered children he did not plan, acknowledge and raise, posited the different and fuller theory of natural selection. Charles' theory was that natural selection is the inheritance of changed genetic characteristics that are better adaptations to the environment; these are not necessarily based in "strength" and "activity", which themselves ironically can lead to the overpopulation that results in natural selection yielding nonsurvivors of genetic traits.

Erasmus Darwin was familiar with the earlier proto-evolutionary thinking of James Burnett, Lord Monboddo, and cited him in his 1803 work Temple of Nature. As already indicated, some four or five years later, in Zoonomia, Darwin is unequivocal in his rejection of all such preformationist versions of embryology, and by the time he comes to write The Temple of Nature (1803), he uses the fact that relatively advanced forms of life, including man, pass in embryo through more primitive, aquatic forms, as confirmatory evidence (as did many in the nineteenth century) of evolution's having taken place, and in particular of its having begun in water and moved at some stage to dry land.

On the occasion of 290th Birth Anniversary celebration of Hon’ble Erasmus Darwin, the Department of Biotechnology, MM(DU) is going to organize ‘5th Annual meeting of IAZ’ and ‘2nd International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology’ on focal theme “Strategies to Combat COVID-19, Zoonoses and Other Communicable Diseases” during 12-18 December, 2021). The seminar will provide a common platform for distinguished scientists, researchers, postgraduate and undergraduate students to understand, discuss and debate over the new developments and scientific advancements that will impact future strategies to intervene with current COVID-19 pandemic, zoonoses and various communicable diseases in human beings, ranging from a mechanistic understanding to prevention, diagnosis, treatment, prognosis, therapy, response monitoring and eradication. This virtual venture will give opportunity to young researchers to present their innovative ideas and finding in the form of e-oral presentation or e-poster presentation in the young scientist categories in front of the scientific community which will be more interactive during special discussion with stalwarts and eminent personalities. The invited Chief Guest, Guests of Honour, Special Guests, Invited speakrs, delegates, young scientists, research sclolars and students of about 21 countries, 25 states, and over 40 universities have showed their interest for active participation. The organizing committee feel immense pleasure to welcome one and all on this vitual venture and thankful to every one for making the event a Grand success.

MAHARISHI MARKANDESHWAR
(DEEMED TO BE UNIVERSITY) MULLANA, AMBALA-133207
(Established under section 3 of the UGC Act, 1956)
(Accredited by NAAC with Grade 'A^{++}')

Prof. (Dr.) Ashok Kumar
Director, MMEC
M.M. (Deemed to be University)
Mullana-Ambala-133207
Email: principalmmec@mmumullana.org

MESSAGE

It is indeed an immense pleasure to know that 5th Annual Meeting of International Association of Zoologists and an 2nd International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology is being held in collaboration with Department of Biotechnology, M.M. Engineering College, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (HR), India during 12th to 18th December, 2021. The focal theme of the conference titled "Strategies to Combat COVID-19, Zoonoses and Other Communicable Diseases" also holds significance in todays context and in my opinion would be providing a strong platform to academicians, scientists and students to discuss their scientific efforts and provide the glimpse of innovative trends in scientific research for biotechnological approaches to eco-friendly & sustainable management of diseases.

My heartiest congratulations to International Association of Zoologists (IAZ) and the whole organizing team for their key initiative in holding this virual seminar at Department of Biotechnology, M.M. Engineering College, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (HR), India. I wish for the grand success of the programme.

(Dr. Ashok Kumar)

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(DEEMED TO BE UNIVERSITY) MULLANA, AMBALA-133207
(Established under section 3 of the UGC Act, 1956)
(Accredited by NAAC with Grade ‘A^{++}’)

Prof. (Dr.) J. K. Sharma
Dean Students Welfare
M.M. (Deemed to be University)
Mullana-Ambala-133207
Email: deanstudentswelfare@mmumullana.org

MESSAGE

I am very pleased to know that the 5th Annual Meeting of International Association of Zoologists and an International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology (RTLSB-2021) is being organized in association with Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (HR), India from 12th to 18th December, 2021. Moreover, the theme of the seminar “Strategies to Combat COVID-19, Zoonoses and Other Communicable Diseases” has been devised meticulously keeping in view of the health challenges and the current pandemic situation. I am pretty sure that the conference would bring scientific and academic fraternity together to find out an amicable solution to the current environmental challenges.

My best wishes to the International Association of Zoologists (IAZ) and the whole organizing team including Department of Biotechnology for organizing this event.

I wish for the grand success of the conference.

(Dr. J. K. Sharma)

MAHARISHI MARKANDESHWAR
(DEEMED TO BE UNIVERSITY) MULLANA, AMBALA-133207
(Established under section 3 of the UGC Act, 1956)
(Accredited by NAAC with Grade ‘A^{++}’)

Dr. Anil K. Sharma, Ph.D
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UIC Chicago, USA (2003-2010)
Prof. & Head, Department of Biotechnology
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MESSAGE

It gives me an immense pleasure to know that International Association of Zoologists (IAZ) in collaboration with Department of Biotechnology, M.M. Engineering College, Mullana, Ambala and Sharda Institute of Science Technology, Education and Research (SISTER) along with Organization for Conservation of Environment and Nature (OCEAN) is organizing a seven days (Dec. 12-18, 2021) International virtual seminar on a unique theme “Strategies to combat COVID-19, Zoonoses and other Communicable Diseases”. The theme has relevance in the context of current pandemic situation and alarming levels of other communicable and animal borne diseases posing threat for the health and well-being of the individuals and ultimately for the survival of the humanity. It is greatly anticipated that as an outcome of this virtual one-week seminar would certainly provide a headway to the conclusion that preventing zoonotic diseases can help curb COVID-19 and other infectious diseases.

My sincere congratulations to Dr. Sushil K. Upadhyay and the whole organizing team and congratulate all the esteemed speakers and participants for tuning to this virtual seminar of international significance and hope this would be a grand success paving the way for a sustainable solution to manage the global disease threats and challenges.

Dr. Anil K. Sharma

INTERNATIONAL ASSOCIATION OF ZOOLOGISTS
(An Association under umbrella of OCEAN (Reg. No. K-37654/K-334/29.052017)
(A Non-Government Organization, India)

Dr. Ashish Tripathi
President
(International Association of Zoologists)
General Secretary
(Organization for Conservation
of Environment and Nature)

MESSAGE

I am happy to note that International Association of Zoologists (IAZ) is going to conduct '5th Annual meeting of IAZ'and an 'International Virtual Seminar onRecent Trends in Life Sciences and Biotechnology' in association with Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (HR), Siddhi Artha Group of Education (SAGE), Organization for Conservation of Environment and Nature (OCEAN) and Sharda Institute of Science Technology Education & Research (SISTER), Sultanpur (UP) w.e.f. December 12th to 18th, 2021.

I am glad our association is participating in this international endeavor by locating areas of further research in advances of Life Sciences, Bio-Molecular Biotechnology, Sustainable Health & Immunity and COVID-19 therapy as well. I am informed that hundreds of academic scholars from country and abroad will participate in this seminar. It is a good number to startwith. As the hosting organization, MM (Deemed to be University) marches forward in this initiative, and as more like it will join in the long march, a day is bound to come when we shall realize disease free society and sustainable livelihood by the next few years.

I wish young participants, visitors and the organizers a very successful conference.

Ashish Tripathi

(Ashish Tripathi)

Sharda Institute of Science Technology Education & Research

Mr. Narsingh Narayan Upadhyay
Hon'ble Founder
Sharda Institute of Science Technology
Education & Research
Sultanpur (UP, India)

MESSAGE

I am delighted to know that Sharda Institute of Science Technology Education & Research (SISTER), Sultanpur (UP, India) is going to organize a seven days (12th to 18th December, 2021) "International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology"and '5th Annual meeting of International Association of Zoologists (IAZ)'in collaboration with Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (HR); International Association of Zoologists (IAZ); Siddhi Artha Group of Education (SAGE); and Organization for Conservation of Environment and Nature (OCEAN).

The theme of the seminar "Strategies to Combat COVID-19, Zoonoses and Other Communicable Diseases" is based on the ongoing health challenges and the incredible steps of scientists, medical experts, pharmacologists and academicians to curb the scenario in positive orientation. As innovation is the key to boon the immunity for COVID-19 and disease therapy, but we need pragmatic, cost-effective, creative, eco-friendly, and sustainable solutions to the problems faced by rural society.

I am glad that our institution is alive to this challenge and doing its best to boost research and solutions to the grass root level. I am confident that the deliberations during these seven days will lead to the formulation of viable and potent solutions to hasten the process of immunity, health and sustainability against current COVID-19, Zoonoses and other communicable diseases. I shall be happy to hear if this seminar turns out to be an opener of many such opportunities of learning and thinking-together in this important field.

Please accept my good wishes for the occasion.

(Narsingh Narayan Upadhyay)

5th Annual Meeting of International Association of Zoologists
2nd International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology
(12th to 18th December, 2021)
Strategies to Combat COVID-19, Zoonoses and Other Communicable Diseases

Message from Convener

It is indeed a matter of great pride for me in organizing '5th Annual meeting of International Association of Zoologists (IAZ)' and "International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology" from 12th to 18th December, 2021 at Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (Haryana), India under the patronage of International Association of Zoologists (IAZ); Siddhi Artha Group of Education (SAGE), Sharda Institute of Science Technology Education & Research (SISTER) and Organization for Conservation of Environment and Nature (OCEAN). In the context of seminar theme "Strategies to Combat COVID-19, Zoonoses and Other Communicable Diseases", emphasis is on novel tools and technologies in the field of Life Sciences, Biotechnology, Medical Sciences and Allied Applied Biosciences to combat the dreaded human disease. This seminar will bring together Global scientific community, policy makers, administrators, pharmaceutical industry representatives and other stake holders to exchange and share their experiences, new ideas and recommendations on focal theme. It will be and opportunity of sharing our expertise and experience with the renowned guest speakers, delegates and young scientists from all over the world. It will also be a platform to strengthen the friendship and collaboration among the scientists, academia and institutes dealing to bio-molecular immunology, COVID-19 pandemic, biology of zoonoses and commicable diseases, epidemiology, human health and sustainability. The various subthemes of the seminar will offer many opportunities to young scientists to learn new things and apply the same in their respective work place to curb the current pandemic, zoonoses and other communicable diseases caused by viruses, bacteria, fungi, protozoa, helminthes, arthropoda, etc. transmitted through air, water, food and vectors.

I express my heartfelt gratitude to the Hon'ble Chancellor, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala for acceptance of invitation as Chief Patron of this International seminar. I am thankful to respected Er. Sanjeev Garg (Secretary MM Trust), Dr. Vishal Garg (Treasurer MM Trust), Dr. Meenakshi Garg (Member MM Trust) for accepting invitation as Patron of this event. I wish to express sincere thanks to Prof H.K. Sharma, Hon'ble Vice Chancellor MM(DU)-Mullana and Prof. Sumit Mittal, Registrar MM(DU)- Mullana for accepatance of request as Co-Patron of this programme. I am highly grateful to respected Prof. Ashok Kumar, Principal M.M. Engineering College, Mullana for accepting invitation as Chairperson, and kind approval to organize this International virtual seminar, incessant encouragement with positive attitude and timely suggestions. I am immensely grateful to the Chief Guest, Guests of Honour, Keynote speaker and Invited guests from various institutions of National and International repute for accepting invitation and positive consent for scholarly deliberation. On behalf myself and organizing committee, I welcome all the Guests, Delegates and Young scientists to this International scientific-cum academic event, and wish the seminar a grand success.

Dr. Sushil Kumar Upadhyay
Convener
Asstt. Prof., Biotechnology, MM(DU)-Mullana

5th Annual Meeting of International Association of Zoologists
2nd International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology
(12th to 18th December, 2021)

Strategies to Combat COVID-19, Zoonoses and Other Communicable Diseases

FROM THE DESK OF CO-CONVENER

I feel extremely proud a privileged to share that Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (Haryana) is going to create à milestone and adding a glorious chapter to its educational history by organizing an "International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology" with the collaboration of International Association of Zoologists (IAZ); Siddhi Artha Group of Education (SAGE), Sharda Institute of Science Technology Education & Research (SISTER) and Organization for Conservation of Environment and Nature (OCEAN). The Departments of Biotechnology collectively organizing the International Seminar of great importance. The aim of the International Seminar is motivating academicians, young students and researchers to achieve greater height in quality education and research. The invited speakers are renowned experts in their respective fields. The topics of discussion are tailored to suit the requirement of the students of different disciplines. This would help not only in sharing of technical knowledge but also encouraging their innovative faculties. Therefore, this seminar will provide an opportunity to explore the hidden aptitude of the young scholars and encourage them for scientific research on emerging topics of Life Sciences and Biotechnology.

On behalf of the organizing committee, I am grateful to all the guest speakers and number of experts, visiting from different educational institutes for sharing their experiences for making this seminar popular to attract scholars from all over the world. I extend my profound sense of gratitude to our esteemed Chief Guest Prof. Neelima Gupta, Hon'ble Vice Chancellor, Dr. Harisingh Gour Sagar University, Sagar, MP; Fmr. Vice Chancellor,, T.M. Bhagalpur University, Bihar; Fmr. Vice Chancellor Munger University, Munger, Bihar; Fmr. Vice Chancellor CSJM University, Kanpur, UP; Guest of Honour Padma Shri Prof. R. C. Sobti, Fmr. Vice Chancellor Punjab University, Chandigarh & Fmr. Vice Chancellor BBAU Central University, Lucknow (U.P.); Prof. Hridaya S. Singh, Vice Chancellor IIMT University, Meerut (UP); Prof. Ummey Shameem, Head Department. of Zoology, Andhra University, Visakhapatnam (AP); Dr. Shokoofeh Shamsi, School of Animal & Veterinary Sciences, Charles Sturt University, Wagga (Australia) and Special Guest & Keynote speaker Prof. Sandeep K. Malhotra D.Sc., Fmr. Head of Zoology Department; University of Allahabad, Prayagraj, UP, for their consent and supports. I am grateful to our esteemed Guests and Speakers of National and International venture for the acceptance of our invitations. They have always stood with us with a sense of dedication for achieving this goal of great worth. I express my heartfelt gratitude to the Convener, Chief Organizing Secretary, Organizing Secretary of the seminar who besides providing us all the necessary facilities and help, always encourages us with their positive attitude and timely suggestions.

I wish the Seminar a grand success and hope that, such noble efforts will continue by us in future also.

Prof. (Dr.) Raj Singh

Co-Convener

5th Annual Meeting of International Association of Zoologists
2nd International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology
(12th to 18th December, 2021)
Strategies to Combat COVID-19, Zoonoses and Other Communicable Diseases

Message Chief Organizing Secretary

To celebrate the *290th birthday* of *Erasmus Darwin*, the first Briton who wrote explicitly about evolution. The descent of life from a common ancestor, sexual selection, discusses the analogy of artificial selection as a means of understanding descent with modification, and a basic concept of what we now refer to as homology. It is celebrated with joy, enthusiasm in the field of life sciences on 12 December. The theme for the year 2021 is "*Strategies to Combat COVID-19, Zoonoses and Other Communicable Diseases*", at Department of Biotechnology, M.M. (Deemed to be University), Mullana(Haryana), India under the patronage of Siddhi Artha Group of Education (SAGE), International Association of Zoologists (IAZ); Sharda Institute of Science Technology Education & Research (SISTER) and Organization for Conservation of Environment and Nature (OCEAN).

My sisters, brothers, colleagues, professors, lecturers, researchers, ladies and gentlemen; it is our honour and pride to warmly welcome you all on the occasion of *'5th Annual meeting of International Association of Zoologists (IAZ)'* and *"2nd International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology"* during *December 12th-18th, 2021.*

The conference will provide a common platform for distinguished scientists, researchers, postgraduate and undergraduate students to understand, discuss and debate over the new developments and scientific advancements that will impact future strategies to intervene with various debilitating human diseases, ranging from a mechanistic understanding to prevention, diagnosis, treatment, prognosis, therapy, response monitoring and eradication. This conference will unfold before the scientific community the latest research trends in a repertoire of areas related to diseases that plague humanity.

It is my hope that the worldwide seminar will be able to meet its goal of offering a useful venue for academics, researchers, and practitioners to advance knowledge, research, and technology for the benefit of humanity. There has always been a divide between those who can effectively utilise technology and those who cannot. 'Humanity' (or being 'humane') can also relate to civil rights and social concerns, or in other words, individuals treating each other with care, compassion, and dignity, while recognising the other person's common 'humanity.' As a result, despite what we may have been led to believe, 'human' rights have no connection to politics or any part of the so-called political spectrum: they are part of our common nature, part of the collective 'humanity' spoken for by our very existence. They do not belong to any political party or faction, nor to any individual or organisation; they are part of our common nature, part of the collective 'humanity' spoken for by our very existence. In fact, all academics, researchers, and practitioners should think about humanity in order to create a peaceful society. We change to a better environment and a better life as a result of humanity. We think that education, research, and technology should be available to all people, including minorities, people with disabilities, and everyone who needs assistance. In this realm of knowledge, no matter how much we can do on our own, whether it's research or development, it's never enough. As a result, the conference's main goal is to share ideas, and it is believed that by engaging in this exchange, all parties who may benefit from the conference will be able to apply what they learn to their own activities.

"Progression from bivalent logic to fuzzy logic is a significant positive step in the evolution of science"

- Lotfi Zadeh.

The special credit goes to our Head of the Department Prof. Anil K. Sharma and Hon. President SISTER & Hon. General Secretary, IAZ; Dr. Sushil Kumar Upadhyay, without their support it would be difficult to maintain this scientific event. We wish them all the success in their work. I would also like to give appreciation to the authors who have submitted their excellent works to this conference.

Last but not least, my deepest gratitude goes to the Advisory Board, Organizing Committee, International Scientific Committee, institutions, companies, esteemed speakers, delegates and participants and volunteer, visiting from different educational institute for sharing their experiences for making this seminar popular to attract scholars from all over the world. The committee has organized a vibrant scientific program and is working hard to present highly respected and internationally notorious speakers to lead it. Although we try our finest to be professional, on behalf of organizing committee, please accept our sincere apologies should there be inconveniences that occur before, during, or after the event. I wish you a very productive conference with exciting and encouraging discussions and exchange of knowledge so that together we can anticipate a future of groundbreaking knowledge, research, and technology for humanities.

Now, I thank you for the last year event, in the name of the most ancient science in the world, I thank you in the name of the energy of life beyond science, and I thank you in the name of millions and millions of scientists of all national and international sectors and sects and I thank you in the name of billions and trillions of thoughts of our maund and minds. I thank you in the name of the presence and participant. I thank you in the name of your important part of the conference's success and I thank you in the name of keeping the conference enjoyable.

May God bless us all with good health to make this event a successful and enjoyable one!

Er. Siddhartha Dan, MIAZ
Chief Organizing Secretary
(President, Siddhi Artha Group of Education)

5th Annual Meeting of International Association of Zoologists & 2nd International Virtual Seminar on Recent Trends in Life Sciences and Biotechnology

Glimpse of Programme

Day 1: December 12, 2021 (9:50 AM - 01:30 PM) (Sunday)		
9:50-10:00	Inauguration & Opening Remarks	
10:00-10:30	Chief Guest & Keynote Speaker	Prof. Neelima Gupta, Hon'ble Vice, Chancellor Dr. Harisingh Gour Sagar University, Sagar (M.P.); Fmr. VC, CSJM University, U.P.; Fmr. VC, TM Bhagalpur University, Bihar; Fmr. VC, Munger University, Bihar
10:30-10:45	Guest of Honour	Padma Bhushan & Padma Shri Dr. Anil Prakash Joshi, Hon'ble Founder, HESCO, Dehradun (UK)
10:45-11:00	Guest of Honour	Padma Shri Prof. R.C. Sobti, Fmr. Hon'ble Vice Chancellor, Punjab University, Chandigarh; Fmr. Hon'ble Vice Chancellor BBAU Central University, Lucknow (UP)
11:00-11:15	Guest of Honour	Prof. H. S. Singh, Hon'ble Vice Chancellor, IIMT University, Meerut (UP)
11:15-11:30	Guest of Honour	Prof. U. Shameem, Head, Department of Zoology, Andhra University, Visakhapatnam (AP)
11:30-11:40	Guest of Honour	Prof. Kamal, Jaiswal, Head, Department of Zoology, School of Life Sciences, B.B.A. Central University, Lucknow (UP)
11:40-11:50	Guest of Honour	Prof. Binay K. Singh, Registrar, Pandit S.N. Shukla University, Shahdol (MP)
11:50-12:20	Guest of Honour & Plenary Guest Speaker-I	Prof. Sandeep K. Malhotra D.Sc., Fmr. Head, Department of Zoology University of Allahabad (A Central University), Prayagraj (U.P.), India
12:20-12:50	Guest of Honour & Plenary Guest Speaker-II	Prof. Shokoofeh Shamsi, School of Animal & Veterinary Sciences, Charles Sturt University, Wagga (Australia)

12:50-01:20	Guest of Honour & Plenary Guest Speaker-III	Prof. Anil K. Sharma, Head, Dept. of Biotechnology Maharishi Markandeshwar (Deemed to be University) Mullana-Ambala (HR) & Fmr. Post Doc & Senior Research Scientist, UIC Chicago, USA (2003-2010)
01:20-01:30	Vote of thanks and concluding remarks of day 1 inaugural function & plenary sessions	Dr. Sushil Kumar Upadhyay, Convener & Assistant Professor, Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University) Mullana-Ambala (HR)
Day 2: December 13, 2021 (2:00 PM - 6:00 PM) (Monday)		
2:00-2:05	Opening Remarks	
2:05-2:50	Invited Lecture-1	Dr. Navneet Sharma, Scientist, Indian Institute of Technology, New Delhi
2:50-3:30	Invited Lecture-2	Dr. Sushil K. Upadhyay, Assistant Professor, Biotechnology, MM(DU), Mullana-Ambala (HR)
3:30:4:00	Invited Lecture-3	Prof. S. Ganapathy Venkata Subramanian, Expert Member of Monitoring Committee, Madras & Professor, Anna University, Chennai
4:00-4:30	Invited Lecture-4	Prof. Kuldeep K. Sharma, Fmr. Head, Department of Zoology, University of Jammu, Jammu
4:30-6:00	Oral Presentations	Delegates & Young Scientists
Day 3: December 14, 2021 (2:00 PM - 6:00 PM) (Tuesday)		
2:00-2:05	Opening Remarks	
2:05-2:50	Invited Lecture-5	Dr. Arun Kumar, Dr. DPR Central Research Institute of Homeopathy, Ministry of AYUSH, Govt. of India
2:50-3:30	Invited Lecture-6	Dr. Usman Umar Zango, Assistant Professor, Biotechnology, Sa'adatu Rimi College of Education, Kumbotso, (SRCOE), Nigeria

3:30-4:00	Invited Lecture-7	Dr. Gazal Sharma, Department of Biotechnology, I.K. Gujral Punjab Technical University, Jalandhar
4:00-4:30	Invited Lecture-8	Dr. G. Suhasini, Head, Department of Zoology, Pingle Government College for Women (Autonomous), Waddepally, Hanumakonda (TS)
4:30-6:00	Oral Presentations	Delegates & Young Scientists
Day 4: December 15, 2021 (2:00 PM - 6:00 PM) (Wednesday)		
2:00-2:05	Opening Remarks	
2:05-2:50	Invited Lecture-9	Dr. Annapurna Jha, Head, Department of Chemistry, Jamshedpur Women's College, Kolhan University, Jamshedpur
2:50-3:30	Invited Lecture-10	Dr. Jasmeet Kaur, Prof. & Head, Department of Biotechnology, (SUSGOI), I.K. Gujral Punjab Technical University, Jalandhar
3:30-4:00	Invited Lecture-11	Prof. J.P. Shukla, Department of Zoology, I.N.G.T.U (A Central University), Amarkantak (MP)
4:00-4:30	Invited Lecture-12	Prof. Sanjay S. Nanware, Post Graduate Department of Zoology, Yeshwant Mahavidyalaya, Nanded (MS)
4:30-6:00	Oral Presentations	Delegates & Young Scientists
Day 5: December 16, 2021 (2:00 PM - 6:00 PM) (Thursday)		
2:00-2:05	Opening Remarks	
2:05-2:50	Invited Lecture-13	Dr. Anjani Kumar Tiwari, Associate Professor, Department of Chemistry, Babasaheb Bhimrao Ambedkar University, Lucknow (UP)
2:50-3:30	Invited Lecture-14	Dr. Arun K. Singh, Assistant Professor, Department of Chemistry, Maharishi Markandeshwar (Deemed to be University) Mullana-Ambala (HR)
3:30-4:00	Invited Lecture-15	Dr. Ashish Tripathi, Sarp Mitra, Hon'ble President IAZ, General Secretary OCEAN, (UP)

4:00-4:30	Invited Lecture-16	Dr. Deepak Yadav, Assistant Professor, Department of Zoology, Miranda House (University of Delhi), New Delhi
4:30-6:00	Oral Presentations	Delegates & Young Scientists
Day 6: December 17, 2021 (2:00 PM - 6:00 PM) (Friday)		
2:00-2:05	Opening Remarks	
2:05-2:50	Invited Lecture-17	Dr. Himanshu Ojha, Scientist "E", INMAS, Defence Research and Development Organisation, New Delhi
2:50-3:30	Invited Lecture-18	Dr. Prasenjit Hazra, Principal, Sri Sri Academy, BRBCL, NPTC, Nabinagar, Aurangabad (Bihar)
3:30-4:00	Invited Lecture-19	Dr. Sunita Manhas, Associate Professor Department of Biochemistry, MMIMSR, M.M. (Deemed to be University) Mullana-Ambala (HR)
4:00-4:30	Invited Lecture-20	Dr. Neeshma Jaiswal, Assistant Professor, Department of Zoology, School of Life Sciences, B.B.A. Central University, Lucknow (UP)
4:30-6:00	Oral Presentations	Delegates & Young Scientists
Day 7: December 18, 2021 (2:00 PM - 6:00 PM) (Saturday)		
2:00-2:05	Opening Remarks	
2:05-2:50	Invited Lecture-21	Dr. Mallika Pathak, Prof. & Head, Department of Chemistry, Miranda House (University of Delhi), New Delhi
2:50-3:30	Invited Lecture-22	Dr. Ripu D. Parihar, Assistant Professor, Department of Zoology, University of Jammu, Jammu
3:30-4:45	E-Poster Presentations	Ph.D Research Scholars & Post Graduate Students
4:45-5:00	Open House Discussion	Interaction of Convener with Young Ph.D Scholars and P.G. Students
5:00-6:00	Valedictory Session	Result Declaration, Innovative and Young Scientist Award Ceremony, Concluding Report and Vote of Thanks

Index

FULL-LENGTH CHAPTERS

ABSTRACTS

Bio-Sketches
of
Guest Speakers

"We are like DNA structure. Science is Adenine and I am Thymine"

Biosketch-1: Neelima Gupta

Prof. Neelima Gupta is presently Hon'ble Vice Chancellor of Dr. Harisingh Gour Sagar University, Sagar (M.P.). Formerly she was Vice Chancellor of CSJM University, Kanpur, UP; Vice Chancellor of T.M. Bhagalpur University, Bhagalpur, Bihar and Vice Chancellor of Munger University, Munger, Bihar. She worked as Dean of student welfare (2009-2018) as a coordinator (2011-2014), as a Dean and professor of Faculty of Applied Sciences (2007-2010) and as the Head of Department of Department of Animal Science (2010-2013), at MJP Rohilkhand University Bareilly. She is also a member of Board of Control of Bareilly College, Bareilly. She worked for Institute of Parasitology, Warsow, Poland (2005, 1989-1990) and Fish Culture Experimental Station, Poland 2001, 1989) as a Research Scientist. She researched on immunity and development of suitable vaccines as a viable strategy fro the control of blood parasites of fishes at Institute of Parasitology, Warsow, Poland. She also investigated the characterization and comparison of Indian and Polish strains of fish microbes and generation of immunity. She also worked as a Research Associate and as a post Doc Fellow at MJP Rohilkhand University Bareilly where she researched on blood parasites of fishes.

She was Senior Research Fellow (1980-1982) and Junior Research Fellow (1978-1980) at Aligarh Muslim University. She has many research experiences as a research scientist, Research Associate and Post Doctorate Fellow in INSA, DST, CSIR. She was also a visiting professor of Fish Culture Exptal Station, Golysz, Poland Institute of Parasitology, Warsaw,Poland and resourses person in various state and central universities of UP, Bihar, Uttarakhand, Jharkhand,Jammu and Kashmir, Haryana, etc.,

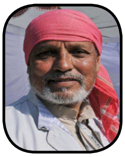
She has more than 190+ publications in journal papers and 6+ book chapters. She is been felicitated with many awards and accolades throughout her career including Honour for Significant Contribution- 2017, Ek Janaki Ammal National Award in Animal Taxonomy, Government of India; Saraswati Samman- 2017; Golden Era Felicitation-2017; Swargeey Raghav Kant Johri Smriti Samman 2017; Life time achievement award 2017; Vaishya Gaurav Samman

2016; Dr. Sah Abidi Vishisht Krishi Vaigyanik Award; Women of the year award-2015; Dronacharya award 2015; Vigyan Ratna 2014; Great Minds of the 21st Century 2011; Indian Academy Environmental Sciences Gold Medal 2001.

She is a member of International Society of Applied Biology; Society of Biosciences; Indian Science Congress Association (Recorder, 2006-2008); National Academy of Sciences, India; Indian Society of Fisheries Professionals; Uttar Pradesh Academy of Agricultural Sciences; and fellow of International Consortium of Contemporary Biologists; Indian Academy of Environmental Sciences; International Society for Ecological Communications. She was also vice President of International Consortium of Contemporary Biologists.

She has supervised many research projects funded by the government of worth more than 1.3 crores, which includes project of Centre of Excellence(UP GOVT.) on Genetic and Molecular Impact of Climate Change on Aquatic Biota , project of UP council of agriculture research on Impact of seasonal variation and pollutions load on aquatic environment and fish farming at micro level in different aquatic zones of River Ramganga and project of UGC on Hazards of effluents and microbial infection on the ecology of aquafauna of river Ramganga. She is also a member of Higher Education Inward Mission, British Council, NAAC Bangalore University Grants Commission. She is an expert of UPSC, New Delhi, Personality Test Board for Indian Forest Service Examination, NISCAIR, New Delhi, Research Council, for Dissemination of Information, Public Service Commission (UP).Under her supervision, 2 post docs (One UGC- DS Kothari Post-Doctoral Fellow and one SERB-DST Post-Doctoral Fellow); 16 Ph.D scholars have already passed. She is truly an inspiration of many students.

Biosketch-2: Padma Bhushan & Padma Shri Dr. Anil Prakash Joshi



Param Adarniya, Prakriti Premi, Pagyanik and Samajsevi, Padma Bhushan & Padma Shri awardee Known as the 'Mountain Man', who truly lived up to his name. He is an Ashoka Fellow, Indian Green Activist and Hon'ble Founder of the Himalayan Environmental Studies and Conservation Organisation (HESCO) and who has initiated the celebration of 'Himalayan Day'. Sir was awarded the Padma Bhushan by Hon'ble President of India in 2020 and Padma Shri in 2006 for his social work in Uttarakhand. This is just a short introduction. Any guesses on whom are we talking about? Well, it is none other than Shradheya Dr. Anil Prakash Joshi Sir who has devoted himself to resource-based rural development for the last 40 years and focuses on economic independence of rural India through community empowerment.

In an effort to spread awareness on the need to conserve and protect our Mother Earth, Dr Anil Prakash Joshi has initiated a series on YouTube named 'ARTH-A mini series promo on Environment and Ecology then and now' which is expected to be released shortly.

Dr Joshi's emphasis has been on inclusive growth of community by economy and ecology both. His concept "Local need, meet locally" has become popular across the mountains and other regions. As a teacher, he guided 20 Ph.D. students and motivated many more to work in the hill villages to use science and technology to solve the basic needs of the mountain community. An Ashoka Fellow, Dr Anil Prakash Joshi has authored over 100 research papers and 10 books dealing with sustainable development of the Himalayas through various means.

He quit his comfortable job as a reader in the Government P.G. College, and plunged himself whole-heartedly into research and development work for rural communities. He formed a voluntary organization entitled HESCO, and concentrated on need-based science and technology developments, and their application for the mountain regions.

Dr Joshi's work and technology to revive abandoned water mills have been adopted by thousands of water millers in the country especially in mountain areas. Since the focus of Dr. Joshi was local resources, he motivated farmers to revive traditional agriculture with new inputs. He promoted hundreds of farmers to use better practices to increase productivity.

His effort has brought employment to hundreds of women and youth across various Himalayan states. He has also initiated Women's Initiative for Self-Employment (WISE), a social platform for women to generate employment and marketing opportunities, as well as to address other economy-related issues. The major strength of this group is to develop their own mechanism for loaning, productions and marketing. This group works on local resources and is an independent organization of women.

Another program popularly known as Technology Initiative for Peace (TIP) was instituted by Dr. Joshi which enlisted the assistance of the Indian Army security forces and Ministry of Youth Welfare. This program has been instrumental in bringing revolution in the villages of the border areas. It brought Dr. Joshi's watermill technology and electrified many villages throughout the border areas and LOC.

Dr. Joshi sir has started a new initiative to focus on GEP (Gross Environment Product) rather than GDP.

Biosketch-3: Padma Shri Prof. Ranbir Chander Sobti

Dr. Ranbir Chander Sobti (M.Sc. (Hons.Sch.), Ph.D., D.Sc., F.N.A.Sc.,F.Z.S., F.N.A.A.S, F.A.M.S., F.P.A.S., F.S.C.G.,F.N.A. (Elect) is the Hon'ble Vice Chancellor of the Punjab University, Chandigarh. Formerly he was the Hon'ble Vice Chancellor of the BBAU Central University Lucknow UP. Dr. Sobti is also a Professor of Cell Biology at Punjab University. He was the Founder Coordinator (1989-1995) of Centre of Biotechnology, chairman 1995-2001) (2002-2005), and Dean at Punjab University. He was also honory. Director of UGC Academic Staff College Punjab University. He worked at the University of Miami, Florida, USA as a Research Associate Professor (1980-1983), where he taught Advance Cytogenetics to the staff and students of the Department of Oncology and Environmental Health (EPH 681) to MSPH students of the Department of Epidemiology.

He received his Ph.D from Punjab University in 1974. He is also an active member of many societies including American Society of Human Genetics., Cell Kinetics Society, USA., Society of Cell and Chromosome Research, Japan. He was also part time Director in NRDC at 2009. He was Elected General President Indian Science Congress Assocaition for the 101st Session 2013-14; Chairman of the Governing Body of National Council of Science Museums, Kolkata; was appointed Vice-Chancellor of newly created Central University of Himachal Pradesh in February 2009 but could not join.

DR. Sobti has many book publications which includes Eukaryotic Chromosomes: Structural and Functional Aspects, with Prof. G.Obe, Director Institute of Genetics, University of Essen; published by M/s Narosa Publishers and Springer Verlag, Heidelberg; Medical Zoology published by S.L. Nagin and Co., India. Some aspects of structure and functions of chromosomes has been published by, M/s Kluwers and many more. He worked on many research projects including Cytogenetical and Biochemical Prognosis of Myeloproliferative Disorders in Human Beings. (CSIR), Lateral Asymmetry of Hetrochromatin Human Cancers, Studies on the Cytogenetics of Persons exposed to Anaesthesia American Cancer society, USA, has worked on the
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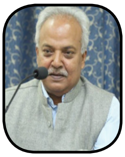
various aspects of Cell Biology and published as many as 159 papers in the Journals of International repute. He worked on cancer cell biology and environmental carcinogenesis, thermostable microbes, antihepatotoxic drugs, disease diagnosis, population genetics, Animal and human cytogenetics and molecular genetics.

In his successful career he has been felicitated with many awards such as Fellowship of UICC, NAAS, FSCG, FPASC, FZS, FMAS, FNASc, Awarded Padma Shri by President of India on 14th April 2009, Geneva, 2002, ICRETT Fellowships of UICC Geneva 2001, 2005, INSA – JSPS Exchange Programme 2001-2002, Indo – German INSA Exchange programme 1998, Lady Tata Memorial Fellowship – 1972, Punjab Rattan Award, Young Scientist Exchange Award between India and U.K. 1978, Professor Sundaram Subramanian Oration Award Indian Association of Biomedical Scientists 2011, General President's Gold Medal of ISCA 2011, "Bharat Gaurav", Life Time Achievement Award at the house of Commons, British Parliament, London, U.K.

He was editorial member of Molecular Cell Biochemistry (Canada), Journal of Human Genetics, International Journal of Human Genetics, Newsletter EMSI, Biotech Bulletin (till 2003), Journal of Cytology and Genetics and reviewer of various International Journals (International Journal of Cancer, Human Genetics, Molecular Cellular Biochemistry, British Journals of Medicine, Cancer Epidemiology etc.). He supervised many thesis which includes Studies on Gene Expression Profile of Mammary Gland through Characterization of Tissue specific Expressed Sequence Tags of Buffalo Genome, Identification of Molecular alteration as risk factor (s) for cancers of upper aero digestive tract Molecular epidemiology of oesophageal cancer.

Biosketch-4: Prof. Hridaya S. Singh



Prof. Hridaya Shanker Singh is presently the Hon'ble Vice Chancellor of IIMT University, Meerut UP. Formerly he was the Pro-Vice Chancellor & Professor & Head of Department of Zoology at Ch. Charan Singh University, Meerut. He received his Ph.D. in Zoology from Lucknow University, UP. He has more than 40 years of teaching and research experience. He successfully completed 11 research projects funded by International National Funding Agencies.

Dr. Singh has more than 200 research paper published since the year 1980. He also has 7 books published notably, A textbook on medical diagnostics, Parasitology, Higher invertebrates and others. Dr. Singh has been awarded by many fellowships and honors. Some of them are; Helminthological Society of India (FHS), Zoological Society of India (FZSI), Fellow Academy of Zoology (FAZ), Fellow Academy of Env. Biol. (FAEB), Fellow Bioved Research & Communication (FBR), and Fellow Zoological Society, Kolkata (FZS, Cal.) He is a member of Review Committee: UPSC (New Delhi), Public Service Commission U.P. and Uttarakhand, member of Technical Advisory Committee, STEM, DST, New Delhi and Member of executive Council, Dr. A.P.J Abdul Kalam University, Lucknow. He has been awarded lifetime membership of Helminthological Society of India, Indian Society of Parasitology, Society of Parasitology and Applied Animal Biology, Indian Association for the Advancement of Veterinary Parasitology, Zoological Society of India and Indian Science Congress Association. He is also an Assessor of NAAC since 2018.

Dr. Singh was also a visiting scientist of SERC, Department of Zoology, A. M. U., Aligarh with (1995-96). Indo-Dutch Cultural exchange program in the Department of Marine Biology, University of Groningen, The Netherlands (1996-97), Indo-Hungarian Cultural exchange program in Vet. Medical Res. Institute, Budapest (2002-03) (2007-08) and (2012-13). He supervised M.Phil. thesis of more than 80 students. He is truly an ideal teacher and his excellence inspires students.

Biosketch-5: Prof. Ummey Shameem

Prof. Ummey Shameem has been working in the Department of Zoology, College of Science and Technology, Andhra University for 31 years. She has been both teaching and Research in the field of Parasitology, Fish Immunology, Fish pathology, Molecular phylogenetic studies. She holds several administrative positions. Presently she is the Head of Zoology Department, Andhra University, College of Science and Technology. She received her Ph.D. in morphology and biology of some larval trematodes from mollusks of Chilka Lake in 1987.

She has many research paper publications including new *Cystophorous carcaria* from snail *(Gyraulus convexiusculus)* from Kondakarla Lake, Histopathology of experimental *Aeromonas hydrophila* infection in Major Carp *Labeo rohita* (Hamilton), *Thysanotohaptor rex* n. gen., n. sp. (Monogenoidea: Neocalceostomatidae) from the gills of the blackfin sea catfish *Arius jella* (Siluriformes: Ariidae) and many more. She was felicitated with Merit Award from the Helminthological Society of India, Lucknow for the work done in Parasitology in 2012 and Siksha Shiromani Award by Council for Creative Literature andn Education, Hyderabad in 2010.

She is the member of Indian Society for Parasitology, Indian Association of Aquatic Biologists, Forum of Fisheries Professionals, Journal of Parasitology and Applied Animal Biology, Society for Science and Environment, Asian Fisheries Society. She actively contributed to many seminars, conferences and workshops and enlightened about Parasitology, Fish Immunology and Fish Pathology held at Ministry of Earth Sciences, New Delhi, Indian Society for Parasitology and National Fisheries Development Board, Hyderabad. She guided many students and supervised their thesis for their Ph. D and M. Phil degree. She has been influencing and impacting life of many science students.

Biosketch-6: Prof. Shokoofeh Shamsi

Professor Shokoofeh Shamsi is an international expert in parasite taxonomy, especially aquatic parasites that cause significant diseases in humans and animals. She holds a Master degree in Medical Parasitology from Tehran University of Medical Sciences, Iran and a PhD from University of Melbourne, Australia, which explains her passion for research into transmissible parasites between animals and humans. She couples conventional morphological techniques with modern molecular technologies to diagnose infections and identify parasite species.

Dr. Shamsi discovered several new pathogenic species and strains causing emerging diseases in humans and animals in Australia and worldwide. This led to her receiving several awards, including the Recognition Medal of Global Biodiversity Meeting on Parasites and Aquatic Ecosystem Health by University of Allahabad, India for sustained academic efforts and contributions to advanced research and Outstanding Female Scientist Award from Tehran Council, Iran.

She has been invited to several national and international conferences as a key note speaker. She has also been appointed to the editorial board of the World Register for Marine Species (WoRMS), Section Editor of Parasitology Research and is Executive members the Australian Society for Parasitology and Japan Society for Promotion of Science - Alumni Association in Australia.

She was felicitated with recognition medals including; Australian Academy of Science Award for International Visit, Best student presentation award in the 20th International Conference of the World Association for the Advancement of Veterinary Parasitology. Christchurch, New Zealand, International Postgraduates Research Scholarship (IPRS), “Outstanding Female Scientist of the Year” awarded by Scientific and Cultural Centre, and Melbourne International Research Scholarship (MIRS).

Biosketch-7: Prof. Sandeep K. Malhotra D.Sc.

Prof. Sandeep K. Malhotra D.Sc. is currently working as Professor Emeritus at University of Allahabad, Prayagraj, India. He was retired as Professor & Head Department of Zoology, University of Allahabad, Prayagraj (UP), India. He obtained his D.Sc. & Ph.D. in Environmental Parasitology from University of Allahabad, India. He is having 45 years teaching and research experience. He successfully completed 15 research projects funded by International & National Funding Agencies.

Prof. Malhotra received number of honors including Golden Globe Award-2014 from International Society for Biodiversity Conservation, Gold Medal Award-2012 at RTCCRB-2012, Recognition Award & Gold Medal from Zoological Society of India, Dr. B.P. Pandey Memorial Oration Award, 2006-IICB, XVIIth National Congress of Parasitology, Kolkata, Awarded Gold Medal for best research paper presentation on Hydrobiology and Pollution at Jamshedpur Symposium, Awarded Young Scientist Gold Medal, and many others. He also invited as Judge at International Estuary Conference, San Francisco, USA, and International Conference World Aqua, Nashville US, and Guest Speaker at West African Research and Innovation Management Association (WARIMA) and Association of Commonwealth Universities (ACU), Ghana.

Prof. Malhotra is member of Australian Society for Parasitology, Australia, Japanese Society of Parasitology, Japan, Indian Science News Association, India, Royal Society of Tropical Medicine & Hygiene, UK, and Life member of Indian Science Congress Association, India, Zoological Society of India, Indian Society for Parasitology, India, Indian Academy of Parasitology, India, Academy of Biosciences, India, Helminthological Society of India, and Fellow of Helminthological Society of India (FHSI), Zoological Society of India (FZSI), Society of BioSciences (FSB) and Society of Environmental Science (FSESc).

He also attended 131 National and International conferences and performed as jury member in many. He supervised 16 students, and 15 awarded D.Phil. Degree and 01 Post-Doctoral Degree under his supervision. He has published 9 books, 15 review papers, 59 research papers in books, 54 research papers in International journals, 111 research papers in National journals, 210 short communications, 16 popular articles contributed as author/co-author in his past academic career. Prof. Malhotra is an ideal teacher and his excellence inspires students.

Biosketch-8: Prof. Anil K. Sharma

Dr. Anil K Sharma is presently at M.M. (Deemed to be University), Department of Biotechnology, Mullana (India) working as a Professor and Head of the Department since the year 2010. Previously he worked as a Senior Research Specialist in health sciences (2008-2010) and a Post-Doctoral Research Fellow (Molecular Biology) in the Microbiology and Immunology Department at UIC College of Medicine Chicago, IL, USA (2003-2008). He also worked for a major multinational pharma R&D, Ranbaxy Research Laboratories as a Research Scientist from 2001-2003 where he explored the antimicrobial drug resistance mechanism by looking into various efflux pump inhibitors in bacteria. He is a PhD from one of the most prestigious institutions of North India, PGIMER/Punjab University Chandigarh which has a credible place in the World University Ranking. During his Ph.D, he worked on a very notorious microorganism "*M. tuberculosis* H37Rv" and could successfully clone, express and purify recombinant 30 kDa protein which had good immunoprophylactic properties from the vaccination perspective.

He has more than 152 publications in peer-reviewed journals of national and international repute with h-Index of 29 (i10~48) and a cumulative impact factor of his publications is more than 227.0 with more than 3380 citations. He has been felicitated with many awards and accolades throughout his career including Abdul Kalam Azad Award-2018, Eminent Scientist Award-2017 & 18 (Molecular & Microbial Science), National Achiever Award-2016 (SADHNA, Y.S. Parmar University Solan, HP), Bharat Excellence Award-2013, MGIMS Young Scientist Award-2000 for outstanding contribution in Microbiology and Molecular Biology. He has been the Editor-in-chief of Current Trends in Biotechnology & Chemical Research (pISSN 2249-4073) till 2018. Moreover, he is in the Editorial board/Reviewer for many journals of international repute (about 25 Journals). He has successfully guest edited special issues of Current Pharmaceutical Biotechnology (Bentham Science Publishers; Impact factor~2.5), Natural Products Journal (SCOPUS Indexed) and Inflammation and Allergy Drug Discovery Journals as well. More recently he has acted as a Lead Guest

Editor for the thematic issues on “Emerging trends in Biomarker discovery: ease of prognosis and prediction in cancer” in Seminar in Cancer Biology (2018), and Mining human microbiome bringing newer paradigms to anticancer therapeutics” in Seminar in Cancer Biology (2020) from Elsevier Publishers (Impact Factor 11.15).

He has published 06 books from prestigious publishers including Springer-Nature Publishers, Pan Stanford publishers, and NOVA while 02 books are in the pipeline. Moreover, his contribution to diverse fields of Medical Biotechnology and Industrial cum Pharmaceutical Biotechnology is greatly acknowledged. He has recently published a patent Invention by exploring the potential of microorganisms entitled “Enhanced biosorption of Lead (Pb) by Microbial Consortium coupled with Agriculture residues” (Application No. 201611030861 Dated: 09/09/2016; IN201611030861). This invention relates to the use of microbial consortium for the removal of lead coupled with agriculture residues. Another patent IN201811029371 published by him deals with the designing and optimizing a lead molecule for inhibiting the breast cancer. 09 PhD scholars have already passed under his Guidance along with 20 Post Graduate students including 02 international PhD students.His research interests are diverse but he has done tremendous progress contributing to Microbial and Molecular biology field finding amicable solutions to diagnose diseases including cancer and to understand the growing problem of antimicrobial drug resistance, leading him to find a place in the list of top 2% scientists recently released by Stanford University California, USA.

Biosketch-9: Dr. Himanshu Ojha

Dr Himanshu Ojha is a Scientist E and Joint Director in INMAS, DRDO. He is currentlyheading CBRN Protection and Decontamination research group in Division of CBRN Defence. His group has been working on the development of a decontamination nano-emulsions for radiological agents and dry decontamination wipes for chemical and biologicalagents. Beside this his group is also working to develop an effective dermal hydrogel forcombat and radiation wounds.He is recipient of the DRDO Laboratory Technology Award in 2012 and 2017.

He has servedas Officer in Charge of CBRN trainings armed forces and paramilitary forces. He served asnodal officer for 12 Airport and 10 Seaport CBRN trainings.He has four patents and 41 research publications in various peer reviewed internationaljournals of high repute. He served as editor for the Reference book for CBRN courses and ESKAPE Pathogens.Besides He was working as Additional Management representative and looking after ISO 9001:2008 certification of the institute. In quality management he trained in ISO 9001:2008, ISO 17025:2007 and ISO/IEC 15189:2007 (NABL). Research interests include the applications of nano-materials for the decontamination of toxic industrial chemicals & biomedical applications in traumatic wounds.

Biosketch-10: Prof. Kuldeep K. Sharma

Prof. Kuldeep Krishan Sharma has served as Dean Life Science and Head Department of Zoology, University of Jammu, J&K, India having 40 years of research cum academic experience in the Life Sciences. Prof. Sharma sir presently working as adjunct Prof. Central University, Jammu. He is also chairman ethical committee Medical College Jammu, IIT Jammu and ASCoM Batra Hospital Jammu. He has visited Dozens of countries for the research and academic purposes few of them are: Academy of Science USA, Chicago Museum & Chicago University,Chicago.

Prof. Sir, has supervised 30 PhD and 35 M.Phil students during his career. He has Published 150 short communication and hundreds of research articles in reputed and high impact journals. He has successfully completed 10 major research projects sanctioned by the various funding agencies of Indian Government. Prof. Sharma sir is recipient of many awards, Gold medals and recognition along the prestigious fellowships from the Zoological Society of India, Indian Inland Fisheries Society, Indian Academy of Environmental Science, and many more. He is an ideal teacher and citizen as per my personal experience; he is very soft spoken and helping personality.

Biosketch-11: Dr. Anjani Kumar Tiwari

Dr. Anjani Kumar Tiwari is Associate Professor, Department of Chemistry, Faculty Nuclear Medicine, Assistant Director, University sophisticated instrumentation centre (USIC) BBAU Central University, Lucknow, India and Ex Scientist E, Institute of Nuclear Medicine & Allied Sciences (DRDO), Delhi. He is also a Member Secretory, University Patent Cell; and; Deputy Dean, Students Welfare (Men), Babasaheb Bhimrao Ambedkar University, Lucknow since 2019 to till date. His research area of interest ranges from Chemical Kinetics, Chelation, Biomedical Sciences, Neuro-receptor, quantification (TSPO/ AChE/5-HT), Computer added drug design (CADD) and Medicinal Chemistry. He visited Professor/ Researcher (National Institute of radiological Sciences, Chiba, japan), IAEA Fellow, United Nation fellow, JSPS/MEXT fellow, ICMR-DHR Fellow.

Dr. Tiwari is Lifetime Member of ICNM, SNMI, ISN, ISCA. He is multiple International Awards & Fellowships; Reviewer panelist of pharmaceutical Sciences section MEXT fellowship, Japan.Commissioned as visiting researcher at quantum medical sciences directorate, NIRS, Department of advanced nuclear sciences from 1 April 2018-31 March 2020. Invited Researcher JAPAN, (MEXT fellow), NIRS, Chiba, Japan, (Invited for 5 weeks to work in the joint programme to work on ligand for 5HT7 receptor, 2016. International Biomedical Fellow, Department of Health Research (DHR), Indian Council of Medical Research (ICMR) 2015-16. JSPS Invited Researcher, 2014-15 (10 months). Award for NIRS-IAEA-CC meeting 2014 (selected by IAEA as a candidate to represent AsiaEuro region), 20th February, 2014 at Akihabara, Tokyo).

He is Lifetime Membership of Japan Society of Nuclear Medicine, Indian Society of Nanomedicine (founder member), Indian Science Congress Association, Indian Society of Nuclear Medicine, Indian College of Nuclear Medicine.He was also Worked for the development and quantification of probes for 18 kDa Translocator Protein, serotonin 5- HT7 receptor and phosphodiesterase 10 in brain at Japan Society for The Promotion Of Science (JSPS), Inage, Chiba, Japan.

Biosketch-12: Dr. Usman Umar Zango

Dr. Usman Umar Zango currently working as Associate Professor & Head, Department of Biological Science, Sa'adatu Rimi College of Education Kano State, Nigeria. His research area of interest ranges from bioremediation of heavy metals, microbial drugs resistance to antibiotics, public health and water sanitation in the environment. He has been working closely with several regulatory agencies within Nigeria such as National Biosafety Management Agency (NBMA), National Agency Food and Drugs Administration and Control (NAFDAC) as well as National Environmental Standards and Regulations Enforcement Agency. He also participated in curriculum development and Nation Universities Entry Examination both within Kano State and National level. He published many papers with high impact factor.

Biosketch-13: Dr. Mallika Pathak

Dr. Mallika Pathak, Prof. & Head, Department of Chemistry, Miranda House, Delhi University, New Delhi. Dr. Mallika Pathak is an alumna of Miranda House. She has been a faculty at Miranda House since 2006. She is a recipient of awards like Most Promising Innovation in 2016 from University of Delhi; Teaching Excellence Award for Innovation in 2015 from University of Delhi and Australian Leadership Award Fellow (ALAF) in 2013. A Computational Chemist by training she has many research papers in various peer reviewed International Journals, authored one book chapter for Elsevier Publishing House and has filed a patent in 2017.

She is passionate about promoting Active Learning and working with students on innovative projects. Her research interests include Drug-molecular interactions, Nano-chemistry and its application to water purification etc. She has been a PI and Co-PI for three major research projects under DU Innovation and Star Innovation Projects. At present she is the Teacher-in-Charge, Department of Chemistry with effect from February 2019. Mrs. Mallika does research in Chemo-informatics, Biochemistry and Chemical Biology. The current project is 'Pharmacological properties assessment of ethyl pyruvate.'She is also a life member of Indian Biophysical Society; Green Chemistry Network Centre; Chemical Research Society of India; and Indian Society of Analytical Scientists.

Biosketch-14: Dr. Annapurna Jha

Dr. Annapurna Jha, grantee of two Indian Patents is currently working as Head of the Department of Chemistry, Jamshedpur Women's College, Jamshedpur. She received Ph.D in Chemistry from the Indian Institute of Technology, Kharagpur, India. She has completed her M.Sc. (Chemistry) degree from Banaras Hindu University, India. She has published several research articles. Her research interests are Industrial Biotechnology, Bioprocess & Biochemical Engineering, Biocatalysis, Biofuels & Bioenergy, Environmental Biotechnology, Food Biotechnology, Immobilization Technology and Statistical modeling and optimization. She has received Visiting Scientist Award 2021 from Indian National Science Academy, New Delhi. She has number of paper and research's as well she has many patents like Enzymatic transesterification of Jatropa oil, is one of the.

Biosketch-15: Dr. Manoj Singh

Dr. Manoj Singh is currently working as an Assistant Professor at Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University), Ambala, India. He completed his PhD from Madurai Kamaraj University, Madurai. He was also the recipient of ICMR-SRF during his PhD. He also worked as Junior Research Fellow on the project entitled "Development of sea water quality criteria for Coral reef ecosystem of "Gulf of Mannar" Region" funded by Ministry of Earth Science (MOESICMAM) in collaboration with CPCB, India. His area of interest belongs to Nanotoxicology, Cancer nanobiology, Drug-Microbial interaction, Biomimetic and Chemical Nanosynthesis, Analytical Method Development, NPs hydrodynamic size and imaging (DLS, AFM, TEM), Drug delivery/controlled release at nano scale, Highpressure Microfluidizer: Interactions of biomolecules and cells at interfaces, anti-fungal drug, physicochemical mechanisms of cell adhesion.

He has worked as Postdoctoral fellow in Department of Ceramic Engineering, IIT-BHU. Varanasi on project entitled "in vivo and in vitro characterization of hydroxyapatite nanomaterials". He has been the recipient of Young Scientist Open International "NUST-MISIS" grant competition as an international to conduct joint research at Ministry of Education and Science of the Russian Federation, Moscow, Russia. There he also worked as an Assistant Professor at National University of Science and Technology, Moscow, Russia. He is also the recipient of National Research Foundation (NRF) Innovation Fellowship at Research and Innovation Support and Advancement, South Africa, 2017. He has more than ten years of research and teaching experience. He has published more than 60 research articles in peer reviewed journals and has contributed in more than 10 book chapters. He also has published a book for post graduate students. He has participated in many International conferences held abroad. He is also the recipient of International Travel Fellowship by Department of Science and Technology, Government of India (DST), CICS (Centre for International Co-operation in Science) and DBT as a scientific delegate for an International conference. He is also the Recipient of PADI Open Water SCUBA Diver. He has around 950 citations for his research findings. He has recently received "Top 50 International Distinguished Academic Leader 2020" award from Green ThinkerZ.

Biosketch-16: Dr. Ashish Tripathi

Dr. Ashish Tripathi ‘Sarp Mitra’ currently elected as Hon'ble President, International Association of Zoologists (IAZ) since 2017. He is working as General Secretary, Organization for Conservation of Environment and Nature (OCEAN) since 2007. He has received his Ph.D Degree in the Zoology fron C.S.J.M University, Kanpur (UP). Dr. Tripathi has served as Assistant Professor, Janta College Bakewar, Etawah (UP) in yesteryears. His research area of interest ranges from entomology, biodiversity conservation and herpetology. He has been working closely with several regulatory agencies within India and abroad as eminent ecologist & biologist. He has participated in many conferences, published research articles and delivered his talk in various reputed institutions and Universities including Delhi University. He is recipient of many National and International awards also.

Biosketch-17: Dr. Arun Kumar

Dr. Arun Kumar, Post-Doctoral Fellow at Defence Research and Development Organisation, is working on a set of rapid radiation biodosimetric tools for quick and possible segregation of exposed and unexposed individuals during radiation triages. He has more than 8 years research experience in the field of cell and molecular Biology. He did Ph.D. life Sciences from Institute of Nuclear medicine and allied Science, Timarpur Delhi, in the challenging area of medical management during radiation accidents. Dr. Arun has studied radio-protective efficacy of natural antioxidants against hematopoietic injuries of mice exposed to gamma radiation. He has many publications, awards, and professional memberships in his credits. In addition, Dr. Arun has expertise in cell culture, animal handling and surgery for various disease models, cytogenetics analysis, DNA damages and repair studies, and drug bioprospecting. He also served as a molecular biologist at CRIH, Ministry of AYUSH Noida. He is very much articulating in scientific research documents and serving reviewer and editorial roles in many reputed journals. His area of research interest is pre-clinical studies of drug discovery includes toxicity, efficacy, and molecular mechanism of drugs in both in-vitro and in-vivo models.

Dr. Arun Kumar worked in Atomic Energy Regulatory Board (AERB) accredited Laboratory at Institute of Nuclear Medicine and Allied Sciences (INMAS), Defense R&D Organization, Delhi-India. He did research relevant to development of Radiation Bio dosimetry services and countermeasures for victims of radiation exposure. His broad area of research is Cell&Molecular Biology, DNA damage & repair, Cytogenetics etc. Dr. Arun has keen interest in Radiation & Cancer biology, Oxidative stress, Pre-clinical Drug testing and looking Post-Doctoral position in an organization under expert guidance where, he would like to put the efforts in this field with best of his scientific knowledge and skills to satiate his desire for research and also allow him to evolve with the deeper understanding of it.

He was also worked in Radiation Bio dosimetry Laboratory accredited by AERB; a part of CBRN division at INMAS. He has good command on cytogenetic and molecular biology methods, which is evident by publications in peer reviewed journals and various awards in his credits. His hands-on expertise in animal’s handling, cell culture and molecular biology techniques makes him expert in completing assignments with accuracy. He is very much articulate to write and present the things in open forum, conference and seminars. His attributes are his confidence, communication skills, calm and supportive nature.

Biosketch-18: Dr. Ripu Daman Parihar

Dr. Dr. Ripu Daman Parihar is an Assistant Professor in the Department of Zoology, University of Jammu, Jammu, Jammu & Kashmir, India. He has studied B.Sc. Medical and M.Sc. Zoology from the University of Jammu. He has been conferred the Degree of Doctor of Philosophy in Zoology from Guru Nanak Dev University, Amritsar in 2018. His areas of specialization are molecular and morphometric categorization, taxonomy and ecological studies of Entomopathogenic Nematodes which are an important asset for Integrated Pest management control. Post the doctoral studies he has experience of 4 years in research and teaching. He has published 20 Research articles in Journals of International and National repute.

He has authored a book titled 'Developmental Biology & Evolution". Besides research activities, he is involved in social activities and has represented India at the international level in International Youth Exchange Programme. In 2014 Government of India honored him with National Youth Award. He organizes and executes many youth-oriented programs for the betterment of the students which makes him an ideal, versatile and responsible teacher.

Biosketch-19: Dr. Sushil Kumar Upadhyay

Dr. Sushil Kumar Upadhyay is working as Assistant Professor in the Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University), Mullana- Ambala, Haryana. Dr. Upadhyay has 13+ years of rich teaching-cum-research experience in the field of Parasitology, Taxonomy, Molecular Biology, Animal and Veterinary Science, Environmental Biotechnology, Bio-Ecology, Nanotechnology, Entomology and Microbiology. Dr. Upadhyay is recipient of the degree of Doctor of Philosophy in Science from University of Allahabad (A Central University) famous as "Oxford of East". He received undergraduate (Life Science) and post graduate (Zoology) degree from Dr. Ram Manohar Lohia Awadh University, Ayodhya, Uttar Pradesh.

Dr. Upadhyay has achieved appreciation certificates, certificate of excellence, Bharat Jyoti award, Paryavaran Ratna Purashkar, Vigyan Ratna Puraskar, Bharat Shiksha Gaurav Puruskar, Paryavaran Shri Samman, Global Green award, Elite Teacher award, Best Researcher award and been honored with Prof. S. P. Gupta Gold medal, Prof. S. L. Mishra Gold medal, Best Educator Gold medal, Innovative Zoologist Gold medal, Best Teacher medal as well for his outstanding contribution in the field of Parasitology and Molecular Taxonomy. He also got Young scientist award, Best trainee award, Best research paper award in the field of life science in yesteryears. He has been honored by Fellowships of various prestigious science societies as FISEC, FSESc, FSSc, FSLSc, FISCA, FZSI, FAGEM, FHSI, FIAZ, FMERC, FBPS, FSEZR, FGESA, FSAN, FI2OR, FGT, FSASS, FSoE, FAELS, & FLS (London) and currently member or life member of forty four societies, various academic bodies, steering committees, selection panels and deputed for esteemed honorary responsibilities including Special Officer, Wildlife Control Bureau, Min. of Forest & Environment, Govt. of India, Sustainable Cosmos Ambassador, MyNEP Ambassador, Global Goodwill Ambassador, Academic Outreach Advisor, UK and many more as well. His research skill, handling of experimental fauna is excellent and published 7 patents, 29 books, 10 book chapters and 115 International and National research papers in reputed refereed and high impact factor journals.

He has attended and actively participated in 65 training and FDPs and presented his research findings in 175 seminars/conferences at International and National level. Dr. Upadhyay has no stone unturned in the field of Molecular Taxonomy and Nano-Biotechnology for helminthes taxon validation and helminthiases which can be evaluated by his great contribution on DNA databases with 73 Genbank submissions as a part tools of phylogenetic validation of parasitic helminthes. His contribution for employment to youths at grassroots level for livelihood and sustainability by the mission "transfer of science and technology to grassroots level" and vision "Earn as you learn" is also remarkable and can't be ignored. Dr. Upadhyay has communicated his visions at individual level through mass communication, magazines, daily newspapers and direct contact. Dr. Upadhyay is an ideal teacher and his hard work inspires the students to achieve their goal and be 'SMART' [S=Specific, M=Meaningful, A=Achievable, R=Relevant, T=Time-bound].

Biosketch-20: Prof. Raj Singh

Prof. (Dr.) Raj Singh is an eminent Professor (Botany) in the Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala, Haryana, India. He holds Doctor of Philosophy (Ph.D.) in Botany, specializing in Mycology as lingo-cellulosic crop residues and its application in livelihood and sustainability, from Ch. Charan Singh University, Meerut, Uttar Pradesh, India. After completing his Ph.D. degree, he joined as Asst. Professor and Head Department of Biotechnology, IIMT University, Meerut. He also established his mile stone in academia and research by joining as Associate Professor and Head Department of Botany, S. V. Subharti University, Meerut, UP, India.

During his yesteryears career Dr. Singh published 15 books and book chapters, more than 97 research and review papers in different peer reviewed and high impact factor National and International journals. There are several honors/awards and recognitions like Best Teacher Award, Outstanding Achievement Award in the field of Mycology and Agri-Biotechnology conferred upon him by esteemed Institutions and Universities of International repute. He is life member in various scientific and academic bodies, steering committees and selection panels. Dr. Singh created a landmark through "Bio-Science Research Bulletin" as Editor-in-Chief. He has delivered speech as a chief guest, invited speaker and resource person in several National and International conferences and published abstracts of his innovative and applicable research findings. Dr. Singh specialized in Mycology, Taxonomy, Pathology and Agri-Business Management. He is also expert in handling of sophisticated instruments for fungal biochemical applicability on field crops residues for sustainable environment. His outstanding guidance skill encourages the students to attain their aim.

Chapter 1

COVID-19 Pandemic: From Emergence of SARS-CoV-2, Structure, Evolutionary Lineage, Spreading, Symptoms, Infectivity, Precautionary Measures, Therapeutic Approaches to Indian Scenario and Vaccination Strategy

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ABSTRACT

The eruption of the COVID-19 (formerly known novel coronavirus (2019-nCoV) disease) was documented in late 2019 from Wuhan, Hubei Province (China), called the epicenter of COVID-19 (coronavirus disease-2019). As of 08th November, 2021, more than 250,654,462 people have been found to be infected by SARS-CoV-2 [severe acute respiratory syndrome coronavirus 2 (the causative agent of COVID-19] among more than 216 countries. As per the report of Worldometers, over 5,065,596 deaths and 226,899,869 recovered cases recorded globally with hardest hit on India with over 461057 fatalities due to COVID-19 by 08th November, 2021. Looking at the COVID-19 trend in

India, the first case was reported in late January 2020, since then, number of positive cases is increasing continuously. The continuous effort of Indian Govt. in combating the situation is very remarkable and appreciated by World health Organization as well. India has manufactured 2 native COVID-19 vaccines (Covaxin and Covishield) and administered more than 108 cores of vaccine doses by 06th November, 2021. The intention of the current article is to explore the different aspects COVID-19 along with steps taken by the Government to cut its further spread.

Keywords: Zoonose, COVID-19, Communicable diseases, SARS-CoV-2, Vaccine, Helminthes

INTRODUCTION

The coronaviruses posed serious health threats to humans and other animals after its eruption as severe acute respiratory syndrome (SARS) in 2003, Middle-East respiratory syndrome (MERS) in 2012 and COVID-19 in 2019 (Ksiazek et al., 2003; Cherry and Krogstad, 2004; Hui et al., 2004; Assiri et al., 2013; Al-Tawfiq et al., 2014; Al-Jazeera, 2020; BBC, 2020; Wang et al., 2020). A rehabilitated curiosity in coronavirus research has led to the breakthrough of several strains of novel coronavirus (nCoV) and given that much advancement has been made in understanding its life cycle and envelope (E) protein (a small integral membrane protein concerned to its pathogenesis)(van Regenmortel et al., 2000; Pradesh et al., 2014; Cui et al., 2019). In broader spectrum, the coronaviruses caused prevalent respiratory, gastrointestinal, and central nervous system diseases in humans and intimidating human health and economy (Read et al., 2020; Wang et al., 2020). The coronaviruses are talented in adapting to new environments through mutation and recombination with relative ease and consequently programmed to alter host range and tissue tropism efficiently (Vijgen et al., 2005; Bakhshandeh et al., 2021; Jungreis et al., 2021; Nguyen et al., 2021). Therefore, health terrorizations due to coronavirus are invariable and long-standing.

ERUPTION OF COVID-19

Severe acute respiratory syndrome considerably coronavirus-2 (SARS-CoV-2, formerly known as 2019 novel coronavirus (2019-nCoV) on 12th January, 2020 by World Health Organization, (WHO, 2020a), with potential origin of bat, has appeared on the Huanan Seafood Market, where livestock are also traded, in China's Wuhan State of Hubei Province, and has been the subject of global attention because of an unexplained cause of pneumonia epidemic (Cherry and Krogstad, 2004; Cui et al., 2019; Adhikari et al., 2020, Andersen et al., 2020; Dan et al., 2020; Li et al., 2020a; Phelan et al., 2020) (Fig. 1). Thus the Wuhan state of Hubei Province of China was reported as the epicenter of the current SARS-CoV-2 responsible for the pandemic COVID-19 'A global threat to human health and life' (Li et al., 2020a,b). The Vietnam registered first case of 2019-nCoV on 24 January, 2020 with no travel history from China, although its family member was the traveler from China (Backer et al., 2020; CDC, 2020) So it is considered as the first incidence of human to human transmission of corona virus (Li et al., 2020b; Shereen et al., 2020; Wang et al., 2020a; Wang et al., 2021). It also proves that this virus spread quickly human to human by transmission through close direct contact, aerosol and droplets generated by coughing and sneezing (Upadhyay et al., 2020a,b).

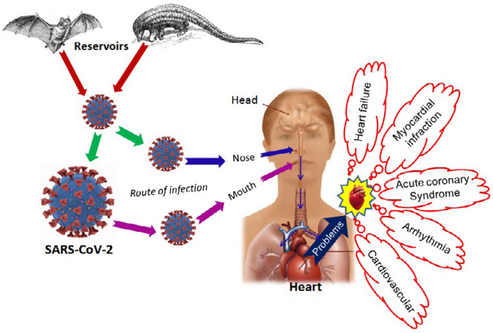


Fig. 1. Source of SARS-CoV-2 infection in human beings and symptomatic problems in immuno-compromised patients. Source: Dan et al., 2020

STRUCTURE AND EVOLUTIONARY LINEAGE OF CORONAVIRUS

Coronaviruses (CoVs) are non-segmented positive sense RNA viruses of the Coronaviridae family and the Nidovirales order that are widely distributed among humans and other mammals (Perlman and Netland, 2009; Azhar et al., 2019). The family Coronaviridae is comprised of four genera: α, β, γ, and δ (Paola et al., 2020) (Fig. 2). These viruses are common in animals worldwide, but very few cases have been known to affect humans. There are seven types of human coronaviruses: 229E (α-CoV), NL63 (α-CoV), OC43 (β-CoV), HKU1 (β-CoV), MERS-CoV (β-CoV), SARS-CoV (β-CoV), and SARS-CoV-2 (β-CoV) (van Regenmortel et al., 2000; Woo et al., 2012; Paola et al., 2020; Peter et al., 2020). MERS-CoV, SARS-CoV, and SARS-CoV-2 can infect humans and cause severe pneumonia in many fatal cases (Junejo et al., 2020; Wu et al., 2020). The virus liable for 2019-nCoV or coronavirus disease-2019 (COVID-19) was the mutated species of SARS-like corona viruses named SARS-CoV-2 larger than typical influenza, SARS and MERS viruses (Zhou et al., 2020).

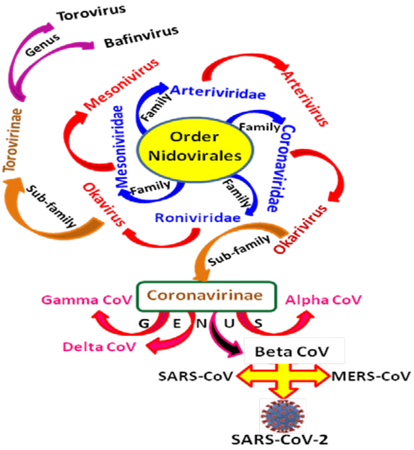


Fig. 2. Evolutionary lineage of SARS-CoV-2.

The SARS-CoV-2 was approximately a descendant of a bat corona virus and closest to a virus of Rhinolophus bat (>96% homology) than the original SARS-CoVs (about 79% homology) (Dan et al., 2020; Latinne et a., 2020; Sood et al., 2020; Upadhyay et al., 2020a,b; Zhou et al., 2020)' The coronaviruses are bulky, enveloped, right handed single stranded RNA viruses (+ssRNA viruses) with largest genome ranging 27kb to 32kb to all RNA viruses (David et al., 1996; Chen et al., 2020a,b; Upadhyay et al., 2020a,b). The genome is jam-packed in a helical nucleocapsid protein (N) and additionally delimited by a larval sachet made of 3 structural proteins (membrane protein (M), envelope protein (E) for virus assemblage, and spike protein (S) to make possible virus doorway into host cells) (Li et al., 2016) (Fig. 3). There are a quantity of coronaviruses may program a supplementary envelope-coupled hemagglutinin esterase (HE) protein. The structural proteins made outsized protrusions at the exterior of virus called spike giving the outward show of crowns hence name corona, in Latin means crown (Fig. 3). The fatality rate in the COVID-19 is comparatively mutifold higher than that of the normal flu and other earlier out breaks of SARS (Perlman and Netland, 2009).

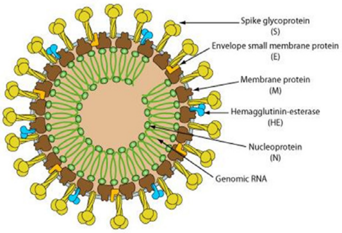


Fig. 3. The schematic structural components of coronavirus.

SYMPTOMS OF COVID-19

Corona virus infected person has many common symptoms such as fever, cough, myalgia, tiredness, pneumonia and complicated dyspnea, whereas less common reported symptoms include headache, diarrhea, hemoptysis, runny nose, and phlegm-producing cough (Fig. 4) (Adhikari et al., 2020; Sood et al., 2020; Upadhyay et al., 2020a,b; Upadhyay et al., 2021). Patients with minor symptoms have been reported to recover after one week while serious and severe cases have experienced progressive respiratory failure due to alveolar damage from the virus, which can lead to death (Dan et al., 2020).

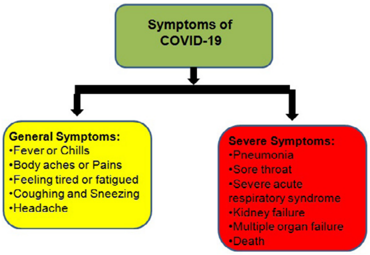


Fig. 4. General and severe symptoms in patients of COVID-19.

SPREADING AND GLOBAL SCENARIO OF COVID-19

Director, USCDC, Dr. Robert Redfield on 13th February 2020 stated that novel coronavirus really a global problem that's not going to go away in a week or two like earlier SARS outbreak (Ksiazek et al., 2003; Hui et al., 2004; Hui et al., 2020). He said the virus will be probably with us beyond this season, beyond this year and eventually the virus has found a foothold. Very soon will get community based transmission like season flu (Guo et al., 2020). Prof. of Epidemiology, Harvard School of Public Health Dr. Marc Lipsitch on 17th February 2K20 mentioned that COVID-19 is likely will be see a global pandemic. He presumed if pandemic happens, 40% to 70% peoples world-wide will likely to be infected in the coming year. Director WHOHEP Dr. Michael Ryan said that all the predictions are important and we must careful with that. As per a report about 5K new infections per day occurring in China probably peak in its epicenter, Wuhan in about one month time; may be a month or later in whole China (WHO, 2020c). Since late 2019, manifold cases happening unexplainable COVID-19 pneumonia were successively reported world-wide in more than 216 countries and WHO declared as global pandemic on 11th March 2020 (WHO, 2020b). The WHO said that about 1 out of 6 people become seriously ill due to COVID-19 in future. The elderly people with medical problems are at a bigger jeopardy of serious illness from novel COVID-19. As COVID-19 is viral pneumonia, therefore, antibiotics are useless in treatment; the antiviral drugs taken against flu will not work also. The recovery of patients depends on the potency of immune system (Tian-Mu et al., 2020).

The NHS advised that anyone with symptoms COVID-19 should stay at home for at least 7 days and no need to have doctor. If patients living with other people, they should stay at home for at least 14 days, to avoid spreading the infection outside dwell (Chen et al., 2020a; Huang et al., 2020; Cheng et al., 2021). This will be application to everybody, despite the consequences of whether they have travelled abroad. In continuation of same many countries have imposed travel bans and lockdown state of affairs in order to attempt and halt the spread of COVID-19 virus. As of 08th November, 2021, more than 250,654,462 people have been found to be infected by SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2, the causative agent of COVID-19) in more than 216 countries. As per the report of Worldometers, over 5,065,596 deaths and 226,899,869 recovered cases recorded globally with hardest hit on India with over 461057 fatalities due to COVID-19 by 08th November, 2021 (WM, 2021) (Fig. 5). Among the European countries Italy has been hardest hit due to COVID-19. In South American countries the cases of COVID-19 recorded comparative lower than the North American countries. On the other hand in Australian or Oceanic countries the number of infection was significantly lower than the other countries.

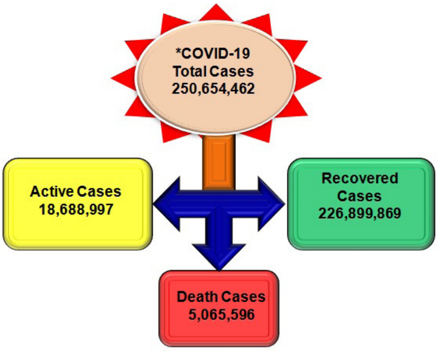


Fig. 5. Schematic summary of worldwide COVID-19 scenario as of 08th November, 2021. Source: Worldometers.

SEX, AGE AND IMMUNO-COMPROMISE PATIENTS BIASED INFECTIVITY OF COVID-19

The case-fatality rate (CFR) in COVID-19 seems to be elevated than in seasonal influenza (Dan et al., 2020; Yadav et al., 2021b). The augmented fatality case of COVID-19 could be because of variations in sex, age, underlying comorbidities of immuno-compromised patients, pathogenicity of the causative agent SARS-CoV-2, immunity status of populace, and responses of host to the infection (Davies et al., 2020; Hu et al., 2020; Jha et al., 2020; Upadhyay et al., 2020a; Upadhyay et al., 2020b; Biswas et al., 2021) (Fig. 6). It has been reported that the COVID-19 patients were more frequently obese, diabetes, frequently hypertension, and dyslipidaemia and experienced acute respiratory failure, pulmonary embolism, septic shock, or haemorrhagic stroke, but less frequently developed myocardial infarction or atrial fibrillation (Dan et al., 2020) (Figs. 1, 6)

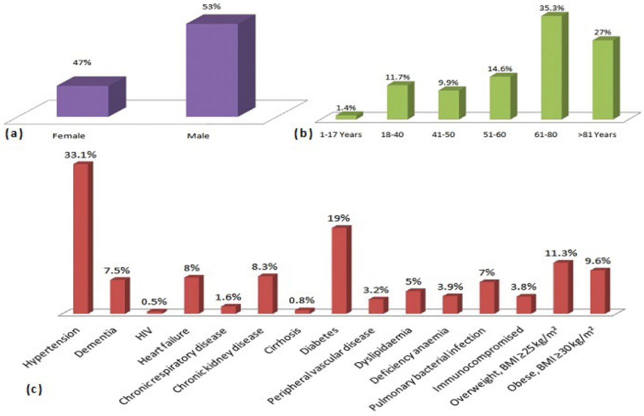
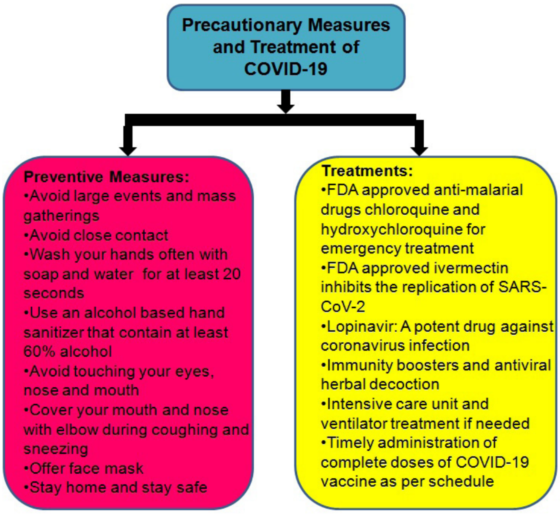


Fig. 6. Risk of infectivity and morbidity among COVID-19 patients: (a) Sex based, (b) Age based and (c) comorbidities.

PREVENTIVE MEASURES FOR COVID-19

To control this pandemic, precautionary measures that may prevent or slow down the transmission of the COVID-19 have been implemented (Flaxman et al., 2020; Mehmet et al., 2020). These include case identification or tracing, isolation or quarantine, follow-up of contacts to break the chain, environmental disinfection or sanitization, use of personal protective equipments to reduce multiple infections during health care and social services, treatments through medicine, immunity boosters, ayurveda, decoctions, etc. (Cascella et al., 2020; Ling, 2020; Yang et al., 2020). Along with these the Governments has forced lockdown in several phases after the recommendation of authorized medical agencies and WHO to combat the further spreading of the COVID-19 (Chen et al., 2020a,b; De Wit et al., 2020). Meanwhile the scientists and Pharma companies were working on the designing, and development of vaccines and their trial for mass production. After successful trial these vaccines were administered to most prone age group first followed by the subsequent one as well pan world.

The WHO and CDC suggested subsequent safety measures to avoid COVID-19 spreads in early exposure periods (Fig. 7): (a) Keep away from large events and mass gatherings, (b) Stay away from close contact (maintain a gap of 6 feet) with anyone or symptomatic, (c) Remain distant yourself and others if COVID-19 spreading in community, particularly if having a top risk of serious illness, (d) Wash your hands over and over again with soap and water for at least 20 seconds, or exercise an alcohol-based hand sanitizer, (e) Face your mouth and nose with elbow or tissue paper during sneezing and coughing and let it thrown into closed dustbin, (f) Shun touching your eyes, nose and mouth from unclean hand, (g) Spurn allotment dishes, glasses, bedding and other household items if symptomatic, (h) Clean and disinfect surfaces habitually touch on daily basis, (i) Stay home, stay safe, work from home, avoid school and public areas if ailing, unless going to doctor, (j) keep away from public transportation if unwell, (k) Offer mask and hand gloves, and (l) Take COVID-19 vaccine doses as per schedule and guidelines recommended by the Government.



Preventive Measures:

•Avoid large events and mass gatherings

•Avoid close contact

•Wash your hands often with soap and water for at least 20 seconds

•Use an alcohol based hand sanitizer that contain at least 60% alcohol

•Avoid touching your eyes, nose and mouth

•Cover your mouth and nose with elbow during coughing and sneezing

•Offer face mask

•Stay home and stay safe

Treatments:

•FDA approved anti-malarial drugs chloroquine and hydroxychloroquine for emergency treatment

•FDA approved ivermectin inhibits the replication of SARS-CoV-2

•Lopinavir: A potent drug against coronavirus infection

•Immunity boosters and antiviral herbal decoction

•Intensive care unit and ventilator treatment if needed

•Timely administration of complete doses of COVID-19 vaccine as per schedule

Fig. 7. COVID-19: Precautionary/ preventive measures and treatments.

MUTATED STRAINS OF SARS-COV-2

Accumulation of mutations within the genome is the primary driving force in viral evolution within an endemic setting (Dan et al., 2020; Baden et al., 2021). This inherent feature often leads to altered virulence, infectivity and transmissibility, and antigenic shifts to escape host immunity, which might compromise the efficacy of vaccines and antiviral drugs (Yadav et al., 2021a; Upadhyay et al., 2021). Since the SARS-CoV-2 as RNA virus lacking mismatch repair mechanism and replication accompanied by a high mutation rate (Domingo and Holland, 1997). Therefore, the mutations of the coronavirus are commonsensical and predictable leads to several rapidly spreading variants

(Table 1). The comprehensive analysis of whole genome sequences of 837 Indian SARS-CoV-2 strains revealed the occurrence of 33 different mutations, 18 of which were unique to India (Tang et al., 2020; Sarkar et al., 2021a,b; Tuli et al., 2021; WHO, 2021a,b). The data showed the even the higher risk of hospitalization for patients with delta variant than alpha variant (B.1.1.7), but two doses of vaccine gave a high degree (90%) of protection (Shrotri et al., 2021; Stowe et al., 2021; Williams et al., 2021). Therefore, it is imperative that currently known variants of COVID-19 and new variants should carefully consider in the design of an effective vaccine.

Table 1. Different variants of SARS-CoV-2 according to the World Health Organization (WHO).

Variant name	Month, Year of detection	1st detected by	Key mutations in spike protein	Reference
614G	January, 2020	Bavaria, Germany	D614G	Brussow, 2021; Plante et al., 2021
20C-US	May, 2020	United States	Q677; Q173	Pater et al., 2021
B.1.427/ B.1.429 (also known as Epsilon variant)	June, 2020	United States	L452R; W152C; S13I; D614G	Tomkins-Tinch et al., 2021
B.1.1.7 (also known as 20I/501Y.V1 or VOC202012/01 or Alpha variant)	September, 2020	United Kingdom	H69/V70; Y144; N501Y; A570D; P681H	Leung et al., 2021; Sarkar et al., 2021a
CAL.20C	October, 2020	Southern California	ORF1a: I4205V; ORF1b: D1183Y; S13I; W152C; L452R	Zhang et al., 2021
B.1.526 (also known as Iota variant)	November, 2020	United States	L5F; T95I; D253G; D614G; A701V; E484K or S477N	Annavajhala et al., 2021
B.1.525 (also known as Eta variant)	December, 2020	United Kingdom, Nigeria	H69-V70; Y144; Q52R; E484K; Q677H; D614G; F888L	Faria et al., 2021
B.1.351 (also known as 20H/501Y.V2 or Beta variant)	December, 2020	South Africa	L242/A243/L244; K417N; E484K; N501Y	Tegally et al., 2021; WHO, 2021a
B.1 descendant with 9 mutations	January, 2021	France	G142; D66H; Y144V; D215G; V483A; D614G; H655Y; G669S; Q949R; N1187D	West et al., 2021

B.1.1.28.1 (also known as P.1 or Gamma variant)	January, 2021	Brazil/ Japan	K417T; E484K; N501Y	Sabino et al., 2021; Chudik and Pesaran, 2021
B.1.1.28.3 (also known as P.3 or Theta variant)	February, 2021	Philippines	E484K; N501Y; P681H	Haseltine, 2021
B.1.1.28.2 (also known as P.2 or Zeta variant)	April, 2021	Brazil	L18F; T20N; P26S; F157L; E484K; D614G; S929I; V1176F	Faria et al., 2021
B.1.617.2 (also known as Delta variant)	March-May, 2021	London, UK, India	T19R; (V70F*); T95I; G142D; E156-; F157-; R158G; (A222V*); (W258L*); (K417N*); L452R; T478K; D614G; P681R; D950N	Salvatore et al., 2021; Williams et al., 2021
B.1.617.1/ B.1.617.3 (also known as Kappa variant)	February, 2021	Maharashtra India	G142D; E154K; L452R; E484Q; D614G; P681R; Q1071H	Cherian et al., 2021; WHO, 2021a,b

COVID-19 IN INDIAN PERSPECTIVES AND ACTION TAKEN BY THE GOVERNMENT

Looking at the trend in India, the first novel coronavirus infection was reported on January 30, 2020. Since then, the number of positive cases is continuously increasing, therefore to tackle the situation, Hon'ble Prime Narendra Modi, called for Janta Curfew of one day and thereafter declared a 21-day lockdown-1 till April 14, 2020 to break the chain of coronavirus transmission due to peculiar incubation period of SARS-CoV-2 (Chen et al., 2020a; Cheng et al., 2021). Furthermore, in a nationwide address Hon'ble PM urged people to practice social distancing, self quarantine and countrywide lockdown-2 for 19 day, until May 3; and soon after lockdowm-3 for 14 day, until May 17, 2020.

Since beginning new year 2020, India as member of Joint Monitoring Group World Health Organization (WHO), through Ministry of Health and Family Welfare (MoHFW), National Centre for Disease Control (NCDC), Indian Council of Medical Research (ICMR) and Ministry of Information and Broadcasting (MoIB) giving technical advice, guidance and resources for enhanced vigilance, preparedness and response to 2019-nCoV at both national and sub-national level. As on 30th January, Director-General WHO declared novel coronavirus (2019-nCoV) as a Public Health Emergency of International Concern (PHEIC) after International Heath Regulations (IHR) Emergency Committee. As on 31st January 2020, a laboratory confirmed case of novel coronavirus was reported in Kerala and admitted in hospital isolation ward. The patient was a student with Wuhan travel history. The Prime Minister's Office (PMO) and MoHFW were closely monitoring 2019-nCoV situation and intensifying preparedness and response efforts. Public health preparedness including surveillance, diagnostics, hospital preparedness, infection prevention and control, logistics and risk communication was constantly reviewed by the national and state health authorities along with NCDC, and created Strategic Health Operations Centre (SHOC) room to provide command and control functions and a helpline opened to answer public queries. The MoHFW and Ministry of Civil Aviation (MoCA) had initiated in flight announcements and entry screening for symptoms of fever and cough for travelers coming from China at 21 airports of India. The people screened also who lived in or have visited an area of Wuhan City, Hubei Province, but has subsequently extended elsewhere in China including family members or health care workers, who were caring for a person infected with 2019-nCoV. Human to human transmission based on current available information, coronaviruses may be transmitted from person to person either through droplets or contact. The MoHFW issued a travel advisory for Indians 'to avoid non-essential travel to China'.

Meanwhile, National Institute of Virology, Pune, equipped with international standards of expertise and capacity, has been testing samples of COVID-19 (formerly 2019-nCoV). From 31st January, 12 additional labs have started to function. Consecutively MoHFW has advised States to open their control rooms, appoint a nodal officer and popularize the control room number to enhance coordination between actors. The WHO India continues to maintain regular communication with WHO South-East Asia Regional Office and WHO Headquarters as well as MoHFW, NCDC, ICMR, other agencies and countries through International Health Regulations (IHR) mechanisms.

On 22nd February, Govt. of India informed that universal screening at airports will also apply for flights arriving from Indonesia, Kathmandu, Malaysia and Vietnam (in addition to China, Hongkong, Japan, Republic of Korea, Singapore and Thailand as being done previously). As the PMO, MoHFW and Cabinet Secretaries are closely monitoring the situation of COVID-19 in India continuously. The Government of India (GoI) previously issued travel advisories requesting the public to refrain from travelling to China, and from 26th February this advisory was applied to Iran, Italy and Republic of Korea also. The people were coming from these countries or having travel history, since 10th February 2020, quarantined for 14 days on their arrival to India.

On 11th March 2020, WHO declared novel coronavirus disease (COVID-19) as pandemic (an epidemic that has spread worldwide affecting a large number of people). On the day, per direction of the Hon'ble Prime Minister of India, a high-level Group of Ministers (GOM) was constituted to review, monitor and evaluate preparedness and measures taken regarding management of

COVID-19 in the country. The Government of India has invoked powers under the Epidemic Diseases Act, 1897 to enhance preparedness and containment of the virus and declared COVID-19 a 'notified disaster' under the Disaster Management Act 2005. Community surveillance, quarantine, isolation wards, adequate PPEs, trained manpower, rapid response teams for COVID-19 were being strengthened further in all States and UTs. All the states and UTs of India have been advised to invoke the provisions under Section-2 of the Epidemic Disease Act 1897. The government has declared the COVID-19 outbreak in the country a "notified disaster", in a move called "a special one-time dispensation", to provide compensation and aid to infected people and the families of those who died due to the virus. Funds for this and other measures will be drawn from the Disaster Response Funds of each state (SDRF).

Travel Advisories had been issued by MoHFW time to time with requisite amendments to following consolidated advisory issued at present. Starting from 13th March, all existing visas, except diplomatic, official, UN/International Organizations, employment, project visas, stand suspended until 15th April 2020 with few exceptions which latter on applied for all. All international passengers entering India are now required to furnish duly filled self declaration form and undergo universal health screening at the designated counters at all points of entry. As of 14th March, there were 52 laboratories identified by the ICMR, for testing of COVID-19 and total 57 laboratories have been identified to support sample collection and referral.

On March 18th, the Govt. of India including 23 states/UTs and New Delhi have issued orders allowing only essential services to operate in 75 districts with confirmed COVID-19 cases until 31st March, 2020. The focus was on closure of all activities except essential services such as hospitals, telecom, pharmacy, provision stores. Meanwhile, the Hon'ble Prime Minister Shri Narendra Modi called for 'Janata curfew' on 22nd March from 7AM to 9PM, urging people to stay home except those in essential services, enforcing publicled social distancing interventions. Allaying concern of the logistics for COVID-19 management particularly masks and hand sanitizers; Government has notified an Order under the Essential Commodities (ECs) Act, 1955 to declare these items as Essential Commodities up to 30 June, 2020.

The Hon'ble Prime Minister Mr. Narendra Modi, in exercise of the powers under section 6(2)(i) of the Disaster Management Act, 2005, issued an order for State/UTs prescribing lockdown for containment of COVID-19 epidemic in the country for a period of 21 days with effect from 25th March to April 14; lockdowm-2 for 18 day, until May 3; and lockdowm-3 for 14 day, until May 17, 2020. India's response to COVID-19 has been pre-emptive, pro-active and graded with high-level political commitment and a 'whole government' approach to respond to the COVID-19 pandemic. Furthermore, no scheduled international commercial passenger aircraft shall take off from any foreign airport for any airport in India, and all train services suspended including sub urban rail services, metro rail services and interstate passenger transport till further order. Good trains may continue to operate for facilitating availability of essential commodities. Indian Railways issued an order that the period from 22nd March to 14th April will be treated under "Force Majeure". The ICMR has issued guidelines for use of commercial kits for nasal/throat swab based diagnosis of COVID-19 and 104 out of 119 proposed labs in public sector are functional for SARS-CoV-2 test 31st March, 2020.

The India has the most stringent shutdown measures of any country battling COVID-19. But the lockdown also poses enormous economic costs and disproportionately hurts the poor in India. Nearly half the country, 700 million people will not be able to survive for three weeks without economic relief and food. At the time of the announcement, known coronavirus cases were doubling every five days. The government declared a countrywide lockdown because it knows India's healthcare capacity is weak and will most likely collapse if there is swift local transmission of the virus. Providing relief to the poor while overall, India had few choices other than some version of a lockdown, a poorly planned and executed lockdown has created a serious humanitarian problem.

Two days after the announcement of the lockdown, the Union finance minister, Nirmala Sitaraman, announced a stimulus to provide additional relief for this group through schemes such as the National Rural Employment Guarantee Scheme. The most important component of the stimulus and relief package was the provision of 10 kilograms of food grain and 1 kilogram of lentils per person per month under the public distribution system (PDS). The PDS has a countrywide network with excellent penetration. Though notorious for its corruption and leakages, this is still the fastest method for the government to transmit essential food supplies to hundreds of millions of people. India needs to add more essentials to the in-kind transfer through the PDS system, such as masks, soaps, and hand sanitizers. The main problem at the moment is that not everyone in need has the "ration card" required to access the local PDS ration store. But Union and state governments should suspend the requirement of a ration card and accept any valid ID to distribute the in-kind transfer. About 850 million Indians have voter identification cards, and more than a billion have the biometrically linked AADHAAR card. Both are good substitutes for the ration card to provide immediate relief. Mobile phone penetration is so high that it can be also be used to survey and crowd source information on availability of food and other essentials at PDS stores.

In particular, economic migrants working in urban areas and now trying to return home to their families struggled, as trains and buses stopped running and state borders closed for the lockdown. There was little to no relief provided in the stimulus for this group. The simplest method to alleviate their stress is a direct cash transfer for a few months to help buy essentials and survive the loss of wages owing to the lockdown and uncertainty thereafter. The government has repeatedly made claims that most Indians have access to a bank account, especially after the launch of the prime minister's Jan Dhan bank account scheme to further financial inclusion. According to the March 2020 progress report of the Jan Dhan Scheme, there are 383.3 million Jan Dhan bank account holders. The stimulus package also announced cash transfers of 500 rupees ($6.60) per month through Jan Dhan accounts to approximately 200 million female beneficiaries. This amount is too small, not even a fifth of the poverty line of $1.25 a day, but is intended to supplement the in-kind food grain transfers. The stimulus also provides a one-time transfer of 1,000 rupees ($13.20) to 30 million senior citizens.

Daily wage earners in the informal sector are truly invisible in the Indian policy framework. There are very little data and identification of this group and its characteristics, and no government schemes exist to provide them a safety net. They fall above the poverty line of $1.25 a day, but they do require assistance during an economic contraction as severe as the government-imposed lockdown. Aside from Jan Dhan accounts, the best way to target these 300-400 million Indians are to transfer money through mobile phones using Paytm and similar applications. Almost all of them have an AADHAAR card, which can be linked to a mobile money transfer to swiftly put cash in their pockets. India's COVID-19 stimulus and economic relief package is the smallest in the world, including among emerging economies. And India's lockdown is the most stringent measure taken so far, at an enormous cost to the economy, in particular to its poorest citizens. Both the Union and state governments need to announce direct cash transfers targeting a larger group. This amount should at minimum cover the poverty line, at 3,000 rupees per month, and should last a minimum of three to four months which further extended for the year. The lockdown in India was a big challange for health, education and economy, but the Indian peoples used this period as an opportunity to transform the traditional and conventional teaching learning methods and skill in to modern trends (Dan et al., 2020; Garg et al., 2020; Kumar et al., 2020; Jha et al., 2020; Sood et al., 2020; Upadhyay et al., 2020a,b; Upadhyay et al., 2021). As for as current Indian scenario of COVID-19 concerned, about 34377113 infected cases were recorded till 08th November, 2021 (Fig. 8). Out of these 33775086 cases recovered successfully with 461389 deaths due to COVID-19. Currently nearly 140638 active cases also hospitalized for their successful treatment as per the report of dated 09th November, 2021.

PAN-INDIA COVID-19 VACCINATION DRIVE

One of the biggest vaccinations drives in the globe commenced in India on 16th January 2021 with the aim of providing vaccines pan-India free of cost. India's effective and powerful program for vaccine development and production aims to synthesize vaccines for domestic use as well as for distribution in countries across the Globe which was economically unequipped to produce vaccines. Simultaneously the other countries wer also trying to produce the vaccines to combat the COVID-19 at their level best (Bagcchi, 2021; Hippich et al., 2021; Kumar et al., 2021; SR, 2021). As per the report of the Press Information Bureau, several brands of COVID-19 vaccines available in India right now (Covishield, Covaxin™, HDT-301, ZyCoV-D, RBD219-N1, and Sputnik V), out of which the main two being applied pan-India are Covishield and Covaxin™. Covishield (Serum Institute of India Ltd) and Covaxin™ (Bharat Biotech International Ltd) have been provided "emergency use authorization" by the. SEC (Subject Expert Committee) of DCGI (Drugs Controller General of India) The vaccination drive has been devised as such that people at greater risk of the disease will be vaccinated first. The vaccination drive aims to prioritize the vaccination of frontline workers, healthcare workers, people >50 years of age (with priority being given to ones >60 years), and people of 50 years with comorbidities. Thereafter, March 1st, 2021 this was extended to everybody of age >45 years and who have explicit comorbidities. The continuous effort of Indian Govt. has been appreciated by WHO and till 06th November, 2021, India has successfully administered more than 108 cores of vaccine doses that is dedicated to the 152nd birth anniversary of Rasthrapita Mahatma Gandhi and 75th Azadi ka Amrit Mahotsav.

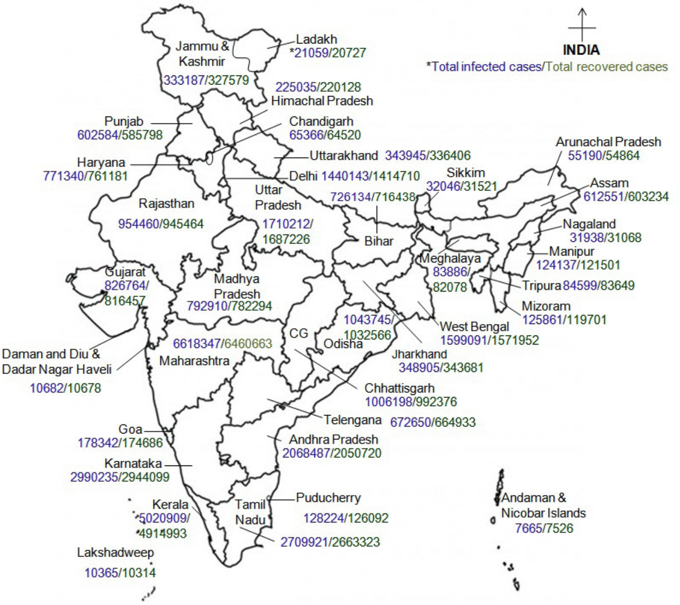


Fig. 8. State wise total confirmed cases of COVID-19 and completely recovered recovered patients discharged successfully from hospitals in India as of 08th November, 2021. Source of data: AarogyaSetu App.

CONCLUSIONS

The COVID-19 (declared as Pandemic by WHO on 11th March 2020) is characterized beyond demographic range because of its worldwide spreading phenomenon. This means that people of any creed are vulnerable to coronavirus, and that each of us needs to take our roles seriously in the fight against the virus. The current situations in all countries have worsened due to non-compliance of people to the rules and regulations pertaining to COVID-19. These regulations are the proper use of masks and the sanitization of hands for at least 20 seconds with the use of soap and water. Coronavirus infected person has many common symptoms such as fever, cough, myalgia, tiredness, pneumonia and complicated dyspnea, whereas less common reported symptoms include headache, diarrhea, hemoptysis, runny nose, and phlegm-producing cough. To control this pandemic, precautionary measures should be taken to slow down the transmission of the COVID-19 including identification or tracing, isolation or quarantine, follow-up of contacts to break the chain or tracking, environmental disinfection or sanitization, use of personal protective equipments to reduce multiple infections during health care and social services, treatments through medicine/, immunity boosters, ayurveda/ therapy, decoctions, etc. In Indian perspectives, one of the biggest vaccinations drives in the globe commenced on 16th January 2021 with the aim of providing vaccines pan-India free of cost. As per the report of the Press Information Bureau, more than 108 cores of vaccine (Covishield and Covaxin™) doses administered as of 06th November, 2021.

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Chapter 2

Zoonoses and Other Communicable Diseases: An Emerging Threat to Human Life, Causes and Therapy

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ABSTRACT

Zoonosis (zoonoses-plural) is an infectious disease that is transmitted between species from animals to humans or from humans to animals. There are over 200 known types of zoonoses including virus borne, bacteria borne, protozoa borne, fungi borne, helminthes borne, arthropodaborne, and airborne waterborne and foodborne infections or communicable diseases. Because of the close association between people and animals, it's imperative to be aware of the common ways through which people can get infected with germs that can cause zoonotic diseases. Thus zoonoses comprise a large percentage of new and existing diseases in humans and some of them are 100% preventable through vaccination and other methods. However, other requires precautionary measures declared by the representative agencies. Along with these, peoples should strictly follow the regulations and guidelines issues by the Government as well which will be a keystone in combating these diseases. The intention of the current article is to explore the various dimensions zoonoses and other communicable diseases as a threat to human life, causes and therapeutic approaches along with steps taken by the Government to cut its further spread.

Keywords: Zoonose, Communicable Diseases, Zoonotic Diseases, Vaccine, Helminthes

INTRODUCTION

Zoonotic diseases (also known as zoonoses) are caused by germs that spread between animals and people (Nichols, 1999; Sambri et al., 2004; CDC, 2021). Since animals provide many benefits (food, fiber, livelihoods, travel, sport, companionship, and education) to people, therefore people interact with animals in their daily lives, both at home (pet and house hold) and away from home (during travel, while visiting animal exhibits or zoos, or while enjoying outdoor activities) (Ghasemzadeh and Namazi, 2015; Stull et al., 2015; Damborg et al., 2019; Kotton, 2021; Davis et al., 2021; Pitol and Julian, 2021). The animals sometimes may carry harmful germs that can spread to people and cause illness – these are kn own as zoonotic diseases or zoonoses (Karesh et al., 2012; Upadhyay, 2012; Seladi-Schulman and Seymour, 2018; Babita et al., 2019; Upadhyay et al., 2019a; Rahman et al., 2020; Upadhyay, 2020a,b). The zoonotic diseases are caused by harmful germs including viruses, bacteria, parasites (protozoa and helminthes), and fungi (Upadhyay, 2012; Dan et al., 2020; Haider et al., 2020; Sood et al., 2020; Tuli et al., 2021). These causative agents may also transfer through air, water, food, contact or contagious infections (Upadhyay, 2012; Upadhyay, 2020b; Zhang et al., 2020). These germs can cause many different types of illnesses in people and animals, ranging from mild to serious illness and even death. The animals may also sometimes work as vector or paratenic hosts and appear healthy even they are carrying germs that can make people sick, and turned into fatal zoonotic disease (Upadhyay, 2012; Sood et al., 2020; Upadhyay, 2020b; Upadhyay et al., 2020a,b). Thus, the zoonotic diseases are very common around the world and as per scientific estimate about more than 60% known infectious diseases in people can be spread from animals, and over 75% new or emerging infectious diseases in people come from animals (Castro, 2010; Rahman et al., 2020; CDC, 2021). There are over 200 known types of zoonoses including virus borne, bacteria borne, protozoan borne, fungus borne, parasitic helminthes borne, food borne, water borne and air borne infections or communicable diseases (Chomel, 2009; Castro, 2010; Upadhyay, 2012; Rahman et al., 2020; Upadhyay, 2020b; Sood et al., 2020; Upadhyay et al., 2021; CDC, 2021; Tuli et al., 2021). The most common example of zoonotic diseases are animal flu, anthrax, bird flu, bovine tuberculosis, brucellosis, *Campylobacter* infection, cat scratch fever, coronavirus infection [severe acute respiratory syndrome (SARS), middle east respiratory syndrome (MERS)], COVID-19, cryptosporidiosis, cysticercosis, dengue fever, ebola, encephalitis from ticks, enzootic abortion, erysipeloid, fish tank granuloma, giardiasis, glanders, hemorrhagic colitis, hepatitis E, human immunodeficiency virus (HIV) infection, hydatid disease, leptospirosis, listeria infection, louping ill, lyme disease, lymphocytic choriomeningitis, malaria, orf infection, parrot fever, pasteurellosis, plague, Q fever, rabies, rat-bite fever, ringworm, rocky mountain spotted fever, *Salmonella* infection, *E. coli* infection, streptococcal sepsis, swine flu, toxocariasis, toxoplasmosis, trichinellosis, tularemia, West Nile virus, zoonotic deptheria, and zoonotic influenza (CDC, 2011a,b; MFMERE, 2011; NLM, 2011; Kumar et al., 2018; Upadhyay et al., 2019a,b,c; Dan et al., 2020; Garg et al., 2020; Jha et al., 2020; Kumar et al., 2020; Sood et al., 2020; Upadhyay et al., 2020a,b; CDC, 2021; Tuli et al., 2021; Upadhyay et al., 2021; Yadav et al., 2021a,b).

TYPES OF ZOONTIC DISEASES

Zoonosis is another name for a zoonotic disease (Nichols, 1999). This type of disease passes from an animal or insect to a human. Some don't make the animal sick but will sicken a human (Thorns, 2000; Sambri et al., 2004). Zoonotic diseases range from minor short-term illness to a major life-changing illness (Akritidis, 2011; Cantas and Suer, 2014). Certain ones can even cause death. The types of zoonosis include air borne, water borne, soil borne, food borne, direct contact and those caused by a virus, bacteria, fungus, parasites (Protozoa, Helminthes, Arthropoda, etc.) (Nichols, 1999; Thorns, 2000; Sambri et al., 2004; Akritidis, 2011; Karesh et al., 2012; Upadhyay, 2012; Esch and Peterson, 2013; Morwal and Sharma, 2017; Adebiyi and Oluwayelu, 2018; Seladi-Schulman and Seymour, 2018; Babita et al., 2019; Upadhyay et al., 2019a; Rahman et al., 2020; Tuli et al., 2021). Zoonotic diseases spread by mosquitos and ticks are some of the most serious of these diseases.

Airborne Zoonotic Diseases

Airborne diseases can be transmitted from one individual to another through the air. Common infections that spread by airborne transmission include COVID-19, measles, morbillivirus, chickenpox virus, *Mycobacterium tuberculosis,* influenza virus, entervirus, norovirus, coronavirus, adenovirus and respriraory syncytial virus (CDC, 2011a,b; MFMERE, 2011; NLM, 2011; Kumar et al., 2018; Upadhyay et al., 2019c; Dan et al., 2020; Garg et al., 2020; Haider et al., 2020; Jha et al., 2020; Kumar et al., 2020; Sood et al., 2020; Upadhyay et al., 2020a,b; Tuli et al., 2021; Upadhyay et al., 2021; Yadav et al., 2021a,b). Airborne pathogens or allergence typically enter the body via the nose, thraoat, sinuses and lungs (Fernstrom and Goldblatt, 2013; Kumar et al., 2020; Upadhyay et al., 2020a,b; Weatherspoon and Pietrangilo, 2020; Zhang et al., 2020; Ather et al., 2021). Inhalation of these pathogens affects the respiratory system and can then spread to the rest of the body (Fernstrom and Goldblatt, 2013).

Waterborne Zoonotic Diseases

The waterborne zoonotic diseases are opportunistic parasites spreading directly from animals to man or man to animals through water that is either ingested or that contains forms capable of skin penetration (Acha and Szyfres, 2003; Nithiuthai et al., 2004; Papadopoulou et al., 2020). Waterborne disease in both epidemic and endemic forms continues to occur in both developed and less developed countries. The waterborne disease pathogens transmitted by the faecal–oral route, consumption of contaminated drinking water, inhalation of faecal droplets (e.g., some adenoviruses), and exposure through contact (e.g., recreational and occupational) (Nithiuthai et al., 2004; Griffiths, 2008; OE, 2021). *Cryptosporidium* and *Giardia* are major causes of diarrhoeal disease in humans, worldwide and are major causes of protozoan waterborne diseases (Monis, 2003; Fayer, 2004a,b; Gajadhar, 2004). The most significant zoonotic waterborne helminthic diseases (cestodiasis and trematodiasis) are either snail-mediated, copepod-mediated or transmitted by faecal-contaminated water (Mas-Coma et al., 2005; Robinson and Dalton, 2009; Upadhyay, 2012; Upadhyay et al., 2013a,b; Babita et al., 2019; Upadhyay, 2020b). These diseases include schistosomiasis, cercarial dermatitis, fascioliasis and fasciolopsiasis (Upadhyay et al., 2013a,b; Jaiswal et al., 2013, Jaiswal et al., 2014a,b). The primary copepod-mediated helminthiases are sparganosis, strongyloidiasis, gnathostomiasis and dracunculiasis, and the major faecal-contaminated water helminthiases are cysticercosis, hydatid disease and larva migrans (Mas-Coma et al., 2005; Robinson and Dalton, 2009; Taylor et al., 2014; Cheng et al., 2014; Liu et al., 2015; Upadhyay, 2017; Upadhyay, 2019; Liu et al., 2020; Grobusch and Hanscheid, 2021; Rawla and Jan, 2021). Human behaviour, particularly poor hygiene, methods of treating sewage and drinking water, and climate is a major factor in the re-emergence, and spread of parasitic infections (Fig. 1).

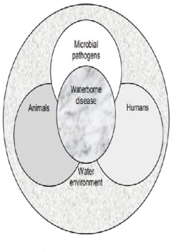

Fig. 1. Water borne zoonotic diseases and its interaction to aquatic environment. Source: Cotruvo et al., 2004.

Foodborne Zoonotic Diseases

Food-borne pathogens are microorganisms (i.e., bacteria, viruses, and fungi) as well as a number of parasites and they are the primary cause of food spoilage and food-borne diseases (Karesh et al., 2012; Belay et al., 2020). Food-borne microbes are major problems affecting food safety and human health. Foodborne zoonotic diseases are the causes of human infections after consumption of the animal products and water contaminated with pathogenic microorganisms (such as bacteria, viruses and parasites) or their toxins (Upadhyay, 2012; Hemlata and Virupakshaiah, 2016; Berhe et al., 2018; Heredia and Gracia, 2018; Abebe et al., 2020). They enter the body through the gastrointestinal tract where the first symptoms often occur. Many of these micro-organisms are commonly found in the intestines of healthy food-producing animals (Dharma et al., 2013; Baidaisee and Macpherson, 2014; Addis and Sisay, 2015; Bintis, 2017; Chlebicz and Slizewska, 2018). The risks of contamination are present from farm to fork and require prevention and control throughout the food chain.

The protozoan, *Cryptosporidium* and *Giardia* have life cycles which are suited to waterborne and foodborne transmission (Hunter and Thompson, 2005). *Cryptosporidium parvum* is the major zoonotic *Cryptosporidium* species, while *G. duodenalis* assemblages A and B have been found in humans and other mammalian orders. The use of harmonised methodology, standardised and validated molecular markers, together with sampling strategies provide sufficient information about all contributors including *Cryptosporidium* in soft fruit and salad vegetables (Zahedi et al., 2015; Pumipuntu and Piratae; 2018; Roberson et al., 2020). The most common foodborne bacteria diseases are caused by *Campylobacter, Salmonella, Yersinia, E. coli* and *Listeria* (Cloeckaert, 2006; Humphrey et al., 2007; Bintsis, 2017; CDC, 2017; Chlebicz et al., 2018; FDA, 2021). Several foodborne and waterborne helminthic diseases including echinococcosis, fascioliasis, taeniasis, cysticercosis, diphyllobothriosis, capillariasis, gnathostoamsiasis, anisakiasis, and ascariasis have been reported (Mas-Coma et al., 1999; Mas-Coma et al., 2005; Mas-Coma et al., 2007; Keiser and Utzinger, 2009; Sithithaworn et al., 2009; Upadhyay, 2012; Pal et al., 2018; Upadhyay, 2020b). Majority of the mentioned parasitosis have no successful detection and controlling mechanisms. Therefore, foodborne zoonotic diseases are a significant and widespread global public health threat.

Virus-borne Zoonotic Diseases

Mammals, birds, reptiles, and probably amphibians are reservoirs for viral zoonoses. Frequently, these viruses cause little or no overt disease in their nonhuman vertebrate hosts (Shanson, 1989). Some zoonotic viruses have very limited host ranges; others may infect a wide range of vertebrates. Transmission of zoonotic viruses may occur by a “variety of routes” calicivirus (including norovirus), rotavirus, hepatitis A virus, hepatitis E virus, HIV-AIDS; “direct” (e.g., rabies virus) or "indirect" (e.g., hantavirus) contact; "nosocomial" (e.g., Ebola virus); "aerosol transmission" (SARS coronavirus, MERS coronavirus, SARS-CoV-2); "vertical" (in utero) (Zika virus); and "vector- or arthropod-borne" (e.g., yellow fever virus and West Nile virus) (Murphy, 2008; Sharp and Hahn 2011; Barrett and Weaver, 2012; Kulkarni et al., 2015; Louten, 2016; Reed, 2018; Charlotte et al., 2021; Higs, 2021; Mirazimi et al., 2021).

Influenza A viruses are widely distributed in nature and infect humans along with a wide variety of birds, especially waterfowl, and mammals (Scotch et al., 2011). Arenaviruses are transmitted by the rodents that carry hanta viruses. Chikungunya (CHIK) is an alphavirus responsible for acute febrile disease with rash and severe arthralgia in people in Africa and Asia (Wood and Long, 2016). The disease is characterized by severe joint pain and can contribute to mortality as well. Zika virus (from Zika forest in Uganda in 1947) is flavivirus maintained in nature through a mosquito–monkey–mosquito (*Aedes* spp.) transmission cycle. The clinical complications of Zika virus infection is vertical transmission from mothers to infants either in utero or during delivery (Silva et al., 2019).

Sindbis (SIN) virus (Podosta disease in Finland) is one of the most widely distributed mosquito-borne viruses cause acute fever, with arthralgia, myalgia, and rash in humans (Ussitalo et al., 2021). Crimean-Congo hemorrhagic fever (CCHF) virus is very widely distributed causing headache, high fever, back pain, joint pain, stomach pain, vomiting, red eyes, a flushed face, a red throat, and petechiae (red spots) on the palate (Tonbak et al., 2006; Shyam et al., 2015). Sandfly fever viruses are endemic in the Mediterranean area and cause acute febrile disease in humans, with occasional aseptic meningitis (Woyessa et al., 2014; Marklewitz et al., 2020). Toscana virus (TOSV) caused aseptic meningitis in central Italy (Charrel et al., 2005; Marchi et al., 2017). Colorado tick fever (CTF) cause fever, chills, headache, retroorbital pain, photophobia, myalgia, abdominal pain, and generalized malaise) with prolonged convalescence (Johnson et al., 1997; Yendell et al., 2015).

Tahyna (TAH) virus produces an influenza-like febrile disease, with occasional central nervous system involvement and transmitted by Ochlerotatus mosquitoes (Osorio and Yuill, 2008; Reed, 2018). Rift Valley fever virus (RVF) is among the most serious arbovirus infections in Africa cause serious disease in humans (Boushab et al., 2016; Javelle et al., 2020; Kwaśnik et al., 2021). The clinical symptoms include abortion storms with febrile disease and bloody diarrhea, and mortality among Youngs. Marburg and Ebola virus (Ebola river, Democratic Republic of Congo) are hemorrhagic fever viruses associated with high mortality in humans and nonhuman primates (Feldmann et al., 2003; Breman et al., 2016; WHO, 2021c). Japanese encephalitis (JE) virus causes the greatest number of clinical human cases in India and transmitted by Culex sp. (Barrett and Weaver, 2012; Tiwari et al., 2012; Kulkarni et al., 2018; Singh et al., 2020; Rao, 2021). Nipah virus (NiV) was recognized to cause mild encephalitis and respiratory disease in transmitted by the giant fruit bats (Pteropus spp.); eventhough NiV was isolated from partially eaten fruit (Field et al., 2001; Luby et al., 2009; Luby et al., 2012; Hayman and Johnson, 2014; Mclean and Graham, 2019).

The eruption of the COVID-19 (formerly known novel coronavirus (2019-nCoV) disease) was reported in late 2019 from Wuhan, Hubei Province (China), called the epicenter of COVID-19 (coronavirus disease-2019) (Glidden et al., 2021; WHO, 2020a,b,c; WHO, 2021a,b). As of 08th November, 2021, more than 250,654,462 people have been found to be infected by SARS-CoV2 [severe acute respiratory syndrome coronavirus 2 (the causative agent of COVID-19] among more than 216 countries (WM, 2021). As per the report of Worldometers, over 5,065,596 deaths and 226,899,869 recovered cases recorded globally with hardest hit on India with over 461057 fatalities due to COVID-19 by 08th November, 2021 (WM, 2021). The main preventive measures were taken to curb the spread of COVID-19 including: social distancing, quarantile, immunity boosters, offer face mask and vaccination (Dan et al., 2020; Garg et al., 2020; Jha et al., 2020; Kumar et al., 2020; Sood et al., 2020; Upadhyay et al., 2020a,b; Tuli et al., 2021; Upadhyay et al., 2021; Yadav et al., 2021a,b). The viral zoonotic diseases occur on every continent except, perhaps Antarctica. (Osorio and Yuill, 2008; Reed, 2018)

Bacteria-borne Zoonotic Diseases

Bacteria are the causative agents of two-thirds of human food-borne diseases worldwide with high burden in developing countries (Abebe et al., 2020). The objective of this section is to highlight the background of food-borne bacterial pathogens and to review common major food-borne zoonotic bacterial pathogens. Food animals are the major reservoirs of many food-borne zoonotic bacterial pathogens, and food products of animal origin are the main vehicles of transmission (Adley and Ryan; 2016; Faour-Klingbeil and Todd, 2020). Meat, dairy products, and eggs are the main ways by which people are exposed to zoonotic bacteria (Abebe et al., 2020). *Staphylococcus aureus, Salmonella* sp., *Campylobacter* sp., *Listeria monocytogenes*, and *Escherichia coli* are the major zoonotic bacterial pathogens which are the causative agents of food-borne illness and death in the world associated with consumption of contaminated animal products (CDC, 2012; EFS, 2014; Abebe et al., 2020). Anthrax is an acute infectious disease caused by the spore-forming bacterium *Bacillus anthracis* (a soil borne bacterial disease) can occur in three forms: cutaneous, inhalation, and gastrointestinal (CDC, 2011a,b; NLM, 2011; Rahman et al., 2020). Bartonella (Cat Scratch Fever) - bacterial disease caused by *Bartonella henselae* begin in the human as a pustule that will gradually progress to regional lymphadenopathy transmitted through the feces of fleas (Van Dyke, 2011; Baranowski and Huang, 2021). Lyme disease or Lyme borreliosis is the most commonly transmitted tick-borne infection (Steere et al., 2004; Brownstein et al., 2005; Steere et al., 2016; Skar and Simonsen, 2021). Brucellosis is a bacterial infection that spreads from animals to people causes fever, joint pain, fatigue and can be treated with antibiotics (Davis and Stoppler, 2021; Miller, 2021). Ehrlichiosis is the general name used to describe several bacterial diseases that affect animals and humans and treated by doxycycline (Ismail et al., 2010; Snowden et al., 2021). Leptospirosis is a bacterial disease that affects humans and animals caused by *Leptospira* spread through direct contact of saliva, or contaminated water, soil, or food (Johnson, 1996; Levett, 2001). Plague is a zoonotic infection in human caused by gram-negative bacillus *Yersinia pestis* and the primary symtoms are bubonic, septicemic, and pneumonic (Perry and Fetherston, 1997; Dennis and Mead, 2006). All of these result from infection with the gram-negative bacillus *Yersinia pestis.* Infection with *Chlamydophila psittaci* (formerly known as *Chlamydia psittaci*) is cause of systemic illness in companion birds (birds kept by humans as pets) and poultry referred to as avian chlamydiosis (also known as psittacosis, ornithosis, and parrot fever) in birds (Smith et al., 2005; Vorimore et al., 2015; Balsamo et al., 2017; Chu et al., 2021).

Fungi-borne Zoonotic Diseases

Zoonotic fungi can be naturally transmitted between animals and humans to cause significant public health problems (Adebiyi and Oluwayelu, 2018). A number of mycoses associated with zoonotic transmission are among the group of the most common fungal diseases, worldwide caused by caused by *Talaromyces (Penicillium) marneffei, Lacazia loboi, Emmonsia* spp., *Basidiobolus ranarum, Conidiobolus* spp. and *Paracoccidioides brasiliensis* (Seyedmousavi et al., 2015; Seyedmousavi et al., 2018; Adebiyi and Oluwayelu, 2018; Rahman et al., 2020) (Table 1). A number of these infections are among the group of the most common fungal diseases, such as: dermatophycosis, sporotrichosis, and histoplasmosis (Bullpitt and Weedon, 1978; Walsh and Dixon, 1996; de Lima Barros et al., 2008; Guarner and Brandt, 2011). Dermatomycoses infections of the skin, hair and nails caused by dermatophytes, and in rarer cases by yeasts and moulds (Nenoff et al., 2014; White et al., 2014). Histoplasmosis associated with bat guano (stool) and is a type of lung infection caused by inhaling *Histoplasma capsulatum* fungal spores (Deepe, 2018; Felcon, 2019). Coccidioidomycosis is an infection usually caused by inhaling the spores of either *Coccidioides immitis* or *Coccidioides posadasii* fungi (Jang et al., 1992; Ampel et al., 1993; Verghese et al., 2002; Page et al., 2012; Nguyen et al., 2013; Johnson et al., 2014; Hernandez et al., 2019). Blastomycosis is a rare fungal infection usually acquired by inhaling the spores of a fungus (*Blastomyces dermatitidis*) that can be found in wood and soil (McBride et al., 2017; Brown et al., 2018; Miceli and Krishnamurthy, 2021).

Table 1. Medically important fungi with the potential of zoonotic transmission to humans. Sourse: Seyedmousavi et al., 2015.

Aetiological Agent	Disease	Transmission to Humans	Target Animals	Symptoms in Animals	Symptoms in Human
Microsporum spp., *Trichophyton* spp.	Dermatophytosis	Direct contact with infected animals or material	All domesticated mammals and sometimes wildlife	Classical ring lesion with central healing and crusts at the peripheral area, some degree of folliculitis	Dermal lesion, Wort, Itching in area of infection
Sporothrix schenckii S. brasiliensis	Sporotrichosis	Work-related trauma, scratches or bites from animals	Cats; occasionally dogs, horse, cow, camel, dolphin, goat, mule, bird, pig, rat, armadillo	Localized cutaneous, lymphocutaneous and disseminated infection	Fixed cutaneous, lymphocutaneous, osteoarticular and disseminated infection
Mallasezia spp.	Malassezia infection (pityriasis)	Malassezia yeasts are commensal of human skin (part of the normal microbiota)	Domestic animals such as dogs, cats, cows, sheep, pig, horse, wild animals held in captivity, and animals from wildlife	Dermatitis, alopecia, stenosis, otitis externa	Chronic superficial disease of the skin (pityriasis versicolor), folliculitis, seborrhoeic dermatitis and dandruff, fungaemia
Cryptococcus neoformans, C. gattii	Cryptococcosis	Mainly by inhalation od fungus, occasionally through breaks in the skin	Wide variety of mammals, birds, reptiles and amphibians	Focal or disseminated infection, affecting a single organ system or many, central nervous system involvement	Cutaneous, ocular, pulmonary and central nervous system involvement

Penicillium (Talaromyces) marneffei	Penicilliosis	Unknown	Bamboo rats, domestic animals such as dogs, cats	Skin dermatitidis, rhinitis, otitis externa and disseminated infection	Non-specific clinical signs (generalized lymphadenopathy, molluscum contagiosum-like lesions of the skin and mucosa) and disseminated infection
Lacazia loboi	Lobomycosis	Trauma	Dolphins	Granulomatous dermatitis	Granulomatous dermatitis
Emmonsia spp.	Adiaspiromycosis	Inhalation of the fungus	Wild rodents	Deep mycoses	Lung and disseminated disease
Conidiobolus coronatus, C. incongruus, Basidiobolus ranarum	Entomophthoromycosis	Traumatic implantation or inhalation of the fungus	Horses, dogs, sheep	Cutaneous and disseminated infection	Chronic subcutaneous and invasive infection
Histoplasma capsulatum	Histoplasmosis	Inhalation of the fungus	Cattle, sheep, horses	Non-specific signs (chronic gastro-intestinal infection) and disseminated infection	Chronic progressive lung disease, chronic cutaneous or systemic disease or an acute fulminating fatal systemic disease
Coccidioides immitis, C. posadasii	Coccidioidomycosis	Inhalation of arthroconidia and skin trauma	Dogs, llamas, non-human primates, cats, horses, domesticated or wild mammals, snakes	Asymptomatic to severe and fatal infection	Cutaneous, pulmonary, disseminated infection

Paracoccidioides brasiliensis, P. lutzii	Paracoccidioidomycosis	Inhalation of the fungus, injuries of the skin and mucosal membranes	Dogs, domesticated and wild animals (armadillos and monkeys)	Non-specific clinical signs depending on the organ involved (lymphadenomegaly, apathy, and hepatosplenomegaly)	Mucocutaneous, pulmonary or disseminated infection
Blastomyces dermatitidis	Blastomycosis	Inhalation of airborne conidia	Dogs, cats, horses, marine mammals	Cutaneous, pulmonary, systemic infection	Cutaneous, pulmonary, disseminated infection (granulomatous and suppurative lesions in lung, skin and bones)
Pneumocystis carinii (mammals), *P. jirovecii* (Human)	Pneumocystosis	Inhalation of airborne conidia	Rodents, dogs, cats, cattle	Lethal pneumonia in immune debilitated animals	Asymptomatic, interstitial pneumonia, progressive pneumonia (in immunocompromised hosts)

Protozoa-borne Zoonotic Diseases

Zoonotic protozoal parasites, including toxoplasmosis (Fig. 2), Chagas′ disease, babesiosis, giardiasis, neosporosis, sarcosporidiosis (sarcocystosis), trypanosomiasis and leishmaniasis, can cause insidious infections, with asymptomatic animals being capable of transmitting diseases (Elbihari et al., 1987; Tenter, 1995; Arness et al., 1999; Wilson et al., 2003; Fayer, 2004a,b; Montoya and Liesenfeld, 2004; Dubey et al., 2007; Truc et al., 2007; Dubey and Jones, 2008; Steverding, 2008; Lemma et al., 2009; Van Wynsberghe et al., 2009; Gray et al., 2010; Feng and Xiao, 2011; Ghawar et al., 2011; Arjona-Jimenez et al., 2012; Longoni et al., 2012; Maritz et al., 2014; Shaapan, 2016; Berhe et al., 2018). Among these common zoonotic protozoal diseases toxoplasmosis, neosporosis, sarcosporidiosis (sarcocystosis), trypanosomiasis causing abortion which caused by single-celled protozoan parasites; *Toxoplasma gondii, Neospora caninum, Sarcocystis* spp and *Trypanosoma evansi*, respectively (Longoni et al., 2012; AbuBakar et al., 2013; Desquesnes et al., 2013; Esch and Petersen, 2013; Dubey, 2015; Chau et al., 2016; Shaapan, 2016; Berhe et al., 2018; Young et al., 2019; Wang et al., 2020). The infection can pass via placenta, causing encephalitis, chorio-retinitis, mental retardation and loss of vision in congenitally-infected children and stillbirth or mummification of the aborted fetuses of livestock (Zhou et al., 2011; Ricardo et al., 2012; Shaapan, 2016; Manuuel et al., 2020; Mose et al., 2020; Wang et al., 2020). *Trichomonas* and *Babesia* species while the zoonotic species had not been incriminated in induction of abortion in both animals and man (Loutan and Loutan, 1995; Dvorakova and Dvorackova, 2007; Genchi and Genchi, 2007; Zanet et al., 2014; Shaapan, 2016; Zeinab et al., 2016). The current section concluded that there is still need of wide scope for evaluation of the zoonotic impact and control of protozoan diseases.

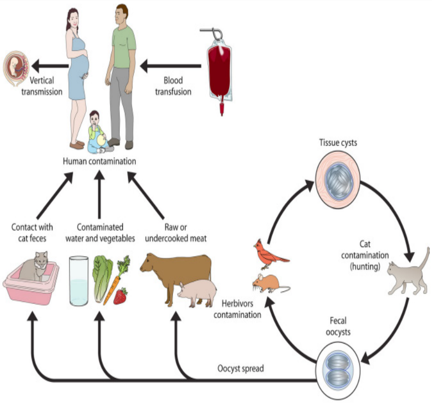

Fig. 2. *Toxoplasma gondii* life cycle and their zoonotic transmission to human. Source: Esch and Petersen, 2013.

Helminthes-borne Zoonotic Diseases

Nowadays, one of the most prevalent zoonotic diseases is infection with helminth parasites, which infect about one-third of the human population worldwide (Malhotra et al., 2009; Upadhyay, 2012; Babita et al., 2019; Upadhyay et al., 2019a,b; Upadhyay, 2020a,b; Upadhyay and Nanware, 2020). Helminths are parasitic worms, an evolutionarily ancient and diverse group of metazoan organisms, which include cestode tapeworms, nematode roundworms, and trematode flukes (Upadhyay et al., 2009; Kumar et al., 2011; Upadhyay et al., 2013a; Jaiswal et al., 2014a; Upadhyay et al., 2015a; Upadhyay et al., 2016; Upadhyay 2017a,b; Nanware et al., 2019; Rani and Upadhyay, 2019; Upadhyay, 2019; Upadhyay, 2020c; Upadhyay et al., 2020c; Upadhyay and Babita; 2021). Mortality is low in healthy hosts, but is often life-threatening to individuals with poor immunity, however morbidity can be quite high (Upadhyay, 2012; Jaiswal et al., 2013; Upadhyay et al., 2013b; Jaiswal et al., 2014b; Upadhyay et al., 2015b; Upadhyay 2017c; Upadhyay, 2018; Upadhyay and Singh, 2018; Upadhyay et al., 2019b) (Table 2). Some of the most important and well-known human zoonoses are caused by worm or helminth parasites, including species of nematodes (ancylostomiasis (Fig. 3) trichinellosis), cestodes (cysticercosis, echinococcosis) and trematodes (schistosomiasis) (Macpherson and Craig, 1991; Acha and Szyfres, 2003; Gracia et al., 2007; Robinson and Dalton, 2009; King, 2011; Standley et al., 2012; Upadhyay, 2012; McGarry et al., 2014; Thompson, 2015; Upadhyay, 2017a,b; Upadhyay, 2018; Thomas et al., 2019; Upadhyay, 2020b,c; Upadhyay and Nanware, 2020; Borlase et al., 2021).

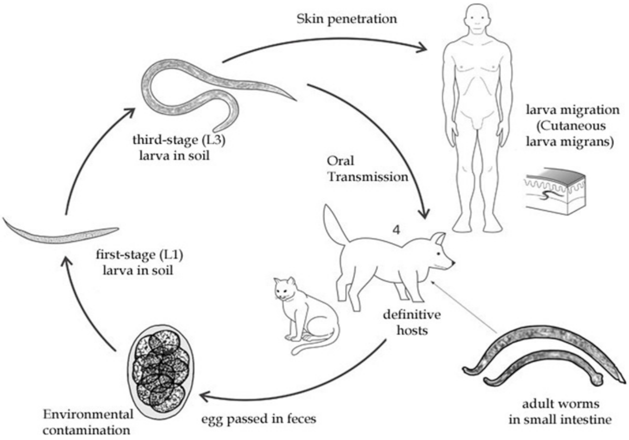

Fig. 3. Simplified life cycle of *Ancylostoma braziliense* and *A. caninum.* Source: CDC, 2011a,b.

Some helminthoses that commonly infect canids and felids are typically soil-transmitted including roundworm *(Ascaris lumbricoides*), whipworm *(Trichuris trichiura)*, hookworms *(Ancylostoma duodenale, A. ceylanicum, A. tubaeforme, Necator americanus* and *Uncinaria stenocephala)*, threadworm *(Strongyloides stercoralis)*, *Baylisascaris procyonis, Toxocara canis, T. cattis* (Rep and Bose, 1979; Acha and Szyfres, 2003; Haas et al., 2005; Gavin et al., 2005; Bethony et al., 2006; Bailey, 2006; Dangoudoubiyam and Kazacos, 2009; Bowman et al., 2010; Soriano et al., 2010; Deplazes et al., 2011; Santarém et al., 2011; Blaszkovska et al., 2013; Beiromvand et al., 2018; Eslahi et al., 2020; Mora Carpio and Meseeha, 2021; Shchelkanov et al., 2021; Winders et al., 2021) (Fig. 4). These are important zoonotic disease with worldwide distribution caused by parasitic helminthes have particular medical, economic, veterinary, and public health importance (Molyneux et al., 2011; Torgerson, 2013; Carmena and Cardona, 2014; Upadhyay, 2016a,b,c; Rohr et al., 2019; Katts et al., 2021). Therefore, their timely and efficient management, prevention and control strategies are urgent need for sustainable life and development.

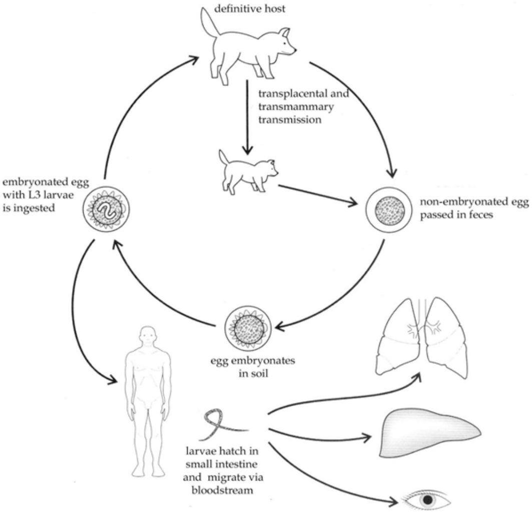

Fig. 4. Simplified life cycle of *Toxocara canis, T. cati* has a very similar life cycle, except that cats (instead of dogs) are the definitive hosts. Source: Despommier, 2003.

Table 2. Most common zoonotic helminthes infections, affected organs and ectopic location in human beings along the methods of diagnosis. Source: Hedley and Serafino Wani, 2015; Rahman et al., 2020.

Genus species	Primary natural/ Reservoir hosts (Secondary hosts)	Route of infection for human host	Location in human host (Secondary/ Ectopic site)	Primary method of diagnosis (Secondary methods)
Trematodes				
Fasciola hepatica	Cattle, sheep, buffalo	Ingestion of metacercariae on contaminated plant material	Liver	Observation of eggs in stool specimens; serology (histopathology)
Paragonimus kellicotti	Cats, dogs, raccoons, foxes, minks, muskrats	Ingestion of metacercariae in undercooked crayfish	Lungs	Observation of eggs in stool or respiratory specimens (serology; histopathology)

Nanophyetus salmincola	Raccoons, minks, skunks, otter, foxes, herons, mergansers (dogs)	Ingestion of metacercariae in undercooked fish	Small intestine	Observation of eggs in stool specimens
Metorchis conjunctus	Bears, foxes, wolves, raccoons, minks, fishers (dogs, cats)	Ingestion of metacercariae in undercooked fish	Liver	Observation of eggs in stool specimens
Cestodes				
Dibothriocephalus latus, D. nihonkaiense	Fish-eating carnivores	Ingestion of pleurocercoid larvae in undercooked fish	Small intestine	Detection of eggs and/or proglottids in stool specimens
Spirometra mansonoides	Dogs, cats	Ingestion of procercoid (microcrustaceans) or pleurocercoid (fish, reptiles, amphibians) larvae	Subcutaneous, soft tissues (eyes)	Histopathology (extraction of spargana from eye)
Dipylidium caninum	Dogs, cats	Ingestion of cysticercoid larvae in infected fleas	Small intestine	Detection of proglottids or egg packets in stool specimens
Hymenolepis nana, H. diminuta	Rodents	Ingestion of cysticercoid larvae in infected insects *(H. nana* eggs directly infectious)	Small intestine	Detection of eggs in stool specimens
Mesocestoides sp.	Cats, dogs	Ingestion of tetrathyridium larvae in intermediate hosts	Small intestine	Detection of proglottids in stool specimens
Taenia serialis	Dogs, foxes	Ingestion of infectious eggs	Subcutaneous tissue	Histopathology
Echinococcus granulosus, E. multilocularis	Dogs, wild canids (cats, wild felids)	Ingestion of infectious eggs	Liver, lung (brain, heart, gall bladder, bone, others)	Serology; histopathology
Nematodes				
Capillaria hepatica	Rodents	Ingestion of embryonated eggs	Liver	Histopathology

Anatrichosoma buccalis	Opossums	Unknown	Oral cavity; subcutaneous	Histopathology
Trichinella spiralis, T. pseudospiralis, T. nativa, T. murrelli, Trichinella T6	Domestic and wild pigs, bears, walruses	Ingestion of infectious larvae in infected animal meat	Adults: small intestine Larvae: skeletal muscle	Serology (histopathology)
Ascaris lumbricoides (syn. A. suum)	Pigs	Ingestion of embryonated eggs	Adults: small intestine (liver, gall bladder) L3 larvae: lungs	Detection of eggs and/or adults in stool specimens (histopathology: L3 larvae)
Baylisascaris procyonis	Raccoons (dogs)	Ingestion of embryonated eggs	CNS, eyes, (liver, lungs, heart)	Serology (histopathology)
Toxocara cati, T. canis	Cats, dogs	Ingestion of embryonated eggs (ingestion of L3 larvae)	Liver, heart, brain, lungs, eyes, other body parts	Serology (histopathology)
Anisakis sp., Pseudoterranova sp., Contracaecum sp.	Fish-eating birds and marine mammals	Ingestion of infective larvae in fish and shellfish	Stomach, intestinal tract (pancreas, mesocolic lymph nodes, perimetrium, mesenteries, peritoneum)	Detection of expelled larvae or larvae removed via endoscopy (histopathology, serology)
Dirofilaria immitis	Dogs, other carnivores	Vectorborne (mosquitoes)	Pulmonary vessels	Radiography
Dirofilaria tenuis, D. ursi, D. striata, D. subdermata	Raccoons *(D. tenuis)*, bears *(D. ursi)*, wild felids *(D. striata)*, porcupines *(D. subdermata)*	Vectorborne (black flies for *D. ursi;* mosquitoes for others)	Subcutaneous nodules (conjunctiva)	Histopathology (extraction of adult worms from the eye)
Onchocerca lupi	Wild canids, felids	Vectorborne (black flies)	Subcutaneous, cervical nodules	Histopathology
Molinema spp	Rodents	Vectorborne (mosquitoes)	Eyes	Extraction of worms from the eye
Brugia spp	Rodents, carnivores	Vectorborne (mosquitoes)	Lymphatic tissue	Histopathology
Gnathostoma spinigerum	Cats	Ingestion of L3 larvae in copepods or paratenic hosts	Skin, liver, eyes, CNS, mesenteries, others.	Histopathology (serology)

Thelazia californiensis, T. gulosa	Dogs, cats, sheep, deer *(T. californiensis)*, cattle *(T. gulosa)*	Vectorborne (muscoid flies)	Eyes	Extraction of adult worms from the eye
Gongylonema pulchrum	Various mammals	Ingestion of infected insect intermediate host	Oral cavity	Extraction of adult worms from oral lesions (detection of eggs in stool specimens)
Ancylostoma caninum, A. braziliense	Dogs, cats	Penetration of skin by L3 larvae	Skin	Clinical presentation
Angiostrongylus cantonensis	Rats	Ingestion of L3 larvae in raw mollusks or produce contaminated with mollusk parts	CNS	PCR (serology; detection of L4 larvae in CSF; histopathology)
Acanthocephalans				
Macracanthorhynchus hirudinaceous, M. ingens	Pigs *(M. hirudinaceous)*, raccoons *(M. ingens)*	Ingestion of cystacanths in infected arthropod intermediate hosts	Intestinal tract	Observation of adults in stool specimens
Moniliformis moniliformis	Rats	Ingestion of cystacanths in infected arthropod intermediate hosts	Intestinal tract	Observation of adults and/ or eggs in stool specimens
Corynosoma strumosa	Seals, sea lions, fish-eating birds	Ingestion of cystacanths in fish paratenic hosts	Intestinal tract	Observation of adults

Arthropod-borne Zoonotic Diseases

The area of arthropod-borne diseases, continue to encounter major threats through malaria, dengue, dengue hemorrhagic fever, Japanese encephalitis and plague (IMFMT, 2008; Gubler, 2010; Pages et al., 2010; Chala and Hamde, 2021). The zoonotic viruses are divided into two groups: arthropod-borne (arboviruses) and nonarthropod-borne zoonotic viruses. The arthropod-borne or arboviruses are transmitted to humans by infected blood-sucking insects, such as mosquitoes, ticks, and *Phlebotomus* flies (sandflies) (Moriello, 2003; Heyman et al., 2010; McPhatter et al., 2012; Dolgin, 2014; Beckham and Tyler, 2015; Brasileira et al., 2016; Weetman et al., 2018; Huang et al., 2019; Žiegytė et al., 2021) (Table 3).

Table 3. Arthrpod borne zoonotic diseases, incubation period and clinical symtoms. Source: Genchi, 1992; Artsob, 2000; Ryan, 2017.

Disease	Microbial category	Arthropod host	Distribution	Incubation period (days)*	Clinical syndrome
Lyme disease	Bacterial	Tick	Southern Ontario, British Columbia, sporadic elsewhere, imported cases	3 to 30	Early disease – erthema migrans, myalgia, fever, arthralgia, lymphadenopathy; late disease – arthritis, enceph-alopathy
Relapsing fever	Bacterial	Tick	British Columbia	4 to 18	Fever, fatigue, chills, myalgia, arthralgia
Tularemia*	Bacterial	Tick	Canada wide	3 to 21	Fever, chills, myalgia types: ulcergl-andular, glandular, oculogranular, oropharyngeal, typhoidal, pneumonia
Plague	Bacterial	Flea	Western Canada	2 to 7	Types: bubonic (febrile illness, regional lymphadenitis buboes), septicemia, pneumonia, meningitis
Bartonella*	Bacterial	Louse, flea	Potentially Canada-wide†	3 to 38	Trench fever, bacillary anglomatosis, bacteremia, heptatitis, endocorditis, chronic lymphadenopathy, cat scratch disease
Q fever*	Rickettsial	Tick	Canada-wide	14 to 39	Fever, chills, fatiague, myalgia, hepatitis, pneumonia, encephalitis

Rocky Mountain spotted fever	Rickettsial	Tick	British Columbia, Alberta, Saskatchewan, Ontario, Nova Scotia	2 to 14	Fever, myalgia, malaise anorexia, exanthem
Human granulocytic ehrlichiosis	Rickettsial	Tick	Potentially in Canada†, imported	3 to 16	Fever, malaise, myalgia, anorexia, seizure, coma
Endemic (murine) typhus	Rickettsial	Flea	Potentially Canada-wide†	8 to 16	Fever, chills, myalgias, diarrhea, exanthem
California encephalitis	Viral	Mosquito	Canada-wide	5 to 15	Febrile illness, encephalitis, possible respiratory involvement
Western equine encephalitis	Viral	Mosquito	Western Canada	5 to 15	Fever, encephalitis, occasional respiratory symptoms
Eastern equine encephalitis	Viral	Mosquito	Quebec, Ontario	3 to 10	Fever, encephalitis, anorexia
Powassan encephalitis	Viral	Tick	Ontario, Quebec, New Brunswick	8 to 34	Fever, encephalitis, respiratory distress, lethargy
Colorado tick fever	Viral	Tick	Alberta, British Columbia	3 to 14	Fever, lethargy, myalgia, exanthem meningoencephalitis
St Louis encephalitis	Viral	Mosquito	Ontario, Quebec, Manitoba, Saskatchewan	4 to 21	Fever, malaise, encephalitis
Cache Valley	Viral	Mosquito	Ontario, Manitoba, Saskatchewan, Alberta	Unknown	Implicated in congenital defects of the central nervous system
Dengue	Viral	Mosquito	Imported	3 to 15	Febrile illness may be biphesic with rash, hemorrhagic fever, shock
Exotic arboviral infections	Viral	Mosquito, tick, sandfly	Imported	3 to 18	Fever, encephalitis, arthralgia, hepatitis

Malaria	Parasitic	Mosquito	Imported	12 to 30‡	Fever, chills, headache, shock, renal failure, encephalitis
Babesiosis	Parasitic	Tick	Potentially in Canada†, imported	7 to 42	Fever, chills, myalgia, arthralgia, fatigue

Where: *The disease may have an arthropod-borne association, but it is not necessarily the main means of transmission to humans; †Reflects speculation by the author.

MODE OF INFECTION AND SPREAD OF ZOONOTIC DISEASES

Anyone can get sick from a zoonotic disease, including healthy people. However, some people like childrens younger than 5 years, adults older than 65 years, persons with immunocompromised systems and pregnant women are higher at risk than others. Because of the close connection between people and animals, it's important to be aware of the common ways people can get infected with agents that can cause zoonotic diseases. These can include:

a. **Direct contact:** Coming into contact with the saliva, blood, urine, mucous, feces, or other body fluids of an infected animal.

b. **Indirect contact:** Coming into contact with areas where animals live and roam, or objects or surfaces that have been contaminated with germs.

c. **Vector borne:** Being bitten by a tick, or an insect like a mosquito or a flea.

d. **Food borne:** Eating or drinking contaminated food can cause illness in people and animals, including pets.

e. **Water borne:** Drinking or coming in contact with water that has been contaminated with feces from an infected animal.

f. **Air and droplets borne:** Inheling or exposure of contaminated air having causative agents including spores, infected droplets may spread through the sneexing, coughing, talking, etc.

CAUSES AND PRECAUTIONARY MEASURES

A zoonosis is an infectious disease that has jumped from a non-human animal to humans (Belizario et al., 2001; Castro, 2010). Zoonotic pathogens may be bacterial, viral or parasitic, or may involve unconventional agents and can spread to humans through direct contact or through food, water or the environment (White et al., 2014; Ghasemzadeh and Namazi, 2015; Damborg et al., 2019; Chowdhury et al., 2021). Zoonoses comprise a large percentage of all newly identified infectious diseases as well as many existing ones including, vector borne, protozoan borne helminthes borne, waterborne and foodborne zoonotic diseases (Topolovec et al., 2003; Craun et al., 2010; Cotton et al., 2011; Yoshida et al., 2011; Robert-Gangneux and Darde, 2012). Some diseases, such as HIV, begin as a zoonosis but later mutate into human-only strains (Preston et al., 2004; Sharp and Hahn, 2011). Other zoonoses can cause recurring disease outbreaks, such as Ebola virus disease, salmonellosis, coronavirus diseases (Feldmann et al., 2003; Hui et al., 2004; Assiri et al., 2013; Chlebicz et al., 2018; Azhar et al., 2019; Brussow, 2021) . The COVID-19, is a droplet borne infectious disease caused by SARS-CoV-2 has been declared as global pandemic (Dan et al., 2020; Li et al., 2020a,b; Sood et al., 2020; Upadhyay et al., 2020a,b; WHO, 2020a,b,c; Brussow, 2021; Tuli et al., 2021; Upadhyay et al., 2021). The clinical spectrum of toxocariasis in humans, ranging from asymptomatic infection to severe organ injury, is determined by parasite load, sites of larval migration, and the host's inflammatory response (Magnaval et al., 2001; Ahn et al., 2014; Lee et al., 2014).

Prevention methods for zoonotic diseases differ for each pathogen; however, several practices are recognized as effective in reducing risk at the community and personal levels (Shiferaw et al., 2017). Contaminated soil is the most important route of transmission of zoonotic helminths to humans. Environmental contamination is particularly relevant when public areas (parks, playgrounds, beaches) are affected. Effective preventive measures include covering sandboxes in public parks and playgrounds when not in use, allowing no dogs and cats on bathing beaches, and controlling stray dog and cat populations. Thus keep healthy pets, be a healthy people. Keep hands clean and wash with soap and clean running water right after being around animals, to avoid getting sick and spreading germs to others. If soap and water are not readily available, alcohol-based hand sanitizer that contains at least 60% alcohol can be used (Jing et al., 2020; Gold et al., 2021). Prevent bites from mosquitoes, ticks, and fleas. Use insect repellent or other methods to keep mosquitos, fleas, and ticks away. Have pets vaccinated and take them for regular annual visits to the veterinarian. Don't eat, drink, or touch your eyes or mouth while you're handling or in close contact with animals. Use gloves if need to handle an animal that is or appears to be sick. Don't handle or approach any animal in the wild that appears sick. Be sure to contact animal control or the local government to have the sick animal removed. Be aware and learn more about ways to handle food safely—whether it's for self or family, pet, or other animals. Be aware of zoonotic diseases both at home, away from home (such as at petting zoos or other animal exhibits), in childcare settings or schools and when you travel. In the last but not the least avoid bites and scratches from animals.

CONTROL AND THERAPEUTIC APPROACHES

The revention of Japanese Encephalitis (JE) disease is mainly through vaccination of humans, horses, and swine (Hegde and Gore, 2017; Amicizia et al., 2018). Insecticides and integrated pest control measures that include natural compounds *(Bacillus thuringiensis* toxins), larvicidal fish, and larval habitat modification have been successfully used (Benelli et al., 2016; Chattopadhyay et al., 2017). Use of permethrin-impregnated bed netting can also prevent transmission. Real-time disease surveillance supported by rapid and accurate laboratory diagnosis is the basis for recognition and control of zoonotic diseases (Cliver and Fayer, 2004; Cotruvo et al., 2004). Standard diagnostic approaches such as acute and convalescent serology, virus isolation and antigen detection, along with nucleic acid amplification techniques are increasingly available in developed countries, but not always can be implemented on short notice in geographic areas that need them the most (Bean et al., 2013; Schwarz et al., 2017; Khan and Zahoor, 2018; Shin and Park, 2018; Mackenzie and Smith, 2020; Le et al., 2021). Where laboratory testing is available, it is equally important that the results reach clinicians treating infected individuals and become incorporated into epidemiological databases and early warning systems to assure rapid response by public health authorities to control outbreaks appropriately. Control of zoonotic virus diseases is accomplished by breaking the cycle of transmission (Osorio and Yuill, 2008; Reed, 2018; Rahman et al., 2020). This is usually achieved by eliminating or immunizing vertebrate hosts, and reducing vector populations (NRCC, 2009; Kilpatrick and Randolph, 2012; Monath, 2013; Meganck and Baric, 2021). Reduction of reservoir host populations is usually not accomplished because it is too expensive, not environmentally safe, and not technically or logistically feasible. In some cases, reduction of reservoir hosts populations can have the opposite effect and actually increase transmission risk.

Helminthes zoonoses are diseases that can be transmitted from helminthes infected animals to humans. Despite zoonotic helminth diseases being still a challenge to the public health and the agriculture industries globally, they were still neglected in both human and veterinary medicine. Moreover, the increasing emergence of anthelmintic drug resistance constitutes failures of most disease control strategies, alarming for a quest to new alternative control approaches (Jackson, 1993; Upadhyay 2016a,b,c; Tinkler, 2019). Consequently, the use of beneficial microorganisms, probiotics, is becoming interesting for its prophylactic or therapeutic application against several diseases including helminths. Recent studies on probiotics against parasites and the interactions between bacteria, parasites, and the immune system in the gut draw much attention (Reda, 2018; Olaimat et al., 2020; Sundararaman et al., 2020; Urban et al., 2021; Youssef et al., 2021). However, the effects of these beneficial microorganisms in helminth infections remain largely unexplored. Therefore, in present rsection authors raise attention and summarized recent findings on probiotics research against helminth parasites and other agents of zoonotic significance.

CONCLUSIONS

Zoonoses are diseases transmissible from animals, other than humans, to people. Zoonoses are diseases of animal origin, usually caused by viruses, bacteria, fungi and parasites which can be naturally transmitted to humans. There is a need to raise awareness of the extent of health problems caused by zoonotic diseases in order to combat their burden and public health consequences, and also provide an integrated platform for development of effective prevention and control strategies. Many diseases are considered neglected zoonotic diseases, including soil-transmitted helminths. Thus, efforts to design public educational programs raising awareness of agents of larva migrans are fundamental to prevent the burden of diseases in companion animals and humans. Further, improvements in diagnostic testing and expansion of epidemiologic surveillance should be promoted in parallel with control and prevention efforts. Bioterrorism diseases are those that may be used in a bioterrorism event, divided into categories depending on the ease of spread and the severity of illness or death they cause including anthrax, plague, brucellosis, and Q-fever may also fall under the zoonotic categories.

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Chapter 3

Droplet Borne COVID-19 Pandemic: Elementary Concept, Precautionary Measures and Indian Scenario of Deadly Contagious Severe Acute Respiratory Syndrome Coronavirus-2

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ABSTRACT

The coronaviruses (CoV) are a large family of viruses that cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS), and Severe Acute Respiratory Syndrome (SARS). The SARS-CoV-2 [formerly known novel coronavirus (2019-nCoV)] is a new strain that has not been previously identified in humans. The coronaviruses are zoonotic, and SARS-CoVs were transmitted from civet cats to humans, however, MERS-CoVs from dromedary camels to humans. However, the most recently erupted coronavirus diseases-2019 (COVID-2019) due to SARS-CoV-2 infection transmitted from human to human supposed to come from bats. The common signs of infection include respiratory symptoms, fever, cough, and breathing difficulties. In more severe cases, infection can cause pneumonia, acute respiratory problems, kidney failure and even death. The standard recommendations to put off infection stretch by regular hand washing, covering mouth and nose during coughing and sneezing, thoroughly cooking meat and eggs. The avoidance of close contact with anyone is showing symptoms of respiratory illness (coughing and sneezing). The WHO notified information and guidance regarding the current outbreak of coronavirus disease (COVID-19) that was first documented from Wuhan, China, on 31st December 2019. WHO is working closely with global experts, governments and partners to rapidly expand scientific knowledge on this new virus. The objectives are to track the spread and virulence of the virus, and to provide advice to countries and individuals on measures to protect health and prevent the further spread of this outbreak. This SARS-CoV-2 is currently affecting more than 221 countries and territories around the globe and has infected more than 243.382 million people out of which, more than 4.947 million have lost their lives, as of 22 October, 2021, making it one of the deadliest pandemics in history.

Keywords: Droplet Borne Disease, COVID-19, SARS-CoV-2, 2019-nCoV, Coronavirus, Contagious Disease.

INTRODUCTION

The coronavirus disease-2019 (COVID-19) formerly to be known novel coronavirus- 2019 (2019-nCoV) disease caused by SARS-CoV-2 (severe acute respiratory syndrome coronaviruses-2) is a member of coronavirus family that has never been encountered earlier so far (Corman et al., 2018; Cui et al., 2019; BBC, 2020). Like other coronaviruses, the new and troubling 2019-nCoVs usually originate in animal hosts. Many of those initially infected either worked or frequently shopped in the Huanan seafood wholesale market in the centre of the Chinese city, which also sold live and newly slaughtered animals (Fernando, 2020; Jon, 2020; Li et al., 2020). The Severe Acute Respiratory Syndrome (SARS) and Middle Eastern Respiratory Syndrome (MERS) are both caused by coronaviruses that came from animal also (Ksiazek et al., 2003; Corman et al., 2018; WHO, 2020a). In 2002, SARS spread virtually unchecked to 37 countries, caused global panic, infected more than 8,000 people and killed over 750 (Cherry and Krogstad, 2004; Huang, 2004). The MERS appeared in 2012 was found to be less easily passed from human to human, but had greater lethality, by killing 35% of about 2,500 people who have been infected (Al-Tawfiq and Memish, 2014; Nassar et al., 2018). Those who have fallen ill are reported to suffer coughs, fever and breathing difficulties (Hui et al., 2004; Assiri et al., 2013). The emerging coronavirus can cause pneumonia and in severe cases there can be organ failure (WHO, 2020a). As this is viral pneumonia, antibiotics are of no use; even the antiviral used against ebola and flu will not work. If people are admitted to hospital, they may get support for their lungs and other organs as well as fluids (Huang et al., 2020). The recovery will depend on the strength of their immune system (Dan et al., 2020). Many of those who have died were already in poor health. The global coronavirus outbreak has put Indians on guard. Over 70% of

Indians say they are alert and taking necessary precautions against COVID-19, the disease spread by the novel coronavirus strains, according to a survey conducted by local circles, a community-led social media engagement platform (Kapur, 2020; Dan et al., 2020).

STRUCTURE AND EVOLUTION OF CORONAVIRUS

Coronaviruses pose serious health threats to humans and other animals (Ksiazek et al., 2003; Sahin et al., 2020). In general, coronaviruses cause widespread respiratory, gastrointestinal, and central nervous system diseases in humans and other animals, threatening human health, social, educational and causing economic loss (Garg et al., 2020; Jha et al., 2020; Kumar et al., 2020; Sood et al., 2020). Coronaviruses are capable of adapting to new environments through mutation and recombination with relative ease (Perlman and Netland, 2009). Therefore; health threats from coronaviruses are constant and long-term. The coronaviruses (CoVs) belong to the family Coronaviridae and order Nidovirales. They can be classified into four taxa: α-CoVs, β-CoVs, γ-CoVs, and δ-CoVs (Cui et al., 2019; Dan et al., 2020). Among them, α andβ-CoVs infect mammals, γ-CoVs infect avian species, and δ-CoVs infect both mammalian and avian species (Corman et al., 2018; Cui et al., 2019). The representative α-CoVs include human coronavirus NL63 (HCoV-NL63), porcine transmissible gastroenteritis coronavirus (TGEV), PEDV, and porcine respiratory coronavirus (PRCV). Representative β-CoVs include SARS-CoV, MERS-CoV, bat coronavirus HKU4, mouse hepatitis coronavirus (MHV), bovine coronavirus (BCoV), and human coronavirus OC43 ((Hui et al., 2020; Upadhyay et al., 2020a,b, Tuli et al., 2021). The representative γ and δ-CoVs include avian infectious bronchitis coronavirus (IBV) and porcine deltacoronavirus (PdCV), respectively. Coronaviruses are large, enveloped, positive-stranded RNA viruses (Fig. 1) (Hui et al., 2020; Li et al., 2020). They have the largest genome among all RNA viruses, typically ranging from 27 to 32kb (Chen et al., 2020). Coronaviruses are spherical to pleomorphic enveloped particles (Graham and Baric, 2010; Li, 2016; Chen et al., 2020). Coronaviruses invade the respiratory tract via the nose. After an incubation period of about 3 days, they cause the symptoms of a common cold, including nasal obstruction, sneezing, runny nose, and occasionally cough (Huang et al., 2020; Dan et al., 2020; Upadhyay et al., 2020a,b). The disease resolves in a few days, during which virus is shed in nasal secretions (Hui et al., 2020). The other manifestations of disease such as multiple sclerosis have been attributed to these viruses but the evidence is not clear-cut.

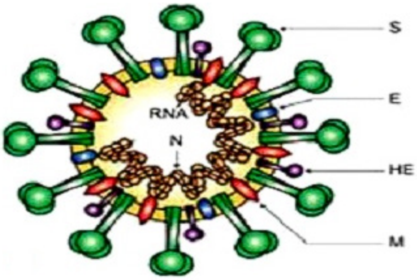


Fig. 1. The schematic presentation of coronavirus. Where: S, Spike protein; E, Envelope protein; HE, Haemagglutin esterase; M, Membrane glycoprotein; N, Nucleoprotein; RNA, Ribonucleic acid.Adopted from: Susan and Julian, 2011; Tok and Tatar, 2017

NOVEL CORONAVIRUS: A PUBLIC HEALTH EMERGENCY

On 30th January 2020, the World Health Organization (WHO) declared the coronavirus outbreak a Global Public Health Emergency (W.H.O., 2020a,b,c). However, the United States declared coronavirus a public health emergency on 31st January 2020, and issued 14 days quarantine rules for citizens entering the US from China (mandatory if entering from the Hubei province) Gostin and Hodge, 2020; Parmet and Sinha, 2020, WHO, 2020). It issued an order to deny entry to foreigners who have traveled to China within the past two weeks. On 30th January 2020, Centers for Disease Control and Prevention (CDC) confirmed the first US case of human to human transmission (CDC, 2020). The cases of human to human transmission are the most worrisome, according to the WHO. Wuhan (city where virus originated) is the largest city in Central China, with a population of over 11 million people. The city, on 23rd January 2020, shut down transport links. Following Wuhan lock down, the city of Huanggang was also placed in quarantine, and the city of Ezhou closed its train stations (Gostin and Hodge, 2020; Parmet and Sinha, 2020). This means that 18 million people have been placed in isolation (Hui et al., 2020). The World Health Organization (WHO) said cutting off a city as large as Wuhan is unprecedented in public health history and praised China for its incredible commitment to isolate the virus and minimize the spread to other countries (Fernando, 2020; Jon, 2020; Li et al., 2020).

GLOBAL SCENARIO OF NOVEL CORONAVIRUS IN EARLY 2020

The China's National Health Commission (NHC) has confirmed its human-to-human transmission, and there have been such transmissions elsewhere. As a report of 17th February, 2020 there were more than 73,336 confirmed cases and 1,874 deaths noticed worldwide (Fig. 2) (Wang et al., 2020). There are cases in

28 other countries outside China, with deaths recorded in France, Hong Kong, Philippines, Japan and Taiwan (Gostin and Hodge, 2020; Parmet and Sinha, 2020). The number of people to have contracted the virus overall could be far higher, as people with mild symptoms may not have been detected.

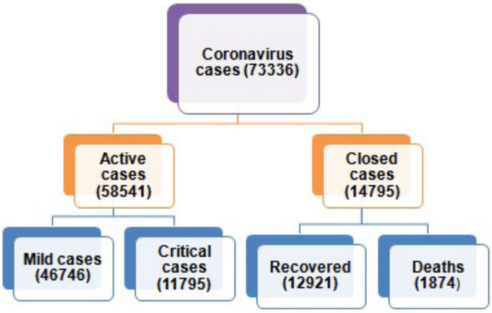


Fig 2. Cladogram showing global scenario of coronavirus cases as of 17th February, 2020. Source: WHO, China's NHC

The mortality rate due to dangerous new coronavirus is around 2% comparison to seasonal flu which typically has a mortality rate below 1%. On contrary the SARS had a death rate of more than common flu, influenza flue, pneumonia, etc. (Dan et al., 2020). However, this is likely to be an overestimate since many more people are likely to have been infected by the virus but not suffered severe enough symptoms to attend hospital, and so have not been counted. A crucial difference is that unlike flu, there was no vaccine for the new coronaviruses in early phases, which means it is more difficult for vulnerable members of the population; elderly people or those with existing respiratory or immune problems, to protect themselves (Sood et al., 2020; Upadhyay et al., 2020; Upadhyay et al., 2021) . Hand-washing and avoiding other people if you feel unwell are important. One sensible step is to get the flu vaccine, which will reduce the burden on health services if the outbreak turns into a wider epidemic.

SPREADING OF SARS-COV-2

The Wuhan coronavirus outbreak is a new illness and scientists are still assessing how it spreads from person to person, but similar viruses tend to spread via cough and sneeze droplets (Fig. 3) (Devlin et al., 2020; Huang et al., 2020).

a. **Sneeze and cough droplets:** When an infected person coughs or sneezes, they release droplets of saliva or mucus. These droplets can fall on people in the vicinity and can be either directly inhaled or picked up on the hands then transferred when someone touches their face, causing infection. Some hospital guidelines define exposure as being within six feet of an infected person who sneezes or coughs for 10 minutes or longer.

b. **Droplets landing on surfaces:** The coronaviruses can be spread by landing on surfaces along the droplets from persons having the infection. Such as seats on buses or trains or desks in school. However, whether this is a main transmission route depends on how long viruses survive on surfaces; this can vary from hours to months.

c. **Transboundary spreading viatravelers:** There are abundant cases of COVID-19 in the infectedcountries from people who are in China or who have recently traveled to China or other countries having the outbreak of SARS-CoV-2. People who have been in close contact with someone who is infected are at higher risk. This includes health care workers who care for people with COVID-19.

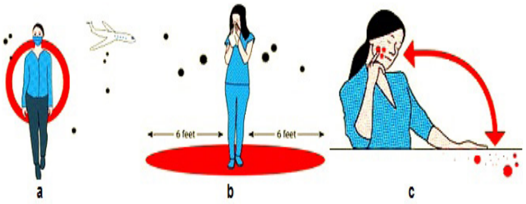


Fig. 3. Spreading of coronavirus via transboundary travelers (a), cough and sneeze droplets of infected patents (b), droplets landing on surfaces (c). Source: Devlin and Wishart, The Guardian, 2020.

PRECAUTIONARY MEASURES FOR INFECTION OF SARS-COV-2

The virus can be spread when an infected person coughs or sneezes. Hand-washing is a first line of defense (Fig. 4). There is anecdotal evidence that the virus can be spread by people before they have symptoms (Li et al., 2020; Wei et al., 2020). Some other illnesses such as flu can be passed from one person to another before symptoms occur; but the extent to which this is happening with the Wuhan coronavirus is not well understood yet (Wang et al., 2020).

a. **Hand wash:** Wet your hands with clean, running water and apply soap. Lather your hands, including the backs, between your fingers, and under your nails and scrub for at least 20 seconds and rinse.

b. **Cover mouth and nose:** Cover your mouth and nose with a tissue paper when you cough or sneeze, then throw the tissue paper in the bin and wash your hands. If you do not have a tissue to hand, cough or sneeze into your elbow rather than your hands.

c. **Face mask:** Face masks offer some protection as they block liquid droplets. However, they do not block smaller aerosol particles that can pass through the material of the mask. The masks also leave the eyes exposed and there is evidence that some viruses can infect a person through the eyes.

d. **Seek early medicine:** Seek early medical help if you have a fever, cough and difficulty breathing, and share your travel history with healthcare providers.

e. **Avoid unprotected direct contact to animals:** If visiting live markets in affected areas avoid direct, unprotected contact with live animals and surfaces that have been in contact with animals.

f. **Avoid raw or undercooked animal products:** If you are in an affected area avoid eating raw or undercooked animal products and exercise care when handling raw meat, milk or animal organs to avoid cross-contamination with uncooked foods.

g. **Avoid transboundary travelling:** Avoid the transboundary and abroad travelling to countries and states having coronavirus cases. If you have returned from an affected area in China or others in the last two weeks, stay isolated and avoid contact with other people for 14 days.

h. **Stay indoor:** If you have returned from an infected area and develop a high temperature, cough, runny nose, sore throat or difficulty breathing do not leave your home until you have been given advice by a doctor. This means not going to work, school or public areas.

i. **Seek early vaccination:** COVID-19 vaccines were developed using scientific methods and found to be are safe and effective and can reduce the risk of getting and spreading the virus that causes COVID-19. Therefore, it is recommended to take the doses of vaccines as early as possible per your schedule, recommendations and guidelines of authorized agencies and Government.

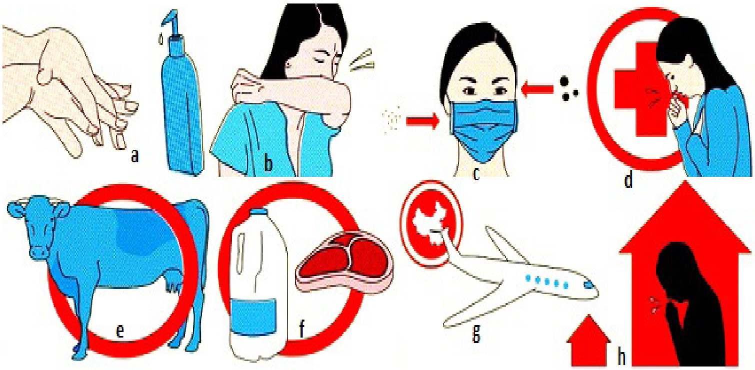
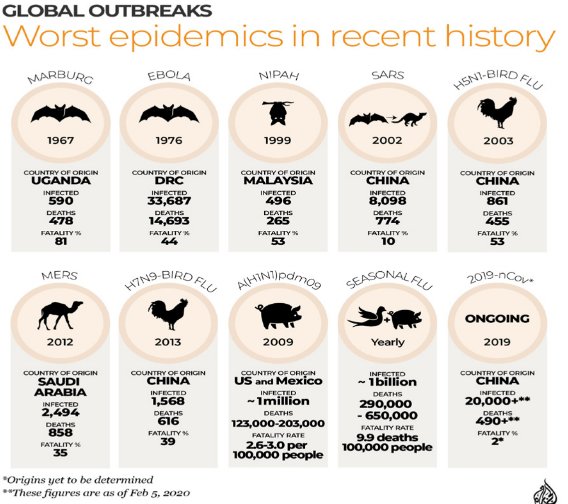


Fig. 4. Protect yourself from coronavirus by hand wash (a), covering mouth and nose during cough and sneeze (b), using face mask (c), seeking early medicine (d), avoiding unprotected direct contact to animals (e), avoiding under cooked or raw animal products (f), avoiding transboundary travelling (g), and stay indoor (h). Source: Devlin and Wishart, The Guardian, 2020.

INCUBATION PERIOD OF NOVEL CORONAVIRUS

The2–14 days represents the estimated range at the moment for the novel coronavirus COVID-19 (formerly "2019-nCoV") (Cheng et al., 2021). The period can vary greatly among patients. The mean incubation period observed 3 days (0–24 days range, based on 1,324 cases); 5.2 days (4.1–7.0 days range, based on 425 cases). However, the mean incubation period in travelers from Wuhan was 6.4 days (range from 2.1–11.1 days). An outlier of a 24 days incubation period has been observed in a recent study also which reflect a second exposure rather than a long incubation period (Backer et al., 2020). The China's National Health Commission (NHC) had initially estimated an incubation period from 10 to 14 days for Wuhan Novel Coronavirus (2019-nCoV). For comparison, the incubation period for the common flu (seasonal influenza) is typically around 2 days. Incubation period for other coronaviruses: SARS 2–7 days; MERS 5 days typically (range 2–14 days). The COVID-19 supposed to be more deadly contagious public health emergency in the history than other global outbreaks of worst epidemics in the yesteryears (Fig. 5).



*Origins yet to be determined
**These figures are as of Feb 5, 2020

Source: WHO | Last updated: 12:30 GMT, Feb 5, 2020

Fig. 5. The worst epidemics in recent history (*Origin yet to be determined; **Number based on report). Source: WHO, 5th February, 2020.

EPIDEMIOLOGY OF COVID-19

The novel coronavirus COVID-19 is affecting over 221 countries and territories around the world and one international conveyance (the "Diamond Princess" cruise ship currently harbored in Yokohama, Japan) (Al Jazeera, 2020). This SARS-CoV-2 is currently affecting more than 221 countries and territories around the globe and has infected more than 243.382 million people out of which, more than 4.947 million have lost their lives, as of 22 October, 2021, making it one of the deadliest pandemics in history (WM, 2021). The epidemiology of coronavirus colds has been little studied during early spread season. Waves of infection pass through communities during the winter months, and often cause small outbreaks in families, schools, etc. and very soon covered entire world (David et al., 1996; Garg et al., 2020; Kumar et al., 2020). The immunity does not persist, and subjects may be re-infected, sometimes within a year (Garg et al., 2020; Jha et al., 2020; Kumar et al., 2020). About one in five colds is due to coronaviruses. The virus is usually transmitted via inhalation of contaminated droplets, but it may also be transmitted by the hands to the mucosa of the nose or eyes. As for as Indian scenario of COVID-19 concerned, about 34377113 infected cases were recorded as of 08th November, 2021. Out of these 33775086 cases recovered successfully with 461389 deaths due to COVID-19. Currently nearly 140638 active cases also hospitalized for their successful treatment as per the report of dated 09th November, 2021 (WM, 2021). Per the report of Chinese

CCDC published in Chinese Journal of Epidemiology has found that the risk of death increases in the older age persons than the younger one (Davies et al., 2020; Hu et al., 2021). The studies of COVID-19 trends documented seasonality biased spreading as well (Fig. 6) (Chen et al., 2021; Biswas et al., 2021).

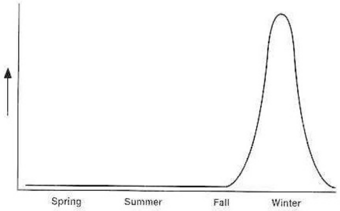


Fig. 6. Seasonal incidence of coronavirus infections. Source: Med. Microbiol. 4th ed.

COVID-19 IN THE INDIA

The India may have only three confirmed cases of coronavirus in February, 2020 but Indians were not taken any chances for its further spread. The local circles survey received 40,000 responses from participants of all 3-tier cities in India during early 2020 (Kapur, 2020). All the three coronavirus confirmed patients were belonging from the southern Indian state of Kerala, have fully recovered and discharged from the hospital. The six Indian nationals onboard the quarantined Diamond Princes Cruise Ship have also tested positive. The ship, in Japan, has become a hotbed for the virus, with 454 people onboard testing positive for the disease. The spread of COVID-19 cases globally could play a key role in Indians' holiday planning in coming days reflected through the survey report. The Indians, expect the government to more stringently monitor travelers coming India from epicenter or likely to be epicenter. However, 53% feel the government is currently not doing enough to keep tabs on travelers from South-East Asian countries. At the same time, Indians want their government to continue being a world leader in humanitarian efforts. Nearly 83% of the respondents felt that India should ramp up production of facial tissues, masks, toilet paper, and drugs and supply them to countries in need. During survey as much as 16% of Indians say their closer home businesses are feeling the heat of the contagion.

On 11th March 2020, WHO declared the novel coronavirus disease (COVID-19) outbreak as a global pandemic (an epidemic that has spread worldwide affecting a large number of people) (WHO, 2020b). On the same day, the Hon'ble Prime Minister of India, constituted a high-level Group of Ministers (GOM) to review, monitor and evaluate the preparedness and measures taken regarding management of COVID-19 in the country. Government of India has invoked powers under the Epidemic Diseases Act, 1897 to enhance preparedness and containment of the virus and declared COVID-19 a 'notified disaster' under the 'Disaster Management Act 2005'. The Prime Minister's Office (PMO), MoHFW and Cabinet Secretary are closely monitoring the situation round the clock and all the states and UTs of India have been advised to invoke the provisions under 'Section 2 of the Epidemic Disease Act 1897', which includes special measures to be taken by the Centre to "prescribe regulations as to dangerous epidemic disease" by 14th March 2K20. The Central Government has declared the COVID-19 outbreak in the country a "notified disaster", in a move called "a special one-time dispensation", to provide compensation and aid to infected people and the families of those who died due to the virus. Funds for this and other measures will be drawn from the State Disaster Response Funds (SDRF).

Hon'ble Prime Minister Mr. Narendra Modi, in exercise of the powers under 'section 6(2)(i) of the Disaster Management Act, 2005', issued an order for State/UTs prescribing lockdown for containment of COVID-19 epidemic in the country for a period of 21 days with effect from 25th March, 2020 to 14th April, 2020 which further extended in many steps for about 1.5 years. Meanwhile several precautionary measures were taken by the Indian Government for combating the COVID-19. The efforts were outstanding and appreciated by the WHO as well. By following the rule of trace, test, therapy, the India became success in curbing the graph of COVID-19 infection (Upadhyay et al., 2021; Yadav et al., 2021). Even though as per the report of 08th November, 2021; about 34377113 COVID-19 patients were recorded since the day of eruption of SARS-CoV2 in India. Out of them 33775086 cases recovered successfully and discharged from the hospitals with 461389 deaths due to COVID-19. Right now about 140638 active cases also hospitalized for their successful treatment as per the report of dated 09th November, 2021. The continuous effort of Indian Govt. has resulted in the successful manufacturing of two native COVID-19 vaccines (Covaxin and Covishield) and administered more than 108 cores of vaccine doses by 06th November, 2021 dedicated to the 152nd birth anniversary of Rasthrapita Mahatma Gandhi and 75th Azadi ka Amrit Mahotsav.

CONCLUSIONS

According to the WHO, coronaviruses are a family of viruses that cause illnesses ranging from the common cold to more severe diseases such as severe acute respiratory syndrome (SARS) and the Middle East respiratory syndrome (MERS). The China was the epicenter of the pandemic COVID-19. On 30th January 2020, the World Health Organization declared the coronavirus outbreak a Global Public Health Emergency which later on declared as Pandemic by the WHO on 11th March, 2020. Coronaviruses (CoVs) (order: Nidovirales, family: Coronaviridae, and subfamily: Coronavirinae) are enveloped viruses with a positive sense, single-stranded RNA genome. Over all, about 64% of patients with confirmed diagnoses experienced mild illness. Nearly 12% had severe cases of COVID-19, and about 4% had critical illnesses. The 30% of those who died were in their 60s, 30% were in their 70s and 20% were age 80s or older. Though men and women were roughly equally represented among the confirmed cases, men made up nearly 64% of the deaths. Patients with underlying medical conditions, such as cardiovascular disease or diabetes, died at higher rates. As of 08th November, 2021, more than 250,654,462 people have been found to be infected by SARS-CoV2 (severe acute respiratory syndrome coronavirus 2, the causative agent of COVID-19) in more than 221 countries/ province and union territories. As per the report of Worldometers, over 5,065,596 deaths and 226,899,869 recovered cases recorded globally with a significant hit on India with over 461057 fatalities due to COVID-19 by 08th November, 2021. As per the report of 08th November, 2021; about 34377113 COVID-19 patients were recorded since the day of eruption of SARS-CoV-2 in India. Out of them 33775086 cases recovered successfully and discharged from the hospitals and right now about 140638 active cases also hospitalized for their successful treatment as per the report of dated 09th November, 2021. The continuous effort of the Government of India has resulted in the successful designing/ development and manufacturing of two native COVID-19 vaccines (Covaxin and Covishield) and subsequently administered more than 108 cores of vaccine doses by 06th November, 2021 under the mission Pan-India COVID-19 vaccination dedicated to the 152nd birth anniversary of Rasthrapita Mahatma Gandhi and 75th Azadi ka Amrit Mahotsav. The understanding the virology of coronaviruses and controlling their spread have important implications for global health, sustainability and economic stability.

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Chapter 4

Emerging Infectious Diseases in Reptiles: Causes and Therapy for Biodiversity Conservation

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INTRODUCTION

Bacterial, fungal, and parasitic infections in reptiles are infrequently caused by primary pathogens, but are more typically the result of an immunocompromised situation, such as insufficient temperature, humidity, or enclosure cleanliness (Pare, 2006). Typically, treating bacterial and fungal infections necessitates addressing the underlying husbandry deficiency. Despite the fact that the focus of this article is on bacterial and parasite diseases, numerous important fungal diseases are listed as differentials to keep in mind. Although viral diseases are not covered in this article, the role of viruses as risk factors for other infectious diseases has been thoroughly documented (Wellehan et al., 2005; Jacobson, 2007) Many bacterial, fungal, and parasitic pathogens have been reported in recent comprehensive publications. This article does not rehash previously discussed content; rather, it examines broad approaches for detecting and treating infectious diseases, as well as specific diseases in connection to body systems. Diseases that have lately been reported are given special attention.

Several nonpathogenic protozoa and nematodes live in reptiles, causing little inflammation and illness. Ciliates such as *Balantidium, Paramecium*, and *Nyctotherus spp* are thought to be normal gut flora in healthy lizards (Jacobson, 2007). Numerous nematodes, trematodes, cestodes, arthropods, and protozoa were found in the intestines and lungs of deceased sea kraits *(Laticauda colubrina)* and tokay geckos *(Gekko gecko)* in separate recent surveys (Reese, 2004; Chinnadurai et al., 2008). None of the parasites discovered in sea kraits were identified to be the cause of death, and the majority of them did not show histologic indications of inflammation. The parasite density in the infected animals may have grown as a result of systemic immunosuppression caused by confinement stress or concomitant illnesses.

DISEASE THREATS TO WILDLIFE

Prior to the year 2000, wildlife diseases were largely investigated to enhance zoo animal survival and welfare, with nothing published on diseases of free-living wildlife unless they affected extensively hunted species (for example, deer in North America) or were deemed a threat to cattle health (e.g. tuberculosis, rinderpest). While non-infectious diseases were widely recognised as important drivers of species declines (for example, DDT poisoning of raptors (Ratcliff, 1967; Hickey et al., 1968), only a small number of researchers investigated infectious disease as a factor in, often covert, wildlife population regulation (Hudson et al., 1998). The function of infectious diseases in large mortality events or population decreases was frequently regarded as contentious or secondary to other reasons (Harvell et al., 1999), and their participation in species extinctions was frequently contested (Dobson et al., 1995; McCallum, 2005). Following the loss of the final population of the Polynesian tree snail P. turgida due to a microsporidian infection, the first unequivocal identification of disease as a cause of species extinction was published in 1996 (Cunningham et al., 1998). This added to evidence that infectious agents were responsible for the extinction of the black-footed ferret in the wild, the extinction of approximately one-third of Hawaiian honeycreepers, and the slime mould-induced decline of eelgrass *(Zostera marina*) beds in the United States, which resulted in the extinction of the eelgrass limpet *(Lottia alveus)* (Thorne et al., 1988). During the 1990s, infectious disease-related wildlife mortality was recorded in zoos, wildlife translocation programmes, and other conservation programmes (Viggers et al., 1993; Woodford, 1993). The discovery of amphibian chytridiomycosis, caused by the chytrid fungal pathogen *Batrachochytrium dendrobatidis,* which was first recognised in the 1990s and has since been implicated in the decline or extinction of over 200 amphibian species (Berger, 1998; Schloegel et al., 2006), was perhaps the most significant of these. This disease is still threatening frogs around the world, and it has been described as "the worst infectious disease ever recorded among vertebrates in terms of the number of species afflicted, and its potential to drive them to extinction.

Although amphibian chytridiomycosis appears to have emerged concurrently in Australia and Central America, connected with large-scale die-offs and extinction events, it is possible that it was causing amphibian mortalities and declines in North America previous to this (Daszak et al., 1999). Proving that a disease is the cause of wildlife population decreases necessitates the collection of longitudinal population and pathogen data, which can be difficult to obtain. As a result, a slew of articles debating the role of chytridiomycosis in amphibian losses arose, with the majority claiming that the illness emerged secondary to other reasons or was not the cause of declines/ extinctions (Pounds, 2001; Stallard, 2001). Long-term datasets have since been released, providing solid evidence that amphibian chytridiomycosis can cause large mortalities and population reductions on its own (Lips, 2006). Policy measures to control amphibian chytridiomycosis, on the other hand, have been slow to be implemented, with the first international policy measure (listing of chytridiomycosis by the World Organisation for Animal Health) occurring in 2010 (Schloegel et al., 2010) and the international community still failing to implement measures recognised to mitigate the spread of this disease.

DRIVERS OF DISEASE EMERGENCE

There are likely to be multiple causes of novel disease emergence, but human-mediated transport of pathogens (often in infected hosts) or vectors across geographical or ecological boundaries, known as 'pathogen pollution,' has been identified as a major driver in both wildlife (Cunningham et al., 2003) and plants (Anderson et al., 2004). Anthropogenic pathogen propagation has resulted in the creation of a number of high-profile animal EIDs, including the two known amphibian chytridiomycosis agents, *B. dendrobatidis* and *B. salamandrivorans* (Fisher et al., 2009; Martel, 2014). Subsequent research indicates that this is only part of the tale, since the global pandemic lineage of *B. dendrobatidis* arose from a single hybrid origin via an ancestral meiosis, potentially through anthropogenic mixing of allopatric lineages (Jame, 2009; Farrer, 2011). There is a considerable body of research that demonstrates how, once evolved, this virulent lineage was disseminated globally via international commerce in frogs and human-assisted invasive species introduction (Fisher et al., 2009; Gilbert, 2012; Wombwell et al., 2016).

In recent years, a body of work has evolved the concept of disease regulation as an environmental service. While still debatable and unlikely to be universal (Salkeld et al., 2013), this hypothesis proposes that natural biodiversity limits the exposure and impact of many pathogens, including zoonotic pathogens, through a dilution or buffering effect, thereby limiting opportunities for pathogen spillover from wildlife to people (Johnson et al., 2010). When biodiversity is depleted (usually as a result of human activity), this ecosystem service is compromised, and zoonotic pathogens are more likely to emerge, as has been demonstrated for hantavirus (Suzan et al., 2009) and *Borrelia burgdorferi,* the causative agent of Lyme disease (Ostfeld et al., 2000). Also, rather than loss of biodiversity per se, changes in species complements (typically as a result of anthropogenic influences) might affect infection dynamics and lead to increased zoonotic disease risk (Kilpatrick et al., 2006). However, our understanding of the linkages between environmental change, disease regulation, and human well-being is still in its early stages.

Despite the fact that the hazards to conservation and human health posed by wildlife EIDs have been recognised for nearly two decades, little effort has been made to implement risk-mitigation programmes. Detecting and stopping the importation of diseased hosts is a frequently utilised method for preventing the importation of various domestic animal diseases of economic or public health significance. Some countries also apply this approach to people migration, conducting (often superficial) surveillance for sick people entering at their international borders, especially during human pandemics (Cetron et al., 2005).

The World Health Organization's International Health Regulations give guidelines and training in this area. The World Trade Organization (WTO) develops and enforces rules and regulations for international trade, including that of animals and their products. The WTO's mission is to ensure that "trade flows as easily, reliably, and freely as possible". The World Trade Organization's agreement on sanitary and phytosanitary measures went into effect on January 1, 1995, with the goal of protecting human, animal, and plant life from disease-causing agents. While governments have some leeway in deciding what to include, they are directed by the World Organization for Animal Health (OIE) list of illnesses of worldwide concern. Despite the OIE's mandate to safeguard biodiversity, only two infections are listed: *B. dendrobatidis* and Ranavirus (Schloegel et al., 2010). As a result, most countries restrict imports to guard against domestic animal diseases of clear public health or economic importance, such as rabies and foot and mouth disease; diseases restricted to wildlife, even if OIE-listed, are not included.

Furthermore, trade agreements frequently ban impediments to international animal migrations for infectious disease prevention. Countries inside the European Union, for example, have little authority to restrict pathogen spread through intra-EU commerce unless it is part of a particular EU disease control programme. Even if legally permitted under WTO rules, countries remain hesitant to adopt unilateral limitations on non-listed diseases for fear of creating an economic disadvantage or being deemed to be in violation of international trade norms. It is probable that if comparable procedures had been applied for amphibian chytridiomycosis, the international spread of the illness might have been minimised (Hudson et al., 2016). Perhaps learning from this, the United States banned the importation of salamanders in January 2016 in response to the appearance of *B. salamandrivoran*s in order to safeguard native species from this novel infection (Bean et al., 2016). Following the identification of *B. salamandrivorans* as a novel fatal fungus infecting and killing captive and wild salamanders in Europe (Martel, 2014; Cunningham, 2015), such protective action was taken quite quickly. Hopefully, this will pave the way for other diseases and states to impose trade prohibitions in order to conserve biodiversity from the anthropogenic spread of infections.

Understanding the wildlife origins of zoonotic EIDs remains a challenge. Identifying the origins of newly discovered human infections is frequently complex, time-consuming, logistically demanding, and extremely expensive. Viruses related to HIV/AIDS, for example, were discovered in nonhuman primates in the early 1980s, but identifying the genuine progenitor viruses in chimps took nearly a decade of additional research (Gao, 1999). Likewise, the origins of the Ebola and Marburg viruses have been studied for over 30 years. Despite evidence that bats are the natural reservoir hosts of these viruses, clear evidence of Marburg virus infection in bats has only been detected in a few areas (Amman, 2012; Amman, 2015). Identifying potential reservoir hosts is only the first step. To identify strategies to avoid or limit future zoonotic spillover, a thorough understanding of the pathogen's ecology in its natural host (s) as well as human–host interactions is essential (Wood, 2012). Significant efforts have been made, for example, to understand the immunological, behavioural, and ecological aspects of bats as part of a strategy to prevent zoonotic spillover from bats (Kamins et al., 2015; Wood et al., 2016). Long-term, multidisciplinary research that comprehensively explore the ecology of zoonotic viruses in their wildlife hosts, as well as the risk features for spillover, are essential for better predicting and preventing future pandemics. A study that included years of field data collection on fruit tree distribution, pig farm management, viral dynamics and satellite telemetry of fruit bats, analysis of climate trends, experimental infection of bats under BioSafety Level-4 conditions, and mathematical modelling of virus infection dynamics identified the pig industry's intensification as the driver of the zoonotic emergence of Nipah virus in Malaysia.These findings influenced government regulations that separated pigs from bats by removing fruit trees from pig farms and relocating farms away from forested areas (Epstein et al., 2006), which has resulted in no future Nipah virus illness outbreaks in Malaysia.

ENDEMIC ZOONOSES FROM WILDLIFE

EID episodes have been the subject of significant investigation over the last two decades, despite the fact that the number of people diagnosed with them is often modest. This excessive focus on EIDs is most likely related to human society's aversion of uncertainty, or, to put it another way, fear of the unknown. This may result in absurd scenarios in which illness dread has a greater influence than the direct impact of the epidemic itself. For example, during a recent Ebola virus epidemic in West Africa, it is believed that more individuals died from malaria as a result of their avoidance of healthcare institutions where they worried, they would get Ebola than from the illness itself (Plucinski, 2015).

Indeed, when the overall impact of zoonotic diseases on the human population is considered, the largest (diagnosed) burden is associated with well-known and fully recognised (in the industrial north), but neglected, diseases such as brucellosis, rickettsioses, and Rift Valley fever (Halliday et al., 2015). This expected burden falls disproportionately on the global poor, as poverty is a primary risk factor for most zoonoses, causing some groups to bear a disproportionate share of the burden of zoonotic disease. Diagnostic neglect (including confusion with other disorders such as malaria (Jephcott et al., 2017) and historical and current research neglect all contribute to therapeutic neglect. The achievement of the United Nations Sustainable Development Goals, which should result in significantly decreased poverty and greater health, will lessen the significant burden of zoonotic illness.

TRANSMISSION OF PATHOGENS BETWEEN SPECIES

The loss of biodiversity may have an impact on disease transmission via a variety of methods. If each species' effect on pathogen transmission was wholly idiosyncratic, losses in diversity would be equally likely to induce a decrease or an increase in disease transmission in the remaining species. However, a consistent picture has developed in recent years—biodiversity loss tends to enhance pathogen transmission and illness prevalence. This pattern is observed throughout ecological systems that differ in pathogen, host, ecology, and route of transmission (Table 1). West Nile virus, for example, is a mosquito-borne virus that hosts various species of passerine birds. Three recent studies (Ezenwa et al., 2006; Swaddle et al., 2008; Allan et al., 2009) found robust connections between reduced avian diversity and greater human risk or incidence of West Nile encephalitis in the United States. Communities with low bird diversity are dominated by species that amplify the virus, resulting in a high infection prevalence in mosquitos and humans, whereas communities with great avian diversity contain many species that are less capable hosts. Correlational and experimental research on hantavirus pulmonary syndrome, a directly transmitted zoonotic disease, have revealed that a lesser diversity of small animals increases the prevalence of hantaviruses in their hosts, hence raising the danger to humans. Plant disease diversity has a similar effect, with species loss enhancing the spread of two fungal rust pathogens that attack perennial rye grass and other plant species (Roscher et al., 2007).

Table 1. Zoonotic parasites of reptiles grouped according to the modality of transmission.

Pathogens (zoonosis)	**Reptile Hosts**	**Clinical Symptoms In Humans**	**Reference**
Giardia duodenalis (giardiasis)	Lizards	Diarrhea	Reboredo, 2017
Cryptosporidium parvum subtype: IIaA15G2R1 (cryptosporidiosis)	Snakes, lizards, turtles	Acute to persistent diarrhea	Traversa, 2008; Díaz, 2013
Sarcocystis nesbitti (sarcocystosis)	Snakes	Muscular sarcocystosis	Fayer, 2015
Leishmania tropica, L. donovani, L. turanica (cutaneous and visceral leishmaniasis)	Lizards, snakes	Unknown	Zhang, 2016
Spirometra erinaceieuropaei, S. mansonoides (sparganosis)	Snakes	Blindness, paralysis, death	Anantaphruti, 2011
Armillifer armillatus, A. moniliformis, A. grandis, A. agkistrodontis (pentastomiasis)	Snakes	Organ damage by larvae	Tappe, 2019
Raillietiella hemidactyli (creeping disease)	Lizards	Subcutaneous pentastomiasis	Paré, 2008
Trichinella zimbabwensis, T. papuae (trichinosis)	Crocodiles, snakes, Monitor lizards, turtles	Fever, myalgia, gastrointestinal symptoms	Valencia, 2013
Contracaecum spp., Anisakis spp., Pseudoterranova spp. (anisakiasis)	Crocodiles	Eosinophilic granulomas	Magnino, 2009
Eustrongylides spp. (eustrongylidosis)	Crocodiles	No specific symptoms recorded so far	Boomker, 2006
Gnathostoma binucleatum, G. doloresi, G. hispidum, G. nipponicum, G. spingerum (gnathostomosis)	Snakes (but mainly fish)	Cutaneous or visceral larvae migrans symptoms	Nawa, 2017
Angiostrongylus cantonensis (neuroangio-strongyliasis)	Monitor lizards	Eosinophilic meningitis	Eamsobhana , 2014

Alaria and *Echinostoma* (echinostomiasis)	Turtles and crocodiles	Catarrhal inflammation Peripheral eosinophilia	Pauwels et al., 2018
Amblyomma spp.	Monitor lizards, tortoises, snakes	Dermatitis and VBDs	Patro et al., 2019; Sánchez-Montes, 2019
Bothriocroton hydrosauri	Snakes, lizards	Vector of Flinders Island spotted fever	Whiley, 2016
Haemaphysalis spp.	Lizards, viperid snakes	Dermatitis and VBDs	Sánchez-Montes, 2019
Hyalomma aegyptium	Tortoises	Dermatitis and VBDs	Sánchez-Montes, 2019
Ixodes spp.	Snakes, lizards	Dermatitis and VBDs	Mendoza-Roldan, 2019
Ornithodoros spp.	Tortoises and viperid snakes	Dermatitis and VBDs	Sánchez-Montes, 2019
Ophionys susnatricis	Snakes, lizards	Dermatitis	Amanatfard, 2014 ; Mendoza-Roldan, 2020
Eutrombicula spp.	Snakes, lizards, turtles	Dermatitis	Mendoza-Roldan, 2019; Mendoza-Roldan, 2020
Neotrombicula autumnalis	Lizards, snakes	Dermatitis	Mendoza-Roldan, 2019; Mendoza-Roldan, 2020

PARASITIC ZOONOTIC INFECTIONS IN OUR BACKYARD: SYNANTHROPIC AND INVASIVE SPECIES

Reptiles can be found in our homes, backyard, or anywhere they can find refuge, food, and heat. As a result, it is not surprising that increased urbanisation and habitat loss have facilitated human contacts and allowed many reptile species to adapt to peridomestic habitats (Wolfe, 2017). Indeed, parasite transmission from reptiles to humans is influenced not only by their biology and quantity in a host population, but also by environmental factors. As a result, urbanisation may both trigger and inhibit the transmission of some parasites (French, 2018). Synanthropic species (i.e., geckos and lizards) may undoubtedly spread zoonotic protozoa and pentastomids by pollution of the environment in peridomestic areas (Table 1) (Kelehear, 2013; Reboredo-Fernández, 2017). Meanwhile, invasive/exotic reptile species may be a source of parasite spillover to native species, posing a new concern to human health (Hoyer, 2017; Miller, 2018). It was an invasive Burmese python *(Python bivittatus)* that was introduced into Florida and brought Asiatic pentastomids (i.e., *Raillietiella orientalis*), which affected native snake species (Miller, 2018).

Although the majority of human infections by pentastomids are caused by the ingestion of snake meat (which is common in Asian and African countries), clinicians should be aware that other routes of infection exist, such as exposure to snake nasal secretions, saliva, and faeces (Dakubo, 2008), implying a potential risk for humans. Such transmission channels may explain some of the human cases reported in the United States, where this infection is unusual or regarded as a travel-medicine concern. Furthermore, when the same species of python was returned to Asia, it introduced American pentastomids *(Raillietiella bicaudata)* into local populations (Westfall, 2019). Muscular sarcocystosis in humans has been linked to the intake of Sarcocystis nesbitti sporocysts (Figure 2A), which are most likely derived from snake faeces (Italiano, 2012; Lau, 2014; Fayer, 2015). Overall, veterinarians play a critical role in preventing zoonotic illnesses by conducting coprological screenings on captive snakes.

Reptiles also provide as a blood source for numerous hematophagous arthropods (such as mites, ticks, sand flies, and mosquitoes), as well as potential reservoirs for bacterial, viral, and protozoan infections (Table 1) (Bosco-Lauth, 2018; Yared, 2019). Some tick (Ixodidae and Argasidae) and mite (Macronyssidae, Trombiculidae) species, for example, prey on both reptiles and humans (Table 1). One of the most common snake mite species, *Ophionys susnatricis,* is a mechanical vector of *Aeromonas hydrophila,* the causal agent of hemorrhagic illness in reptiles, gastroenteritis, and, in rare occasions, necrotizing fasciitis in humans (Tsujimoto, 2019; Kwon, 2020). The epidemiological importance of argasid and ixodid ticks as vectors of zoonotic infections has gained a lot of attention in the last decade. For example, *Ornithodoros turicata,* an argasid tick that primarily parasitizes tortoises, is the vector of *Borrelia turicata*e, a relapsing fever clade (Krishnavajhala, 2018), which has been linked to tick-borne relapsing fever in five cases among cave workers in the United States (Campbell, 2017). Exotic tick species, as well as the illnesses they transmit, may be introduced into nonendemic habitats alongside reptiles. This is the case of *Hyalomma aegyptium*-infested tortoises that were illegally imported into Italy (Brianti, 2010). This tick species has been discovered to be molecularly positive for zoonotic diseases (Paştiu, 2012; Sirok, 2014; Barradas, 2019). Furthermore, several tick species parasitizing reptiles were vectors of *Coxiella burnetii,* the agent of Q fever (for example, *H. aegyptium* ticks in the Mediterranean basin) (Sirok, 2010). Reptiles also play a direct role in the epidemiology of several Rickettsiaceae diseases (Novakova, 2015). This is true in the instance of African fever, a human disease caused by *Rickettsia africae* and transmitted by *Amblyomma variegatum,* which was found in ticks brought from Africa with reptiles (Burridge et al., 2003). *Rickettsia honei*, the causative agent of Flinders Island spotted fever in humans, has been found in ticks (e.g., *Bothriocroton hydrosauri*) infesting a variety of reptile species, which serve as the pathogen's principal reservoirs (Whiley, 2016). *Rickettsia anan* was also found in ticks of the species *Amblyomma exornatum* in varanid lizards imported into the United States. Finally, lacertid lizards are primary hosts of young *Ixodes ricinusticks,* contributing to the epidemiology of tick-borne infections such as Borrelia burgdorferi sensulato group, which causes Lyme borreliosis (Mendoza-Roldan J, 2019).

Phlebotomine flies, primarily of the genus *Sergentomyia*, are herpetophilic hematophagous insects previously linked to the transmission of the nonpathogenic species *Leishmania tarentolae* (Bravo-Barriga, 2016). Recent research has shown that *Sergentomyia* spp. can carry harmful *Leishmania* species such as *Leishmania infantum* and *Leishmania major* (Campino, 2013; Latrofa, 2018). Furthermore, other pathogenic *Leishmania* species have been detected in lizards (e.g., *Leishmania turanica, Leishmania tropica*, and *Leishmania donovani*) (Zhang, 2019) (Table 1), raising the possibility that lizards and associated sand flies may play a role in the leishmaniasis epidemiological cycle. This issue should be handled more thoroughly and comprehensively. Indeed, research on vector-borne infections provides a unique opportunity to bring together veterinarians, clinicians, and public health officials to better understand the impact of reptile vector-borne viruses in the context of One Health.

PARASITIC ZOONOTIC INFECTION OF REPTILES IN OUR DISH

Reptiles are an important component of the food chain in many environments (Valencia-Aguilar, 2013). While big carnivorous reptile species (e.g., crocodilians, monitor lizards, a variety of snakes, marine and aquatic turtles) are top predators, smaller reptile taxa (mostly in the Squamata) are common prey for many carnivores. It is hardly unexpected, then, that a large variety of heteroxenous protozoan and metazoan parasites cycle through reptiles, employing them as intermediate or ultimate hosts (Greiner, 2003). Humans, being huge omnivorous primates, also play a part in food chains that include reptiles. Crocodiles and other large carnivorous reptiles, such as crocodiles, can hunt and consume adult humans on rare occasions (Patro et al., 2019). Various reptiles, on the other hand, have long been a staple of human diets over the world, and in many places, this practise continues to this day. In addition to wild-caught reptile consumption, reptile farming has been established in recent decades to meet rising demand and replace animals from declining natural populations (Hossain, 2013). Crocodiles are most likely the most farmed reptiles; nevertheless, snake and turtle farming are rapidly expanding in South Eastern (SE) Asia, and iguanas are farmed locally in South America. This farming system urgently requires established food-inspection processes as well as qualified personnel, which can be achieved by revising animal science curriculum. Reptiles are also employed in traditional medicine, primarily in Asia. Cases of zoonotic helminthic infections have been documented all over the world, and they have been linked to reptile intake or the use of reptile flesh in medical practises (Magnino, 2009). Humans are aberrant or dead-end hosts in all food-borne parasitoses linked with reptile intake (e.g., *Anisakis* spp., *Gnathostoma* spp., *Spirometra* spp., *Angiostrongylus cantonensis, Trichinella* spp., and numerous pentastomids (Table 1). The most prevalent reptile-borne zoonotic helminths are Pseudophyllidean tapeworms of the genus *Spirometra* (Diphyllobothriidae), with *Spirometra erinaceieuropaei, Spirometra mansonoides,* and *Spirometra proliferum* being among the most regularly reported species. *Spirometra* spp. life cycle is often characterised by carnivorous mammals as definitive hosts and freshwater crustaceans (i.e., *Cyclops*) and poikilothermic vertebrates as first and second intermediate hosts, respectively. The infective larval stages (plerocercoids, also known as sparganum or spargana in plural) are typically found in subcutaneous tissue and/or muscles of reptiles and can be transmitted to humans by eating raw meat. Plerocercoids travel to different organs and tissues in the human body after infection, including subcutaneous tissue, muscles, the lungs, the pleural cavity, urogenital and abdominal viscera, and, most crucially, the central nervous system (Kwon et al., 2004; Presti, 2015). As a result, sickness is characterised as subcutaneous, ophthalmic, cerebral, or visceral sparganosis depending on which organs are invaded (Liu, 2015). Plerocercoids can reproduce asexually within the human host, resulting in a severe clinical disease known as proliferative sparganosis. The majority of human sparganosis cases are found in Southeast Asia, owing to the widespread eating of raw or undercooked snakes, frogs, and tadpoles contaminated with the plerocercoid. Cases lately reported from Europe were foreigners who were most likely infected on other continents. Alternative routes of human infection include drinking untreated water with infected copepods (i.e., first intermediate hosts) or putting the meat of an infected snake or frog as a poultice to a wound (Liu, 2015). Because the condition in people is difficult to detect at the preoperative stage, anamnesis is critical for accelerating diagnosis and treatment

PARASITIC ZOONOTIC INFECTION OF REPTILES IN OUR BEDROOM: THE PET SCENARIO

Reptiles are frequently kept as pets. From tranquil ball pythons to gorgeous green iguanas to long-living tortoises, keeping reptiles in our homes is now more of a habit than an exclusive interest. Reptiles and amphibians, for example, account for 2.4 percent of the pet population in the United States (Rataj, 2011; Pasmans, 2017). Many housed species have little information about husbandry and basic care, and these animals are still among the most inhumanely handled in the pet industry (Cervone, 2016). As a result, veterinarians must be aware of the growing need for medical treatment, given that keeping reptiles in captivity frequently results in unnatural events (e.g., metabolic imbalances, low immunity, poor enclosure hygiene), which encourages parasite transmission. As a result, zoonotic parasites could infect pet owners, particularly those with immunosuppression or children, in poor husbandry settings and without routine veterinary follow-up (Mitchell, 2011; Mader, 2013). The possibility of zoonotic agents (mainly bacteria but sometimes parasites) being transmitted to the aforementioned categories of individuals has prompted public health agencies, such as the Centers for Disease Control and Prevention (CDC), to advise against keeping reptiles as pets (Cervone, 2016). Furthermore, the reptile pet trade has been identified as a possible source of exotic parasite introduction and emergence in nonendemic countries (Nowak, 2010).

Protozoa (e.g., *Cryptosporidium, Sarcocystis*), pentastomids, and ectoparasites (e.g., Trombiculidae and Macronyssidae) are among the zoonotic parasites linked with pet reptiles (Table 1) (Rinaldi, 2012). *Cryptosporidium* species with zoonotic potential have been isolated from pet reptiles in recent years through genetic detection of *Cryptosporidium muris, Cryptosporidium tyzzeri,* and most critically *Cryptosporidium parvum* variants previously reported in humans (Pedraza-Daz, 2009). Because they do not develop in the ophidian host, the identification of zoonotic *Cryptosporidium* spp. in snakes is connected with the ingestion of contaminated prey (e.g., rodents). However, lizards, snakes, and tortoises have been observed to excrete *Cryptosporidium* oocysts that are potentially harmful to humans (Daz, 2013). Larger pet snakes, such as ball pythons or giant African vipers, are common hosts of pentastomids, which can pose a major zoonotic danger due to faecal egg contamination of the environment (Rataj, 2011).

Furthermore, the parasite fauna of captive reptiles, in addition to those species having zoonotic potential, can aid in distinguishing animals caught in their natural environment from those raised in captivity (Lyons et al., 2015). This is especially true for different hemoprotozoa, which are only discovered in reptiles who have had contact with the infected vector in their natural environment (Wolf, 2014). As a result, correct identification of captive reptile parasite fauna has become a significant tool for controlling and preventing the illicit reptile trade, as well as a surveillance technique for potential public health problems linked with this diverse collection of animals.

Finally, to reduce the danger of zoonotic pathogen transmission in the home, adequate and proper sanitary precautions, as well as personal cleanliness when handling these animals – as well as good husbandry conditions and removing reptiles from places where food is produced – should be taken. In addition, when keeping reptiles as pets, animals should be checked and tested for parasites and other pathogens on a regular basis, and suitable quarantine procedures should be used to avoid bringing diseases into a healthy population of reptiles. It is also critical for public health experts to have up-to-date population figures on reptiles kept as pets in order to advocate for excellent care practises and hygiene.

CONCLUSION

We have described the common clinical signs, diagnostic plan, and therapeutic options for several reptile infectious diseases. The breadth of this article prevents us from providing detailed descriptions of different causes; instead we have highlighted the similarities found in common reptile diseases presented by organ systems.

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Chapter 5

Biotechnology Intervention in Aquaculture: A Nutritional Food Security in India

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ABSTRACT

Biotechnology has played a vital role in boosting production in the aquaculture that has evolved as the fastest growing food-producing sector and developed as an important component in food security. The global issue of food and nutritional security demands substantial enhancement on the culture of several fish species commonly consumed by human beings under several constraints emerging from increasing population, urbanization, industrialization, climate change shrinkage of natural water bodies, technological innovations in aquaculture are being witnessed as an important development for achieving the target to fulfill the requirement of the growing the population globally. Fisheries apart from contributing to nutritional security component of the food basket of the country, is recognized for providing livelihood and employment to millions of people in the country.

Keywords: Hormonal manipulation, artificial gonadal maturation, fish seed production, disease management.

INTRODUCTION

Aquaculture and fisheries is one of the fastest growing sectors in the world (Tacon, 2020) and developed as an important component in nutritional food security (Panigrahi and Azad, 2007). It also play an important role in the economic development, national income, employment opportunities as well as generating livelihood options (Kumar and Shivani, 2014). It is the primary source of animal protein and nutrient rich animal source food for billions of people Worldwide, where capture fishery and aquaculture serves the livelihoods of more than 10% of the global population (Anonymous, 2020). In general, fish production contributes 0.5 – 2.5 percent of GDP globally (Allison, 2011) but for India, the contributions is 1.07 % to the national GDP and 5.4% of the agricultural GDP (Ngasotteret al., 2020).

Fisheries is an important sector for India's nutritional food security and rural development, engaging over fifteen million people in fisheries/ fish culture and ancillary industries with an annual growth rate of over 14.8% (2016-17). Presently, India ranks second in aquaculture and third in fisheries production. This rise in fish production has been possible due to quantum jump in inland fish production, with its contribution to total fish production going up from 29% (1950-51) to over 67% (2014-15). However, with all growth registered in fish production, the average per capita availability in the country during 2014-15 was only around 13 kg (assuming 55% as fish eating population) against the world average of 20.2 kg. It is estimated that in our country about 10 million tons of fish are required to meet the annual demand of fish proteins as compared to an actual annual production of only 3.5 million tons (Srivastav et al., 2007).

India has vast available inland resources, both in form of open water fisheries (river, canals, lakes/ flood-plain wetlands and reservoirs) and for aquaculture (freshwater ponds & tanks and brackish water areas). Catch from rivers and lakes/ flood-plain wetlands is on a continuous decline and has even fallen below the sustenance level, with canals being hardly utilized as a fishery resource and development of reservoir fisheries being given some importance only since Ninth Plan. There has been paradigm shift in the production scenario from marine to inland fisheries in recent years. In spite of continued decline in inland open water fisheries resources, due to various incorrigible reasons, the observed jump in inland fish production is a result of quantum jump in inland aquaculture production during the last three decades, especially from freshwaters.

The growing importance of culture fisheries invites refinement of the technique necessary for securing the population of fish seeds such as fry and fingerling for stocking at the desired period. Changes in breeding cycling; induction of advanced delayed maturation and multiple breeding; ovulation, releasing of milt and artificial fertilization are to be practiced where nutritive and reproductive physiology might help for faster progress in aquaculture.

Biotechnology provides powerful tools for the sustainable development of aquaculture, fisheries, as well as the food industry. Increased demand of nutritious food and decreasing natural resources have encouraged scientists to study ways that biotechnology can increase the production of culture fisheries, and making aquaculture as a growing field of animal research. Biotechnology allows scientists to investigating genes that will increase production of natural fish growth factors as well as the natural defense compounds. Modern biotechnology is give important contributions and poses significant challenges to aquaculture and fisheries development. It perceives that modern biotechnologies should be used as adjuncts to and not as substitutes for conventional technologies in solving problems, and that their application should be need-driven rather than technology-driven.

BIOTECHNOLOGY IN FISH BREEDING

Gonadotropin releasing hormone (GnRH) is now the best available biotechnological tool for the induced breeding of fish. GnRH is the key regulator and central initiator of reproductive cascade in all vertebrates (Bhattacharya et al., 2002). Though GnRH the main regulator of reproduction in vertebrates; appeared phylogenetically first in cnidarians (coelenterates with evolution of nervous system) is reported from molluscs, echinoderms and protochordates too.

With evolution of pituitary gland (hypophysis), hypothalamus-pituitary-gonad (HPG) axis came into existence which plays pivotal role in neuroendocrine regulation of reproduction in chordates. GnRH has been reported from non-hypothalamus tissues also but its role appears to be autocrine / paracrine in nature. GnRH binds specially to receptors in the pituitary gonadotrops and stimulates secretion of gonadotrophic hormone (GtH-I, II). The GtHs function at the target sites in two ways-it induces synthesis and secretion of estradiol-17 a during previtellogenic phase which, in turn, induces vitellogenesis or yolk production during post-vitellogenic phase, GtH-II triggers the synthesis of 17a, 20a-dihydroxy –progesterone (17,20-P) and 17a, 20a, 21-trihydroxy-4-pregnen-3-one (20a-S) which are responsible for the final maturation leading to ovulation and sperminatiom.

The recent researchers in fish endocrinology have led to a better understanding of the hormones involved in control of gametes formation (ovulation and spermiation), mode of action and regulation of their secretion during different stages of sexual cycle. Environmental factors like temperature, humidity, rainfall, turbidity and photoperiod act as stimuli and that are perceived by the brain which releases gonadotropin releasing hormones (GnRH).

Seven or eight different forms of GnRH have been isolated from fish species. (Halder et al.,1991).The most recent GnRH purified and characterized was by Carolsfeld et al. (2000). Depending on the structural variant and their biological activities, number of chemical analogues have been prepared and one of them is salmon GnRH analogue profusely used now in fish breeding and marked commercially under the name of 'Ovaprim'throughout the world. The induced breeding of fish is now successfully achieved by development of GnRH technology.

Role of nutrition in brood stock management for quality seed production in fishes has been appreciated during the recent years. Advancement in gonadal maturation of the Indian carps and catfish for two months under pond conditions has been achieved by keeping the brood stocks on semi-balanced diets supplemented with protein and essential aminoacids. Thyroxine (T4) and cortisol treatments improve growth and survival in the larvae of carps and catfish. Role of reproductive pheromones in gonadal maturation, synchronization of reproductive processes and spawning as well as reproductive containment of invasive species may not be overlooked.

BIOTECHNOLOGY AND FISH HEALTH MANAGEMENT

To keep a sustainable growth pattern, health management strategies must go beyond antibiotics and chemotherapeutics, which create resistant bacteria and immunosuppression in the host. Besides development of drug resistant bacteria and pathogens, the adverse effect of antibiotics is caused by their influence on the aquatic microflora, and the retention of harmful residues in aquatic animals. On the other hand, the microbes with their unique structure and cell wall components can trigger immunity, and thus exposure plays an important role in the evolution. Microbial intervention through an environmentally friendly approach is an alternative method of health management. India is endowed with a bounty of varied climatic conditions, microbial diversity and fish fauna and aquaculture systems offering challenges in biological and environmental pursuits.

Disease problem are a major constraint for development of aquaculture. Biotechnological tools such as molecular diagnostic methods, use of vaccines and immunostimulants are gaining popularity for improving the disease resistance in fish and shellfish species; avoidance of the pathogen is very important.in this context so there is a need to rapid method for detection of the pathogen. Biotechnological diagnostic methods such as gene probes and polymerase chain reaction (PCR) have great potential and also developed for a number of pathogens affecting fin and shell fish (Karunasagar, 1999). In case of finfish aquaculture, numbers of vaccines against bacteria and viruses have been developed. Some of these have been conventional vaccines consisting of killed microorgansism but new generation of vaccine consisting of protein subunit vaccine genetically engineered organism and DNA vaccine are currently under development.

In the vertebrate system, immunization against disease is a common strategy. However the immune system of shrimp is rather poorly developed, biotechnological tools are helpful for development of molecule, which can stimulate this immune system of shrimp. Recent studies have shown that the non specificdefense system can be stimulated using, microbial product such as lipopolysacharides, peptidoglycans or glucans. Among the immunostimulants known to be effective in fish glucan and levamisole enhance phagocytic activities and specific antibody responses (Sakai, 1999).

CONCLUSIONS

Biotechnological research and development are growing at a very fast rate. The biotechnology has assumed greatest importance in recent years in the development of fisheries, agriculture and human health. The biotechnology is capable to give new tools and technique and also has a great power to create novel genes and genotypes of organisms including fish. The application of biotechnology in the fisheries sector is a relatively recent practice. Nevertheless, it is a promising area to enhance fish production. The increased application of biotechnological tools can certainly transform our fish farming.

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Chapter 6

Antiviral and Therapeutic Potential of Flavonoid Quercetin: Future Perspectives

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ABSTRACT

Flavonoids or "bioflavonoids" are now well known for their biological properties and therapeutic potential. They are used in form of functional food to obtain various health benefits. Various flavonoids have proved beneficial against COVID-19 diseases. Quercetin is one of the important plant based flavonoids. It is found in a variety of fruits and vegetables. Quercetin has been shown to have various biological properties. It has been reported to have anti-infective and anti-replicative properties against viruses. In recent, research has suggested the preventive role of quercetin against COVID-19. It can inhibit the replication of virus. Further extensive research is required on antiviral potential of quercetin and mechanism of action against COVI-19 diseases. Quercetin may be molecule of interest to be used as safe, alternate or complementary treatment against COVID-19 after extensive research and clinical trials.

Keywords: Flavonoid, Quercetin, COVID-19, Antiviral Potential.

INTRODUCTION

Flavonoids are abundant in plants in which they execute several functions e.g., produce colour to attract pollinating insects, works as chemical messengers, also required for nitrogen fixation, UV filtration and cell cycle inhibition etc. Flavonoids are abundant in plants and thereby are the most common type of polyphenolic compound found in the human diet. Bioflavonoids are believed to provide health benefits through cell signalling pathways and antioxidant properties. Being important antioxidants, flavonoids promote several health effects. With their low toxicity in comparison to other plant compounds, and their abundance, flavonoids can be ingested by animals in a massive quantity, including humans. Apart from their antioxidant activity flavonoids have anti-viral, anti-inflammatory, anti-cancer, and anti-allergic effects.

Quercetin is considered as a member of flavonol subclass of flavonoids. Quercetin is found in a variety of fruits and vegetables. Quercetin-type flavonols (primarily as quercetin glycosides), the most abundant of the flavonoid molecules, are widely distributed in the plant kingdom. They are found in a variety of foods including apples, berries, Brassica vegetables, capers, grapes, onions, shallots, tea, and tomatoes, as well as many seeds, nuts, flowers, barks, and leaves. Quercetin is one of the most substantial bioflavonoid compounds found in fruits, grains, and vegetables for more than 30 plant species. In recent years, quercetin has been reported for antiviral properties also. More extensive research is required on this flavonoid to be used as therapeutic molecule of interest against various diseases.

BIOLOGICAL PROPERTIES

Quercetin is a kind of widely available flavonoid, which is synthesized as a defensive response of plants to their environment e.g., in response to UV radiation and lipid peroxidation (Mohle et al., 1985; Mariani et al., 2008). Some of the important biological and therapeutic properties of quercetin are presented in Figure 1. The quercetin has been reported to have various biological properties. The major biological properties are as follows:

- Antioxidant properties
- Direct radical scavenging action:
- Xanthine oxidase inhibition:
- Inhibition of inducible nitric oxide synthases:
- Decreasing Leukocyte immobilization:
- Interaction with other enzyme systems:

- Modulation of gene expression:

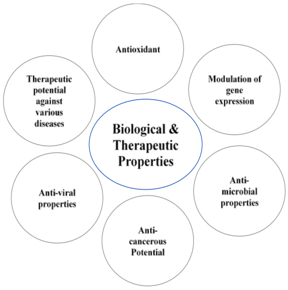

Fig. 1. Major biological and therapeutic properties of flavonoid Quercetin.

THERAPEUTIC POTENTIAL AND APPLICATIONS OF QUERCETIN

Quercetin has been found to have therapeutic potential in various studies for the prevention and treatment of various conditions including allergies, asthma, hay fever, arthritis, antibacterial, anti-cancerous, anti-diabetic, cardio-protective, antiviral and others.

Allergies, Asthma, Hay Fever and Hives

Some allergies, such as hay fever and hives, can benefit from the use of quercetin. It functions by stabilizing mast cell's membranes, which prevents the development and release of histamine and other allergic/inflammatory substances (Lombard, 2005; Thornhill and Kelly, 2000).

Antibacterial activities

Quercetin appears to have antibacterial activity against nearly all bacteria strains recognized to cause respiratory, skin, gastrointestinal, and urinary disorders (Riganoetal., 2007; Adamczak et al., 2020).

Arthritis

Quercetin inhibits the activities of both cyclo-oxygenase and lipo-oxygenase, reducing the production of inflammatory mediators (Kim et al., 1998; Yoshimoto et al., 1983). There have also been reports of people with rheumatoid arthritis (RA) who saw an improvement in their symptoms after switching from a traditional western diet to a vegan diet rich in uncooked berries, vegetables and fruits which contain quercetin, among other antioxidants (Hanninen et al., 2000).

Cancers

Quercetin has been shown to prevent the growth of cancer cells in animal and test tube tests, including those from breast, colon, prostate, and lung cancers (Plakas et al., 1985).

Diabetes

Quercetinhas been discovered to affect diabetic condition by many different ways e.g.,by inhibiting the absorption of glucose in the intestine, by intervening the activities related to secretion and sensitization of insulin along with improved glucose utilization in peripheral tissues (Eid and Haddad, 2017).

Osteoporosis

Quercetin is thought to find therapeutic application in sustaining bone health as it enhances bone mass density (BMD), and bone formation, decreases osteocalcin levels and maintains bone biomechanics in ovariectomized rats (Yang et. al., 2020).

Peptic Ulcer

Quercetin appears to be crucial in the prevention and treatment of peptic ulcer disease. It works as a gastroprotective agent by encouraging mucus secretion. *Helicobacter pylori,* an infectious bacterium, is thought to be the cause of many peptic ulcers. In vitro experiments have shown that quercetin inhibits the development of this bacterium (Alarcon-de-la-Lastra et al., 1994). Alkushi and Elsawy (2017) showed quercetin to protect gastric mucosa against indomethacin-induced gastric ulceration with its antioxidant effect.

VIRAL INFECTIONS AND COVID-19

In a research conducted by Wang et al.,(1998) the antiviral activity of flavonoid was demonstrated. Herpes simplex virus, respiratory syncitial virus, and adenovirus are among the viruses that have been confirmed to be influenced by flavonoids. Quercetin has been shown to have anti-infective and anti-replicative properties against viruses. Majority of experiments have been conducted in vitro, and only a little is known about flavonoids' antiviral effects in humans. A few substantiations are there which show that flavonoids in their glycon form tend to have a greater inhibitory effect on rotavirus infectivity than flavonoids in their aglycon form (Bae etal., 2000).Because of the worldwide spread of HIV, studies related to antiviral activity of flavonoids have largely been focused on HIV for last two three decades. Most of the studies have been focused on RNA guided DNA polymerase inhibitory activity or reverse transcriptase,though anti-integrase and anti-protease activities have also been reported in the in vitro studies (Ng et al., 1997; Vlietinck et al., 1998).

Wu et al., (2015) studied the inhibitory effect of quercetin on different strains of Influenza A viruses including A/Puerto Rico/8/34 (H1N1), A/FM-1/47/1 (H1N1), and A/Aichi/2/68 (H3N2) with an IC50 (half maximal inhibitory concentration) of 7.756 ± 1.097, 6.225 ± 0.467, and 2.738 ± 1.931 µg/mL respectively. Quercetin has been identified to interact with the HA2 subunit.

Due to overlapping antiviral and immunomodulatory properties and the ability of ascorbate to recycle quercetin, co-administration of vitamin C and quercetin has a synergistic antiviral impact (ColungaBiancatelli et al., 2020). In vitro and in silico studies confirmed that quercetin can interfere with different stages of the coronavirus entry and replication cycle e.g., PLpro, 3CLpro, and NTPase/helicase. Quercetin and its derivatives represent an important drug candidate compound due to lack of systemic toxicity and its pleiotropic activities (Agarwal et al., 2020; Di Pierro et al., 2020). Efficacy of quercetin supplementation for the treatment or prevention of COVID-19 has been tested with 3 three human clinical trials, it was found that though beneficial effect on the incidence and duration of respiratory tract infections in certain populations have been observed with oral quercetin, but further research is required to recommend quercetin supplementation as a therapy for the treatment or prevention of COVID-19 (Aucoin et al., 2020). A case reported by Moskowitz et al., (2020) an 18-year-old asthmatic male with symptoms of COVID19, responded strongly to quercetin. SARS-CoV-2 is a betacoronavirus, the causal agent of COVID-19, excessive inflammation is considered one of the main life-threatening conditions in patients. Quercetin, as an anti-inflammatory, antioxidant compound, is probably a potential treatment for severe inflammation in patients with COVID-19 (Saeedi-Boroujeni and Mahmoudian-Sani, 2021).

CONCLUSIONS AND FUTURE PERSPECTIVES

Quercetin has been shown to have beneficial medicinal properties in the treatment of a variety of diseases. Quercetin's broad-spectrum antimicrobial properties can be used to prevent and treat a variety of infectious bacterial diseases, as well as provide treatment options that minimize antibiotic usage, which has significant consequences. Quercetin, has been found one of the promising flavonoids in the various studies carried out by various researcher time to time. Though most of the studies have been carried out in-vitro or animal models, hence before pharmacological application further research into quercetin is needed.

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Chapter 7

Fish As Biomarkers of Aquatic Pollution: A Review

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ABSTRACT

The present review gives a brief account of the toxic effects of industrial effluent on fish. In aquatic ecosystem, industrial effluents are considered as one of the most important pollutants, since these are generally released into waterbodies without proper treatment. Industrial effluent contains number of toxicants or pollutants in the form of pesticides, heavy metal and other several harmful substances in critical amounts. They are extremely dangerous for the health of fish. Most of these pollutants are characterized by being accumulated in tissues, and lead to the poisoning of fish. These metals can effectively influence the vital function and reproduction of fish by suppressing the immune system, and induce pathological changes. As such, fish are used as bio-indictors, playing an important role in monitoring water pollution. Thus the fish biomarker responses provide definitive assumption regarding impact of water pollution on fishes and their consumers.

Keywords: Fish, Biomarkers, Pollutants, Industrial effluent.

INTRODUCTION

Growing human population and pollution are two major problems of the world particularly for developing countries. Increasing population is putting pressure on all sections including agriculture, industry, environment etc. There is exploitation of all natural resources to meet the demand of population. This has disturbed the delicate ecological balance of the biosphere. India is one of the leading industrialized countries of world with good industrial infrastructure. This has caused production of several types of industrial effluent which are discharged into the waterbodies. At the same time agricultural revolution has added pesticides, fertilizers and other types of chemical agents also to increase production. All the pollutants ultimately find their way to the water bodies and degrade the aquatic environment. All these changes consequently deteriorate the water quality of water bodies and led to the aquatic pollution. Pollution affects all the living being which is exposed to such environment. It disturbs behavior, biological activities, metabolism, physiology and overall performance of the organism.

Due to feeding and living in the aquatic ecosystem, fish have been widely documented as useful indicators of water quality because of their differential sensitivity to pollution. Fish, in comparison with invertebrates, are more sensitive to many toxicants and are a convenient test subject for indication of ecosystem health (Authman et al., 2015). Waste water of various industries such as sugar factory and distillery; pulp and paper mills; and pesticides, fertilizers and chemicals manufacture units contain number of heavy metals and metalloids in detrimental concentrations, so their contamination is a serious threat because of their toxicity, long persistence, bioaccumulation and biomagnification in the food chain.

FISH AS BIOMARKER OF AQUATIC POLLUTION

The expression 'Bioindicator' is used as an aggregate term referring to all sources of biotic and abiotic reactions to ecological changes. Instead of simply working as gauges of natural change, taxa are utilized to show the impacts of natural surrounding changes, or environmental change. They are used to detect changes in natural surroundings as well as to indicate negative or positive impacts. They can also detect changes in the environment due to the presence of pollutants which can affect the biodiversity of the environment.

Whereas 'Biomarker' is any indicator of stress agent that is somehow affecting the organism ability to grow, reproduce, survive and adapt in a given environment. It is used to refer an indicator at sub individual or at individual level of organism. This may be alterations in molecular and biochemical processes, cellular structures and functions, tissue organization, length and weight ratio (condition factor) and ratio between individual organ and whole body weight (organosomatic index). Basics of biomarker are the capability of an organism to adapt to subtle changes in the environment. This adaptation is mechanistically based on changes in molecular and biochemical processes within the cellular metabolism in response to climate changes. Alterations in these processes can lead to modification in cellular structure, tissue organizations and so on up the hierarchical level of biological organizations. Basic concept of the biomarker's approach to assess adverse effects or stress is based on the hypothesis that effects of stress are typically manifested at lower levels of biological organization before disturbances are realized at the population, community or ecosystem level (Adams, 1987).

In environmental pollution context, biomarkers often promise as sensitive indicator demonstrating that toxicant has entered organism, distributed between tissues and is electing toxic effect at targets. Good biomarkers are sensitive indices of both pollutants bioavailability and early biological response.

Regarding the aquatic habitats fishes are considered to be most significant biomonitors for the estimation of metal pollution level(Benaduce et al., 2008), water borne and sediment deposited toxicants (Viarengo, et al. 2007).

Fish can be found virtually everywhere in the aquatic environment and they play a major ecological role in the aquatic food-webs because of their function as energy carriers from lower to higher trophic levels. The understanding of toxicant uptake, behavior, and responses in fish may, therefore, have a high ecological relevance (Espino, 2000). They are good model for the studies involving biochemistry, physiology and cellular studies which can be easily reproduced under laboratory condition (Powers, 1989). Thus fishes are well recognized bioindicators of environmental changes including chemical or industrial effluents pollution.

In order to assess the effect on aquatic ecosystem several parameters of fish can be examined such as behavioural, morphological and histological alterations; haematological and immunological parameters; biochemical and physiological parameters; reproductive and endocrine parameters; genotoxic parameters; biotransformation enzymes (Phase I and Phase II) as well as oxidative stress parameters and stress protein concerned with the toxicity are mainly the organs where metabolic processes are carried out to neutralize or remove toxicants, such as kidney and liver as these are the main sites of metabolic activities. They offer several specific advantages in describing the natural characteristics of aquatic ecosystems and in assessing changes to habitats. In addition, fish are located at the end of the aquatic food chain and may accumulate pollutants and pass them to human beings through food causing chronic or acute diseases. Thus fish biomarkers can play important role in environmental management as they respond to presence of contaminants in environment indicating water pollution. This information can help to improve the environmental health and eventually the organism health.

CONCLUSIONS

The use of biomarkers in aquatic ecosystem has long been established as an early warning, predictive and relatively low cost tool to indicate water pollution. However, the fish health in tropical ecosystems knowledge acquired by researcher has not been applied to its full potential by government agencies and private industries in monitoring the impacts of human activities on aquatic ecosystems. The fish biomarker responses provide definitive assumption regarding impact of water pollution on fishes and their consumers. They also help to scientists to reach a definite conclusion and policy makers to make and enforce the laws and legislations regarding the protection of aquatic environments must be taken into consideration. Though not a definite proof of pollution, biomarkers are indeed an excellent tool to indicate a possible contamination in aquatic ecosystems. Moreover, biomarkers indicate that this possible contamination would have been reaching the biota, causing changes in the metabolism or even harm to individuals. These metabolic changes indicate that fish and other species of the community are exposed to chemical compounds that are naturally not present in their habitat and that, most likely, originate from anthropogenic activities.

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Chapter 8

Preventive Role of Luteolin Against Viral Infections

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ABSTRACT

Flavonoids are now considered as an indispensable component in a variety of nutraceutical, pharmaceutical, medicinal and cosmetic applications. This is attributed to their anti-oxidative, anti-inflammatory, anti-mutagenic and anti-carcinogenic properties coupled with their capacity to modulate key cellular enzyme function. Flavonoids are now well known for their biological properties and health benefits. Luteolin is among the important flavonoid with anti-cancer, anti-oxidant, anti-apoptotic, and anti-inflammatory properties. Luteolin has been reported for the protective nature against viruses also. It has been shown to have protective role against the old SARS-CoV. It is a promising molecule of interest against COVID-19 disease. Dietary intake and protective role of this flavonoid requires elaborated and extensive research for effective management of COVID-19.

Keywords: Luteolin, flavonoid, COVID-19, SARS-CoV.

INTRODUCTION

Flavonoids, a group of natural substances with variable phenolic structures, are found in fruits, vegetables, grains, bark, roots, stems, flowers, tea and wine (Middleton, 1998). These natural products are well known for their benefificial effects on health and efforts are being made to isolate the ingredients so called flavonoids. Research on flavonoids received an added impulse with the discovery of the French paradox, i.e, the low cardiovascular mortality rate observed in Mediterranean populations in association with red wine consumption and a high saturated fat intake. The flavonoids in red wine are responsible, at least in part, for this effect (Formica and Regelson, 1995). Furthermore, epidemiologic studies suggest a protective role of dietary flavonoids against coronary heart disease (de Groot and Rauen, 1998). The association between flavonoid intake and the longterm effects on mortality was studied subsequently (Hertog et al., 1995) and it was suggested that flavonoid intake is inversely correlated with mortality due to coronary heart disease (Knekt et al., 1996)

Flavonoids can be divided into various classes on the basis of their molecular structure (Rice-Evans et al., 1996). The flavones are characterized by a planar structure because of a double bond in the central aromatic ring. One of the best described flavonoids, Luteolin, is a member of this group and is found in abundance in Celery seeds, Oregano, Parsley, Bird chili, Juniper berries and Onion leaves. The second group is the flavanones, which are mainly found in citrus fruit. An example of a flavonoid of this group is narigin. Flavonoids belonging to the catechins are mainly found in green and black tea and in red wine (de Groot and Rauen 1998), whereas anthocyanins are found in strawberries and other berries, grapes, wine, and tea.

Luteolin (30,40,5,7-tetrahydroxyflflavone) is a polyphenolic flavone found in many herbs, fruits and vegetables and traditionally used in Chinese medicine, which has been found to have anti-cancer, anti-oxidant, anti-apoptotic, and anti-inflammatory properties (Molnar et al., 1981; Selvi et al., 2015; Xia et al., 2016). Luteolin was reported to also have protective and anti-inflammatory effects in models of traumatic brain injury, spinal cord injury, and MPP+ induced toxicity (Wruck et al., 2007; Paterniti et al., 2013; Xu et al., 2014). Molecular formula of Luteolin is C15H10O6. Belonging to the flavone group of flavonoids, luteolin has a C6-C3-C6 structure and possesses two benzene rings (A, B), a third, oxygen-containing (C) ring, and a 2−3 carbon double bond. Luteolin also possesses hydroxyl groups at carbons 5, 7, 3′, and 4′ positions (Ross and Kasum 2002). The hydroxyl moieties and 2−3 double bond are important structure features in luteolin that are associated with its biochemical and biological activities (Chan et al., 2003). As in other flavonoids, luteolin is often glycosylated in plants, and the glycoside is hydrolyzed to free luteolin during absorption (Hempel et al., 1999). Some portion of luteolin is converted to glucuronides when passing through the intestinal mucosa (Shimoi et al., 1998). Luteolin is heat stable and losses due to cooking are relatively low (Le Marchand, 2002).

DIETARY SOURCES

Luteolin (Lut) is a naturally occurring plant-derived flavonoid that is widely distributed in edible herbs, vegetable and fruits such as bird chilli, oregano, juniper berries, celery seeds and parsley in significant amount (Miean and Mohamed, 2001). Besides the high abundance of Luteolin in dietary substances, its bioavailability is very low that is approximately 4.10% at a dose of 50 mg/kg because of significant first pass effect (Sarawek et al., 2008). After dietary intake, Luteolin is converted into its glucuronide/sulphate conjugates as in rat model study or remains in free form as in human plasma. The 4 main groups of flavonoids are listed in Table 1, together with the best-known members of each group and the food source in which they are present.

Table 1. Dietary sources of major flavonoids.

Group	Flavonoid	Dietary sources
Flavones	Apigenin	Apple skin
	Chrysin	Berries
	Kaempferol	broccoli
	Luteolin	Celery seeds, Oregano, Parsley, Bird chili, Juniper berries & Onion leaves
	Myricertin	Fruit peels
	Rutin	Cranberries
	Sibelin	Grapes
	Quercetin	Lettuce
Flavanones	Fisetin	Citrus fruit
	Hesperetin	Citrus peel
	Narigin	
	Narigenin	
	Taxifolin	
Catechins	Catechin	Red wine
	Epicatechin	Tea
	Epigalallocatechingalate	
Anthocyanins	Cyanidin	Berries
	Delphinidin	Cherries
	Malvidin	Grapes
	Pelargonidin	Raspberries
	Peonidin	Red Grapes
	Petunidin	Red Wine

BIOLOGICAL PROPERTIES OF FLAVONOIDS

Flavonoids possess many biological properties such as: (i) Antioxidant activity, (ii) Antibacterial activity, (iii) Antiviral activity, (iv) Anti-inflammatory activity, (v) Anticancer activity, (vi) Hepatoprotective activity.

Antioxidant activity

The best-described property of almost every group of flavonoids is their capacity to act as antioxidants. The flavones and catechins seem to be the most powerful flavonoids for protecting the body against reactive oxygen species. The antioxidant activity of flavonoids depends upon the arrangement of functional groups about the nuclear structure. The configuration, substitution, and total number of hydroxyl groups substantially influence several mechanisms of antioxidant activity such as radical scavenging and metal ion chelation ability. The B ring hydroxyl configuration is the most significant determinant of scavenging of ROS and RNS because it donates hydrogen and an electron to hydroxyl, peroxyl, and peroxynitrite radicals, stabilizing them and giving rise to a relatively stable flavonoids radical. Mechanisms of antioxidant action can include (Mahomoodally et al., 2005) suppression of ROS formation either by inhibition of enzymes or by chelating trace elements involved in free radical generation, (Pandey, 1983) scavenging ROS and (Dixon et al., 2007) upregulation or protection of antioxidant defenses.

Antibacterial activity

Flavonoids are known to be synthesized by plants in response to microbial infection; thus it should not be surprising that they have been found in vitro to be effective antimicrobial substances against a wide array of microorganisms. Flavonoid rich plant extracts from different species have been reported to possess antibacterial activity. Several flavonoids including apigenin, galangin, flavone and flavonol glycosides, isoflavones, flavanones, and chalcones have been shown to possess potent antibacterial activity. Antibacterial flavonoids might be having multiple cellular targets, rather than one specific site of action. Their mode of antimicrobial action may be related to their ability to inactivate microbial adhesins, enzymes, cell envelope transport proteins, and so forth. Lipophilic flavonoids may also disrupt microbial membranes.

Antiviral activity

Natural compounds are an important source for the discovery and the development of novel antiviral drugs because of their availability and expected low side effects. Naturally occurring flavonoids with antiviral activity have been recognized since the 1940s and many reports on the antiviral activity of various flavonoids are available. Various combinations of flavones and flavonols have been shown to exhibit synergism. Kaempferol and luteolin show synergistic effect against herpes simplex virus (HSV). Synergism has also been reported between flavonoids and other antiviral agents. Quercetin is reported to potentiate the effects of 5-ethyl-2-dioxyuridine and acyclovir against HSV and pseudorabies infection (Cushnie and Lamb, 2005). Flavonols are more active than flavones against herpes simplex virus type 1 and the activity order was found to be galangin, kaempferol, and quercetin (Cushnie and Lamb, 2005). Many flavonoids, namely, dihydroquercetin, dihydrofisetin, leucocyanidin, pelargonidin chloride, and catechin, show activity against several types of virus including HSV, respiratory syncytial virus, polio virus and Sindbis virus (Gerdin and Srensso 1983). Inhibition of viral polymerase and binding of viral nucleic acid or viral capsid proteins have been proposed as antiviral mechanisms of action (Zandi et al., 2011). List of some flavonoids and their efficacy against viruses is given in Table 2.

Table 2. Antiviral properties of flavonoids. Source: Kumar and Pandey, 2003.

Flavonoid	Virus
Quercertin	Rabies virus, herpes virus, parainfluenza virus, polio virus, mengo virus, and pseudorabies virus
Rutin	Parainfluenza virus, influenza virus, and potato virus
Apigenin	Immunodeficiency virus infection, Herpes simplex virus type, and Auzesky virus
Naringin	Respiratory syncytial virus
Luteolin	Auzesky virus
Morin	Potato virus
Galangin	Herpes simplex virus type

Anti-inflammatory activity

Inflammation is a normal biological process in response to tissue injury, microbial pathogen infection, and chemical irritation. Inflammation is initiated by migration of immune cells from blood vessels and release of mediators at the site of damage. This process is followed by recruitment of inflammatory cells, release of ROS, RNS, and pro-inflammatory cytokines to eliminate foreign pathogens, and repairing injured tissues. In general, normal inflammation is rapid and self-limiting, but aberrant resolution and prolonged inflammation cause various chronic disorders. A number of flavonoids such as hesperidin, apigenin, luteolin, and quercetin are reported to possess anti-inflammatory and analgesic effects. Flavonoids may affect specifically the function of enzyme systems critically involved in the generation of inflammatory processes, especially tyrosine and serine-threonine protein kinases. The inhibition of kinases is due to the competitive binding of flavonoids with ATP at catalytic sites on the enzymes. Flavonoids also inhibit phosphodiesterases involved in cell activation. Much of the anti-inflammatory effect of flavonoid is on the biosynthesis of protein cytokines that mediate adhesion of circulating leukocytes to sites of injury. Certain flavonoids are potent inhibitors of the production of prostaglandins, a group of powerful pro-inflammatory signaling molecules. Several flavonoids are reported to inhibit platelet adhesion, aggregation, and secretion significantly at 1–10 mM concentration. The effect of flavonoid on platelets has been related to the inhibition of arachidonic acid metabolism by carbon monoxide. Alternatively, certain flavonoids are potent inhibitors of cyclic AMP phosphodiesterase, and this may in part explain their ability to inhibit platelet function.

Anticancer activity

Dietary factors play an important role in the prevention of cancers. Fruits and vegetables having flavonoids have been reported as cancer chemo-preventive agents. Consumption of onions and/or apples, two major sources of the flavonol quercetin, is inversely associated with the incidence of cancer of the prostate, lung, stomach, and breast. In addition, moderate wine drinkers also seem to have a lower risk to develop cancer of the lung, endometrium, esophagus, stomach, and colon. The critical relationship of fruit and vegetable intake and cancer prevention has been thoroughly documented. It has been suggested that major public health benefits could be achieved by substantially increasing consumption of these foods.

Hepatoprotective activity

Several flavonoids such as catechin, apigenin, quercetin, naringenin, rutin, and venoruton are reported for their hapatoprotective activities. Different chronic diseases such as diabetes may lead to development of hepatic clinical manifestations. Several clinical investigations have shown the efficacy and safety of flavonoids in the treatment of hepatobiliary dysfunction and digestive complaints, such as sensation of fullness, loss of appetite, nausea, and abdominal pain.

ANTIVIRAL POTENTIAL OF FLAVONOID (LUTEOLIN) AGAINST SARS VIRUSES AND COVID-19

Flavonoids are a class of phenolic natural products, well-identifified in traditional and modern medicines in the treatment of several diseases including viral infection. Flavonoids showed potential inhibitory activity against corona viruses including the current pandemic outbreak caused by the severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) and designated as COVID-19. COVID-19 is the sixth CoV outbreak identified globally (WHO, 2020). SARS-CoV-2 is closely related to SARS-CoV (Lau et al., 2005; Ge et al., 2013). In addition to COVID-19 outbreak, corona virus has caused three zoonotic outbreaks within the last two decades that belong to beta corona virus family

(Boopathi et al., 2020). These include acute respiratory syndrome corona virus (SARS-CoV), Middle East respiratory syndrome corona virus (MERS-CoV) in China during the 2001 to 2003 period and from 2012 to 2015 in Saudi Arabia (Cushnie and Lamb 2005). SARS-CoV-2 can develop severe complications including septic shock and multiple organ failure that may result in death especially in people at high risk including Immuno-compromised and those with underlying medical conditions such as cancers, diabetes, cardio-vascular disease, and chronic respiratory diseases. A computational study indicated the potential importance of luteolin-7-glucoside, as potential inhibitors to SARS-CoV-2 Mpro (Khaerunnisa et al., 2020). Luteolin is one such compound which is used as an anti-inflammatory agent. Several studies have explained the protective nature of Luteolin by inhibiting virus entry and fusion with human receptors in old SARS-CoV that had emerged in 2003. Thus, regular consumption of foods having adequate amount of luteolin in our diet may be helpful in inhibiting the SARS-CoV-2 infection as well and may prevent the consequent symptoms in COVID-19 patients.

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Chapter 9

Colletotrichum as A Successful Biocontrol Agent in Weed Management for Sustainable Agriculture

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ABSTRACT

Management of weeds to ensure food security to meet the needs of increasing human population is necessary. There is an urgent need for more robust and sustainable solutions to mitigate yield losses in crops caused by weeds and to reduce impacts of pest management on human health and the environment. Biological control is a pest management tactic that utilizes deliberate introduction of living natural enemies to lower the population level of invasive pests. *Colletotrichum* is one of the most economically important plant pathogenic genus causing anthracnose of fruits and leaves of a wide range of hosts worldwide. *Colletotrichum* species are regarded as hemibiotrophs or facultative biotrophs, having an initial biotrophic phase with high host specificity followed by a necrotrophic phase with extensive tissue death; thus species have relatively high specificity and virulence. Out of the total 25 mycoherbicides reported, five mycoherbicides are based on this fungus including both liquid and solid formulations. There are huge possibilities to develop more mycoherbicides by using this fungus as the novel candidate.

Keywords: Biological control, Mycoherbicide, *Colletotrichum*, Hemibiotrophs.

INTRODUCTION

To date, there are more than 10000 fungal species known to cause diseases on plants, compared with roughly 50 species that cause diseases in humans (Koeck et al., 2011). *Colletotrichum* is one of the most economically important plant pathogenic genus causing anthracnose of fruits and leaves of a wide range of hosts worldwide, and particularly in the tropics and subtropics (Sutton, 1992; Hyde et al., 2009a, 2009b). It has continued to rank highly as one of the most studied genera of phytopathogenic fungi and there has been a surge of interest in this genus. This pathogen can affect the above-ground parts of plants and fruit trees by causing anthracnose and when fruit infection occurs it results in reduction in quantity and/or quality and post-harvest losses (Phoulivong et al., 2012). Diseases caused by *Colletotrichum* species are often referred to as anthracnose because of the appearance of sunken necrotic lesions which contain the acervuli. It is also believed that *Colletotrichum* species may adapt to new environments (Sanders and Korsten 2003), leading to serious cross infection problems in plant production. *Colletotrichum* species are cosmopolitan and it has been shown that multiple species can infect a single host, while a single species can infect multiple hosts (Cai et al., 2009; Hyde et al., 2009a) and for most of the *Colletotrichum* spp. the complete host range is unknown (Fagbola and Abang, 2004). The genus *Colletotrichum* with over 60 species includes a number of plant pathogens of major importance, causing diseases of a wide variety of woody and herbaceous plants. It has a primarily tropical and subtropical distribution, although there are some high-profile species affecting temperate crops. *C. gloeosporioides* (teleomorph *Glomerella cingulata*) with over 600 synonyms has been reported as one of the most important pathogens worldwide that infects at least 1000 plant species (Kirk et al., 2008; Phoulivong et al., 2012).

Colletotrichum spp. employs different infection strategies in plants ranging from endophytic to hemibiotrophic and subcuticular intramural growth (Smith et al., 1999). Many of these produce phytotoxic substances which are involved in causing disease symptoms. In many of the reported hosts, quiescent mesophyll intercellular mycelia instead of necrotrophic growth are observed (Wei et al., 2004). Mycoherbicides commercially available in the market, maximum are based on Colletotrichum gloeosporioides (Aneja, 2009).

COLLETOTRICHUM

Colletotrichum was first time identified in the genus *Vermicularia* by Tode (1790), but was later re-described in the order Melanconiales as *Colletotrichum* under Deuteromycotina subdivision (Corda, 1831). *Colletotrichum* species consist of "Coelomycetes" (imperfect or asexual taxa) with a teleomorphic *Glomerella* stage and capable of sexual and asexual reproduction (Sutton, 1992). Many of the species seem to reproduce exclusively by asexual mode and produce only the characteristic *Colletotrichum* anamorph. As compare to it, some species also produce a *Glomerella* teleomorph (perfect state) (Sutton, 1980; Kirk et al., 2008).

Colletotrichum is characterized by aseptate, typically elongated, hyaline, guttulate phialoconidia with pointed to rounded ends, produced in acervuli. Masses of conidia appear pink or seldom coloured. The acervuli are subepidermal and break out through the surface of the plant tissue. Dark, long, hairlike hyphae called setae often are found in acervuli, although this characteristic is variable under cultural conditions. On germination conidia produce appressoria. They are described initially as resting spores (Hasselbring, 1906) but are generally regarded as infection structures, although it is recognized that *Colletotrichum* spp. has the ability to survive as dormant appressoria (Walker, 1992).

COLLETOTRICHUM: AS A PHYTOPATHOGEN

The pathogen is capable of affecting various plant parts such as root, twigs, leaves, blooms and fruit, causing a range of symptoms such as crow root rot, defoliation, bloom blight and fruit rot (Lubbe et al., 2006). Most *Colletotrichum* species produce symptoms known as anthracnose (literally means 'coral like' leaf spot disease), characterized by sunken necrotic lesions on leaves, stems or fruit and is, therefore, commonly referred to as the anthracnose fungus. Moreover, it is a major pathogen of various disease complexes where more than one *Colletotrichum* species is associated with a single host. Flower infection (blossom blight) can destroy flower and young fruit and cause complete crop failure (Adaskaveg and Forster, 2000). Some important plant diseases caused by this fungus are: anthracnose of cereals and grasses (*C.graminicola*), anthracnose of cucurbits (*C. orbiculare* syn. *C. lagenarium*), anthracnose or fruit rot of brinjal and tomato (*C. phomoides*), red rot of sugarcane (*C. falcatum* teleomorph *Glomerellatucumanensis*), onion smudge (*C. dematium* f. sp. *circinans*) flax seedling blight (*C. lini*), potato black spot (*C. coccodes*), anthracnose of strawberry *(C. acutatum*), anthracnose of beans (*C. lindemuthiana*), bitter rot apples *(Glomerellacingulata)* (Kirk et al., 2008).

HEMIBIOTROPHIC NATURE

Phytopathogenic fungi on the basis of their mode of nutrition are classified into three forms: necrotrophs or perthotrophs (derive their energy from killed cells); biotrophs (derive their energy from living cells, mainly through haustoria); and hemibiotrophs (the organism having an initial biotrophic phase followed by a necrotrophic phase) (Bailey et al., 1992). *Colletotrichum* is regarded as hemiobiotroph or facultative biotroph (Kim et al., 2004). This combination can result in both relatively high specificity and virulence (i.e. the degree of pathogenicity). The biotrophic phase in the weed provides high degree specificity and the subsequent period of necrotrophic growth causes extensive tissue damage or death of the weed. Many potential biological control agents of weeds have been found to be hemibiotrophs. *Colletotrichum* spp. share both of these characteristics, hence are commonly found on lists of promising mycoherbicides (Templeton, 1992; Goodwin, 2001; Aneja, 2009).

Biotrophic and hemibiotrophic fungi are successful groups of plant pathogens that require living plant tissue to survive and complete their life cycle (Koeck et al., 2011). Biotrophic fungi establish a close association with the host through the development of specialized infection hyphae or haustoria within living plant cells from which nutrients are taken up (Mendgen and Hahn, 2002). The biotrophic stage which is generally short-lived includes all events in which infection develops without visible disruption of host systems. On the other hand, necrotrophic fungi secrete toxins and enzymes that kill host cells and then take up nutrients released from the dead tissue (Horbach et al., 2011). The pathogen colonizes the intramural region beneath the cuticle and spread rapidly throughout the tissues.

Hemibiotrophic fungi combine both strategies. An initial biotrophic phase, during which the host's immune system and cell death is actively suppressed, allows invasive hyphae to spread throughout the infected plant tissue. This is followed by a necrotrophic phase during which toxins are secreted by the pathogen to induce host cell death. Plant pathogenic fungi produce and secrete many so-called effector proteins that interact with the host and play an important role in virulence (Dodds et al., 2009; Kamoun, 2009).

Colletotrichum species are regarded as hemibiotrophs or facultative biotrophs, having an initial biotrophic phase with high host specificity followed by a necrotrophic phase with extensive tissue death; thus species have relatively high specificity and virulence (i.e., degree of pathogenicity). An example of hemibiotrophy is found in infection of avocado, chilli and citrus by putatively named strain of *C. gloeosporioides* which produce both intracellular biotrophy at an early stage and later intramural necrotrophy. *Colletotrichum* species are therefore prime targets for use in weed control and there are presently several products on the market and several under investigation (Templeton, 1992). Many potential mycoherbicidal pathogens have been found to be hemibiotrophic, i.e. the organisms having an initial biotrophic phase followed by a necrotrophic phase (Aneja et al., 2009).

BIOLOGICAL CONTROL POTENTIAL OF COLLETOTRICHUM

Biological control is a pest management tactic that utilizes deliberate introduction of living natural enemies to lower the population level of invasive pests (Van Driesche and Bellows, 1996). Microbial preparation of herbicide is defined as bioherbicide that can control the weed (Li et al., 2003). In this approach, indigenous plant pathogens isolated from weeds are cultured to produce the large numbers of infective propagules which are applied at a rate that will cause high levels of infection leading to suppression of the target weed. Numerous plant pathogens have been considered as potential biocontrol agents but in reality there has been little commercial success. It is estimated that there are over 200 plant pathogens that have or are under evaluation for their potential as bioherbicides.

Colletotrichum species attack a variety of wild and weedy plants and several host-specific strains have been utilized for biological weed control (Templeton, 1992). Many other species of *Colletotrichum* are being developed as mycoherbicides for biological control of weeds (Charudattan, 1991; Templeton, 1992). Mycoherbicides are fungal pathogens of weeds that are applied in large doses in a similar manner as chemical herbicides. The goal is to achieve infection, disease development and significant damage to the specific weed host in a relatively short period of time (TeBeest et al., 1992). A common assumption is that highly virulent pathogens always make the most effective bioherbicides, but this concept has been effectively challenged (Hallett, 2005). Some host–pathogen interactions produce dramatic symptoms, but may not meaningfully reduce the weed population. In contrast one of the most commercially successful bioherbicides to date, *C. gloeosporioidesf.* sp. *aeschynomene,* does not produce impressive symptoms or particularly rapid mortality of northern joint vetch *(Aeschynomene virginica)*, the target weed. Instead, its success has been due to (i) its low cost of production; (ii) its comparatively simple formulation requirements; and (iii) its rapid and efficient secondary spread in the field (Bowers, 1986; Smith, 1991). This might not be the only model for success with a bioherbicide, but it provides a useful benchmark for comparing candidate bioherbicides.

Spores often have longer shelf-lives and are more tolerant of suboptimal storage conditions. Inoculum density may affect fungal sporulation. Slade et al. (1987) found that a high inoculum density (2.5x106 spores/ml) of *C. gloeosporioides* resulted in slimy masses of conidia, called 'slime spots', when grown on several commonly used growth media. Slime spots are associated with microcyclic conidiation, where sporulation occurs directly after spore germination in the absence of mycelial growth. Conversely, reduced inoculums concentrations or concentrated growth media resulted in dense, vegetative mycelia growth; and microcyclical conidiation did not occur (Hildebrand and McCain, 1978; Slade et al., 1987). Slade et al. (1987) developed a simple method to assess inoculum production of *C. gloeosporioides* in liquid culture using microplate assays of the fungus on various solid media. This system could possibly be used to provide an accurate, rapid and inexpensive means of screening various growth media for spore yield and virulence.

Both the number of weeds targeted for control and the number of candidate pathogens studied has increased. Practical registered or unregistered uses of bioherbicides have also increased worldwide. The efficacy of a bioherbicide depends on the establishment of the disease during the primary infection by the formulation and also on the complete control of the weed via its secondary infection.

PRIMARY INFECTION

The importance of environmental conditions such as dew and temperature on primary infection has been demonstrated by Walker et al. (1983) and Auld (1993). Environmental conditions vary from field to field and from year to year. Differences in primary infection between years and locations have been observed during experiments with *C. gloesporioides f. sp. malvae* (BioMal) and *Alternaria alternate* (Babu et al., 2003). Even for Collego, which is used in free moisture, low levels of initial infections were recorded in some years.

However, low initial infections due to a varying effect of environmental parameters may be increased as a result of the high capacity for dispersal and secondary infections by these pathogens for control efficacy (Boyette et al., 1979; Walker et al., 1983).

SECONDARY INFECTION

Numerous mycoherbicide studies indicate the importance of secondary infection and subsequent dispersal for effective control, both requiring time. Boyette et al. (1979) reported that anthracnose disease caused by *C. gloeosporioidesf. sp. jussiaea,* which has an incubation period of 3-5 days, required 28 days to progress from 29% (primary infection) to 94% on the winged water primrose in a rice field. In the same field experiment, the dispersal of fungal disease was evident, because 25% of the plants in untreated plots were infected, even at a distance of 100 m from inoculated plants.

MYCOHERBICIDES BASED ON COLLETOTRICHUM

Mycoherbicidal formulations of *C. gloeosporioides* (Daniel et al., 1973), *C. truncatum* (Boyette et al., 1993) have been used as liquid or granular formulations with varying degree of success. Similarly several strains of *C. gloeosporioides* have been shown to be effective mycoherbicides but they do not have adequate market potential to warrant registration and development costs. Researchers are attempting to hybridise special forms of *Colletotrichum* to produce new pathotypes that will attack a wider range of weeds than the parent isolates.

Formulation is the blending of an active ingredient, such as fungal spore, with inert carriers, such as diluents and surfactants, in order to alter physical characteristics of the mycoherbicide to a more desirable form.

Of the total 25 mycoherbicides reported, five mycoherbicides are based on this fungus including both liquid and solid formulations (Kumar et al., 2021). The registered liquid formulations are Lubao, Hakatak and solid formulations are CollegoTM/LockDownTM, VelgoR, BioMalR, Hakatak used to control different target weeds (Table 1).

Table1. Commercial bioherbicides and type of formulation based on Colletotrichum.

S.No.	Target weed	Fungus	Product name	Year of registration	Formulation type
Liquid formulations					
1.	Dodder *(Cuscata-chinesis* and C. *australis)* in soybeans	*Colletotrichum gloeosporioides f. sp. cuscutae*	Lubao	1963	Conidial suspension
2.	*Hakea gummosis & H. sericea in* native vegetation	*Colletotrichum acutatum*	Hakatak	1999	Conidial suspension
Solid formulations					
1.	Northern joint-vetch *(Aeschynomene virginica)*	*Colletotrichum gloeosporioidesf.sp. aeschynomene*	CollegoTM LockDownTM	1982, 2006	Wettable powder
2.	Velvet leaf *(Abutilon theophrastus)*	*Colletotrichum coccodes*	VelgoR	1987	Wettable powder
3.	Round-leaved mallow *(Malva pussila)*	*Colletotrichum gloeosporioidesf.sp. malvae*	BioMalR	1992	Mallet wettable powder
4.	*Hakea gummosis & H. sericea* in native vegetation	*Colletotrichum acutatum*	Hakatak	1999	Granular (dry conidia)

Collego

Collego is a dry powdered formulation of the fungus *Colletotrichum gloeosporioides f.* sp. *aeschynomene* (CGA). The product was registered in 1982 for the selective control of northen jointvetch *(Aeschynomene virginica).* Collego provide high levels of control act speedily and are easy to use. It provides typically more than 85% control of weed target, northern jointvetch within 4-6 weeks, and can be easily applied with conventional equipment as post-emergent aerial, over the top or directed sprays (Charudattan, 1989). It consists of a water-soluble spore rehydrating solution used both to improve wetting of the spores and plant surfaces, and to improve spore germination and a dry formulation containing 15% viable conidia (an active component) and 85% inert ingredients

(Douglad et al., 1996). Herbicide agent *C. gloeosporioides* f.sp. *aeschynomene* has been reregistered as of March 2006 under the commercial name LockDown for use in the rice in Arkansas, Lousianna and Mississippi (Yandoc et al., 2006b).

Lubao

Luboa is a formulation of a selected strain of *Colletotrichum gloeosporioides* f. sp. *cuscutae* used as a mycoherbicide in People's Republic of China to control dodder (*Cuscuta chinensis* and *C. australis*) parasitic on broad cast planted soybeans. The fungus sporulated on solid and liquid media with maximum spore germination (Boyette et al., 2011).

BioMal

In Canada, BioMal a formulation based on *C. gloeosporioide*s f.sp. *malvae* was released in 1992 to control round-leaved mallow *(Malwa pusilla)* in lentil, flax and wheat crops in the prairie provinces of Canada and the northern plains states of the United States. An effective formulation of BioMal using silica gel carrier has routinely provided over 90% control of this weed in field. The wettable powder formulation disperses easily in water and is applied as a spray to its target weed (Mortensen, 1988).

PESTA

Granular formulation of *C. truncatum* (Schw.) Andrus and Moore was developed by mixing conidia, microsclerotia, and mycelia from liquid culture to semolina wheat flour and kaolin. The product called 'PESTA' can be stored at room temperature for several months with little decline in pathogen viability or virulence has shown that conidial formulations of the fungus *C. truncatum* are effective in controlling hemp sesbania under field conditions. In addition to producing mycelium (hyphae) and conidia in solid and liquid culture, *C. truncatum* can also be induced to produce structures called microsclerotia, which are compact, dense aggregates of darkly pigmented, thick-walled hyphal cells that can remain dormant for long periods until conditions favorable for growth to occur. (Boyette et al., 2007)

MULTIPLE PATHOGEN BIOHERBICIDES

Mltiple-pathogen bioherbicides (cocktails) consisting of a number of pathogens and directed at one or more related weeds. Sometimes, the combined action of two or more potential biocontrol agents can have a synergistic effect in terms of weed control. *Colletotrichum* plays very important part in multiple pathogen system in many biocontrol systems. For example, the weed *Xanthium occidentale* is normally resistant to infection by the fungus *C. orbiculare*. However, if the weed is infected with the rust fungus, *Puccinia xanthii*, it becomes very susceptible to infection by *C. orbiculare* which forms extensive necrotic lesions and may even kill plants. Mixtures of two or more host-specific pathogens may permit simultaneous control of multiple weeds with a single bioherbicide application. The use of several pathogens of a single weed species in a bioherbicidal treatment may improve weed control efficacy, insure against possible failure of one or more pathogens in a mixture, and minimize selection for host resistance to a single pathogen used repeatedly (Chandramohan and Charudattan, 2002).

The fungus based bioherbicides registered for commercial use in all around the world are used to control a single weed species. However, several weed species need to be controlled simultaneously. The rice weeds northern jointvetch and winged water primrose *(Ludwigia decurrens)* can be simultaneously controlled with a single application of CGA3 and *C. gloeosporioides* f.sp. *jussiaea.* A mixture of these two pathogens along with *C. malvarum* also effectively controlled northern jointvetch, winged water primrose and prickly sida. Application of several host-specific fungal pathogens in a bioherbicide mixture as a multi-component bioherbicide system may be advantageous for further development of simultaneous, broad-spectrum weed control.

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Chapter 10

PI3Kinase/AKT/mTOR Pathway in Breast Cancer; Pathogenesis and Prevention with mTOR Inhibitors

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ABSTRACT

The most recurrent and considered second most frequent cause of cancer-related death in women is the breast cancer worldwide. In breast cancer cases patients are usually diagnosed in the beginning at the curable stage. However, its treatment remains a great clinical challenge. A number of studies have been carried out for the treatment of breast cancer which includes the targeted therapies and increased survival rates in women. Essential PI3K/mTOR signaling pathway activation is observed in most breast cancers. The cell growth and tumor development in this case involves phosphoinositide 3 kinase (PI3K)/Akt/mammalian target of rapamycin (mTOR) pathway. It has been observed, through preclinical and clinical trials, that there are a number of other inhibitors of PI3K/Akt/mTOR pathway, which either alone or in combination with other agents can be used for treatment of cancer. Pre-clinical studies have confirmed that P13K, Akt and mTOR inhibitors achieve anticancer effects by targeting different levels of the PI3K/Akt/mTOR pathway. This chapter evaluates the role of mTOR along with some of its inhibitors and the PI3K/Akt/mTOR pathway in the pathogenesis and prevention of breast cancer.

Keywords: Phosphoinositide 3 kinase, PI3Kinase, Mammalian target of rapamycin, mTOR, Breast cancer, Signaling pathway.

INTRODUCTION

The mammalian target of rapamycin (mTOR) is an atypical serine/threonine (S/T) protein kinase which is a central controller of cell growth, proliferation and metabolism by forming and signaling through two protein complexes, mTORC1 and mTORC2. mTOR complex 1/2 (mTORC1/2) are evolutionarily conserved from yeast to mammals[1]. The introduction of mammalian target of rapamycin (mTOR) inhibitors marked a pivotal development in the treatment of various cancers including breast cancer. These inhibitors inhibit serine/threonine-specific protein kinase that belongs to the family of phosphatidylinositol-3 kinase (PI3K) related kinases (PIKKs). Oncogenic activation of the PI3K/AKT/mTOR pathway can occur through a variety of mechanisms; this often includes mutation and/or amplification of genes encoding RTKs, subunits of PI3K (e.g., p110β, p110α, p85β and p85α; encoded by PIK3CB, PIK3CA, PIK3R2 and PIK3R1 respectively), AKT (AKT1), or activating isoforms of RAS. Loss-of-expression or function of PTEN, through deletions, mutations or epigenetic silencing, is also common. Rapamycin was first discovered in 1975 and it is a macrolide which is produced by the microorganism Streptomyces hygroscopius and used as an antifungal. Rapamycin had also been demonstrated to have an immunosuppressant property[2]. In 1980s, rapamycin was also found to have anticancer activity as evaluated by the Developmental Therapeutic Branch of the National Cancer Institute (NCI)[3,4]. After this, rapamycin derivatives known as rapalogs were developed having similar therapeutic effects as rapamycin but with improved hydrophilicity and can be used for oral and intravenous administration[5]. Rapalogs are the first generation mTOR inhibitors, have been proven effective in a range of preclinical models[6,7]. Due to partial mTOR inhibition, rapalogs are not sufficient for achieving a broad and robust anticancer effect, at least when used as monotherapy[8,9]. The inhibition of mTORC1 by rapalogs fails to suppress a negative feedback loop that results in phosphorylation and activation of AKT[10]. Due to these limitations, the second generation of mTOR inhibitors was developed[11]. The second generation of mTOR inhibitors is known as ATP-competitive mTOR kinase inhibitors. mTORC1/mTORC2 dual inhibitors are developed to compete with ATP in the catalytic site of mTOR[12]. They inhibit the kinase-dependent functions of mTORC1 and mTORC2 and therefore[13], block the feedback activation of PI3K/AKT signaling, unlike rapalogs that only target mTORC1[14]. In addition, some naturally occurring compounds have been found to down regulate mTOR signaling. The chapter discusses the role of PI3K/AKT/mTOR pathway in the pathogenesis of breast cancer and preclinical and in vitro findings with the respect to PI3K/AKT/mTOR inhibitors have also been presented[15,16].

mTOR PATHWAY

mTORC1 and mTORC2 are the two structurally and functionally different complexes of mTOR Both of these complexes play very important role in the pathway at various levels (Fig. 1). mTORC1 comprises of mainly five components: mammalian lethal with Sec13 protein 8 (mLST8) (The mLST8 erasure does not change mTORC1 activity in vivo), Raptor (the regulatory-associated protein of mTOR) Raptor enrolls substrates for mTOR and the complex formation gets regulated[17], proline rich AKT substrate 40 kDa (PRAS40), Deptor (DEP-domain-containing mTOR-interacting protein) and mTOR[18,19]. mTORC2 complex consists of six different proteins: mTOR, Rapamycin-insensitive companion of mTOR (Rictor), mSIN1, mLST8, Protor-1, Deptor. Some of the main components: mTOR, mLST8 and Deptor are shared commonlyamong both mTORC1/C2 complexes[1,20,21].

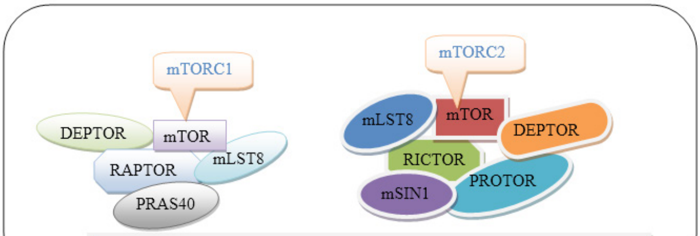

Figure 1: Domain Structure of mTOR

PI3K/AKT/mTOR pathway is a cell cycle regulation pathway that is a key regulator of cell metabolism, growth, proliferation and cell survival. The activation of the pathway starts with different cellular processes like angiogenesis; formation of tumor etc. PI3K/AKT complex activates mTORC1 and is inhibited by the complex TSC1/TSC2 while mTORC2 is activated by growth factors. mTORC1 regulates ribosomal formation and protein synthesis through the phosphorylation followed by inactivation of the repressor of mRNA translation 4EBP1 and phosphorylation and activation of S6K[22]. The pathway is regulated by various growth factors, ATP, amino acids and Oxygen levels[23,24]. When AKT is phosphorylated then it triggers the mTORC1 signaling. The second messenger PtdIns (3,4,5) P3 is prodcued by Class I PI3K, upon generation of the second messenger binds to the pleckstrin-homology (PH) domain of AKT and PDK1. PtdIns (3,4,5) P3 to the PH domain of AKT brings the kinase to the cell membrane formed by its activation by phosphorylation of PDK1 at Thr308 position and by phosphorylation of mTORC2 at Ser473 position. PTEN negatively controls AKT activation, as it transform PtdIns (3,4,5) P3 to PtdIns(4,5) P2, resulting in reduced recruitment of AKT to cell membrane [25,26] .

PI3K/AKT/mTOR INHIBITORS

There is a class of PI3K/AKT/mTOR inhibitors, which has a significant role in the treatment of disease. NVP-BKM120 is a new generation of Class 1 PI3K-specific inhibitor which act upon NF-κB expression and PI3K/AKT signaling. NVP-BKM120 is quite effective in reducing AKT phosphorylation. PARP inhibitor alone reduces tumor growth. NVP-BEZ235 is a novel and orally available dual PI3K/mTOR inhibitor [27]. Jolkinolide B induces apoptosis in MDA-MB-231 cells. N-Hydroxyphthalimide (NHPI) has a capability of being selective anti-proliferative effect on human breast carcinoma BT-20 cells [23,28,29]. ZSTK474 is a specific and new class I phosphatidylinositol 3-kinase inhibitor that induces G1 arrest and autophagy in human breast cancer MCF-7 cells[30]. AZD8835, another inhibitor which is a potent and selective inhibitor of PI3Kα and PI3Kδ.SZC015[31].Another study reported an inhibitor which induces both apoptosis and autophagy in MCF-7 breast cancer cells[32,33]. Melittin (MEL) is a major peptide constituent of bee venom, in studies it has been observed that this has the capability of inhibition of EGF-induced invasion and migration of breast cancer cells[34]. ARQ 092 and ARQ 751 (next generation AKT inhibitor) are selective, allosteric, pan-AKT[35,36]. Trisubstituted-Imidazoles pyridine has the property of targeting oncogenic PI3K/Akt/mTOR Signaling Pathway and induced apoptosis in human breast cancer cells[37,38]. INK128 is a novel and selective small molecule active-site mTORC1/2 dual kinase inhibitor[24].

CONCLUSIONS

Current Chapter has mainly focused on providing a detailed information of various components and their role in the regulation of PI3K/AKT/mTOR pathway. Efforts have been made to understand the structure-function relationship and regulation/deregulation of mTOR, along with modern generation inhibitors for PI3K/AKT/mTOR pathway besides targeted therapies. The mTOR inhibitor studies have clearly revealed their role in antitumor activities as a result of either the activation of different components as well as some alterations at the gene expression levels. Moreover, it will help building in a precise and accurate platform for the personalized medicines paving a way for understanding dreadful diseases like cancer for their proper management. The mTOR inhibitor development needs to be further encouraged which might prove useful to control malignancies.

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Chapter 11

A Detailed Study of Effect of SARS-CoV-2 Vaccines On HIV Patients

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ABSTRACT

The corona virus global pandemic created the requisite urgency to promote extensive research oriented approaches to understand and develop viable immune responses generating vaccines against SARS-CoV-2. These hard times required additional healthcare and better risk-mitigation strategies for people living with HIV/AIDS (PLWH). Even though not all HIV patients are considered immunosuppressed, the coinfection of human immunodeficiency virus (HIV) and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), presents intriguing problems with many uncertainties concerning cellular immune deficiency and response inflammation that could influence their pathogenesis, disease severity, viral evolution and might affect the degree of immune responses. After much research and scattered evidence it is a fair judgment that people living with HIV/AIDS are equally or slightly more susceptible to SARS-CoV-2, than the general population with normal immune systems, and therefore are more likely to have more serious outcomes. Currently available limited vaccine trials for COVID-19 account vaccines to be both safe and effective in HIV/AIDS patients' protection too. Despite over 96.2 million cases of COVID-19 worldwide as of January 22, 2021, the lack of proper extensive study and research reports of patients with HIV and SARS-CoV-2 coinfection suggest the urgent need to expand research horizons to explain the under-representation of severe COVID-19 cases among the HIV patient population. Through our paper we aim to highlight the requirement for COVID-19 related research for HIV/AIDS patients and to explore the prospective protective mechanisms of cART for them. In this review, briefly describe HIV and SARS-CoV-2 pathogenesis, the unique dynamic of HIV/AIDS and COVID-19 coinfection, the trends of clinical outcomes among coinfected patients, and the available vaccines against SARS-CoV-2 along with certain precautionary immune parameters monitoring suggestions.

Keywords: HIV, AIDS, SARS-CoV-2, COVID-19, coinfection, immunity, vaccine.

INTRODUCTION

The enduring worldwide pandemic of novel coronavirus disease (COVID-19), which emanated from Wuhan, China, has quickly dissipated all over the world, causing great anxiety in various dimensions[1][2]. The global outburst of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), resulting in COVID-19 disease, has concluded in an overall 3% case casualty rate, presenting remarkable healthcare challenges around the world [3]. Epidemiological testimony indicates that the threat of severe COVID-19 disease boosts with male gender, age, and the presence of comorbidities [4]. The aged patients who are above 60, and those people who are having underlying diseases such as respiratory diseases, cardiovascular disease, hypertension, diabetes, and chronic kidney disease boon with a more severe form of COVID-19 and have unfavorable consequence [5].

When the acquired immunodeficiency syndrome (AIDS) was first illustrated in 1981 and thereafter revealed, two years later, to be inflicted by a formerly anonymous pathogen, human immunodeficiency virus (HIV), it was speculated to be constrained to a small number of risk groups that were mainly gender-based and who were of a particular sexual exposure or ethnicity[6]. As more knowledge evolved bout the epidemiologic resemblance of HIV communication, it became clear that the illness was transferred mainly through sexual contact and exposure to blood either from the intake of a contaminated blood product or through injection-drug use, as well as perinatally either from the pregnant mother to the fetus or during parturition [7]. In the US, Human immunodeficiency virus type 1 (HIV-1) is the dominant strain, whereas HIV type 2 (HIV-2) is common elsewhere [8]. In 2018, roughly 40,000 recent cases of HIV disease were deduced in the territories of the United States [8]. In 2018, 69% of new HIV infections were diagnosed in men who have copulation with men, 21% in young people,10% in injection-drug users, 42% in Africa-Americans [8]. Although perinatal transmission in the United States has reduced to very low levels owing to routine checking for HIV and initiation of antiretroviral therapy (ART) in HIV-infected women, cases in adults have decreased by only 7% between the years 2014 and 2018 [9].

With an evolving pandemic, pressing and profitable protocols are expected for optimized interventions particularly in inpatient communities with underlying chronic illnesses. Without significant ART, HIV directs to deformity of CD4 T-lymphocytes, ensuing in a weakened immune response. Although some reports have found the drugs that are anti-HIV such as lopinavir/ritonavir, atazanavir, nelfinavir, and tenofovir to be beneficial against SARS-CoV-2 [10][11][12]. In the existence of ART, the cellular immune reaction restores to inconsistent degrees; however, people with HIV seem to persist at greater risk for many infections [13][14][15][16][17][18]. There has been an inconclusive indication of the HIV-1 protease inhibitors exhibiting in vitro clinical efficacy against the SARS-CoV outbreak and other coronavirus infections [19].It is also inferred that SARS-CoV-2 may not effectively disrupt the accessory system and stimulus cytokine storms in pre-existing dysfunctional immune systems of people having HIV (PLWH), giving rise to them less vulnerable to the drastic form of COVID-19 [20]. The majority of PLWH/AIDS globally are over the age of 50, which suggests a greater risk for formulating a severe sequence of symptoms. from COVID-19 [21]. Across the board, the majority of the population infected with SARS-CoV-2 in the absence of HIV develop reliable antibody responses encompassing counteracting antibodies and T cell responses [22]. Given the abundance of arising articles regarding HIV and SARS-CoV-2 coinfection, it becomes significant to systematically assemble all available evidence to evaluate the impact of COVID-19 clinical presentation in this susceptible patient population and substantiate the implication of conserving the HIV care continuum during this demanding time.

HUMAN IMMUNODEFICIENCY VIRUS (HIV) PATHOGENESIS

HIV is a retrovirus that is accountable for immunosuppression and leads to numerous infections, secondary neoplasms, and neurological as well as retinal peculiarities. It is a blood-borne virus so the major communication includes sexual contact, mother to newborn and parenteral transmission. There are two types of HIV that include HIV-1 and HIV-2[6] .

HIV-1 has a globular structure with an electron-dense, cone-shaped core surrounded by a lipid envelope that comes from the host cell membrane. The HIV-1 RNA genome contains the various types of genes out of which gag, pol, and env genes are the most common to retroviruses[23]. The products of the gag and pol genes are large antecedent proteins that result in mature proteins. HIV also comprises other auxiliary genes, encompassing tat, rev, vif, nef, vpr, and vpu, which is reliable for the regulation of the synthesis and assembly of infectious viral particles and the pathogenicity of HIV[23].

PATHOGENESIS

The target site of HIV is the immune system, along with its effects on our central nervous system (CNS). The final stage of HIV is AIDS, which causes severe immunodeficiency, primarily influencing cell-mediated immunity, resulting in infection and death of CD4+ T cells and devastation in the processing of helper T cells. Along with that infection of macrophages and dendritic cells also occurs[23]. HIV enters the body from mucosal tissues and blood. At first, it infects T cells, dendritic cells as well as macrophages. After that, it is established in lymphoid tissues of the body and may remain latent for a long period, which is changeable[24].

ACUTE STAGE OF HIV INFECTION

The initial stage of HIV is marked by the affliction of memory CD4+ T cells in mucosal lymphoid tissues which results in the death of many infected cells. Along with that, there is a tremendous loss of lymphocytes because memory T cells are more vulnerable to HIV. Mucosal infection is often correlated with devastation to the epithelium resulting in translocation of other microbes across the epithelium[25]. After mucosal infection, the spreading of the virus and the growth of host immune responses occur. Dendritic cells capture the virus and may enact HIV onto CD4+ T cells through cell-to-cell contact. After the first exposure to HIV, viral replication can be seen in the lymph nodes. The virus is dispersed all over the body and infects helper T cells, macrophages, and dendritic cells [25]. As the HIV infection spreads, antiviral humoral and cell-mediated immune responses are produced by the patient leading to seroconversion and the growth of virus-specific CD8+ cytotoxic T cells [25]. CD8+ T cells are inspected in the blood resulting in initial containment of HIV infection. These immune responses somewhat control the infection and viral exposition. The "acute retroviral syndrome" is characterized by a non-specific acute illness having flu-like symptoms[26]. Measuring the viral load of HIV-1 RNA in the blood is a useful way to monitor HIV disease. CD4+ T-cell count in the blood is the most credible short-term indicator of disease Viruses advancements. Hence, the 4 cell count is the primary clinical way that is used to determine when to start antiretroviral therapy[27].

CHRONIC HIV INFECTION

During the chronic phase of HIV infection, the two major areas of HIV replication and cell destruction are the spleen and lymph nodes. In this interval, there are no clinical incarnations of the HIV infection. Although most of the peripheral T cells do not have the virus, the number of CD4+ T cells in the blood continues to wane [25]. Along with this loss of CD4+ T cells, host defenses decrease, and the proportion of enduring CD4+ cells contaminated with HIV increases. HIV may evade immune control because of the downfall of the CD4+ T cells desired for effective immunity [25]. In this phase, the virus is dependent on CCR5 to enter its target cells or it may depend on either CXCR4 or both CCR5 and CXCR4. This switch is correlated with a rapid decline in CD4+ T-cell counts because more T cells are contaminated. Sufferers in this chronic phase of infection are either asymptomatic or develop certain types of other infections[23].

LIFE CYCLE OF HIV

The life cycle of HIV is divided into 3 stages the first stage includes the infection of the cells, after that, there is an integration of provirus into the genome of the host's cell resulting in activation of viral replication, and generation and release of infectious virus progeny[23]. Through the CD4 molecule as a receptor and other chemokine receptors, HIV infects cells. Along with that HIV gp120 also binds to other coreceptors for entry into the cell, especially CCR5 and CXCR4 [23]. Different viruses that are isolated are recognized by the use of the following receptors: R5 strains use CCR5 and X4 strains use CXCR4. They are usually M-tropic. Whereas the X4 strains are T-tropic means mostly infecting T cells. In most cases, the R5 (M-tropic) type of HIV is the dominant virus. As the infection spreads, T-tropic viruses gradually expand, which are infectious because they can contaminate many other T cells and thymic T cells, which results in more loss of T cells[28][23]. The envelope of HIV has two glycoproteins, gp120 and gp41. The initial step includes binding to the respective surfaces. This results in a new distinction site on gp120 for the coreceptors CCR5 or CXCR4. Binding to the coreceptors causes conformational changes in the gp41 surface so that a hydrophobic region is exposed at the tip of gp41. This peptide inserts itself into the cell membrane of the target cells or the t cells, which leads to fusion between the virus and the host cell membrane, allowing the virus core to enter the genome of the host cell [25][28]. Chemokines hinder HIV infection. Once inside the host cell, the RNA genome of HIV undergoes reverse transcription, which leads to the synthesis of double-stranded complementary DNA (cDNA). The complementary DNA first enters the nucleus and then integrates into the host genome. After integration, the provirus may be latent for a longer period. HIV infects memory and activated T cells but is not profitable at productively infecting T cells because these cells have an enzyme that inaugurates a mutation in the HIV genome. There is an introduction of cytosine-to-uracil, resulting in the mutations in the viral DNA that are produced by reverse transcription [26].

The viral life cycle is completed in infected cells. Activation of T cells Viruses by antigens or cytokines upregulates transcription factors, one of which include NF-κB, that stimulate transcription of genes that encode cytokines [26]. It is translocated to the nucleus. In the nucleus, the binding of regulatory sequences of genes takes place. HIV seems to prevail when the host T cells and macrophages are activated. HIV-infected people are at increased risk for other infections that lead to an increase in activation and proinflammatory lymphocyte cytokines [26].

They stimulate more HIV as a result of which there is a great loss of additional CD4+ T cells and more infection[26][29]. As the disease progresses, there is the direct killing of cells by the virus. Along with that, HIV infection activates the inflammasome pathway, which leads to cell death via pyroptosis. The virus not only infects the CNS but also affects the cells in secondary lymphoid organs such as the spleen, lymph nodes, and tonsils. Immature precursors of CD4+ T cells can be lost either by direct infection of thymic progenitor cells or by infection of cells that secrete cytokines. Also, there is a fusion of infected and uninfected that results in giant cells, and they die within a few hours leading to loss of T cells. This occurs mostly in the T-tropic X4 type of HIV-1[26][29]. Also, there is a qualitative defect in T cells even in asymptomatic HIV-infected persons. There will be a severe deficiency of cell-mediated immunity due to the loss of Th1 responses. This leads to boosted exposure to infections by viruses and other microbes. A significant characteristic of HIV infection is a low-level chronic infection of T cells. The integrated provirus can stay in the cells for months to years. Even with antiviral therapy, the latent virus remains within the CD4+ cells in the lymph nodes [29].

COVID-19 PATHOGENESIS

COVID-19 is caused by a RNA virus called SARS-CoV-2, Severe Acute Respiratory Syndrome Coronavirus 2. Coronaviruses that are found in humans and animals are large and enveloped with single-stranded viral RNA [30]. SARS-CoV-2 has protein subunits as a spike surface glycoprotein (S), a nucleocapsid protein (N), a small envelope (E) and a matrix protein (M)[31]. The S glycoprotein is responsible for receptor binding and letting the virus into host cells. The virus assembly is executed by M and E proteins [32]. The S protein consists of three sub-segments— a single-pass transmembrane anchor, an ectodomain, and a short intracellular tail. The ectodomain contains receptor-binding S1 domain and membrane-fusion S2 domain, that through receptor binding and membrane fusion lets virus into the host cells [31].

RNA viruses portray a lot of genetic variability because of lack of proof-reading by viral RNA-dependent polymerase to better its chances of survival [33]. SARS-CoV-2 tends to develop drug resistance by varying the amino acid sequences in the spike protein and evolving viral proteins into mediators cells that protect infected cells from the host immune system [33].

Air-borne transmission of COVID-19 is most common. Direct inhalation of infected particles and contact transmission through oral, nasal, and eye membrane of respiratory droplets from talking, coughing, and sneezing during face-to-face exposure [31][30]. The incubation period of the virus can be anywhere between 3 days to 2 weeks. 97.5% of the survey population develop symptoms within 11.5 days of contact [30].

After being inhaled, SARS-CoV-2 enters the host cells by surface binding the angiotensin converting enzyme (ACE) 2 receptor to the spike protein [34]. It then enters into the cell, the virus replicates, and the viral load becomes higher causing compromise of the epithelial-endothelial barrier [31]. Smokers have an increased lung expression of ACE2 receptors, which could exacerbate disease progression [33]. The host's elicited inflammation response results in an infiltration of numerous monocytes and neutrophils to the target sites [30]. Also inflammatory signaling molecules like alveolar macrophages, neutrophils, recruited monocytes and T lymphocytes are released by infected cells [33]. Further SARS-CoV-2 virus infects pulmonary capillary endothelial cells, fibrin thrombi in alveolar arterioles, thromboembolism, triggers an influx of monocytes and neutrophils, killing T lymphocyte cells, further increasing the inflammatory response [34]. Results of this include a thickened interstitium, hyaline membrane formation, pulmonary edema, and activation of coagulation factors, microthrombi in the heart, lower limbs, lungs, liver, brain, hands, and kidneys [31][34]. Myocarditis and cardiomyopathy, fibrin thrombi in alveolar arterioles, brain infarction, endotheliitis, acute renal tubular damage, white pulp depletion in the spleen, necrosis of cardiac myocytes, recruitment of megakaryocytes, and hemophagocytosis —therefore Multiorgan failure arises as a consequence of the viral sepsis leading to critical illness or death in extreme case due to severe pneumonia and other complications [31][34][33][35].

DIAGNOSIS OF COVID-19

The next most reliable method of detection of COVID-19 is serology [36]. The high level of serology's sensitivity is its most promising feature. Antibodies are directed against the spike and nucleocapsid antigens[36]. They appear relatively early (2–3 weeks of infection) as compared to other methods. However these antigen-antibody detection tests show a variety in their sensitivity [36].

COVID-19 VACCINES

The remarkably rapid and brilliant development of vaccines against COVID-19 has been possible because of the urgency of the situation created, research and pharmaceutical cooperation and willingness of the general population to actively participate in trials [37]. Majorly two types of vaccines are available for COVID-19. Both of them use the spike protein as an immunogenic agent involved in antibody response [37]. First type consists of purified messenger RNA (mRNA), where the mRNA encodes for the SARS-CoV-2 spike protein[37]. It is administered in two intramuscular injections, the second jab after 3–4 weeks from the first one[37]. The second type of vaccine has a viral vector with a safe and living adenovirus carrying the genome of the SARS-CoV-2 spike protein and is to be administered only once [37].

mRNA based vaccines

DNA and mRNA-based vaccines are mostly easier to design and can rapidly develop into clinical trials. They also show a high degree of adaptability, safe administration, high potency, short production cycle, strong induction of immune responses and low-cost manufacturing [38][39]. Prophylactic RNA vaccines have similarities to subunit vaccines, DNA vaccines, and live-attenuated [40]. The mRNA sequence is read and mRNA is used as a template for endogenous expression of proteins, allowing the person's body to manufacture the proteins itself [38][39].

Viral vector-based vaccines

Genetically Modified Viruses (GMVs) vector-based vaccines consist of one or more immunogenic SARS-CoV-2 proteins with an attenuated viral backbone[41]. Recombinant vectors are generated by replacing the viral structural protein-coding regions with genes of interest (GOI)[41]. This vaccine enters cells by the virus medium and induces strong cell-mediated immune and humoral responses[41].

SARS-COV-2 vaccines for HIV patients

Vaccines are the most effective means of preventing infectious illnesses, and their administration increases chances of survival, shields people from new infectious agents, and boosts social production [42]. The pace with which safe and efficient vaccinations to prevent COVID-19 have been created has been amazing, if not astounding. Potential vaccines were manufactured by various firms and made available for testing barely a few months after the pandemic was identified as a worldwide nightmare and a sense of urgency had crept into the picture [43].

Recently, there has been much of debate about the vaccination of COVID-19 in people with immunodepressed systems. Some studies suggests, individuals with Human Immunodeficiency Virus (HIV) infection and other immunocompromising disorders are considered to be at a higher risk of acquiring SARS COV-2 and getting severely ill [44]. HIV causes CD4 T-lymphocyte depletion in the absence of effective antiretroviral medication, resulting in a reduced adaptive immunological response [45]. While, some other studies say, to yet, the evidence does not indicate that HIV/AIDS patients are much more susceptible to SARS-CoV-2 infection, with differences in socioeconomic determinants of health and comorbidities presumably having a bigger impact [46]. People infected with HIV exhibit decreased anti-spike IgG concentrations and after a primary infection with COVID-19 [47]. Researchers from the Novavax COVID-19 vaccination study's South African locations stated that when patients living with HIV were added in the assessment part, effectiveness dropped from 60% to 49%. These findings have not yet been published [48]. Because of these risks, public health officials have advised selective use of facemasks and physical separation following immunisation among immunocompromised people until further data is available [49].

HIV patients who are on effective antiviral therapies with stifled viral loads and increased CD4 cell counts do not have diminished humoral and cell-mediated responses to the ChAdOx1 nCoV-19 (covishield vaccine) prime-boost vaccine, according to Frater and colleagues' findings, though longer-term follow-up is needed to examine the durability of these responses. Increasing evidence suggests that SARS-CoV-2 seropositivity during natural infection is linked to subsequent protection, however prospective HIV follow-up after immunisation will be crucial [50]. The preliminary findings from [51] show that the ChAdOx1 nCoV-19 vaccine, given as prime-boost dosing 4–6 weeks apart, was well considered acceptable and produced comparable immune responses in hiv - infected Individuals who are well controlled on antiretroviral therapy compared to a similar adult population without HIV. These data imply that for persons on antiretroviral therapy who have CD4 counts of more than 350 cells per microlitre, no vaccine dose adjustment is required. The assessed immune responses are similar to those seen in bigger investigations of HIV-negative subjects, despite the fact that this trial was too small to report protection from infection.

Although a large, population-based study in South Africa found a greater rate of death owing to COVID-19, the majority of the published data has not indicated a considerably higher risk of severe disease among HIV/AIDS patients in the United States and Europe. Higher frequencies of comorbidities among HIV/AIDS patients are linked to COVID-19 disease severity [52]. This is an area that has to be continuously examined. COVID-19's immediate consequence is that it may limit access to HIV prevention programmes and testing, as well as HIV treatment and virologic suppression, which may result in poorer HIV control and other desirable positive outcomes [43].

While the currently available vaccination formulations are not live vaccines (Jannsen/Johnson & Johnson and Astra-Zeneca use a live), they are replication-incompetent human adenovirus vectors encoding for the recombinant SARS-CoV-2 spike glycoprotein that have been stabilised in their pre-fusion form[53]. The goal of the viral vector is to transfer the DNA that encodes for the spike protein into the human body in a unique way so that several copies of it can be made in vivo, perhaps reducing the need for a booster injection. Even for immunocompromised patients, such as those with HIV/AIDS, such a viral vector vaccine is thought to be safe [53].

CONCLUSIONS

The COVID-19 pandemic is resulting in much global apprehension, primarily for people with pre-existing medical ailments such as PLWH. Although preliminary researches and small companions found similar rates of illness and harshness in PWH, the thriving literature in various settings throughout the pandemic now indicates that PWH is at tremendous risk for severe disease, even with well-controlled HIV. Precautions to limit excessive exposure and reduce the risk for acquisition should be encouraged extremely during explosions in infection rates. While the general care of PWH who furthermore acquire SARS-CoV-2 infection does not differ from the population without HIV, certain deliberations regarding drug-drug interactions can be counseled through a conference with an HIV specialist. In addition, we speculate it is crucial to comprehend the influence of geographic and cultural results on both the consequences of coinfected sufferers and the differences in population illness rates from SARS-CoV-2. For illustration, the preponderance and harshness of HIV, strategies for facial coverings and social assemblies, and the accessibility to COVID-19 testing and medication differ across nations. Further, factors such as social determinants of health can participate in our reported consequences and findings. In this study, we intended to bridge the understanding ravines in our knowledge of the specificity, magnitude and period of immunity to SARS-CoV-2 in this sufferer group, which is crucial for modifying current and future mitigation measures, including vaccine strategy and question that: will the currently accessible vaccines be fully defensive against the variants of SARS-CoV-2, particularly the more recently recognized highly invasive delta variant. What is the longevity of preservation that is furnished by any of these vaccines, and will additional boosters be desired beyond what is presently being done? Whether seroconversion rates and kinetics of antibody responses fluctuate according to HIV status demanded to be dealt with in longitudinal researches from acute infection or vaccination into recuperation. Lastly, while distinct from the direct obstacles of COVID-19, the withdrawal and loneliness suffered during this pandemic, probable interruptions of healing therapy, and reduced access to care may have an additional profound consequence on those encountering the remorse of HIV. Assuring that PWH can stay connected to local resources and monitoring for the effect on mental health and well-being will have significant long-term indications. Results from ongoing clinical examinations of redelivering, the most active antiviral drug against the SARS-CoV-2 to date, have also shown commitment in nonhuman primate researches. Researches were restricted by small sample size, geographic coverage, short follow-up durations and lack of patient details. Although some anti-HIV medications have indicated assuring in vitro activity against SARS-CoV-2, there is no explicit proof of the clinical efficacy of any anti-HIV drug in the medication of COVID-19. Additional exploration is needed to explain the under-representation of drastic COVID-19 cases among the HIV patient community and to examine the possible protective mechanisms of cART in this susceptible population.

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Chapter 12

Erythrocytes: Not Only Oxygen Carriers but also Immune Decoy

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ABSTRACT

Erythrocytes, the most abundant blood cells present in the blood are long assumed to be the carriers of oxygen and are only known for their role in aerobic respiration through delivery of oxygen to distant tissues. However, recent researches suggest that these cells are also involved in generating immune response. Nucleated erythrocytes, present in the non-mammalian organisms were found to be involved in instigating immune response. These blood cells trigger interferon type 1 response, interleukin-IL-1, IL-8 and instigate antimicrobial peptides- protein-defensin 1 (BD1) and Nk-lysin (Nkl) and protein expression. The role of nucleated red blood cells in immune response further suggested the research for investigating their role in enucleated red blood cells present in mammalian organisms. In these organisms, red blood cells bind and scavenge chemokines, nucleic acids, and pathogens in circulation.In this paper, we'll learn more about the immunomodulatory functions of nucleated as well as enucleated RBCs against endogenous and exogenous molecules.

Keywords: Interferon, Interleukin, Antimicrobial, Protein-Defensin, Nk-lysin, Chemokines, Immunomodulatory.

INTRODUCTION

Erythrocytes are the most numerous cell type in the bloodstream, with estimated life spans of 120 and 50 days in mammals and mice, respectively (Khan and Saxena, 2008). Mature RBCs in mammals are biconcave discs without a cell nucleus, organelles, or ribosomes (Moras et al., 2017). The nucleus and other organelles are extruded by a complicated process that includes chromatin condensation, budding, and mitophagy (Ji et al., 2011; Moras et al., 2017). The absence of the erythroid nucleus is suggested to have aided the evolution of mammalian endothermy by allowing erythrocytes to specialise even further for effective gas exchange (Morera et al., 2011). The nucleus of nonmammalian RBCs is their main distinguishing feature, allowing them to transcribe and translate proteins (Morera et al., 2011).

Erythrocytes have long been stereotyped as merely oxygen transporters in the literature. However, there is growing evidence that these cells play a crucial role in the innate immune system (Darbonne et al., 1991; Neote et al., 1993; Hotz et al., 2018). The knowledge of immune response in nucleated erythrocytes led to the discovery of RBCs' role in immune response in mammals. In non-mammalian organisms, the presence of a nucleus allows for additional roles other than oxygen transport to tissues (Morera et al., 2011). Pathogens are able to respond to nucleated RBCs through a variety of methods. Despite their incapacity to carry out transcription and translation due to the loss of organelles during erythropoiesis, mammalian erythrocytes can interact with endogenous and external inflammatory chemicals in the blood. These cells, like their evolutionary counterparts, retain the ability to bind and interact with a variety of inflammatory chemicals such as chemokines, nucleic acids, and pathogens, thereby regulating and modulating immune responses, according to research conducted over the last several decades.A better knowledge of erythrocyte activity will be essential for identifying how these cells contribute to the pathophysiology of a wide range of acute and chronic diseases (Anderson et al., 2018).

IMMUNE RESPONSE IN NUCLEATED ERYTHROCYTES

Nucleated Rbcs Trigger IFN Type I Response

Pattern recognition receptors (PRRs) for pathogen-associated molecular patterns (PAMPs) have been found in nucleated RBCs (Morera et al., 2011). PAMPs are tiny molecular patterns that have been conserved throughout evolution and are unique to pathogens. PAMPs include bacterial lipopolysaccharides (LPS), bacterial flagellin, Gram-positive bacteria lipoteichoic acid, peptidoglycan, and viral nucleic acid variations such as double-stranded RNA (dsRNA) or nonmethylated viral 5'-C-phosphate-G-3′ (CpG)-containing DNA (Janeway, 1989; Janeway and Medzhitov, 2002). Toll-like receptors (TLRs), retinoid acid-inducible gene I (RIG-I)-like receptors (RLRs), AIM2-like receptors (ALRs), and nucleotide-binding oligomerization domain (NOD)-like receptors (NLRs) are some of the PRRs that identify PAMPs in host cells (Janeway and Medzhitov, 2002; Creagh and O’Neill, 2006).

TLRs, which allow RBCs to respond to both bacterial and viral pathogens, have been identified among these receptors in nucleated RBCs (St. Paul et al., 2013). TLR3 which recognizes viral patterns like viral double-stranded RNA (dsRNA), tlr21 (a homolog of mammalian TLR9 (Morera et al., 2011; St. Paul et al., 2013), and tlr2, tlr4, and tlr5 gene transcripts are all expressed constitutively in chicken RBCs (which recognize bacterial patterns (St. Paul et al., 2013). Furthermore, rainbow trout RBCs (Rodriguez et al., 2005; Morera et al., 2011) and Atlantic salmon RBCs (Wessel et al., 2015) express the tlr3 and tlr9 genes, which detect CpG patterns in microbial genomes. Tlr3 overexpression was also discovered in tilapia RBCs using polyinosinic: polycytidylic acid (polyI:C, a compound chemically similar to dsRNA) (St. Paul et al., 2013). RIG-I, a member of the RLR family of receptors that interact intracellularly with viral dsRNA (Rodriguez et al., 2005; Morera et al., 2011; Wessel et al., 2015), has been found in salmon RBCs.

When these receptors are activated by their respective PAMPs, signalling networks are activated, causing the transcription of a group of genes associated with the innate immune response, such as interferon type I expression (IFN1) (Robertson, 2006; Zou et al., 2010). IFN1 binds to their cellular receptors, triggering the transcription of interferon-stimulated genes (ISGs), which include important antiviral mediators like myxovirus resistance protein (Mx), 2′–5′oligoadenylate synthetase (OAS), protein kinase RNA-activated (PKR), viperin, interferon-stimulated gene 15 (ISG15), IFN-induced protein with tetratricopeptide repeats (IFIT), and tripartite motif (TRIM) family, tetherin, among others (Schneider et al., 2014).

Nucleated RBCs induce interleukin response

TLR signalling leads to cellular activation and cytokine production (Medzhitov, 2001). Cytokines are secreted proteins that play a role in cell recruitment and immune response modulation, both innate and adaptive. They are required for a successful pathogen immune response in the host (Kaiser et al., 2006). Apart from type I IFN expression, nucleated RBCs have been shown to generate additional cytokines at the gene or protein level in response to a variety of PAMPs.

Interleukin 8 (IL-8) transcripts increased by almost 4 log in chicken RBCs activated with polyI:C, which was at least two to three orders of magnitude greater than those reported in monocytes, thrombocytes, and heterophils (St. Paul et al., 2013). Furthermore, polyI:C stimulation of rainbow trout RBCs was shown to trigger de novo mRNA production from chemokine (C-C motif) ligand 4 (ccl4) (Morera et al., 2011), a chemoattractant for natural killer cells, monocytes, and a range of other immune cells (Bystry et al., 2001).

IL-8 and interleukin 1 (IL-1) protein levels were increased in rainbow trout RBCs exposed to viral hemorrhagic septicaemia virus (VHSV) (Nombela et al., 2017). Heterophils and other leukocytes, such as monocytes, respond to IL-8 as a chemotactic factor (Kogut, 2002). However, more research into the chemotactic characteristics of nucleated RBCs is required. Rainbow trout RBCs exposed to infectious pancreatic necrosis virus (IPNV), on the other hand, demonstrated a downregulation of IL-8, IL-1, and tumour necrosis factor (TNF-) protein expression (Nombela et al., 2017).

Interferon gamma (IFN), a highly pleiotropic pro-inflammatory and antiviral cytokine generated only in immune-related cells, has been discovered in mouse nucleated erythroid cells and may regulate the growth and activity of monocyte/macrophage cells (Seledtsova et al., 1997). Furthermore, chicken RBCs activated with the fungus species *Candida albicans* produce cytokine-like factors with IFN-like activity (Passantino et al., 2007).

Nucleated RBCs produce antimicrobial peptide and protein expression

Antimicrobial peptides (AMPs) are found in all living things and serve as the first line of defence against infectious pathogens through molecular processes of cellular disruption and a variety of immunomodulatory effects (Smith et al., 2010; Yi et al., 2017).

When rainbow trout RBCs were exposed to VHSV, the protein -defensin 1 (BD1) was upregulated (Anderson et al., 2018). Defensins are short cysteine-rich peptides with amphiphilic and cationic characteristics that belong to the defensin family (Peschel and Sahl, 2006). Epithelial cells, neutrophils, and phagocytes all make and store BD (beta defensin). BD accumulated in granular bodies is released into phagosomes or the extracellular system upon pathogen infection (Casadei et al., 2009). They are also known as immune cell chemotactic attractants and have a role in immunological control (Ellis, 2001).

Nk-lysin (Nkl) is another AMP recently discovered in fish RBCs (Pereiro et al., 2017). Natural killer cells and cytotoxic T lymphocytes generate Nkl, which is implicated in the elimination of bacteria, fungi, and parasites (Andersson et al., 1995; Pena and Krensky, 1997; Clayberger et al., 2012). Nkl, along with perforin and granzymes, is contained in cytolytic granules (Andersson et al., 1995; Pena and Krensky, 1997). Nkl, on the other hand, was identified in autophagolysosomes in turbot RBCs. This process is thought to be linked to VHSV protection in turbot RBCs (Pereiro et al., 2017).

IMMUNE RESPONSE IN ENUCLEATED RBCS

Chemokine binding

A lot of research has demonstrated that red blood cells have more roles than only transporting oxygen (Darbonne et al., 1991; Neote et al., 1993; Fukuma et al., 2003; Lee et al., 2006). The ability of human erythrocytes to bind a wide range of chemokines is an essential immunomodulatory characteristic. The Duffy antigen receptor for chemokines (DARC), discovered by Darbonne and colleagues in 1991, is one of the most important binding sites (Darbonne et al., 1991).

This study found that erythrocytes operate as a sink for CXCL8(C-X-C Motif Chemokine Ligand 8- a Protein Coding gene), inhibiting neutrophil recruitment by inactivating the CXCL8-dependent chemokine gradient (Darbonne et al., 1991). In addition to CXCL8, Duffy interacts other immunomodulatory proteins with great affinity, including other CXC and CC chemokines (Neote et al., 1993; Lee et al., 2006). Lee et al. (2006) found that blood lacking erythroid Duffy had greater plasma chemokine levels after LPS treatment in vitro, indicating that Duffy is involved in chemokine scavenging. Duffy knockout mice had greater chemokine (i.e., MIP-2(macrophage-inflammatory protein-2) and KC (Keratinocyte chemoattractant) concentrations in the lung vascular space, which is an evolutionarily conserved property of DARC (Lee et al., 2006). Some researchers believe that inflammatory chemicals are sequestered by red cell surface receptors, which dampens immune response by inhibiting neutrophil signalling (Darbonne et al., 1991). Overstimulation of the immune system can cause excessive inflammation and tissue damage; therefore, an inhibitory mechanism could provide a selective advantage (Anderson et al., 2018).

An alternate scenario for broad chemokine binding by Duffy receptors, on the other hand, may result in the preservation of blood chemokine levels, because chemokines would stay in circulation rather than being removed. Duffy wild type mice had considerably greater blood chemokine concentrations than Duffy knockout mice, which supports this theory (Fukuma et al., 2003). Darbonne's research, which showed that chemokine binding is superficial and easily reversible, might potentially point to the possibility of persistent immunological activation, as erythrocyte receptors in the tissue milieu could alternatively bind and release their substrates (Anderson et al., 2018).

The "sink" theory (i.e., erythrocyte chemokine binding serves to reduce immune-activating signals) and the "reservoir" hypothesis (i.e., erythrocyte chemokine binding serves to increase immune-activating signals) are two hypotheses for erythrocyte control of blood chemokine levels (i.e., erythrocyte binding prevents chemokine clearance, thereby prolonging chemokine half-life in the blood). While these models appear to be mutually incompatible at first glance, they may not be: According to Fukuma et al., erythrocytes scavenge chemokines from inflammatory areas, but then release them in response to declines in plasma chemokine concentrations, thus preserving homeostasis (Fukuma et al., 2003).

Nucleic acid binding

In addition to controlling chemokines, new study shows that erythrocytes may bind nucleic acids, another type of molecule that has the ability to influence inflammatory reactions. Our latest research has focused on erythrocytes' ability to bind DNA generated from mitochondria (mtDNA) (Hotz et al., 2018). Mitochondria store a large amount of potentially inflammatory nucleic acids, which are released into the blood during regular cell turnover, by activated immune cells, and during cell death. mtDNA, like its bacterial predecessors' DNA, is rich in immunostimulatory CpG patterns and promotes pro-inflammatory signalling by binding CpG-containing DNA sections to toll-like receptor 9 directly (TLR9). Furthermore, cytosolic mtDNA is a powerful inducer of STING (stimulator of interferon genes), an ER protein that detects a cellular second messenger released in response to cytosolic double-stranded DNA(Zhang et al., 2013; Zhang et al., 2014; West et al., 2015; Chen et al., 2016) and bacterially derived cyclic dinucleotides (Rongvaux et al., 2014; West et al., 2015).

Recent discovery shows that human erythrocytes express TLR9, suggesting that they may be able to scavenge or buffer potentially inflammatory nucleic acids in the circulation (Hotz et al., 2018). TLR9 is trafficked to endolysosomal compartments and cleaved by lysosomal cathepsins to begin innate immune signalling in non-erythroid cells (Ewald et al., 2008; Ewald et al., 2011; Mouchess et al., 2011), however it is uncertain whether erythroid surface TLR9 is cleaved and signals after engaging mtDNA. TLR9-positive erythrocytes bind and sequester circulating cell-free mtDNA, and in vivo mice studies showed that this function is lost during inflammatory conditions, resulting in increased lung damage (Hotz et al., 2018). RBCs also scavenged CpG-DNA from human microvascular endothelial cells (HMVECs) in vitro, which might help to reduce TLR9 activation in endothelial cells (Hotz et al., 2018).

Notably, there is a lot of variation in erythroid TLR9 expression both across and within people (Hotz et al., 2018). Some people have high levels of erythroid TLR9 expression, whereas others have almost none. Even among individuals who do express erythroid TLR9, the receptor is only found in a small percentage of all RBCs. Even a small number of TLR9-positive cells would have enormous potential to alter systemic function or regulate organ harm due to the massive number of erythrocytes in circulation — between 20 and 30 trillion in the average adult (Bianconi et al., 2013).

We are only beginning to comprehend how nucleic acid binding in erythrocytes affects systemic function. Nucleic acid scavenging, like RBC chemokine binding, may have varying impacts on inflammation. RBCs may reduce inflammation in the lung compartment by scavenging mtDNA from endothelial cells in some cases; however, due to the close mechanical contact between erythrocytes and the microvascular endothelium, RBCs binding mtDNA may exacerbate inflammation by presenting inflammatory molecules to immune or endothelial cells by accident. Furthermore, mtDNA binding promotes erythrocyte membrane crenation, which might lead to faster clearance of defective RBCs or trapping of RBCs in the microvasculature (Anderson et al., 2018).

While the new findings support a paradigm in which RBCs scavenge mitochondrial DAMPs from the lung compartment, the dynamics of mtDNA scavenging might be more complicated. It's plausible that, like Duffy antigen and the chemokines it binds, mtDNA binding might operate as a protective or pathogenic mechanism, depending on the local microenvironment's characteristics. RBCs have not been shown to be capable of scavenging other forms of nucleic acids. The identification of several TLRs (including TLR3) in the transcriptome of mammalian reticulocytes provides a possible mechanism for this binding, and suggests that more TLRs and nucleic acid scavengers may be identified on the surface of mature human erythrocytes in the future (Liang et al., 2015).

Pathogen binding

Human erythrocytes have been shown to bind pathogens in addition to endogenous substances like mitochondrial DNA and chemokines. *Plasmodium*, a genus of protists responsible for malaria, is without a doubt the most well-known and evolutionarily significant erythrocyte pathogen (Anderson et al., 2018).

Plasmodium species have evolved different adhesion methods to human erythrocytes. *P. vivax* and *P. knowlesi* connect via the chemokine receptor Duffy (Horuk et al., 1993; McHenry and Adams, 2006). Duffy's capacity to scavenge chemokines was clearly outweighed by its negative effects in the presence of malaria, leading in the propagation of the gene imparting Duffy negativity (Anderson et al., 2018).

P. falciparum, the most virulent of the human malaria parasites, infects erythrocytes by attaching to glycophorin A, B, or C (Facer, 1983; Cowman et al., 2012). Despite the fact that persons lacking any of the glycophorin types are more resistant to *P. falciparum*, glycophorin A (GYPA) is the most frequent erythrocyte surface protein in humans (Poole, 2000; Passantino et al., 2002; Baum et al., 2002). Complete erythrocyte GYPA deficiency is a feasible but exceedingly unusual phenotype, implying that the lack of GYPA must come at a cost (Baum et al., 2002) or that GYPA's presence must give enough advantage to overcome *P. falciparum's* selection pressure. Otherwise, *P. falciparum* would have been responsible for the widespread loss of GYPA in malaria-endemic areas.

GYPA may function as a "decoy receptor," guiding infections away from vital tissues and into the spleen, where they may be destroyed by macrophages (Baum et al., 2002). Many pathogens that bind human glycophorins (such as reovirus, influenza C, Sendai, *Mycoplasma pneumoniae*, *Escherichia coli*, and *Ureaplasma urealyticum*) do not infect erythrocytes, which support this notion. This might also explain why GYPA survives on the erythrocyte surface despite *P. falciparum's* selection pressure. Engineering decoy viral receptors on erythrocytes to enhance adsorption and hinder nucleated cell invasion therefore presents a potentially viable technique to clearing infections from circulation. Indeed, in mouse models, such a strategy has been demonstrated to reduce coxsackievirus B infection (Asher et al., 2005).

Regrettably, not all decoy adsorption has positive outcomes.Human erythrocytes, for example, bind HIV-1 virions, resulting in a 100-fold increase in viral infectivity (Beck et al., 2009). HIV-1 binding to DARC on erythrocytes also keeps the virus alive and delivers viral particles to CD4-positive T cells (He et al., 2008). Erythrocyte binding activity may thus assist the trans infection of other viruses in specific instances. Local circumstances in the circulation and precise interactions between viral ligands and their host receptors, as with chemokine and mtDNA binding, may ultimately determine whether erythrocyte pathogen attachment is beneficial or harmful to the host (Anderson et al., 2018).

CONCLUSIONS

These findings provide ample evidence thatboth, nucleated as well as enucleated RBC play a significant role in the regulation of innate immunity. Nucleated RBCs possess different mechanisms against pathogenic encounters, as well. They may be production of cytokine, phagocytosis, complement system activation or communication with other cells in a paracrine manner. As a result, such RBCs may play a significant role in immune cell recruitment and activation. On the other hand, human erythrocytes also possess several immunomodulatory functions. These RBCs exhibit high affinity for endogenous molecules including chemokines, nucleic acids as well as exogenous molecules like various pathogens. The presence of TLR, PRR or Duffy antigen receptor for chemokines plays a great role in regulating immunological functions of enucleated RBCs. However, furtherresearches are still going on to understand the complete function of RBC in various acute and chronic blood-related disorders.

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Chapter 13

Antimicrobial Susceptibility of Some Bacteria Associated with Respiratory Tract Infection Among Patient Attending Yusuf Maitama Sule University Teaching Hospital, Kano

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ABSTRACT

Respiratory tract infections have been known to be a significant cause for morbidity and mortality, it is of concern since many years. The current study isolated and identified some bacterial pathogens in respiratory tract and determined their susceptibility to some antibiotics among patients attending Yusuf Maitama Sule University teaching hospital, Kano state. A total of 50 sputums were collected between January 2019 and December 2020 and inoculated onto MacConkey agar and chocolate agar then incubated at 37°C for 24hours. Of the 50 sputum sample tested, 96% (n=48) of the specimen were positive cultures with the most predominant being *Staphylococcus aureus* 60.42% (n=28) and *Streptococcus pneumoniae* 39.58% (n=19). Most of the isolates were resistance to most of the commonly used antibiotics.Higher susceptibility was recorded for ceftriaxone followed by ofloxacine while higher resistance was recorded for cloxacillin followed by erythromycin and augumentine. It is concluded that people at aged > 80 are at higher risk to respiratory tract infection. However, antibiotics resistance is alarming and brings to light the timely and suitable diagnosis of the common bacteria causing RTI and proper administration best on susceptibility test.

Keywords: Susceptibility, Respiratory Tract, *Staphylococcus aureus*, *Streptococcus pneumoniae*,

INTRODUCTION

Respiratory tract infections are common conditions among humans, with a high burden in terms of public health (Martin et al., 2016). Depending on their location, diseases can be divided into upper and lower respiratory tract infections (LRTIs). The respiratory tract can be infected by a variety of bacteria, both gram positive and gram negative, although the diseases that they cause may range from mild to severe. In most cases, the microbes remain localized within the respiratory system. Fortunately, most of these infections also respond well to antibiotic therapy. Respiratory tract infections are considered as one of the most common important infection among human worldwide (Carroll, 2002). LRTIs including bronchitis, bronchiolitis and pneumonia are heavy burden diseases, and also cause significant economic losses in low-income/ middle-income countries and especially those in Sub-Saharan Africa. (Bates andMudenda, 2013), LRTIs rank third after HIV/AIDS and malaria in terms of causes of mortality. LRTIs are the leading cause of death in nine African countries (Neumark, 2010). A systematic analysis in 2015 found that LRTIs caused 2.74 million deaths and 103 million disability-adjusted life-years (DALYs) worldwide, making them the fifth leading cause of death overall and the second leading cause of DALYs. Murray et al. (2015) compared to other regions, the burden of these infections is higher in Sub-Saharan Africa and Asia, where the highest mortality is among children under 5years. For instance, 546.8 and 511.3 deaths per 100 000 were reported in Somalia and Chad, respectively. Meanwhile, the lowest reported mortality was in Finland in Western Europe, with 0.65 deaths per 100000 (Uzoamaka et al., 2017). Several bacteria have been identified as the aetiology of LRTIs, including *Streptococcus pneumoniae* (pneumococcus), *Haemophilus influenzae, Klebsiella pneumoniae, Staphylococcus aureus, Acinetobacter species, Streptococcus viridans, Pseudomonas aeruginosa, Escherichia coli* and *Proteus* species (Egbe et al., 2015; Uzoamaka et al., 2017). The epidemiology of LRTIs in Africa can be specific based on socio-demographical, environmental and ecological specificities. A systematic review performed between 2000 and 2015 showed the prevalence of respiratory pathogens in children under five (5) living in Sub- Saharan African countries (Rudan et al., 2013).

However, upper respiratory tract infections are one of the common diseases which can be found in the individuals of all age groups. Pharyngitis, nasopharyngitis, tonsillitis, otitis media and sinusitis are the major infections of upper respiratory tract. These major problems are generally caused by viruses (Rhinovirus, Adenovirus, Parainfluenza virus, human Metapneumovirus, and influenza virus. After the viral invasion, the secondary infection is caused by various types of bacteria resulting in chronic obstructive lung disease and high fever. The different types of bacteria which are involved in upper respiratory tract infections (RTIs) are *Haemophilus influenzae, Streptococcus pyogenes, Moraxella catarrhalis, Staphylococcus aureus,* and *Streptococcus pneumoniae.* Although the upper respiratory tract infection cases are not complicated, the acute swelling caused by these infections may threaten airway patency resulting in asthmatic condition or cause obstruction in the passage of ingestion which further leads to significant dehydration. The RTIs are more common in developing countries in which, after diarrhea, RTIs are the second cause of death in children due to pneumonia (Carroll, 2002). Each year, United States reports that mortality rate of 14 % (5.6 million cases) is directly associated with community-acquired pneumonia (CAP) (Karchmer, 2004). Bacteria are becoming resistant to conventional antibiotics. Ten years ago, concern centered on Gram- positive bacteria, particularly methicillin-resistant S. aureus and vancomycin-resistant Enterococcus spp (Kumarasamy et al., 2010). Now, however, large numbers of clinical microbiologists agreed that multi-drug- resistant Gram-negative bacteria pose the greatest risk to public health (Ukpai et al., 2015). The increase in resistance of Gram- negative bacteria (faster than in Gram-positive bacteria) is higher than active new/developmental antibiotics, and only a few drug development programs are insufficient to provide therapeutic cover in next 10–20 years. The main reason for increase in resistance from antibiotics in bacteria is due to the mobile genes present on the plasmids which spread and transfer through bacterial populations (Bennett, 2009). Another reason for antibiotic resistance of bacteria has been considered to be the production of biofilms during quorum-sensing- regulated mechanism which releases beta-lactamase responsible for degradation of various antibiotics (Wilke et al., 2005). It has been reported that S. pneumoniae were found to be resistant to penicillin and erythromycin, H. influenzae were resistant from ampicillin, whereas S. pyogenes isolates were resistant from erythromycin (Karchmer, 2004). A common upper respiratory infection, streptococcal pharyngitis (strep throat) is caused by *Streptococcus pyogenes.* The World Health Organization (WHO) estimated that acute respiratory infections account for 1.9 to 2.2 million childhood deaths annually, with 70% occurring in Africa and Southeast Asia (Williams et al., 2010). The definition of ARI includes all infections of the respiratory tract. However, a majority of respiratory deaths are attributed to acute lower respiratory infections (ALRIs). The incidence of ALRIs in children aged less than 5 years is estimated to be 0.22 episodes per child-year, with most cases occurring in India, China, Pakistan, Bangladesh, Indonesia and Nigeria (Lozano et al., 2012; Rudan et al., 2013). Numerous pathogens can cause infections of the respiratory tract. Many of these infections produce similar signs and symptoms, but appropriate treatment depends on accurate diagnosis through laboratory testing.The current study isolated and identified some bacterial pathogens in respiratory tract and determined their susceptibility to some antibiotics among patients attending Yusuf MaitamaSule University teaching hospital, Kano state.

MATERIALS AND METHODS

Sampling site

This research was carried out at Yusuf MaitamaSule University Kano (YUMSUK) Teaching Hospital which is located at KwanarDawakin kudu along Zaria road, Kano.

Sample collection

A total of 50 sputum sample not saliva was collected from patients suspected of respiratory tract infection at the reception unit of YUMSUK Teaching Hospital in a sterile wide mouth container and immediately transported to the YUMSUK Teaching Hospital Laboratory.

Preparation of culture media and reagents

Culture media: All the culture media used were prepared according the to manufacturer's instruction (Oxoid, UK). The media were autoclaved at 121^0C for 15 minutes and dispensed into labeled sterile Petri dishes aseptically. They were allowed to solidify and stored in a refrigerator at 4^0C.

Biochemical media: All the identification media used were prepared according to manufacturer's instruction (Oxoid, UK). The media were dispensed into labeled test tubes or bottles and autoclaved at 121^0C for 15 minutes. They were allowed to set in a slanting position while peptone water was allowed to cool aseptically and stored in a refrigerator at 4^0C.

Gram staining reagents: The gram staining reagents used include: crystal violent, lugols iodine, acetone and neutral red. These were prepared according to the manufacturer's instruction (Oxoid, UK), dispensed into labeled, dark brown bottles and stored at room temperature.

McFarland turbidity standard: This is the Barium sulphate standard against which the turbidity of the test and control inoculawere compared. When matched with the standard, the inocula should give confluent growth. The McFarland standard was prepared by adding 0.6ml of the diluted Barium chloride (1%v/v) to 99.4ml of the diluted sulphuric acid (1%v/v) and mixed. A small volume of the standard turbid solution was transferred into a dark brown bottle and stored in the dark at room temperature (Cheesbrough, 2010).

Specimen culture: The sputum samples were cultured on Chocolate agar and MacConkey agar. The Chocolate agar plates were incubated anaerobically in an incubator (5-10% CO) at 37ºC for 24 hours, while MacConkey agar were incubated in an aerobic atmosphere at 37ºC for 24 hours. Suspicious colonies were then subculture on suitable solid culture media.

Identification of isolates

Culture: The colonial appearances of the bacterial isolates were examined on MacConkey and chocolate agar. The features examined included: size, shape, odor, pigmentation, consistency elevation, edge opacity and color as described (Cheesbrough, 2010).

Gram staining: This was performed according to the procedure described by Cheesbrough (2010). A clean microscopic slide containing a drop of normal saline was smeared with a bacterial colony using a sterile wire loop and allowed to air dried then heat fixed. It was placed on a staining rack, flooded with crystal violet and allowed to stand for 60 seconds. Using a pair of forceps, the stains were poured off. The slide was rinsed with water and flooded with Lugols iodine for 60 seconds. The iodine was poured off and washed with water. Acetone was used briefly to decolorize the smear and washed off thoroughly with water. The slide was then flooded with neutral red and allowed to stand for 2 minutes. The slides were then finally rinsed off with water, blotted with filter paper and allowed to air dry on a staining rack.

Microscopy: After drying, the slides were examined under the light microscope. A drop of immersion oil was dropped at the centre of each smear and examined under objective lens of the microscope. Morphological characteristics and gram reaction pattern were examined and recorded.

Biochemical tests: The identity of bacterial isolates was confirmed by biochemical tests such as catalase test, Coagulase test, optochin sensitivity test and bile solubility test.

Catalase test: Catalase test was done to distinguish between *Staphylococcus* species and *Streptococcus* species. One colony of the isolates was placed on to glass slide and a drop of hydrogen peroxide (H_2O_2) was mixed with the colony of bacteria. The bacterial suspension on the slide was then observed immediately for vigorous bubbling. The absence of bubbling from a transferred colony indicates a negative testany bubbling from a transferred colony indicates a positive test. Quality control was performed in which *S.aureus* strain were used for a positive control and a known *S. pneumoniae* strain for a negative control.

Coagulase test: This is a method for differentiating between pathogenic and non-pathogenic strains of *Staphylococcus.* Bacteria that produce free coagulase use it as a defense mechanism by clotting the areas of plasma around them and convert fibrinogen into fibrin to resist phagocytosis . Few drops of Staphylococci suspension is inoculated onto 5 ml plasma in a tube and incubated at 37 ºC for 4 hrs, clot formation was then observed absence of clot formation was an indication of negative results.

Optochin test: Optochin test was done to further identify *Streptococcous pneumoniae*. A colony of alpha hemolytic isolates was streaked on to blood agar. Optochin disk of 6mm in diameter was then placed on to the streaked plates and incubated at 37°C for 24 hours. Zone diameter of 14mm indicates positive result. While anything less than that indicates negative result. *S. pneumoniae* strain ATCC 49619 and *S. mitis* strain ATCC 49456 were used for quality control.

Bile solubility test: The bile (Sodium deoxycholate) solubility test distinguishes *S. pneumoniae* from all other alpha-hemolytic streptococci. *S. pneumoniae* is bile soluble whereas all other alpha-hemolytic streptococci are bile resistant. The bacterial isolates were added to 1.0ml of saline in a test tube to achieve turbidity. The bacterial suspension was then divided in to two(0.5ml each tube),0.5ml of bile salt was added to one tube and 0.5ml of saline was added to the other test tube and mixed well. All the tubes were then incubated at 37°C. Clearing of turbidity in test tube A not in B indicate positive result.

Antibiotic susceptibility testing: The susceptibility of the isolates to different antibiotics was determined by the Kirby-Bauer disc diffusion as described by CLSI, (2017) .The isolates were streaked on the surface of Mueller Hinton agar by swabbing the plates and then allowed to stand for 10minutes at room temperature. Ten disc of antibiotics which includes: gentamicin (10ug), cefuroxime (30ug),cipro floxacin(5ug), erythromycin(15ug), ceftriaxone(30ug), ceftazidime(30ug), augumentine(10ug), ofloxacine, cloxacillinlevo floxacine (5ug) were then placed on to the streaked plates Then incubated at 37ºC for 24 h, and the diameters of zone of inhibition were compared with those of the reference isolates *(S. aureus,* ATCC 25923; *S. pneumoniae*, ATCC 49619) to determine the susceptibility or resistance based on Clinical and Laboratory Standards Institute guidelines (CLSI, 2017).

RESULTS

Out of the 50 sputum samples, 48(96%) were positive for bacterial cultures. Among the isolates, *Staphylococcus aureus* 29(60.42%) was the most predominant isolate, followed by *Streptococcus pneumoniae* 19(39.58%).Table 1 show the distribution bacterial isolates with regard to age. Age group >80years had the highest prevalence 20(41.67%) of RTI while, age group 61-70 years had the least 5(10.42%).

Table 1. Distribution of Bacterial isolates with Regard to Age Group.

Age	No. of S. aureus (%)	No. of S. pneumoniae (%)	Total
1-20	00(0.00)	00(0.00)	00(0.00)
21-40	4(8.33)	5(11.11)	9(18.78)
41-60	9(18.75)	5(11.11)	14(29.17)
61-80	4(8.33)	1(2.08)	5(10.42)
Above 80	12(25.00)	8(16.66)	20(41.67)
Total	29(60.42)	19(39.58)	48(100)

Table 2 showed the distribution of bacterial species by gender. Out of 24 males enrolled in this study, 22 (45.83%) were positive for RTI, while all the females enrolled 26(54.17%) were positive for RTI, The result shows that no significant difference in the occurrence of RTI in both males and in females.

Table 2. Distribution of Bacterial isolates Among Patient's Gender.

Sex	No. of isolates(%)	No. of S. aureus (%)	No of S. pneumoniae (%)
Males	22(45.83)	14(29.17)	8(16.67)
Females	26(54.17)	29(31.25)	11(22.29)
Total	48(100)	29(60.42)	19(39.58)

Antibiotic sensitivity of the isolates is shown in Tables 3 and 4. The most effective antibiotic for *S.aureus* was ceptriazone 24(82.76%), followed by levofloxacine 23(79.31%) and ciprofloxacin 20(68.96%), while 100% resistance was recorded for cloxacillin.High resistance was also recorded for ceftazidine and erythromycin.Ciprofloxacine, ceptriazone and levofloxacine were the most effective antibiotic for S. pneumoniae, while it was 100% resistant to cloxacillin.

Table 3. Sensitivity of the *S. aureus* to different antibiotics.

S.No.	Antibiotic	Sensitivity (%)	Intermediate (%)	Resistivity (%)
1	Augmentine	10.34	65.52	24.14
2	Gentamycine	20.69	62.07	17.24
3	Cefuroxime	17.24	17.24	65.52
4	Ceptazidime	10.34	31.03	58.62
5	Ofloxacin	20.69	10.34	68.97
6	Cloxacillin	0.00	13.79	86.21
7	Erythromycin	10.34	17.24	72.41
8	Levofloxacin	75.86	24.14	0.00
9	Ciprofloxacin	68.97	27.59	3.45
10	Ceptriazone	86.21	13.79	0.00

Table 4. Sensitivity of the *S. pneumoniae* to Different Antibiotic.

S.No.	Antibiotic	Sensitivity (%)	Intermediate (%)	Resistivity (%)
1	Augmentine	0.00	84.21	15.79
2	Gentamycine	5.26	31.58	63.16
3	Cefuroxime	15.79	36.84	47.37
4	Ceptazidime	5.26	73.68	21.05
5	Ofloxacin	26.32	21.05	52.63
6	Cloxacillin	0.00	0.00	100
7	Erythromycin	26.32	63.16	10.53
8	Levofloxacin	73.68	21.05	5.26
9	Ciprofloxacin	78.95	15.79	5.26
10	Ceptriazone	73.68	15.79	10.53

DISCUSSION

Respiratory tract infection is a major health concern, which leads to several disabilitiesworldwide. In this study, two bacterial isolates that causes respiratory tract infections and determine their susceptibility to some antibiotics among patients attending YUMSUK teaching hospital from December 2019 to January 2020. The overall rate of RTI with positive cultures were 96% which were higher than finding in Cameroon 46.6% and Sri Lanka 29.4% (Smith et al., 2014), but comparable with the other part of the world such as Kenya 95.4% and Tripoli city in Libya with 71.1%(Atia et al., 2018). The probable reasons for this could be attributed to difference in study area, study period, climate and geographical variation. The findings of this study showed that staphylococcus aureus was the most predominant pathogen 60.42% among patients with respiratory tract infections which was similar with the previous study done in Kano (Garba et al., 2015) with *S. aureus* 54.1% and *S. pneumoniae* 45.9%. However, the result was in contrast to other findings such as study from Nasarawa State, Nigeria, *S. aureus* was found to have prevalence of 12.7% (Saini et al., 2012) and in other parts of the world. And also some study such as study done in other part of the country reported no case of S. pneumoniae. In this research, it was recorded that patients at age >80 were at higher risk to respiratory tract Infections. The probable reason could be a diminishing immunity due to age as well as other health complications. However, some study recorded no significance difference in bacterial Infections with regards to age (Akingbade et al., 2012). Some study recorded an increase in risk with increased in age groups such as study done in Benin City, Egbe recorded an increase in the prevalence with increased in age group (Egbe et al., 2015). It was found in the United Kingdom there was an increase in the prevalence of RTI with increased in age group (Millet et al., 2013). Resistance is an extremely scary situation for both patients and health care workers. This study showed that certain antibiotics are effective and cheaper than other antibiotics in both *S. aureus* and *S. pneumoniae* such as ciprofloxacin, levofloxacine and ceftriaxone, while most of the isolates showed higher resistance to augumentine, cloxacillin. The work of Usman and Muhammad, (2017) revealed high susceptibility of fluoroquinolones in the patients with lower respiratory infections.

CONCLUSIONS

This study concludes that people at the age>80 are at higher risk to respiratory tract infections. It was also concluded that ceftriaxone shows high activity against the isolates followed by ciprofloxacin and levofloxacine which are broad spectrum antibiotics. However the rate of antibiotics resistance is significantly high and proper intervention should be put in place by the relevant government ministry to prevent these infections and their complications. Resistance of respiratory tract pathogens to cloxacillin is of concern; this implies that this drug is no longer feasible for treatment of most bacterial Infections.

RECOMMENDATIONS

i. It is recommended that Hospitals should employ the methods of thorough identification of aetiologic agents of RTIs and not limited to only culture and morphological identification.

ii. Rampant and extensive administration of antibiotics should be stopped. This will help in tackling the danger of drug resistance.

iii. It is also recommended that, physicians should be well aware of susceptibility Pattern in a particular region before prescribing antibiotics (empirical therapy should be based on most recent study).

iv. This study is only limited to some bacterial agents of RTIs, studies on other aetiologic agents such as viruses should be conducted.

v. More research on RTIs should be performed as there are very few studies conducted in Nigeria

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Chapter 14

Wetland: Fish Diversity and Conservation Strategies

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ABSTRACT

Water is indispensably important for sustenance of life. Wetlands serve as potential reservoirs of water which also harbour coveted bioresources, which sustain animal life. Fish is a potential bioresource for nutrition and offer work places for people. The Asian continent has innumerable wetlands with the Indian sub-continent portraying myriads of wetlands of different kinds, including perennial wetlands (locally called "Taal") and seasonal floodplain wetlands. In addition to playing a pivotal role in providing nutrition and work places to the people, wetlands also play a significant role in flood management, in regulating biogeochemical cycles, and above all, perhaps, in the rehabilitation of the innumerable fish stock. Fishes are among those invariable living components which act as important food resources and good indicators of the ecological health of the aquatic ecosystem. The fish production from the wetlands of India is declining as various anthropogenic stresses such as habitat modification, over exploitation etc. are impacting the water-bodies in a destructive way

Keywords: Wetland, Fish Diversity, Conservation.

INTRODUCTION

Life is water; water is life (Steel et al., 2010) i.e. water is indispensably important for sustenance of life. Water is very broadly classified into two categories based on the type of water bodies. These are: (i) the standing water or the "lentic" water; and, (ii) the running water or the "lotic" water. In this regard, it may be mentioned here that, although the name is "standing water", actually, the water in such bodies is in motion in different ways. Hence, "standing water" does not necessarily mean "static". It simply means that the water does not flow (Kar, 2013).

WETLAND

Wetland day press release 2016, of Convention on Biological Diversity (CBD), highlighted that wetlands are essential for human being to live and prosper. These are one of the Earth's richest ecosystems, offering ''sanctuary'' to a wide diversity of plants and animals. In addition, they play other key roles, for example provisioning and maintaining water quality for countless living organisms. India supports unique geographical diversity and different climatic zones, which in turn supports diverse wetland habitats throughout the subcontinent and covers nearly 58.2 million hectares. Indian wetlands are classified into two major groups: Natural and Man-made. According to IUCN wetland directory, the man-made wetlands in our country are about 1.8 times higher than the natural wetlands. Wetlands serve as potential reservoirs of water which also harbour coveted bioresources, which sustain animal life. Natural floodplain wetlands of India are biologically rich sensitive ecosystem that support unique aquatic biodiversity and play vital role in providing livelihood and nutritional security to a large section of the population of the country. Besides contributing to the environmental sustainability through nutrient cycle, wetlands of India are the major sources for inland fish production of the country, offering vast potential for capture as well as culture fisheries. Degradation and shrinkage of the floodplain wetlands have been recorded due to several natural and anthropogenic reasons. In addition to that, the change in the climatic condition may have a far more devastating impact on these natural resources.

FISH DIVERSITY

Fish constitute almost half of the total number of vertebrates in the world (Nelson, 1994). They live in almost all conceivable aquatic habitats. Around 21,723 living species of fish have been recorded out of 39,900 species of vertebrates (Nelson, 1994; Jayaram, 1999). Of these, 8,411 are freshwater species and 11,650 are marine. India has one of the mega biodiversity countries in the world and occupies 9th position in terms of freshwater biodiversity. In India, there are around 2,500 species of fish, of which, around 1,570 are marine species and around 1027 freshwater species, comprising primary, secondary and alien freshwater fishes. Among them primary freshwater fishes include 858 species belonging to 167 genera under 40 families and 12 orders. Further, 137 species of secondary freshwater fishes that frequently enter and thrive in freshwater reaches of rivers are also known from India. Thirty-two species of alien fishes belonging to 21 genera of nine families and seven orders are found in the fresh water systems of India. Out of this, 16 species are well known, potential invasive alien fishes in India (Gopi et al., 2017).

The wetlands in India support subsistence and livelihood to thousands of people through fishing, collecting edible plants, agriculture, water transport, irrigation and fisheries, besides rich biodiversity. They also form a major inland fisheries resource in the country. The inland wetlands of India alone support 20% of the known range of biodiversity which harbours almost all taxonomic groups. In addition to playing a pivotal role in providing nutrition and work places to the people, wetlands also play a significant role in flood management, in regulating biogeochemical cycles, and above all, perhaps, in the rehabilitation of the innumerable fish stock. Although the value of wetlands for fish and wildlife protection has been known from several decades, some of the other benefits like conservation of biodiversity, maintenance of water quality, recharge and discharge of water regime etc. have been identified only in recent years. Freshwater fish are one of the most threatened taxonomic groups because of their high sensitivity to the quantitative and qualitative alteration of aquatic habits.

Presence of fishes in an aquatic habitat is a good indicator of the health and status of that ecosystem. In recent years, contemporary freshwater fish diversity has been decline constantly in wetland due to destruction of habitat on account of various natural and anthropogenic factors. The polluted water and declining water table in most of the wetlands is affecting water quality, biodiversity and fish growth (Brraich and Jangu, 2013).

WETLAND DEPLETION

Anthropogenic activities as well as ecological process contribute to the fishery status of wetlands. It is also strongly affected by socio-economic factors such as land policies, property right, population migration, urbanization, resource availability, other commercial activities, and market for resources. Thus, studies on status of wetland require an integrated interdisciplinary approach as any alterations or disturbances of the wetlands can have an adverse impact on the environment and fishery potential (Fernandes and Achuthankutty, 2010).

Wetlands and its biodiversity are getting depleted alarmingly due to habitat destruction, pollution, overexploitation of aquatic resources, tourism and the introduction of invasive exotic species along with alien pathogens and parasites (Sandilyan, 2016). In particular the freshwater ecosystem which supports 40% of the globally recorded fish species is highly vulnerable to aforesaid anthropogenic pressures. In recent decades invasive alien species are considered as one of the major factors for the devastation of the freshwater ecosystem and have emerged as a great threat for the existing indigenous aquatic diversity, in particular fish species (Sandilyan, 2016).

WETLAND AND FISH DIVERSITY CONSERVATION

Fishing is an essential part of the livelihood strategies for hundreds of people associated with aquatic ecosystems. Growing demand for inland fish against the background of a resource is declining. As a result, the future appears to be for better regulation of conventional capture fisheries but also to pursue methods for production enhancement that are better adapted to the changing environment. Thus to conserve the fish diversity in wetlands the following recommendations are suggested to be implemented immediately.

i. Overexploitation is tremendously detrimental to the overall fish diversity of the wetlands. Indiscriminate fishing should be prevented at any cost to save the fish diversity in the taal. Strict measures should be taken for those who will catch juvenile fishes.

ii. To maintain a sustainable stock, the fishing net with lower mesh size should be prevented. Fishing net with mesh size of more than one centimeter may be used. Regular inspection by the authorities of fisheries department should be undertaken to prevent such malpractices. In this respect, net makers should also be given the proper instructions.

iii. To carryout undisturbed spawning, closed season should be implemented during the monsoon months (June to August) to maintain the optimum fish stock. All types of fishing activities should strictly be prohibited at that time.

iv. As the wetland is thickly infested by a number of aquatic weeds, the eradication of these aquatic weeds should be undertaken at regular intervals. To eradicate these aquatic weeds, different weed eating fishes might be introduced in addition to mechanical methods.

v. Awareness programme regarding the conservation of threatened and endemic fishes should be undertaken. In this aspect, the state and district fisheries department, educational institutions, other government and non-government organizations can play a vital role.

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Chapter 15

Ethnopharmacological Survey of Herbal Formulations Used Against the Treatment for Dandruff

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ABSTRACT

This study aimed to investigate the use of natural remedies for the treatment of hair and scalp disorders. Traditional knowledge about the herbal wealth of India is an important example of how ancient and accumulated knowledge is applied in a holistic approach in present-day health care. The article discusses in detail about the plants, their various parts, and herbal preparations used for the treatment of dandruff. Further, it discusses the detail about various treatments/ methods available to treat the scalp condition like dandruff. The status of dandruff being amphibious – a disease/disorder, and relatively less medical intervention is sought after for the treatment.

Keywords: Ethnopharmacology, Herbal Medicine, Dandruff.

INTRODUCTION

Dandruff is a very common scalp problem from which more than half of the population is suffering. It affects the people of all age groups and gender. It is caused by the pathogen like fungus *Malassezia furfur, Malassezia globosais* earlier known as *Pityrosporum*, and *Candida albicans* the major cause of dandruff (Shuster, 1984; Krishnamoorthy, 2006). Dandruff causes itching, hair loss (Al-Waili 2001), and shedding of dead skin cells (Shuster, 1984). Dandruff is more common in males than in females. (Agarwal et al., 2009). The growth of dandruff-causing *Malassezia* is more common in moist, warm, and unhygienic conditions (Rippon, 1974). Excessive dandruff can be due to seborrhoeic dermatitis, excess androgenic hormone fungal infection, and excessive sebaceous secretion (Sharma et al., 2013). It is the most common problem and also related to social and self-esteem, self-confidence (Revansiddappa et al., 2018). As dandruff is one of the most popular hair problems so several companies have started to make anti-dandruff shampoos and oil based on synthetic and herbal formulations (Rai, 2015). Naturally extracted active ingredients from (plants, animals, microorganisms) are used from ages for the preparation of traditional cosmetics (Fowler Jr. et al. 2010). The bioactive compounds extracted from the various plants have also shown the potential to cure dandruff (Tripoli et al., 2007). The present article is mainly based on traditional knowledge and herbal formulations to overcome dandruff without any side effects and at a low cost.

CAUSE OF DANDRUFF

Pityro sporum is naturally occurring lipophilic yeast that is present on the scalp and other parts of the body, without any harm. But due to stress, moist and warm weather, hormonal changes, and under unhygienic condition our scalp produces more natural oil (sebum) because of which this fungus proliferate and cause itching, dandruff, and redness that may result in hair fall (Fig. 1). *Malassezia* (fungus) is having the capacity to break the sebum into oleic acid by using enzymes. This oleic acid penetrates the uppermost layer of the scalp which results in the constant shedding of dead skin cells of the scalp in the form of dandruff (Fig. 2) (Kothari et al., 2018).

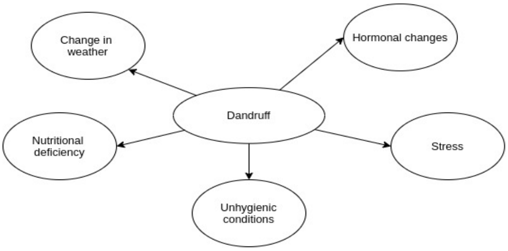

Fig. 1. Root causes of dandruff in the scalp.

MODE OF ACTION OF ANTI-DANDRUFF COMPOUNDS

The main aim of antidandruff agents is to remove fatty acids, natural oil and excessive sebum from the scalp as the fungus used the free fatty acids for their survival and growth. The antidandruff compounds can be natural or synthetic in nature. (Devasena and Ravimycin, 2009)

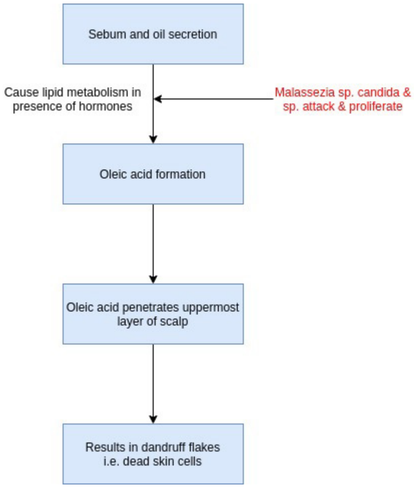

Fig. 2. Flow chart representing mechanism of dandruff formation in scalp.

HERBS USED IN THE TREATMENT OF DANDRUFF

In India, the usage of herbal plants in cosmetics, medicines, and in toiletry is very common from ancient times. Many herbal shampoos have captured the market are made from the different plant extract and essential oils which are rich in bioactive compounds and efficient to treat hair related problem (Pingale et al., 2014).

Plants contain several phytochemicals that show antifungal, antibacterial, antioxidant properties. Dandruff can be treated with both synthetics as well as with herbal formulation. Unlike synthetic shampoos, herbal shampoos show no side effects (Revansiddappa et al., 2018).

Leaves extract of *Azadirachta indica* (neem) shows antifungal properties as the concentration was increased the zone of inhibition also increases and at 100% neem leaves extract widest zone of inhibition was found (Niharika et al., 2010.)

The herbal anti-dandruff shampoo was made from garlic are loaded solid lipid nanoparticles in which garlic containing allicin compound have shown the antifungal activity. Garlic was used to treat dandruff as a homemade remedy from ancient time as prolong use of garlic reduce the fungal infection (Rai et al., 2013)

Bacopa monnoria (reetha) and *Acasia cancina* (shikaka) are commonly used in the maximum of the Indian houses from olden days to clean hairs they are also part of many herbal shampoos which are present in the market and have potential to treat the scalp fungal infections like dandruff (Bijauliya et al., 2017).

There are some other common herbal ingredients used in herbal shampoos like *Sida cordifolia* (Kurunthotti), *Emblica officinalis* (amla), and *Citrus lemon* (lemon) are claimed to have antidandruff properties (Pingale et al., 2014).

Cymbopogon flexuosus (lemongrass) has a novel protein known as lemin which is an active compound against lipophilic yeasts. The hair tonic made from 10 % oil of lemongrass showed maximum potential against fungus growth (Chaisripipat et al., 2015). The essential oil extracted from lemongrass also showed maximum potential against *C. albicans* by showing deleterious morphological changes in cellular structures and cell surface alterations of fungus (Tyagi and Malik, 2010).

The Polyherbal Shampoo was also formulated by using natural herbs from different plants like Bhringraj *(Eclipta Alba)*, Fenugreek (methi), *Azadirachta indica* (neem), *Acacia concinna* (shikakai), *Sapindus mukorossi* (reetha), *Ocimum santum* (tulsi), *Piper betle* (paan), *Hibiscus rosasinensis* (Gurhal), *Camellia sinesis* (green tea leaf), *Citrus aurantifolia* (lemon), *Phyllanthus emblica* (amla), *Eclipta alba* (Brhingaraj leaf powder), *Aloe vera* (Aloe leaf Powder), Ashwagandha powder, Triphala powder Nagarmotha Powder, Brahmi Root. This polyherbalshampoo are good sources of chemicals which is required hair related problems especially dandruff (Lodha, 2019). Dano is one more polyherbal oil that is made from the combination of *Wrightia tinctoria* (Indrajev), *Cassia alata* (Dadmari), and bitter fraction of *Azadirachta indica* (Neem or Nimba). Fungus like P. ovale and C. albicans both has been shown sensitivity against Dano (Krishnamoorthy et al., 2006)

The ethanolic extract of *Evolvulusal sinoides, Lawsonia inermis, Azadirachta indica, Hibiscus rosa- sinensis,* and *Murraya koenigii* were made to determine their antifungal properties out of which *Azadirachta indica* showed the highest zone of inhibition followed by *Murraya koenigii* and *Lawsonia inermis*. Whereas Evolvulusal sinoides showed reasonable zone of inhibition at minimum concentration (Deviha and Pavithram, 2015).

Saponin containing *Acacia concinna, Sapindus trifoliate, Dodonea viscose, Albizzia amara* and *Trigonella foenumgraceum* were combined in different ratio and polyherbal hair care powder was made which showed effective antidandruff property (Azam et al., 1996).

The petroleum ether extract of *Tridax procumbens* (coat buttons) was found to be effective against dandruff. The formulation (liquid cream shampoo) was developed using an active extract of *Tridax procumbens* and was evaluated using various parameters, which proved its efficacy and safety (Sagar and Dixit, 2005).

A various number of plants are found to be useful to overcome the problem of dandruff-like *Glycine max* (soyabean), *Rosmarinus officinalis* (rosemary), *Arctium lappa* (burdock), *Zingiber officinalis* (ginger), *Plantago major* (greater plantain), *Melaleuca* spp (tea tree), *Camellia chinensis* (tea), *Salvia officinalis* (sage), *Mentha piperata* (mint), *Thymus vulgaris* (thyme), *Glycerriza glabra* (yashtimadhu) (Chhavi et al., 2011). The oils and shampoos that are made from these plants have shown a success rate against dandruff.

Table. The Following Table has Shown the Details of Plants and their Parts Used to Treat Dandruff.

S .No.	Plant name	Plant part used	Remark	References
1	*Allium cepa* (dungli)	Bulbs	Juice is squeezed from bulbs.	Mitaliya et al., 2003
2	*Azadirachta indica* (Neem)	Leaves, seed	Crushed seed+ oil+ boil, Juice of leaf	Mitaliya et al., 2003
3	*Brassica campestris* (sarsav)	seeds	Paste of seeds	Mitaliya et al., 2003
4	*Cicer arientum* (chana)	seeds	Seeds flour + butter milk	Mitaliya et al., 2003
5	*Derris indica* (Karanj)	seeds	Crushed seeds +boil with mustard oil	Mitaliya et al., 2003
6	*Linum usitatissium* (Alsi)	seeds	Seed oil is made	Mitaliya et al., 2003
7	*Melia azedarach* (bakanlimbdo)	seeds	Crushed seeds + oil + boil Crushed seeds + oil + boil	Mitaliya et al., 2003
8	*Annona squamosa* (seetaphal)	seeds	Paste of seeds are made	Mitaliya et al., 2003
9	*Hibiscus rosa-sinensis* (Gurhal)	Flower	Latex obtained from flower	Pekamwar et al., 2013
10	*Lawsonia inermis* (mendhi)	Leaf	Juice from leaves + water	Chakkilam et al., 2017
11	*Datura metal* (datura)	Fruit	Paste of fruit	Soni , 2012
12	*Mangifera indica* (mango)	Kernel	Grind kernel+ mix milk	Parvez, 2016
13	*Nyctanthes arbor-tritis* (Harsingar)	Seeds	Powder of seeds	Agrawal and Pal, 2013
14	*Camellia sinensis* (tea)	Leaf	Boiled leaves + lime	Parmar et al., 2012
15	*Vitex negundo* (Chaste tree)	Leaf	Juice of leaves + oil	Dharmasiri et al., 2003
16	*Citrus aurantifolia* (Nimbu)	Juice	Juice + castor oil	Mohanapriya et al., 2013
17	*Aloe vera* (Aloe)	Juice	Juice	Pandey and Singh, 2016

CONCLUSIONS

The Dandruff is a very common scalp condition in the present time which affects a large number of populations worldwide. In this modern world, people are searching for alternatives to chemical-based shampoos as they are having serious side effects. The use of natural elements in shampoos is an alternative to avoiding the negative effects of chemical or artificial compounds. In addition to its benefits, natural resource utilisation is not only profitable but also environmentally friendly. Further to ensure the efficient creation of novel product for dandruff treatment it is crucial to establish a collaborative effort between researcher, traditional knowlegde and industry specialists. The present article prescribed the information regarding the Herbs and their formulations used against dandruff without any side effects.

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Chapter 16

Herbal Medicines to Cure Cough in Livestock

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ABSTRACT

Dependence of animals on whole plant or plant parts for different purposes like food, shelter, medicine, etc. is practiced from ancient times in developing countries like India. There are several medicinal plant species which are used to treat various diseases in human and livestock. The leaves are the main source of herbal preparation which is used to treat the cough like medical problems in livestock. There are majorly two modes of administration of natural ingredients to treat cough in cattle's either it is given orally or sometimes applied to the skin. This traditional knowledge needs to be transferred from one generation to another for the betterment of both human beings and different animals as these medicines are prepared from natural ingredients so they are pure, safe, and affordable in nature. The present review discusses the various species of plants and their different parts used from ancient times in the treatment of cough in animals.

Keywords: Medicinal Plants, Cough, Livestock.

INTRODUCTION

Plants and animals directly or indirectly depend on one another in the rule of nature. In ancient times the survival of animals depends on plants for their daily needs like food, shelter, fuelwood, clothing, medicines, and other purposes. India is an agricultural country and livestock also plays an important role in farming, rural transport, manure, fuel, milk, meat, wool (Maikhuri, 1992; Verma et al., 2014). In developing countries like India and Africa, the major section of the population is economically weak so their livelihood depends greatly on farming and animal husbandry. Livestock is also the source of income in a developing country. About 80% of the population in Asia and Africa depends on traditional herbal medicines for their primary health-care (Rastogi et al., 2015). Traditional knowledge-based folk medicines are quite effective for both humans and livestock as they are the treasure of any country. Farmers believe more on household remedies based on traditional knowledge gain from their ancestors orally for the treatment of their cattle (McCorkle, 1986; Mathias-Mundy and McCorkle, 1989; McCorkle et al., 1996). Ethnoveterinary medicines (EVM) are better and reliable than western-based veterinary healthcare systems as they are cheap, safe, long time tested and based on indigenous communities and natural resources. They can be a suitable alternative to the western-based veterinary healthcare system (McCorkle, 1995; McCorkle et al., 1996; Kumar, 2002). So there is a need to preserve our traditional knowledge systematically so that it can be utilized by the upcoming generation.

TREATMENT OF COUGH IN CATTLE BASED ON TRADITIONAL KNOWLEDGE BY INDIGENOUS COMMUNITIES

Chemical-based synthetic medicines may cause side effects whereas usage of herbal medicines is non-toxic, affordable, and eco-friendly. In India, usage of herbs is very common and these herbs are rich in bioactive compounds that fight against various diseases. Some specified plant parts or whole plants itself act as a medicine to cure a particular disease. There are majorly two modes of administration of natural ingredients to treat cough in cattle. Mostly decoction, infusion, juice or paste of particular herbal plants are made and given orally against several natural ingredients are made and applied externally to the neck sometimes herbs chopped and mixed with food (Rastogi et al., 2015).

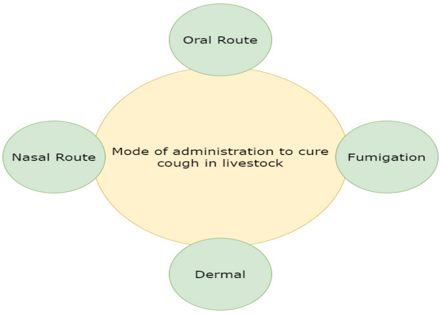

Fig. 1. Different Mode of administration to cure cough in livestock.

In some parts of the Jalaun district at Uttar Pradesh, milk fat (desi ghee), *Cinnamomum camphora* (kapoor), and *Urena lobota* L. (bhayriya) are taken in equal amount, crushed properly and applied externally to the neck of the cattle to cure cough (Kumar and Bharati, 2012). Community people of Silarpur village in Alwar at Rajasthan use homemade remedies to cure cough by making a paste of *Allium sativum* (garlic), *Syzygium aromaticum* (clove) and jaggery mixed with the food of cattle or pomegranate outer covering mixed with jaggery, turmeric, and ginger given to the cattle to cure cough (This is the traditional practice used by Dodi Devi, Silapur, Alwar).

Table 1. The Details of Plants and their Parts Use to Treat the Animal Cough.

S. No.	Name	Plant parts used	Mode of administration	Refrences
1	*Achyranthes aspera* Linn (UbatKandri)	Whole plant	Plant parts boiled in water	Qureshi et al., 2010
2	*Citrullus colocynthis* (Linn.) Trooh	fruit	half piece (approx. 100 grams) of ripened fruit is given twice a day	Qureshi et al., 2010
3	*Aloe barbadensis* Miller. (Kunwar Buti)	leaf	Sodium chloride is dusted on a leaf and is given to cattle thrice a day	Qureshi et al., 2010
4	*Callilepis laureola* (Ox-eye daisy)	leaf	Leaves boiled in water	Kunene et al., 2003
5	*Cissus quadrangularis* (Climbing cactus)	leaf	Leaves boiled in water	Kunene et al., 2003
6	*Clerodendrumg labrum* (Stinkboom)	leaf	Leaves boiled in water	Kunene et al., 2003
7	*Crinum macowanii* (River lily)	leaf	Leaves boiled in water	Kunene et al., 2003
8	*Gnidia kraussiana* (Gifbossie)	leaf	Leaves boiled in water taken orally	Kunene et al., 2003
9	*Laportea peduncularis* (River nettle)	leaf	Leaves boiled in water	Kunene et al., 2003
10	*Pentanisia prunelloides* (Wild verbena)	leaf	Leaves boiled in water	Kunene et al., 2003
11	*Sarcostemma viminale* (Bush vine)	leaf	Leaves boiled in water	Kunene et al., 2003
12	*Allium cepa* Linn. (onion)	Bulb	Bulb paste mixed with mustard oil and given thrice daily for one month	Verma., 2014; Mishra et al., 1996; Borthakur and Sarma, 1996
13	*Ocimum sanctum* Linn. (tulsi)	leaf	fresh leaf (350 g) is boiled in water (200-250) mL	Verma, 2014

14	*Tribulus terrestris* Linn. (bindii)	leaf	Juice of fresh leaves taken	Verma , 2014
15	*Vigna radiate* L. (green gram)	seed	250 g seed powder is mixed with 100 mL oil of *Arachis hypogea* , given twice a day for a week	Verma, 2014
17	*Adhato davasika* Nees (Basanga)	bark	Bark of Adhatodavasika + leaves *Ocimum sanctum* leaves are boiled in water of equal amount ,when thick decoction is obtained little honey is added and given twice daily for five consecutive days.	Das, 2011
18	*Calotropis procera* Ait. (Arakha)	flowers	sun-dried flowers(500gm) are boiled in water (5000ml). A decoction is made and 15-20 ml is given 3-4 times a day for 10-12 days	Das, 2011
19	*Justicia adhatoda* L. v	Leaf, flower	Paste of leaf and flower, mixed with half the amount of leaf paste of *Ocimum tenuijlorum* L. is given, about 10 tablespoons, 3 times a day for 5 days	Manandhar, 2001
20	*Schkwal lichii* (Chilaune)	bark	Juice of bark, about 20 tablespoons 4 times a day for 5 days	Manandhar, 2001
21	*Zingiber offinale* (Aduwa)	rhizome	Paste of rhizome, mixed with half the amount of the cloves of *Allium sativum* L, is given about 10 tablespoons 3 times a day for 7 days	Manandhar, 2001

22	*Cistanche tubulosa* (Schenk) Hook.f. (Herbeeta)	Whole plant	The plant powder	Khattak, et al., 2015
23	*Datura metel* L. (Berbaka)	fruits	roasted fruits	Khattak, et al., 2015
24	*Periploca aphylla* Decne. (Bararrah)	Stem	Stem boiled in water	Khattak, et al., 2015
25	*Adhatoda vasica* Nees. (Adusa)	Leaves	Leaves boiled in water	Parthibanet al., 2016
26	*Andrographis paniculata burm.f* (green chireta)	Leaves	Leaves boiled in water	Parthibanet al., 2016
27	*Ocimum tenuiflorum* L. (holy basil)	Leaves, whole plant	Leaves boiled in water	Parthiban et al., 2016; Sudarsanam et al., 1995
28	*Dendrocalamus strictus* (Banss)	leaves	Green leaves grind with seeds of *Hordeum vulgare*	Phondani et al., 2010
29	*Oryza sativa* (Dhan)	Seeds	Seeds are boiled with water and juice (Mund) is applied	Phondani et al., 2010
30	*Thymus linearis Benth.* (JangliJavind)	Aerial parts	Aerial portion is boiled with water	Lone and Bhardwaj, 2013
31	*Piper nigrum* (Maricha)	seed	-	Mishra et al., 1996
32	*Vernonia amygdalina* Delile (Lubilili)	Leaf	Infusion made after adding leaves of *Chenopodium opulifolium* and *Senna occidentalis*	Tabuti et al., 2003
33	*Solanum marginatum* L.f. (Abiyengule)	Fruit	Remove the seed from the fruit, add the milk on it and give through the nasal cavity	Hishe and Asfaw, 2014
34	*Azadirachta indica* (Neem)	Leaves	-	Sikarwar, 1996
35	*Cinnamomum camphora* (camphor)	Whole plant	-	Sudarsanam et al., 1995
36	*Urena lobata* (Congo jute)	Whole plant	-	Kumar and Bharati, 2012
37	*Hypoestes forskaolii* (Girbia)	Root	Place it on fire for fumigation	Hishe and Asfaw, 2014

38	*Ocimum tenuijlorum* (Chimida)	Leaf	Crushed, mixed with *Allium sativum* , filter and add through the nasal cavity	Hishe and Asfaw, 2014
39	*Solanum mariginatum* L.f.	Seed	Burn, grind, mix it with sugar or honey and swallow it	Hishe, & Asfaw, (2014).

CONCLUSIONS

India is a developing country and a major population of it is economically weak. Farming, livestock, animal husbandry, etc. play an important role in the income of the people and also affect the economic status of the country. India has an enormous diversity of flora and the usage of this flora for the preparation of medicines and using these herbal medicines is considered far better by the farmers for the treatment of diseases in humans and different animals than the chemical-based synthetic medicines as these synthetic medicines may cause side effects but herbal medicines are non-toxic, cheap and eco-friendly. Various parts of the plant like leaves, fruits, roots, etc. or the whole plant are used for preparing the medicines. So, conserving this traditional knowledge and exploring this sector more and sharing this knowledge is the need of the hour.

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Chapter 17

Alternative Pest Control Method Against Bollworm

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ABSTRACT

Many pesticides have been used as pest control, but their widespread usage has resulted in insect pest resistance and agro-ecosystem disruption. Bollworm is one of the most destructive pests which also damaged other crops along with cotton. However, a lack of consideration for crop protection principles, as well as the indiscriminate and excessive use of synthetic pesticides, has resulted in issues such as insecticidal resistance, pest rebound, and the extinction of natural enemies. The use of chemical insecticides may lead to some undesirable effects which can adversely affect the soil, water bodies, crops, and make pests insecticides resistance. So, this study aimed to investigate natural remedies for pest control. This article discussed in detail about the plants, their parts used, different herbal formulation and other natural combination of like cow's urine and dung, usage of honey bee propolis to overcome the problem of bollworm. In the present study, we have discussed complementary pest control methods against bollworms other than chemical pesticides.

Keywords: Bollworm, Pest Control, Chemicals, Herbal Formulation.

INTRODUCTION

India is an agricultural country and cotton is one of the most important cash crops grown here which plays a remarkable role in the economy. Gujarat is one of the major producers of cotton in India. Across the globe, there are more than 160 species of insects that have been reported to cause major loss to cotton crop production up to 60%of total productions. They attack different stages of plant growth as defoliators, tissue borers, and sap-suckers (Manjunath, 2004). Insecticides used to protect the crops can be chemicals or natural (animals, plants, microorganisms' source) based in nature (Parekh and Chanda, 2007). Natural insecticides are the best alternative of chemical as they are environment friendly. Plant-based insecticides have been used by the farmers for at least two thousand years (Thacker, 2002). Plants are the rich source of phytochemicals and the secondary metabolites extracted from these are capable of pest management. (Georges et al., 2008; Baskar et al. 2009; Muthu et al., 2012). Plants like *Nicotiana tabacum* (tobacco), *Datura stramonium* (thorn apple), *Tagetes minuta* (khaki weed), and *Allium sativum* (garlic) have the potential to fight against pests (Prakash and Rao, 1997). Bollworm is one of the most destructive pests which also damaged other crops along with cotton. *Helicoverpa armigera* (American or African bollworm) is polyphagus, highly mobile, and cosmopolitan lepidopteran in parts of Asia, Africa, Australia, Europe, and other countries (King, 1994). In India it was reported that only due to *Helicoverpa armigera* there is an annual loss of $500 million in 2003 and reached up to $1 billion in 2005 annually, (Ganguli, 2003 and Chandrashekar, et al., 2005). *Pectinophtora gossypiella* (pink bollworm) and *Earias insulana* (spiny bollworm) are two serious pests which have been observed causing a considerable loss in cotton production in Egypt and other countries (Shalaby et al., 2018).

MODE OF ACTION OF BOLLWORM ON PLANTS

Helicoverpa armigera is a common pest of chickpea and other pulse crops and now frequently attacks the American cotton crop of North Zone in IndiaIts larvae most prominently attack the fruiting body and cause excessive shedding of a cotton boll. The larvae cause major damage to crops by moving from one boll to another rather than consuming them (Arora et al., 2009).

Cotton crops of Punjab, Haryana, and Pakistan are much more affected by Pectinophtora gossypiella which damage the crop in various ways which results in lower ginning percentage, lower oil extraction and inferior spinning quality of the cotton (Arora et al., 2009). *Diparopsis castanea* (red bollworm) larvae feed on the seeds. They burrow into the bolls, reach the seeds and damage the lint which results in degrading the quality of cotton (Godfrey et al., 2008). *Earias insulana* (spiny bollworm) infects the different parts of the plant like leaf, stem, and fruit during vegetative, flowering, and fruiting stages of their growth. *Earias insulana* penetrates the terminal bud of the vegetative shoot and moves downwards from the growing point, or it directly penetrates the internodes. The color of the whole apex turns blackish-brown and the plant dies (Kashyap and Verma, 1987; Reed, 1994).

NATURAL PESTICIDES AGAINST BOLLWORM

To overcome the problem of bollworm and also to reduce the use of chemical-based pesticides the novel approach was taken to make insecticides by using animal and plant products. Cow dung is used as manure from ages but when cow dung combined with cow urine it is used as a natural pesticide. Cow urine contains 24 different types of salts like water 95%, urea 2.5%, minerals, salt, hormones, and enzymes-2.5%. It also contains iron, calcium, phosphorus, carbonic acid, potash, nitrogen, ammonia, manganese, iron, sulfur, phosphates, potassium, urea, uric acid, amino acids, enzymes, cytokine, and lactose, etc. (Dharm et al., 2005). The studies proved that natural pesticides made by the combination of cow 's urine-dung extract in definite proportion with water in ratio 1:1 and 1:4 showed measurable potential against *Pectinophora gossypiella* and *Earias insulana* whereas adding neem oil showed no advantage. Cow`s urine-dung extract: water in 1:4 ratio was the most effective and recommended treatment (Shalaby et al., 2018).

The essential oils extracted from *Cymbopogon citrates* (lemongrass), *Cymbopogon nardus* (Citronella grass), and *Citrus* sp shows the insecticidal activity against *Pectinophora gossypiella*. Nine different concentrations of each essential oil were made out of which *C. citrates* richest in oxygenated monoterpenes was found poisonous against *Pectinophora gossypiella* followed by *Cymbopogon nardus* (Kobenan et al., 2018).

Natural resin, (Propolis) obtained from honeybee which is a rich source of polyphenols, flavonoids, terpenoids, steroids, amino acids. It has been proved that both Egyptian and Chinese propolis are toxic against many cotton pests. It is stated that Egyptian honeybee propolisis more poisonous against eggs and newly hatched and 4th instars larvae of *Pectinophora gossypiella* (Amer, and Nafea, 2011)

The extracts of *Nicotiana tabacium* (tobacco), *Azadirachtin indica* (neem), and *Datura stramonium* (datura) were prepared and sprayed on the Bt cotton as well as on to the non-Bt cotton crop which was infected by *Pectinophora gossypiella. Nicotiana tabacium* specifies the highest reduction in the population of pests followed by *Azadirachtin indica* and *Datura stramonium* (Rajput et al., 2017). It is reported that nicotine sulfate which has been isolated from waste tobacco leaves shows toxic property against American bollworm (Prabhu et al., 1990; Patil et al., 2007)

Artemisia annua L. is an aromatic, medicinal weed belongs to Asteracea family rich in several bioactive compounds like including flavonoids, coumarins, steroids, phenolics, purines, lipids, aliphatic compounds, monoterpenoids, triterpenoids, and sesquiterpenoids (Bhakuni et al. 2001; Haghighian et al. 2008; Brisibe et al. 2009), terpenoids and sesquiterpene lactones have a strong odor and bitter taste. The essential oil extracted from the *Artemisia annua* was found toxic against *Helicoverpa armigera.* The α-amylase is one of the most important enzymes required for the digestion of carbohydrate, bioactive compounds that were present in the *Artemisia annua* inhibits the activity of α-amylase causing the death of *Helicoverpa armigera* (Mahboubkar et al., 2015).

Azadinachta indica (neem) and *Millettia pinnata* (pongam) oil were taken and different botanical formulations were made out of which maximum insecticidal activity was shown by PONNEEM formulation against the bollworm. The mortality rate was directly proportional to the concentration of insecticide, 15 µl/L concentration of PONNEEM have been found most toxic one and significantly affects the midgut of *Helicoverpa armigera* by cellular shrinkage, necrosis, disorganization of peritrophic membrane and epithelium, loss of secretary products, cytoplasmic vacuolization, nuclear pycnosis (a conglomeration of nuclei) and irregular nuclear arrangement (Packiam et al., 2013).

The 70% methanolic extract of *Artemisia annua* L (Sweet Annie), when mixed with 96% ethanolic extract of *Capsicum annuum* L (hot pepper) in the ratio 1:1, shows maximum insecticidal potential against *Pectinophora gossypiella* rather than each extract used individually. *Artemisia* is a rich source of terpenoids and sesquiterpene lactones have a strong odor and bitter taste (Cetkovic et al., 2004). Whereas *Capsicum annuum* is a rich source of vitamin C and other phytochemicals (Muchena 2009). It was estimated that essential oil extracted from the rhizome of *Cheilocostus speciosus* has a moderate toxic effect on *Helicoverpa armigera* but Zerumbone, α-humulene, and camphene are the three bioactive compound isolated from its essential oil show most promising insecticidal potential (Benelli et al., 2018).

CONCLUSIONS

Cotton is one of the major cash crops of India. The use of chemical insecticides may lead to some undesirable effects which can adversely affect the soil, water bodies, crops, and make pests insecticides resistance. So in this review, several herbal plants rich in bioactive compounds and also capable to fight against bollworm are discussed. These will be the best alternative of the synthetic insecticides and are easily available, cost-effective, and sustainable.

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Chapter 18

KRAS Mutations as A Predictive Marker of Non-Small Cell Lung Carcinoma

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ABSTRACT

Human pulmonary neoplasms can be divided into two major forms namely non-small cell cancers and small cell cancers. Non-small cell cancer has become the most important form of lung cancer for the last two decades. C-Ki-ras-2 gene has been implicated in the pathogenesis of human lung cancer. Although the precise molecular and cellular mechanisms that constitute the oncogenic effects of activating KRAS mutations remain incompletely understood, in vitro and animal model studies have showed that the gene is involved in regulation of genes of cell adhesion, cytokine signalling, cell survival, apoptosis and colon development. Recent studies have suggested that in non-small cell cancer most of the mutations are occurring in KRAS gene. In the present paper we have reviewed the role of KRAS mutations in pathogenesis of non-small cell lung cancer and have tried to explore the potential of KRAS mutations to be used as predictive biomarker for non small cell lung carcinoma.

Keywords: KRAS, Mutation, Lung Cancer.

INTRODUCTION

Lung cancer is one of the commonest cancers and the leading cause of cancer-related mortality worldwide (Jemal et al., 2011). At the beginning of the 21st century, lung cancer was considered to be rare (Nath et.al., 1935). But now it has reached the epidemic proportions. Lung cancer is the second most commonly diagnosed cancer worldwide, after breast cancer, and its incidence continues to grow. In 2020, an estimated 2.2 million new cases of lung cancer were diagnosed globally, accounting for approximately 11.4% of the global cancer burden. An estimated 1.8 million lung cancer deaths occurred in 2020. (World Health Organization, 2020). According to the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program, there were an estimated 229,000 new cases of lung cancer in the US in 2020, accounting for 12.7% of all cancer diagnoses. The current prevalence of 45.6/100,000 is down from a peak of 69.5/100,000 in 1992, largely due to smoking cessation. In many Western countries report a similar trend, developing nations such as China and the nations of the former Soviet Union have not seen similar success with smoking cessation and lung cancer incidence (Howlander et al., 2019). Thus the lung cancer is the leading cause of death in developed countries and has been rising in alarming (Weinstein et al., 2002). In India, it is the commonest and is the leading cause of cancer-related mortality in both men and women (Brambella et al. 2001; Hussain et al., 2010) and most lethal cancer among males accounting for 10.9% of all cancer cases and 13% of cancer-related mortality (Parkin et al., 2008).

According to National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) 2010 report, lung cancer is the second most common cancer worldwide, in both males (accounting 15% of all cancer) and females (accounting 14% of all cancer) and it is the most common cause of cancer death worldwide (Longo et al., 2012). Compared to the western population, epidemiological study reveals that there is an increased prevalence of lung cancer in the Indian population (Jagadish et al., 2009). In India, approximately 63,000 new lung cancer cases are reported each year (Ganesh et al., 2011). Lung cancer has been reported to be the second most common malignancy in an earlier hospital-based study from Kashmir valley (Shah Azra et al., 1990) the first being cancer of the upper gastrointestinal tract (Shah Azra et al., 1990; Dhar et al., 1993). However, a recent study reported that Srinagar, the summer capital of Jammu &Kashmir has the highest incidence of lung cancer among males in India (Koul et al., 2010).

Efforts have also been made to find out the total number of cancer cases in five metro cities of India (New Delhi, Bombay, Chennai, Bhopal and Bangalore) during 2008. These data have been plotted in Figure 1. It is clear from this Figure that Delhi has the highest number of total cancer cases among the five metropolitan cities studied. Total numbers of cancer patients reported in Delhi was 13920 having 6815 and 7105 males and females, respectively. Mumbai showed the second-highest number of cancer patients with 8505 total cases including 4170 and 4335 males and females, respectively. Bangalore occupied the third position with 2262 and 2998 male and female patients, respectively (total patients; 5250). Chennai stood at the fourth position having 2296 and 2528 as male and female cases; with a total number of 4824 cancer patients. Total cancer patients were low in Bhopal (1255) with 701 and 554 males and females, respectively. These trends of cancer patient distribution among discussed metropolitan cities may be due to different levels of environmental pollution, food habits, living style etc. Besides, the population density in these cities may also be a contributing factor to the increasing number of cancer patients.

Human pulmonary neoplasms can be subdivided into two major forms: non-small cell cancers and small cell cancers. Non–small cell lung cancer (NSCLC) accounts for 80% of all lung cancer cases. The non-small cell cancers include adenocarcinoma, squamous cell carcinomas, large cell carcinomas, and adenosquamous carcinomas. Adenocarcinoma has become the most important form of lung cancer over the past 20 years with both a relative and an absolute increase in incidence rates. During the last few years, improvement in the knowledge of lung cancer biology led to identification of molecular events crucial for tumor cell survival. Cancer cell survival might depend on the expression of a single-mutant oncogene according to a model called "oncogene addiction" (Weinstein et al., 2002; Fisher et al., 2001). In NSCLC a number of driving mutations have been identified, including Epidermal growth factor receptor (EGFR) mutations, KRAS mutations, HER2 mutations and EML4-ALK translocations. One gene implicated in the pathogenesis of human lung cancer is c-Ki-ras-2. The K-ras gene was originally identified by its presence in the Kirsten murine sarcoma virus, an acute transforming retrovirus, and subsequently identified in the genome of mammalian cells (Kirsten et al., 1967; Ellis et al., 1981). The KRAS gene encodes a 21-kDa small protein that is activated transiently as a response to extracellular stimuli or signals such as growth factors, cytokines, and hormones via cell surface receptors. On its activation, the KRAS protein also is capable of turning off the signalling pathway by catalyzing the hydrolysis of guanosine triphosphates (GTP) to guanosine diphosphates. The most common KRAS mutations in codons 12 and 13 are activation mutations, leading to continuous activation of downstream pathways.

The most frequently observed types of mutations in KRAS in all human cancers are G > A transition and G > T transversion. Although the precise molecular and cellular mechanisms that constitute the oncogenic effects of activating KRAS mutations remain incompletely understood, in vitro and animal studies showed that KRAS regulated genes involve cytokine signalling, cell adhesion, cell survival, and proliferation, apoptosis, and colon development. A human oncogenic c-Ki-ras-2 allele was first characterized in the Calu-1 lung carcinoma cell line and was determined to be activated by a point mutation in the first position of the twelfth codon. Subsequent investigations revealed activating K-ras point mutations in approximately one-third of human lung adenocarcinomas (Rodenhuis et al., 1987; Rodenhuis et al., 1988). These initial studies of ras mutations in human NSCLC reported mutations only at codon 12 of the K-ras gene and only in the adenocarcinoma subtype of NSCLC. K-ras mutations occurred more frequently in lung adenocarcinomas from smokers than from nonsmokers (Slebos et al., 1991). Recent analyses of the three ras genes (K-, N-, and H-) in large numbers of NSCLC specimens cell lines demonstrated mutations in 18-36% of all tumors examined, with 73-91% occurring in the K-ras gene (Suzuki et al., 1990; Mitsudomi et al., 1991). In patients with either early-stage or late-stage NSCLC, detection of a K-ras point mutation in the tumor was a negative prognostic factor (Slebos et al., 1990; Mitsudomi et al., 1991). Beagles experimentally exposed to cigarette smoke develop epithelial lesions in their trachea bronchial tree similar to the histological changes in airway morphology seen in human smokers (Auerbach et al., 1967).

RAS GENE

RAS genes, like many oncogenes, were originally discovered through the study of cancer-causing retroviruses in animals. RAS related investigations began in the early 1960s when researchers observed that a preparation of a mouse leukaemia virus, taken from a leukemic rat, induced sarcomas in rodents (Harvey et al., 1964). A similar type of retrovirus was identified in 1967, by serial passage of mouse leukaemia viruses through rats (Kirsten et al., 1967). These two rat sarcoma (ras) inducing retroviruses, named after their discoverers (Harvey and Kirsten, respectively), were later found to carry sequences derived from the rat genome (Ellis et al., 1981). In 1982, multiple groups reported molecular cloning of transforming genes from human cancer cell lines. These genes turned out to be the human homologs of rat Harvey (Ha- or H-) ras and Kirsten (Ki- or K-) ras (Shih et al., 1981; Goldfarb et al., 1982; Pulciani et al., 1982). Oncogenes are normal genes with an important role in the process of stimulation of controlled cellular proliferation. Mutations in these genes result in uncontrolled proliferation and development of cancer. RAS genes are expressed in normal cells, and are involved in controlled cell growth. Three distinct mutations of RAS have been identified: H-ras, N-ras, and K-ras. In general, colon, pan creas and lung carcinomas have mutations of KRAS, bladder tumors have HRAS mutations, and hematopoietic neoplasms are associated with NRAS mutations.. It is important to highlight that activation of RAS oncogene is only one component in the 'genetic cascade' of events that finally results in malignant transformation (Huncharek et al., 1999). Another ras family gene, neuroblastoma or N-ras, was identified a year later (Hall et al., 1983; Shimizu et al., 1983). Today, we know that the RAS genes encode a family of membrane-bound 21-kd guanosine triphosphate (GTP)-binding proteins that regulate cell growth, differentiation, and apoptosis by interacting with multiple effectors, including those in the MAPK (mitogen activated protein kinase), STAT (signal transducer and activator of transcription), and PI3K (phosphoinositide 3-kinase) signalling cascades (Downward et al., 1998; Vojtek et al., 1998; Shields et al., 2000). Activating mutations in the ras family of proto-oncogene's (H-, K-, and N-ras) occur in a large proportion of some human tumours (1). The three functional ras genes code for highly homologous A/r 21,000 guanine nucleotide-binding proteins, comprising 188 or 189 amino acids. The proteins are located on the inner aspect of the plasma membrane, and they appear to be involved in a process of mitogenic signal transduction that is regulated by GTP binding and hydrolysis on the M, 21,000 protein (2, 3). The oncogenic forms of M, protein RAS appear to constitutively activate the signal transduction pathway by being locked in the GTP form, either through mutations that impair intrinsic GTPase (amino acids 12, 13, and 61) or that increase the guanine nucleotide exchange rate (amino acids 116 to 119).

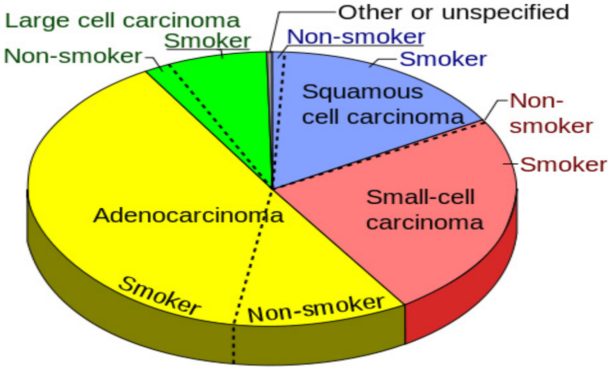
RAS AND NON–SMALL CELL LUNG CANCER

RAS proteins acquire transforming potential when an amino acid at position 12, 13, or 61 is replaced as a result of a point mutation in the gene (Bos et al., 1989). These mutations lead to forms of RAS that have impaired GTPase activity, leading to constitutive activation of RAS signalling. RAS mutations are found in approximately one-third of all human malignancies (Hall, 1983). KRAS accounts for most of the RAS mutations found in the majority of human malignancies. Notably, KRAS accounts for 90% of RAS mutations in lung adenocarcinomas, and approximately 97% of KRAS mutations in NSCLC involve codon 12 or 13 (Forbes et al., 2006). KRAS mutations are uncommon in lung squamous cell carcinomas (Suzuki et al., 1990; Brose et al., 2002). K-RAS mutations incidence varies among different ethnic groups, with lower frequency observed among Asian population and higher frequency among African Americans compared to white Caucasians (Riely et al., 2008). Very recently K-RAS mutations have been detected in a significant proportion of never smoker NSCLC patients, with an incidence up to 15% (Riely et al., 2008).

KRAS MUTATIONS AND CIGARETTE SMOKING IN NSCLC

Since KRAS mutations are common in NSCLC, and since cigarette smoking is a frequent cause of NSCLC, KRAS mutations have been widely hypothesized to be related to direct tobacco exposure. However, analyses attempting to associate smoking history with KRAS mutations have suffered from an absence of detailed patient smoking histories (i.e., the intensity of smoking, duration of smoking), and most reports have studied only relatively small numbers of never-smokers with NSCLC (defined as those individuals who smoked, 100 cigarettes in a lifetime) (Pao et al., 2004). Moreover, despite high frequencies of KRAS mutations in colorectal cancer, colon cancer has not been associated with smoking. Recently, we evaluated the frequency of KRAS mutations in lung adeno carcinomas from nearly 500 patients, of whom 17% had never smoked cigarettes (Riely et al., 2005). We noted that KRAS mutations occurred in 22% of the overall population and in 15% of lung adenocarcinomas from never-smokers.

KRAS transition mutations (G/A) were more common in patients who had never smoked cigarettes. In contrast, transversion mutations (G/TorG/C) were more common in former/current smokers. These data suggest that while some mutations in KRAS are associated with cigarette smoking, KRAS mutations do occur in never-smokers. Thus, unlike EGFR mutations, which occur more frequently in tumours from never-smokers (Pham et al., 2006) KRAS tumour status cannot be easily predicted based on smoking history alone.



KRAS MUTATIONS AS A PREDICTIVE MARKER OF THERAPY FOR NSCLC

Data are emerging that KRAS mutation status may assist in the prediction of clinical outcomes for patients receiving various treatments. One example exists in the adjuvant setting. Since only approximately 10% of patients who receive adjuvant chemotherapy for NSCLC derive benefit (Pignon et al., 2008), and accurate predictive marker could decrease the frequency of administration of chemotherapy to patients who are unlikely to benefit. Recently, the national cancer institute of Canada reported a pre-planned KRAS mutational analysis from a prospective, randomized trial allocating patients with resected stage IB–II NSCLC to receive adjuvant cisplatin/vinorelbine or observation (Tsao et al., 2007; Winton et al., 2005).

KRAS MUTATION AND RESISTANCE TO ERLOTINIB

KRAS mutation and resistance to erlotinib EGFR and KRAS mutations are considered to be mutually exclusive. Non-Small Lung Cancer patients with KRAS mutations have primary resistance to erlotinib (Kris et al., 2005). Again this may be an example of a individualized treatment decision on the basis of biomarkers. Patients with an EGFR mutation but not a KRAS mutation have a high probability of response to erlotinib. Those tumor cells that are positive for a KRAS mutation and negative for the EGFR mutation are resistant to erlotinib; thus, this costly treatment in this group of patient should be not used

KRAS MUTATION AND PERSONALIZED MEDICINE

Thus in current scenario the challenge of clinical medicine is to translate very complex scientific data into the clinical setting so that medical management can be better guided (Weber et al., 2005). A concept of personalized medicine becomes very essential in clinical oncology. Our overall goal is to individualize treatment depending on both cancer and patient features. This personalized or tailored therapy may improve outcomes. Physicians can avail now opportunity to use biomarkers to personalize therapeutic options. As discussed in above KRAS mutation in non-small Lung Cancer is also associated with resistance to erlotinib. Hence, a physician should not use this very expensive drug in the treatment of Non-Small Lung Cancer with a KRAS mutation.

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Chapter 19

Impact of Various Diseases on Heart Related Diseases

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ABSTRACT

Cardiovascular diseases are diseases of the heart and blood vessels, namely coronary artery disease (CAD), heart attack, heart failure, cardiomyopathy, arrhythmia, angina (cardiac chest pain), and rheumatic heart disease etc. CAD is a disease of the blood vessels of the heart that causes heart attacks. Cardiovascular diseases are occurred due to the impact of other diseases on heart like diabetics, hypertension, respiratory disorder, renal disorder, anaemia, gastro-intestinal disorder, cholesterol, thyroidism etc. Diabetes is the most common disease showed major bearing on heart accounting 75%. Next to diabetics, hypertension exhibited 42%, thyroid 20%, cholesterol 15%, renal disorder 14%, anaemia 13% and gastro-intestinal disorder 9%. All these diseases have their own impact on heart even loss of life. Sedentary life style, diet, ageing, stress, tension and hereditary were found to the main causes of various heart diseases.

Keywords: Heart Diseases, CAD, Heart Attack, Heart Failure, Diabetese, Hypertension, Cholesterol.

INTRODUCTION

Integration of body, mind and soul results in harmony within one self. This harmony enables people to experience sound health with good immune system that fight against pathogens and keep body free from all diseases. Heart is the center of the circulatory system which supplies the body with blood and necessary materials through a series of arteries and veins.

Healthy arteries insides are smooth and elastic and they allow the body to respond well to periods of stress and changes in the blood pressure, while still continuing to supply the organs with the oxygen and nutrition they need. Heart can be affected by various other diseases specially the fat deposits called plaque formed inside the arteries that narrow down the walls of arteries and cause chest pain during exercise or other stress on the heart leading to heart attack. Now a days as many people are prone to get heart related diseases, a study was undertaken to identify the causes for heart attacks.

MATERIALS AND METHODS

For our study we choose Ramesh Hospital, the most famous Multi Specialty Hospital, Vijayawada, Krishna district, Andhra Pradesh, India. The primary data was collected personally by interviewing 200 patients. We witnessed the analysis of patients' blood, understood the severity of heart diseases and their effect on human health. Different parameters involved in analysis of heart diseases were troponin, blood gases, electrolyte levels, coagulation analyzers and haemetoposises. The secondary data collection was done through OER.

RESULTS AND DISCUSSIONS

The number of people affected by heart diseases increased with age in both men and women. This is due to the other diseases which influenced the hear diseases. There are many types of diseases which have impact on heart such as diabetes, hypertension, cholesterol, anaemia, hepatic disorder, respiratory disorders, gastro – intestinal disorders etc., that result in heart diseases. Out of 200 patients 35% were affected with Coronary Artery Disease, 5% with Arrhythmia and Cardiomyopathy, 6% with congenital heart disease and Myocardial Infraction, 23% with Heart Attack and 20% with Heart failure in Fig. 1 and Table 1.

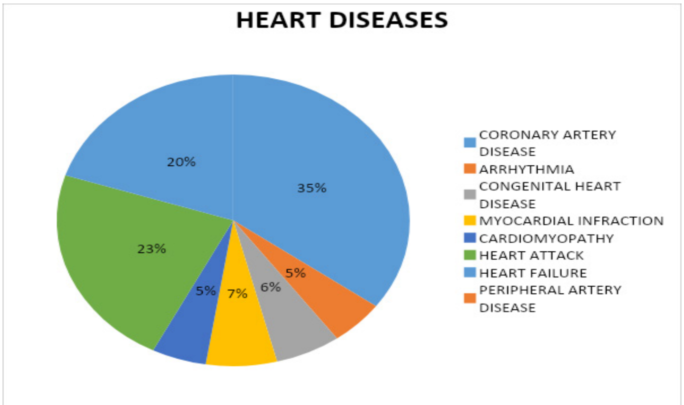

Fig. 1. Percentage of Heart Diseases.

Heart diseases were found to be more between the age group of 60 – 70 which is followed by age group 50 -60 and 40 – 50. The following fig-2 represents the age group affected by different heart diseases. Out of 200 patients 58 between the age group of 60-70 had diabetics, hypertension, thyroidism, which were at high level. This had severe impact on heart leading to coronary artery disease.

Table 1. Heart Diseases and other associated diseases affecting heart.

S. No	Heart Diseases	Other Diseases Affecting Heart	No. of Patients
1.	Coronary artery disease	Hepatic disorders, renal disorders, respiratory disorder, hypertension, domestic violence.	70 patients
2.	Arrhythmia	Thyroidism, diabetes, hypertension, cholesterol.	10 patients
3.	Congenital heart disease	Cholesterol, anemia, diabetes, hypertension.	12 patients
4.	Myocardial infraction	Diabetes, hypertension, cholesterol, respiratory disorders.	13 patients
5.	Cardiomyopathy	Diabetes, anemia, cholesterol, hypertension.	10 patients
6.	Heart attack	Diabetes, hypertension, thyroidism, gastro-intestinal disorder.	45 patients
7.	Heart failure	Diabetes, thyroidism, cholesterol, respiratory disorder, renal disorder, hypertension.	40 patients

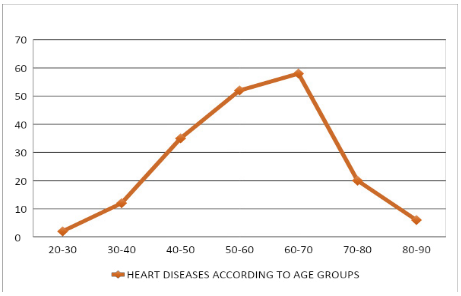

Fig. 2. Heart diseases at different age groups.

Coronary Artery Disease (CAD)

CAD caused by various diseases were as follow: Diabetics 100%, Hypertension 50%, Thyroid 20%, Renal disorder 10%, Respiratory disorder 8% and Hepatic disorder 5% (Fig. 3). Coronary artery disease (CAD) is a major determinant of the long-term prognosis among patients with diabetes mellitus (DM). DM is followed by age group 50-60 and 40–50. CAD is the main cause of death in both type 1 and type 2 DM (Berry, et al., 2007).

According to Doron and Elazer (2014), DM is associated with a 2 to 4 fold increased mortality risk from heart disease. Furthermore, in patients with DM there is an increased mortality after MI, and worse overall prognosis with CAD. Preis et al. (2009) observed that among adults with DM there was a prevalence of 75% to 85% of hypertension, 70% to 80% for elevated LDL, and 60% to 70% for obesity. Ochsner (2014) stated that the first 3 risk factors identified to promote CHD were hypertension, hypercholesterolemia, and left ventricular hypertrophy (LVH). These findings go in alliance with our results.

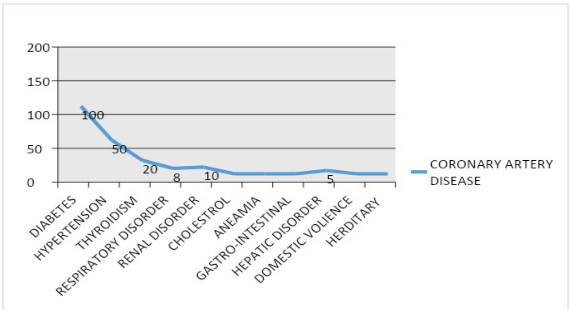

Fig. 3. Coronary artery disease.

Dawber et al. (1959) observed that hypertension was one of the most traditional risk factors that have been consistently correlated with increased probability of developing CAD in various populations. The epidemiological studies supported by experimental evidence postulating that hypertension predisposes to atherosclerosis through a shared synergistic mechanism involving inflammation and oxidative stress in the arterial wall (Chen et al., 2009; O'Keefe et al., 2009; Chen et al., 2010).

Arrhythmias

The people affected by arrhythmias were 20% (Fig. 4). The other diseases such as diabetes, cholesterol, hypertension, thyroidism too had a severe impact on arrhythmia. This is the evidenced from the graph given below.

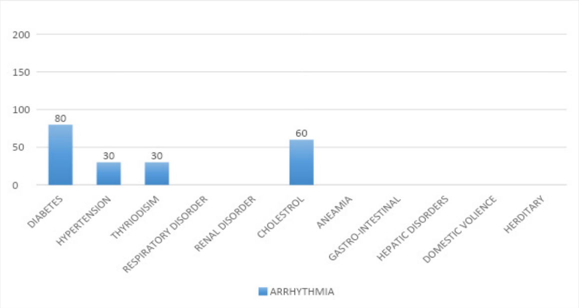

Fig. 4. Reasons for arrhythmia.

According to Movahed et al. (2015) chronic hyperglycemia of type 2 diabetes mellitus (T2DM) caused long-term damage to the heart resulting in coronary artery disease (CAD), myocardial infarction (MI), congestive heart failure (CHF), and sudden death from arrhythmias. Previous studies have shown that ventricular arrhythmias are frequent in T2DM.

Heart Attack

Next to CAD, heart attack recorded for 20%. Diabetes was found to be the main reason for heart attacks which was found to be 124%. Heart attack also called as myocardial infarction occurs when the flow of blood to the heart is blocked. The blockage is most often a buildup of fat, cholesterol and other substances, which form a plaque in the arteries that feed the heart (coronary arteries) which can be fatal, but proper treatment over time showed improvement in the health of the patients. In our study the effect of other diseases on heart attack was in order of Diabetes >Thyroidism> Gastro-Intestinal disorder > Hypertension > Renal disorder (Fig. 5). 30% of the people were affected by heart attack because of hypothyroidism followed by gastrointestinal disorder and the least impact was due to hereditary.

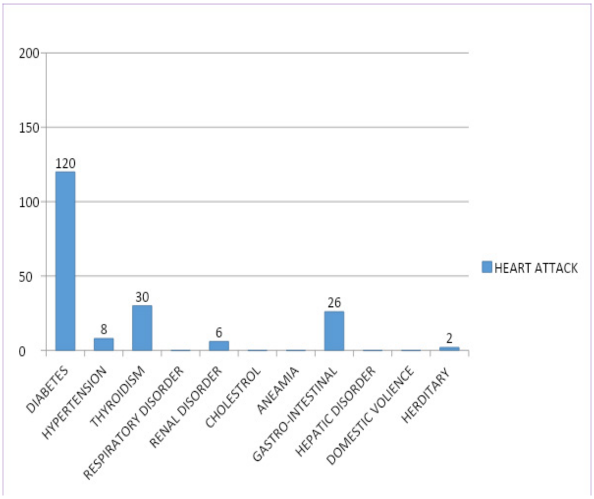

Fig. 5. The effect ofother diseases in heart attack.

There is a correlation between our findings and the findings of Dedov et al. (2015) who stated that there is a close link between DM and cardiovascular disease, which is the most prevalent cause of morbidity and mortality in diabetic patients. About 60% of patients are diagnosed with both cardiovascular disease and DM2. It is known that the risk of development of acute myocardial infarction in patients with type 2 DM is 6–10 times higher than in a whole population. Louis Potier et at. (2020) observed that diabetes is associated with both an increased risk of all-cause death, mainly driven by cardiovascular mortality, and poorer outcomes after acute myocardial infarction (AMI).

Patricia et al. (2017) notified that hypothyroidism is a commonly encountered clinical condition with variable prevalence. It has profound effects on cardiac function that can impact cardiac contractility, vascular resistance, blood pressure, and heart rhythm. Thyroid hormones have a variety of effects on the cardiovascular system that can greatly impact cardiac function.

Madalena von Hafe et al. (2019) notified that thyroid hormones have a central role in cardiovascular homeostasis. In myocardium, these hormones stimulate both diastolic myocardial relaxation and systolic myocardial contraction; have a pro-angiogenic effect and an important role in extracellular matrix maintenance. Thyroid hormones modulate cardiac mitochondrial function. Dysfunction of thyroid axis impairs myocardial bioenergetics status.

Heart Failure

After heart attack, the next heart diseases were found to be heart failure which was observed in 45 out of 200 patients at the age group of 50-60yrs. It was caused by diabetics 82%, hypertension 50%, thyroidisim 36%, cholesterol 24% which were at high levels and renal disorder 6% and respiratory disorders 4% were at low level. In this diabetics and hypertension were the main reasons to cause heart failure. Fig. 6 showed the order of various diseases and their influence on the heart that led to heart failure. Out of 200 patients 20 were affected with congenital heart disease and they were at the age group of 40-50yrs. The main causes for congenital heart disease were hereditary 65%, diabetes 40%, hypertension 35%, cholesterol 30% and anaemia 30%, they were found to be at great levels. In congenital heart diseases hereditary and diabetes played major roles to influence the heart to cause congenital heart disease. They are in order of priority: Hereditary > Diabetes > Hypertension > Cholesterol >Anemia.

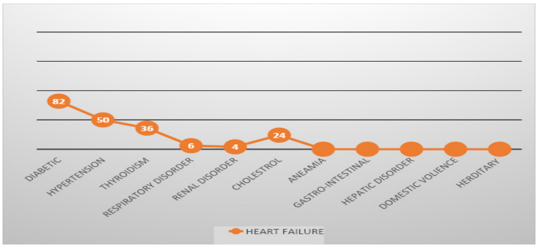

Fig. 6. Various diseases and their influence on heart failure.

Cardiomyopathy was observed in 15 patients out of 200 at the age group of 70-80 yrs. The reasons for this particular disease were diabetes 110%, hypertension 46%, cholesterol 34%, and anaemia 5%. Through fig - 6 we can observe the diseases that affect heart are as follows: Diabetes > Hypertension >Thyroidism> Cholesterol > Respiratory disorder > Renal disorder. Coughlin et al. (2006) observed that heart failure was associated with diabetes mellitus. Within populations of patients with heart failure, diabetes is twice as common as in matched controls.

CONCLUSIONS

Cardiovascular diseases are diseases of the heart and blood vessels, such as coronary artery disease (CAD), heart attack, heart failure, cardiomyopathy, arrhythmia, angina (cardiac chest pain), and rheumatic heart disease etc. CAD is a disease of the blood vessels of the heart that causes heart attacks. Cardiovascular diseases are occurred due to the impact of other diseases on heart like diabetics, hypertension, respiratory disorder, renal disorder, anaemia, gastro-intestinal disorder, cholesterol, thyroidism etc. Diabetics is the most common disease showed major bearing on heart accounting 75%. Next to diabetics, hypertension exhibited 42%, thyroid 20%, cholesterol 15%, renal disorder 14%, anaemia 13% and gastro-intestinal disorder 9%. All these diseases have their own impact on heart even loss of life. These heart diseases associate with other disease are in order of priority: diabetes > hypertension > thyroid > cholesterol > renal disorder > anaemia > gastro-intestinal. From the collected data we found that among 200 patients 58 were affected with coronary artery disease between the age group of 60-70yrs. They were found to be highly diabetic. Diabetes led to other heart diseases like heart attack and heart failure. Hypertension, cholesterol and thyroidism too caused various heart diseases. Through our analysis we discovered that other diseases affect heart due to various factors such as sedentary life style, diet, ageing, stress, tension and hereditary etc. Hence we need to create awareness among the people to have a healthy heart by having regular exercise, control over diet, enough sleep and avoid tensions.

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Abstracts

Abst-1

EDX Microanalysis, Rt PCR, the Noval Diagnostic Tools and Remedial Procedures for Noval Virulent Pathogens

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Abstract

The issues that have perturbed mankind today have been to search the methods and techniques to apply, firstly, for diagnostics of the faster spreading anonymous disease elements, as well as secondly, the urge to find tools for alleviation of diseases as serious as having the potential of being fatal to humans. Energy Dispersive X-Ray Microanalysis being a revolutionary introduction to significant methods of diagnostics of parasitic organisms to the extent of analysis of their role as Accumulator Bioindicators, has come a long way as an extension of scanning electron microscopy interpretations. This could well be a tool to assist in the differentiation of endoparasitic nematode taxa harboured by marine vis-à-vis freshwater riverine ecosystems. Noval Corona Virus, the agent of COVID-19 disease, that has proved fatal to humans devastatingly, has been a hazardous organism that changed its form frequently due to different site oriented mutations as well as when it encountered variable populations world over. Its latest fatal form has been its mutant, AY 2.1 due to which China and Russia have been at the forefront of being closed down recently. The trauma caused gave varied experience to the detriment of public health in the whole world. Vaccines have received recognition of being the only safer remedial measure. A small piece of the DNA is taken from the disease-causing bacterium or virus, for the preparation of a Recombinant Vaccine. The particular gene is incorporated into plasmid or a carrier vehicle which enabled production of large quantities of well-defined proteins, which were then used as vaccines. Examples: Hepatitis B vaccine, and Human papilloma virus (HPV) vaccine. Recombinant protein vaccines can be divided into recombinant S vaccines, recombinant RBD vaccines and virus like particle (VLP) vaccines. These recombinant proteins can be expressed in different expression systems including insect cells, mammalian cells, yeast and plant. A small group of "memory" B-cells and T-cells remain in the body thus could quickly initiate a strong immune response, by producing antibodies, and helping the production of killer T-cells or antibodies, respectively. The next time the real pathogen entered body, the immune system remembered it & mounted a much larger, quicker response than it would have, if the individual had never received the vaccine.

Keywords: Microanalysis, Endoparasitic, HPV, VLP.

Abst-2

Antimicrobial Susceptibility of Some Bacteria Associated with Respiratory Tract Infection among Patient Attending Yusuf Maitama Sule University Teaching Hospital, Kano

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Abstract

Respiratory tract infections have been known to be a significant cause for morbidity and mortality, it is of concern since many years. The current study isolated and identified some bacterial pathogens in respiratory tract and determined their susceptibility to some antibiotics among patients attending Yusuf Maitama Sule University teaching hospital, Kano state. A total of 50 sputum were collected between January 2019 and December 2020 and inoculated onto MacConkey agar and chocolate agar then incubated at 37°C for 24hours. Of the 50 sputum sample tested, 96% (n=48) of the specimen were positive cultures with the most predominant being *Staphylococcus aureus* 60.42% (n=28) and *Streptococcus pneumoniae* 39.58% (n=19). Most of the isolates were resistance to most of the commonly used antibiotics. Higher susceptibility was recorded for ceftriaxone followed by ofloxacine while higher resistance was recorded for cloxacillin followed by erythromycin and augumentine. It is concluded that people at aged > 80 are at higher risk to respiratory tract infection. However, antibiotics resistance is alarming and brings to light the timely and suitable diagnosis of the common bacteria causing RTI and proper administration best on susceptibility test.

Keywords: Susceptibility, Respiratory Tract, *Staphylococcus aureus, Streptococcus pneumoniae.*

Abst-3

Green Synthesis of Metal and Metal Oxides Nanoparticles Using Plant Extract

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Abstract

Nanoparticles have enormous importance in a wide variety of disciplinesdue to their specific physical and chemical properties. A number of different physical and chemical approaches are being used to synthesize nanoparticles. However, there are also certain disadvantages associated with these methods, such as the adsorption of hazardous toxins on the surface of material, high capital investment, high manufacturing energy demand, etc., which makes their effective implementation almost impossible. An alternative method of synthesizing nanoparticles to avoid aforementioned disadvantages is by using microorganisms (bacteria, fungi, virus, yeast) and different parts of plants (root, shoot, leaves, gums, flowers, barks, stem) under aqueous conditions. Compared to microorganisms, plant-mediated synthesis of nanoparticles has become increasingly favour owing to its low capital investment, faster reaction rate, eco-friendly nature and rich diversity of plants. Noble metals and their oxides are used to synthesize nanoparticles, due to their enormous potential applications. In a single step green synthesis process, the phytochemical constituents present in plant extracts are used to reduce metal salts into nanoparticles.The biosynthesized metal and metal oxides nanoparticles are generally characterised by using several techniques such as UV-Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, Scanning Electron Microscopy (SEM) analysis, Transmission Electron Microscopy (TEM) analysis, X-Ray Diffraction (XRD) analysis. These techniques provide the information about stability, size, shape, morphology, elemental composition, size distribution and crystal structure of metal and metal oxides nanoparticles.

Keywords: Nanoparticles, Toxins, Microorganisms, Plant-mediated.

Abst-4

Acute Toxicity Evaluation of Zinc Oxide Nanoparticles on Marine Invertebrate *(Donax faba)*

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Abstract

The main goal of the research was to investigate the effect of zinc oxide nanoparticleson marine invertebrate, *Donax faba.* Zinc oxides are known for toxicity on longer exposure to microbial communities, aquatic organisms, and mostly to marine biota but there is very little information available regarding the toxicity of zinc oxide nanoparticlesin aqueous media. The acute toxicity assay was conducted on adult of *Donax faba*. The concentrations were in range of 0.125 to 2.0 (mg/L). The Statistical analysis revealed that the mean LC 50 values were significant on marine invertebrate after exposure of five different increasing concentrations on to 96 h. The histopathological examination of collected tissues confirmed its damage with increased concentration. The other findings of biomarker enzyme were summarized and the result confirmed that the toxicity could be mainly attributed to the Zn ions, confirming that the dissolution processes play a crucial role in the toxicity of the ZnO NPs.

Keywords: Nanotechnology, *Donax faba*, zinc oxide nanoparticles, Toxicity.

Abst-5

Studies on Haematobiochemical Parameters of Freshwater Fish *Channa striatus* Naturally Infected with Cestode Parasites

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Abstract

Fishes have been extensively used as a protein-rich diet for human consumption in Indiaand thus, contribute a lot to its economy. Fishes are infected with arrays of parasites, where these parasites alter host's swimming ability, weight loss, inertia, hemorrhage, respiratory difficulty,burning in the gills and focal necrosis ultimately the growth is retarded reducing their marketvalue or may cause death in small fish. Blood parameters can be useful in measuring the physiological disorders in the parasitized fish and provide information to reach conclusions regarding the diseases and the level of damage in the host. Therefore, the changes associated with haematological parameters due to various parasites establish a database and allow precise diagnosis guiding the implementations of treatment or preventive measures which are indispensable in fish farming and the fish industry (Roberts, 1981). The analysis of blood indices has proven to be a valuable approach for analyzing thehealth status of fish as these indices provide reliable information on metabolic disorders,deficiencies and chronic stress status before they are present in a clinical setting (Bahmani et al., 2001). It also acts as a pathological reflector of the whole body. Hence, the haematological parameters are important in diagnosing the functional status of the fish (host) infected byparasites. The present investigation was performed to analyze alterations in selected haemato-biochemical parameters of freshwater fish *Channa striatus* that is naturally infected with cestodeparasite *Senga orientalis* sp. Out of 24 organisms under study, 16 were infected with the cestode parasites. A significant increase in the size of RBC and the number of WBC was recorded; however reduction in the count of RBC, Hb, PCV, MCV in infected *Channa striatus* compared with the control was evident. Significantly, higher serum cholesterol level and lower blood glucose level were recorded in infected host over normal host. The haematological parameters ofthe infected fish *Channa striatus* show high infection cause macrocytic anaemia, lymphocytosisdue to deficiency of related factors.

Keywords: Cestode Infection, *Channa striatus*, Haematobiochemical Parameters, Senga.

Abst-6

Global Warming, Biodiversity Conservation with Special Reference to Ajmer

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Abstract

Ajmer is located in the center of Rajasthan (INDIA) between 25^0 38“ and 26^0 58“ north Latitude and 73^0 54“ and 75^0 22” east longitude covering a geographical area of about 8481sq km hemmed in all sides by Aravalli hills . About 7 miles from the city is Pushkar lakecreated by the touch of Lord Brahma. The Dargah of khawaja Moinuddin chisti is holiest shrinenext to Mecca in the world. Ajmer has hot dry summer and cold bracing winter. The winter extends from November to February and summer extends from March to June followed byrainy season till mid September. The temperature varies from 2 ^{0}C in winter and 49 ^{0}C insummer. The normal annual rainfall is 527.3 mm. The total population of the district is 2180526 persons. Around 5.56 % of total area available for land utilization is covered underforest. Deserts are arid regions which receive less than 10 inches (25 cm) of precipitationannually or rate of evaporation is greater than rate of precipitation.Rajasthan State Government has declared number of areas as protected. Global warming is increased earth temperature due to increase use of fossil fuel; anthropogenic activities; heat catching GHGs (Green house gases)

The government of India has started a centrally sponsoredscheme under the title of DDP (Desert Development Programe) based on watershed management with the objective to check spreading of desert and improve life of people indesert. Ajmer is abode of certain flora and fauna that are particularly endemic to semi-arid andare specially adapted to survive in the dry waterless region of the state.

Keywords: Faunal Diversity, Mammals, Threats, Conservation, Aravallis, Ajmer.

Abst-7

A Kinetic Approach on Biodegradation of Commercial Dyes through Aqueous Extract of Marine Macroalgae: An Environmental Health Hazard Control

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Abstract

The present findings were focused on investigation of marine macroalgae as potential biological absorbing material for common commercial dyes used in batch culture procedure. All the seaweeds were compared with the standard dye solution for their dye adsorbing ability.Results indicated that, all the seaweeds vary in their dye adsorbing capacity to the individual dyes.. In the present study, *Padina gymnsospora* showed maximum removal of dyes such asgreen color dye, malachite green and methyl violet color. *Padina terastomatica* showed adsorbing ability for maximum removal of red color dye, methyl yellow and methyl orange whereas *Acanthophora* sp. Removes blue color dye, congo red and methyl blue dyes. In the present study, it was indicated that like any other biological system, marine macroalgae can alsobe used effectively in removal of dyes form waste waters to control environmental health hazard.

Keywords: Macroalgae, Biosorption, Dye, Environmental Health Hazard.

Abst-8

Entomopathogenic Nematodes: A Reliable Alternative Against Insecticides

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Abstract

India is an agrarian society where agriculture is the main occupation. Emergence of green revolution in India raised food grains tremendously but due to excessive utility of chemicals like insecticides and pesticides routed new troubles. These pesticides penetrate into food chain and have been reported from milk, butter, meat, fish, egg, mother's milk and even human fats. This raises a serious concern regarding human health and environment. In this scenario Entomopathogenic nematodes which are natural enemies of insect pest is a better and reliable alternative. They feed on various larvae instars and have a wide host range like *Spodoptera litura, Plutella xylostella, Cydia pomonella, Thaumatotibia leucotreta, Phlyctinus callosusetc.* Two families Steinernematidae and Heterorhabditidae possess symbiotic bacteria *Xenorhabdus* and *Photorhabdus* respectively in their gut. The infective juveniles enter into the larvae where it releases the symbiont to kill the host within 48 hours. Such effective, cheap, eco-friendly solution for insect control is much better than the chemical control. Although mortality rate varies with dose and time. They are safe to handle, easy to culture and available as formulations in market. The need of the hour is to popularize them, educate and encourage farmers to prefer them instead of chemicals. Their application in integrated pest management can prove a much beneficial tool for sustainable agriculture.

Keywords: Entomopathogenic, Larvae Instars, Steinernematidae, Heterorhabditidae.

Abst-9

Functional Nanoparticles Coated Surfaces as Viral Entry Inhibitor to Combat COVID-19

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Abstract

The rapid transmission of viruses responsible for various epidemic and pandemic on a global scale and posing extraordinary human risk including death. For instance, the current ongoing worldwide COVID-19 pandemic caused by novel coronavirus (SARS-CoV-2), is a communicaible disease which is transmitted via touching the contaminated surfcaes and then nosocomial route. Considering the threat to public health, antiviral coatings are essential in order to prevent or slowdown of viruses rapid transmisssion. In this prospective, In the recent past, various nanomaterials based on carbon and metals have been modified in the form of enginnered nanomaterials with effective anviral efficacy against specific viruses. In this review, various recent fundamental aspects for fabrication of engineeered nanoparticles coated surfaces and their antiviral efficacy to inhibit viral transmission along with related conceptual mechanisms are discuused.

Keywords: Engineered Nanomaterials, Nanostructured Coatings, COVID-19, Antiviral efficacy.

Abst-10

SARS-CoV-2 Key Risk Factors and Therapeutic Advances: A New Medical Paradigm in the Strategic Fight against the COVID-19 Pandemic

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Abstract

People who were at high risk of morbidity and mortality as a result of SARS-CoV-2 infection and who improved or had a moderate clinical outcome after taking doxycycline were studied in this study. Despite its safety, we would not advise taking doxycycline to treat COVID-19+ persons unless they are under the care and supervision of a physician. The Indian Council of Medical Research is now evaluating the benefits of ivermectin and doxycycline as potential COVID-19 therapies. Azithromycin may have antifibrotic and proapoptotic actions on primary fibroblasts once fibrosis has occurred. As a result, in the late fibroproliferative-fibrotic phase of ARDS, COVID-19 azithromycin may reduce lung fibrosis. In non-allergic chronic rhinitis with goblet cell metaplasia, intranasally administered N-acetylcysteine has been demonstrated to lower neutrophils, lymphocytes, goblet cells, bacterial count, turbinate hypertrophy, nasal symptoms, and rhinorrhea. The benefits are attributed to the action of N-mucolytic acetylcysteine, its capacity to restore surface ciliary activity at the nasal epithelium, and the management of the inflammatory response, which is a critical component of the nasal mucosa's immunological defence mechanism. A nasal douche containing flunisolide and N-acetylcysteine has been linked to a less stuffy nose, reduced severity of symptoms and rhino sinus signs as measured by endoscopy, improved cytological grading of neutrophil and eosinophil cells, fewer exacerbations, and increased mucociliary motility in patients with acute recurrent rhinosinusitis. Montelukast, a cysteinyl leukotriene receptor antagonist, may be used to treat COVID-19 infection, and the potential for delaying the progression of severe COVID-19 infection will be investigated. In order to improve this cutting-edge therapy procedure, we need information from the COVID-19 community, such as how to better safeguard our patients who are already vulnerable because to corona. While information has been openly exchanged throughout the pandemic, results from ongoing and future clinical trials are still needed to better understand how different pharmaceutical medications interact in the setting of COVID-19 infections.

Keywords: SARS-CoV-2, Ivermectin, Doxycycline, Azithromycin, N-acetylcysteine, Montelukast.

Abst-11

Mucormycosis (zygomycosis) Correlated with Coronavirus Infections (SARS-CoV-2): A Dynamic Assemblages, Pathogenesis, Treatment, and Prevalence

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Abstract

Invasive fungal infection (IFI), such as mucormycosis, is caused by a variety of saprophytic fungi and is common in patients with a variety of co-morbidities, such as diabetes and organ transplantation. It has only been seen in a few cases and has proven to be a lethal fungal infection. The second wave of SARS-CoV-2 epidemics indicated a spike in bacterial and fungal co-infections in SARS-CoV-2 patients, such as pulmonary aspergillosis associated with SARS-CoV-2. Individuals recovering from SARS-CoV-2 who undergone a fresh heart transplant for the management of severe heart failure were among those featured in this review paper. After two months, several reported cases experienced upper respiratory and systemic symptoms in the transplanted heart and tested positive for SARS-CoV-2 by RT-PCR. After three months of recovery from SARS-CoV-2, one individual developed cutaneous mucormycosis. This review paper also described the proper reported mucormycosis cases prevailing in SARS-CoV-2 patients and demonstrated the significant mechanism of action by which SARS-CoV-2 can eventually incline to invasive fungal infections in patients suffering from diabetes mellitus, neutropenia, and under the inaccurate dosage regimen of corticosteroids for managing the severe case of SARS-CoV-2. Mucormycosis, which is common in SARS-CoV-2 patients, should be studied to see if there is a link between the two disorders. Infected patients with SARS-CoV-2 should be monitored for mucormycosis and treated appropriately. Amphotericin-B deoxycholate, an antifungal medication, is the first line of treatment, and liposomal dose formulations are recommended due to less nephrotoxicity. Because certain patients are intolerant to amphotericin liposomal preparation, posaconazole should be evaluated clinically as a viable alternative treatment option. Novel inhibitors of iron uptake in *R. oryzae* could disrupt the fungus' ability to enforce angio-invasive growth. This critical role of iron internalisation during *R. oryzae* infection adds to the confidence in using innovative iron chelators like deferasirox and lipid polyenes like caspofungin to improve mucormycosis patient survival.

Keywords: COVID-19, Mucormycosis, SARS-CoV-2.

Abst-12

Diversity and Conservation Status of Fishes Inhabiting Chittaura Jheel, Bahraich, U.P.

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Abstract

In order to record diversity and conservation status of fishes inhabiting ChittauraJheel (Bahraich), Uttar Pradesh, regular monthly surveys werte conducted during October, 2020 to September, 2021. During this study period, 38 fish species belonging to 28 genera, 14 families and 7 orders have been identified. The order Cypriniformes was found the dominated order with 15 species(39.47%) followed by Siluriformes 10 species (26.31%), Perciformes 4 species(10.52%), Ophiocephaliformes 4 species (10.52%), Synbranchiformes 2 species (5.26%), Osteoglossiformes 2 species (5.26%) and Clupiformes 1 species (2.63 %), The present investigation showed that the wetland, ChittauraJheel possesses rich fish biodiversity but proper conservation measures are required to maintain sustainability and richness of the fish species diversity of that wetland of U.P. According to IUCN, 30 were enlisted as Least Concern (LC), 2 species as near endangered (NE), 3 species as near threatened (NT), 2 listed as Endangered (EN) and 1 species was listed as Vulnerable (VU). There is a need of conservation of fish diversity of this natural wetland. The pressure is increasing day by day due to increasing population, leading to loss of fish diversity hence identifying the problem and making a better management plan is the way for conservation of the fish diversity of the Chittaura Jheel, a wetland of Bahraich district of Uttar Pradesh.

Keywords: Fish diversity, Chittaura Jheel, Conservation status.

Abst-13

Antiviral Compounds from Various Plant Species

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Abstract

Antiviral therapy is used to treat viral infections; however, the outcomes have been poor. Antiviral-resistant refractory viral infections are a serious public health concern. Interferon and vaccine therapy are no longer the primary alternatives for viral hepatitis due to the reemergence of the hepatitis C virus. Existing therapy techniques must be improved, and innovative antiviral drugs must be identified to address refractory viral illnesses, due to the increased occurrence of viral infections, particularly resistant viral strains. It is widely recognised that medicinal plant heritage is a gift from nature, rich in resources for the treatment of metabolic and infectious disorders. The goals of this review are to compile the facts and draw conclusions about medicinal plants' therapeutic potential in the eradication and management of various viral diseases, such as influenza, human immunodeficiency virus (HIV), herpes simplex virus (HSV), hepatitis, and coxsackievirus infections, as shown in clinical studies. Antiviral activities have been discovered in hundreds of plant extracts. Only 36 families' data from in vitro and in vivo studies met the review's inclusion requirements, nevertheless. The antiviral potential of medicinal plants has been evaluated based on findings from a scientific literature review focusing on putative therapeutic benefits of medicinal plants on HIV, HSV, influenza, hepatitis, and coxsackievirus in animal models.

Keywords: HIV, HSV, Influenza, Hepatitis.

Abst-14

SARS-CoV-2: Zoonosis or Emerging Infectious Disease

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Abstract

The World Health Organization defines a zoonosis as any infection naturally transmissible from vertebrate animals to humans. The pandemic of Coronavirus disease (COVID-19) caused by SARS-CoV-2 has been classified as a zoonotic disease, however, no animal reservoir has yet been found, so this classification is premature. We propose that COVID-19 should instead be classified an "emerging infectious disease (EID) of probable animal origin." To explore if COVID-19 infection fits our proposed re-categorization vs. The contemporary definitions of zoonoses, we reviewed current evidence of infection origin and transmission routes of SARS-CoV-2 virus and described this in the context of known zoonoses, EIDs and "spill-over" events. Although the initial one hundred COVID-19 patients were presumably exposed to the virus at a seafood Market in China, and despite the fact that 33 of 585 swab samples collected from surfaces and cages in the market tested positive for SARS-CoV-2, no virus was isolated directly from animals and no animal reservoir was detected. Elsewhere, SARS-CoV-2 has been detected in animals including domesticated cats, dogs, and ferrets, as well as captive-managed mink, lions, tigers, deer, and mice confirming zooanthroponosis. Other than circumstantial evidence of zoonotic cases in mink farms in the Netherlands, no cases of natural transmission from wild or domesticated animals have been confirmed. More than 40 million human COVID-19 infections reported appear to be exclusively through human-human transmission. SARS-CoV-2 virus and COVID-19 do not meet the WHO definition of zoonoses. We suggest SARS-CoV-2 should be re-classified as an EID of probable animal origin. We therefore argue that it is imperative to review COVID-19 predominantly as an EID in order to address the underlying drivers of the emergence of such pathogens which can be so readily driven, yet so easily adjusted by human activities. In closing, we propose that a whole of society debate around the designation of a disease as a zoonosis vs. An EID as well as the nuances within each term is needed to reduce the risks of disease events such as COVID-19 in the future through appropriate actions in the human political landscape.

Keywords: COVID-19, SARS-CoV-2, Zoonoses, Emerging infectious disease (EID), Spillover

Abst-15

In Silico Molecular Docking Studies of Spike Receptor Protein of SARS-CoV (2AJF) with Apigenin, Kaemferol, and Quercetin

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Abstract

COVID-19 has been characterized as a pandemic by the World Health Organization (WHO) in early 2020. The main infection is caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS – CoV-2). Several researchers and people in the community are trying to find the best way to prevent and cure the disease by using natural plant substances. Numerous studies have shown that flavonoids, can be very effective in preventing virus-induced infection. The aim of this study was to perform molecular docking studies between plant-derived flavonoids and spike receptor protein of SARS-CoV. Pyrx virtual screening tool and biovia discovery studio visualizer were used in the current molecular docking studies. Results of docking studies revealed that ligands have interacted with target molecule 2AJF, spike receptor protein of SARS-CoV with binding energies in the range of -5.8 to -8.7 kcal. In conclusion plant flavonoid quercetin may be a better inhibitor for the inactivation of SARS-Coronavirus.

Keywords: SARS -CoV-2, Molecular Docking, Phytochemicals, PYRX.

Abst-16

Role of Probiotics in Management of COVID-19 Disease: Current Status and Future Perspectives

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Abstract

Probiotics are living microorganisms that provides various health benefits when ingested. Probiotics are usually bacteria that generally belong to group *Lactobacillus* and *Bifidobacterium.* Yeast has also been reported to have probiotics properties and impart health benefits to consumer. The common type is Saccharomyces boulardii. Probiotics are beneficial for digestive system as well as for immune system. Probiotics improves the overall health of the gut. Probiotics have proved effective in management of various diseases and disorders including microbiome dysbiosis, cancer, gut related disorders like IBS (irritable bowel syndrome), intestinal infections, diarrhea and others. Recently, COVID-19 has emerged as deadly viral infection and affected the human population world wide. During COVID-19, the probiotics has shown the ability to boost human immunity by preventing colonization of pathogens and also reduced the severity of infections. Probiotics helps in balancing the defensive immune response of host by stimulating the mucosal barrier function and modulating the immune system. The intestinal bacteria have been shown to have beneficial effects through production of vitamin, maintaining barrier integrity and regulation of gut mucosal inflammation. Probiotics have important role in maintaining the healthy gut microbiome and regulation of immune system. Extensive research is required on probiotics for management of COVID-19 disease and providing health benefits to the patients during the disease and recovery phase.

Keywords: COVID-19, Probiotics, Health benefits, Microbiome.

Abst-17

From Potential Mechanisms and other Factors Associated to Treatment Strategies, COVID-19 Disorder Advancement Tends to be Associated with the other Microbial Community

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Abstract

Although COVID-19 is a respiratory infection caused by SARS-COV-2, recent study indicated that the human microbiome is also involved in the disease. We don't know how the metabolic activity of microbial communities living on human mucosal surfaces (airway epithelial cells, gastrointestinal enterocytes) influences initial sensitivity to SARS-CoV-2 infection, pathogenesis, or outcome. Diet, environment, and genetics all have a part in the gut microbiota's development. In small groups of COVID-19 patients, these parameters are linked to gut microbial dysbiosis with enrichment by opportunistic bacterial *(Coprobacillus, Clostridium species)* and fungal pathogens *(Candida, Aspergillus species)*, and depletion of beneficial symbionts *(Faecali bacterium)* that are positively and inversely correlated with COVID-19 severity. In addition, an inverse correlation was noted between abundance of Bacteroides and SARS-CoV-2 load in fecal material during the course of hospitalization of these patients. Inadequate sanitation and exposure to microbial diversity (including Gram-negative bacteria) may be associated with reduced COVID-19-associated mortality in developing and underdeveloped countries, according to recent demographic analyses of COVID-19-associated mortality rates (death/106) in 122 countries. The authors discovered an inverse relationship between COVID-19-related fatality rates and water quality scores, the percentage of the population living in slums, and the percentage of the population suffering from diarrhoea. Based on these findings, it was suggested that microbially induced, inherently elevated levels of type I interferon (IFN) could protect these populations from COVID-19 death. Finally, SARS-CoV-2 infection may have a direct impact on the gut and respiratory microbiomes. On airway epithelial cells and enterocytes in the digestive tract, the virus's cell surface receptor (ACE2, angiotensin converting enzyme 2) is expressed. The respiratory microbiota and COVID-19 infections are currently being studied. Despite the limited data, the probiotics *Lactobacillus* and *Bifidobacterium* appear reduced in the intestines of COVID-19 patients, indicating an unstable state (termed dysbiosis). Furthermore, COVID-19 patients who are hospitalised may be given high-dose antibiotics, which drastically affect microbial communities. Further data will provide a more complete understanding of microbiome alterations during COVID-19.

Keywords: Covid-19, Dysbiosis, Gut microbiome.

Abst-18

Intelligent Drug Delivery System by a Living Programmable Organism: ‘Xenobot’

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Abstract

Integration of hardware and software technologies with biological sciences has made Healthcare, an advanced and a sophisticated industry. Technological advancements in Pharmaceutical industry such as Automation, Nanofluids, Imaging, Assay technologies, High Throughput Screening (HTS), Genome Sequencing, Bioinformatics, Mobile health sensors, 3D-Printed drugs (Spritam), Chatbots, IBM Watson etc. Helped in reducing costs and time of the drug discovery and delivery processes as well as improved patient outcomes. Now, Algorithms of Artificial Intelligence have led to the creation of World’s first living machine- “Xenobot”, from the stem cells of African clawed frog. Xenobot, which is less than a millimetre in size, can locomote, self-heal, and is completely biodegradable. Xenobots could be used to clean up radioactive waste, collect microplastics in the oceans, carry medicine inside human bodies, or even travel into our arteries to scrape out plaque. The Xenobots can survive in aqueous environments without additional nutrients for days or weeks, making them suitable for internal drug delivery. Aside from these, the Xenobots could also help researchers to learn more about cell biology, opening the doors to future advancement in human health and longevity. Further research on Xenobots could have a massive impact on regenerative medicine such as building body parts inducing regeneration. On the contrary, without the right political, economic and ethical framework for interventions, there is a risk of uncontrolled development and a negative impact of AI that could be passed into healthcare industry and could probably lead to Bio-Cyber wars.

Keywords: Xenobots, 3D Printed Drugs, Stem cells, Artificial intelligence.

Abst-19

COVID-19: Approaches Towards the Vaccine Development

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Abstract

After the development of first vaccine in 1796 by Edward Jenner, way to battle with several viral and bacterial diseases came into light. The way SARS-CoV-2 (Severe acute respiratory syndrome coronavirus 2) emerged in 2019 and captured the world in its tentacles just within the span of 6 months, WHO listed it as pandemic COVID-19 (coronavirus diseases 2019). Since then, several vaccine candidates came into race of being labelled as safe, effective and with lesser side effects. SARS-CoV-2 is a single stranded, positive sense RNA that spreads through respiratory droplets and primarily attacks at respiratory tract. SARS-CoV-2 is entirely covered with spike proteins and responsible for viral attachment, fusion and entry in host cell through angiotensin-converting enzyme 2 (ACE 2) receptors. Till now, several conventional attempts have been made to develop vaccines including inactivated vaccines, recombinant proteins vaccines, live attenuated vaccines, DNA and RNA vaccines. All these vaccines are injected intramuscularly and intravenously but these vaccines have certain disadvantages in terms of risk of integration of viral genome with host genome, misguiding the synthesis of structural viral proteins, and difficulty in induction of immune response. However, SARS-COV-2 virus primarily transmits through respiratory tract, it is must to induce the mucosal immunity and for this it is worth mentioning that inhalable nanovaccine comes into play. Studies have shown inhalable nanovaccine with structure similar to SARS-CoV-2, that comprises nucleic acid (Poly I:C), spike proteins (RBD) and capsid (biomimetic Pulmonary surface layer) transmitted through nasal passage to stimulate viral infection process. Poly (I:C) enhances secretion of a different immune-activated cytokines by stimulating TLR signalling pathway and later help receptor binding domain (RBD) to mature T lymphocytes cells and B lymphocytes cells. Also, nasally transmitted nanovaccines produce high titers IgA in respiratory mucosal layer which acts as significant barrier for respiratory infectious diseases and can possibly prevent them from becoming an emerging pandemic.

Keywords: Nanovaccine, Genome, Respiratory Pathway.

Abst-20

Diversity of Fungal Endophyte Associated with *Ageratum conyzoides* L., an Invasive Alien Plant Species of Asteraceae of Tripura

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Abstract

Invasive plants have threatened the integrity of ecosystems throughout the world. They affect notonly the species diversity of native areas but also their biological integrity. In India, a number of invasive exotic weeds have been reported among which *Ageratum conyzoides*, from tropical *Americais troublesome* and have caused adverse ecological, economic and social impact. This weed can be seen growing in different landscapes but are luxuriantly localized in unattended forests and cultivatedareas. In the present investigation endophytic fungi were isolated from explants of *Ageratum conyzoides* L., collected from different locations of Tripura. *Ageratum conyzoides* (Asteraceae, Billygoat weed) has invaded agricultural fields and it interferes with crops and causes yield reductions of major staple crops of India. All plants seem to harbour endophytic fungi with some bioactive content and activities. However, there are certain metabolites that are characteristic of certain specific plantspecies. In this research work, the endophytic fungi of *Ageratum conyzoides* were studied. In order to isolate endophytic fungi, several plant segments of *Ageratum conyzoides* were collected from itsnatural habitat. Ten different fungal isolates were obtained from root, leaf and stem plant parts. All the plant samples were found to harbour various endophytic fungi with different colonization frequency (CF) and isolation rates (IR). The objective of this study was to report new dataregarding the endophytic fungi found in invasive alien plant *Ageratum conyzoides*. This systematic investigation revealed that invasive plants are a rich and reliable source of novel endophytic fungi.

Keywords: Endophytic fungi, Tripura, Asteraceae, Invasive plant.

Abst-21

Analysis of Physicochemical Parameters of Water from River Yamuna at Baghpat, Uttar Pradesh, India During 2019-2021

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Abstract

Water is most abundantly available on Earth and required by all kinds of life. The quality ofwater is of vital concern for mankind since it is directly linked with human welfare. Yamuna River is one of the most polluted rivers of India and it the sub-basin of the Ganga river system. Theriver water is used for both abstractive and in stream uses like irrigation, domestic water supply, industrial etc. The discharge of untreated waste water is the main reason of the decreasesin water quality. While emission source like dumping of waste material, religious offering of flowers or food, immersion of idols, holy baths, clothes washing or cattle bathing can lead to serious pollution, industrial wastewater pollution is a serious matter of concern. The prevailing conditionof the river is of serious concern, and there is an urgent need to take strict measures to ensurecleansing of the river and prevent further contamination. The main stream of the river Yamuna river originated from the Yamunotri glacier near Bandar Punch (38 °59′ N; 78 °27′ E) in themussourie range of the lower Himalayas. The catchment of the Yamuna river system coversUttaranchal, Uttar Pradesh, Himachal Pradesh, Haryana, Rajasthan, Madhya Pradesh and Delhi. The study was conducted during July, 2019 – June, 2021 to assess the quality parameters of river Yamuna water. The sample water were collected from the sites of investigation and brought to the laboratory for hydrobiological analysis using titrimetric/volumetric methods. However, the water temperature and dissolved oxygen wasenumerated onsite using digital thermometers and modified winkler's method respectively.During investigation the monthly oscillations in the hydrobiological attributes were recorded. The trends of fluctuation in physicochemical parameters of river Yamuna corroborated to the seasonality as well. An inversely proportional trend in water temperature and dissolved oxygen was well marked during two years consecutive investigation in a stretch of 10 km (5 km upstream and 5 km downstream from the central site of sample collection) in Baghpat district of Uttar Pradesh, India.

Keywords: River Yamuna, Hydrobiology, Physicochemical attributes, Dissolved oxygen, Water pollution.

Abst-22

Molecular Characterization and DNA Quantification of *Labeo gonius*

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Abstract

The present study was conducted on *Labeo gonius* collected from different sites of Western Uttar Pradesh. Mitochondrial DNA of taxonomic importance i.e., COI gene was amplified andsequenced. The phylogenetic analyses of all the sequences were performed using software MEGA 7.0. The results revealed that the molecular data based on COI was close to topotype population. The cryptic samples and other fish were identified and characterized based ongene studies viz. COI showed maximum similitude to gene sequences of gene sequenceavailable on NCBIand hence considered as the same. In female *Labeo gonius* (Site 1, cultured samples) the DNA content ranged in 65ng/ µl- 70ng/ µl; and at Site 2, 68ng/ µl-72ng/µl; at Site 3 (wild samples) 74ng/ µl -80 ng/ µl.So the highest content was seen in wild samples of *Labeo gonius* In male *Labeo gonius* (Site 1) the DNA content ranged in 73ng/ µl-76ng/ µl, at Site 2, 70 ng/ µl-82 ng/ µl and at Site 3 (wild samples) 76ng/ µl-88 ng/ µl. So the highest content was also seen at site 3.

Keywords: Phylogenetic analysis, DNA extraction, *Labeo gonius,* COI gene.

Abst-23

Scrub Typhus

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Abstract

A mysterious illness has been reported in a western Uttar Pradesh district during last months. The illness, has affected over dozens of peoples. After getting reports of infections in the area, themedical teams carried out tests on the samples taken from the villagers. It was later revealed that thesamples were infected with scrub typhus. According to Centres for Disease Control and Prevention (CDC), Scrub typhus is an acute infectious zoonotic disease caused by *Orientia tsutsugamushi.* Theoriginal name of scrub typhus, which was given by Hashimoto in 1810, is "tsutsugamushi disease.The infection spreads to people through bites of infected chiggers (larval mites) *Leptotrombidium deliense* and *L. akamushi.* Scrub typhus is a severe public health problem that affects mainly Asia-Pacific areas; scrub typhus threatens one billion people and causes illness worldwide each year. Scrub typhus is prevalent in many parts of India, including outbreaks in the sub-Himalayan belt, from Jammu to Nagaland. In 2003-04 and 2007, there were reports of outbreaks in Himachal Pradesh, Sikkim and Darjeeling. The clinical symptoms of scrub typhus include a scab at the site of the bite ofthe mite, acute febrile illness, malaise, high fever, headache, cough, disseminated intravascular coagulation (DIC), pulmonary edema, and hepatic dysfunction. A pathologic characteristic of scrubtyphus is disseminated vasculitis, which can cause damage to one or more organs, such as the liver, kidney, lung, brain, meninges, and skin. One third of the cases may suffer from multiple organ dysfunction syndrome (MODS) during the course of the disease. The diagnosis of scrub typhus is amajor challenge for clinicians, and as more organs are affected, the rate of misdiagnosis increases. One of the main reasons for the misdiagnosis of scrub typhus is that some clinicians are unaware ofthe complexity of the clinical manifestations of this disease.

Keywords: India, Mysterious zoonotic disease, Scrub typhus, Chiggers, Multiple organ dysfunction syndrome (MODS).

Abst-24

Chemoprofiling Studies of Honeybee Venom Using NMR and HPLC Techniques

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Abstract

Venom is a natural product, synthesized inside the venomous animals such as wasps, bees,scorpions and snakes, are is highly used in the field of therapeutic medicine nowadays.Honeybee venom (HBV) produced by female bees provides direct protection from microbes and other enemies. HBV is a complex mixture of various active molecules such as enzymes and peptides that have tendency to cure Alzheimer and Parkinson disease. Apart from theseapplications, HBV also has also been reported to show multiple effects against cancer andHIV. In recent times, many studies described about the molecular composition of bee venomand its biologically active compounds to be used as the next generation drugs. The aim of thepresent investigation is to perform a comparative analysis of the HBV chemoprofiling byusing NMR and HPLC techniques for further exploring the medicinal application of various compounds possessing biological properties in Apitherapy.

Keywords: Honeybee, Apitherapy, Venom, *Propolis,* Cancer, HIV, HPLC, NMR.

Abst-25

Isolation and Identification of Bacterial Population in Gut of *Puntius*

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Abstract

Fishes are important participants of biological diversity. The gut microflora plays important role in healthand growth of fish. In the present investigation, bacterial population were identified from the gut of freshwater fish of the genus *Puntius* with the help of 16s rRNA sequencing. The fish samples were taken fromthe Gomti River at Lucknow with the help of local fishermen. Isolates of fish from gut were introducedon nutrient agar plate in order to obtain the mixed culture of bacteria. The pure cultures were prepared forthe purpose of identification and preserving its DNA for further isolation. Further, 16rRNA sequencing of 5 isolates showed the presence of *Bacillus firmus, Brevibacillus agri, Paenibacillus cisolokensis, Aeromonas veronii* and *Plesiomonas shigelloides.* The present study promises to play an important role inoverview of fish microbiota and its significance in sustainable growth and development.

Keywords: 16srRNA Sequencing, *Puntius* species, Nutrient agar, Bacteria.

Abst-26

Population Dynamics of Helminth Parasites in *Channa punctatus* and *Heteropneustes fossilis* of Sultanpur District, Uttar Pradesh

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Abstract

In the present study, two types of fresh water fishes, i.e., *Channa punctatus* and *Heteropneustes fossilis* were examined for understanding the distribution pattern of helminth infection in fishes from different water bodies (wetland and ponds) of Sultanpur district. The different helminth parasites like nematodes, cestodes, trematodes and acanthocephalans were isolated from the gastrointestinal tract, gills and skin of the host during the study periodspanning from January, 2021 to April, 2021. The gastrointestinal tract was found to be highlyinfected in the host snakehead fish *Channa punctatus* and cat fish *Heteropneustes fossilis*, with trematodes on skin and muscles. The highest prevalence (69.44%) of parasites wasobserved in the month of February 2021; highest abundance (0.79), highest intensity (1.31) and highest index of infection (0.59) was recorded in the month of March, 2021 with the highest loss of body weight along with highest mortality rate. However, further study is stillrequired to reveal many enclosed parasitic infection of fishes and its causation, particularly inthis region with high diversity of fishes.

Keywords: Gastrointestinal tract (GIT), Helminth parasites, Mortality, Diversity.

Abst-27

Communicable Diseases: A Review

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Abstract

Communicable diseases are caused by viruses or bacteria that people spread to one anotherthrough contact with contaminated surfaces, bodily fluids, blood products, insect bites, or through theair. There are many examples of communicable diseases, some of which require reporting to appropriate health departments or government agencies in the locality of the outbreak. Somee xamples of the communicable disease include HIV, hepatitis A, B and C, measles, salmonella, measles and blood-borne illnesses. Most common forms of spread include fecal-oral, food, sexual intercourse, insect bites, contact with contaminated fomites, droplets, or skin contact. Many of thes diseases can be prevented from spreading by care and following hygiene.

Keywords: Communicable diseases, HIV, Hepatitis.

Abst-28

Vector Borne Diseases and Transmission: A Review

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Abstract

Over the last four decades, a number of arthropod-borne infections have been recognized. Some have become of considerable public health importance, such as dengue hemorrhagic fever (DHF) and others are spreading geographically and their incidence is increasing. Vector-borne diseases are human illnesses caused by parasites, viruses and bacteria that aretransmitted by vectors. Arthropods form a major group of pathogen vectors with mosquitoes, flies, sand flies, lice, fleas, ticks, and mites transmitting a huge number of pathogens. Many such vectors are haematophagous, which feed on blood at some or all stages of their lives. When the insects blood feed, the pathogen enters the blood stream of thehost. The *Anopheles* mosquito, a vector for malaria, filariasis, and various arthropod-borne-viruses inserts its delicate mouthpart under the skin and feeds on its host blood. The parasites carried by mosquitoes are usually located in its salivary glands and the parasites are transmitted directly into the host blood stream. The burden of these diseases is highest intropical and subtropical areas, and they disproportionately affect the poorest populations. Since 2014, major outbreaks of dengue, malaria,yellow fever and Zika have afflicted populations, claimed lives, and overwhelmed health systems in many countries. Many of vector-borne diseases are preventable, through protective measures, and community mobilisation. Environmental management strategies can reduce or eliminate vector breeding grounds altogether through improved design of water resources development projects as wellas use of biological controls that target and kill vector larvae without generating the ecological impacts of chemical use.

Keywords: Vectors, Disease transmission, Prevention, Management.

Abst-29

Rational Selection of Drug-Nanocarrier Combination: Nano Medicines and Nano-Vaccines Research for COVID-19 Therapeutics

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Abstract

The present global health danger posed by the new coronavirus illness 2019 (COVID-19) necessitates the rapid deployment of innovative treatment alternatives. The role of nanotechnology in combating this "virus" nano adversary is critical. The topic of nano-intervention is explored in terms of creating effective nanocarriers to overcome the traditional limits of antiviral and biological treatments. This method guides the safe and effective distribution of accessible treatment alternatives via designed nanocarriers, as well as the inhibition of viral spike glycoprotein initial contacts with host cell surface receptors and the interruption of virion formation. Controlling and eradicating the spread and recurrence of this pandemic necessitates the development of a safe and efficient vaccination approach. Nanocarriers have the potential to be used to develop risk-free and effective vaccination methods for SARS coronavirus 2 vaccine candidates such as protein constructions and nucleic acids. We address current and continuing nanotechnology-based curative and preventive efforts to combat this epidemic, emphasising important areas where nano-scientists may help.

Keywords: Coronavirus disease 2019, Severe acute respiratory syndrome coronavirus 2, Immunopathology, Nanomedicine, Vaccine nanocarriers, Vaccine adjuvant nanoparticles, Repurposed Nanotechnology.

Abst-30

Novel Drug Delivery System Loaded with Natural Agent for Prevention of Arthritis

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Abstract

Rheumatoid arthritis is chronic, progressive, autoimmune disease characterized by systemic inflammation, the bone, cartilage, tendons, and ligaments of joints are destroyed. All this damage to the joints causes deformities and bone erosion, usually very painful to patients. Many synthetic medications are prescribed as conventional treatment for rheumatoid arthritis, but they have side effects that can adversely affect the therapeutic outcome. *Calotropis procera* is described in Ayurvedic literature for the treatment of inflammation and arthritic disorder. The bark and leaves of *Calotropis procera* are known to show anti-inflammatory and analgesic effects. The leaves contain mainly the chemical constituents' α-amyrin, α-amyrin acetate, β-sitosterol, urosolic acid which are responsible for the antiarthritic activity, anti-inflammatory activity, and analgesic effect. Microsponges delivery system is a highly cross-linked, porous, polymeric microsphere, a polymeric system consisting of porous microspheres that can entrap and release drugs into the skin over a long period of time, which could be incorporated into a formulated product such as a gel, cream, liquid or powder. The present work is focused on the development of microsponges of *Calotropis procera* by quasi emulsion solvent diffusion method and loaded them in gel to deliver the drug in form of a novel drug delivery system (NDDS) as a topical formulation for the treatment of arthritis. Accordingly, the current investigation showed that the *Calotropis procera* markedly reduced the paw inflammation; hence it has great potential in the treatment of RA.

Keywords: Rheumatoid Arthritis (RA), Natural agent, Microsponges, Novel drug delivery system (NDDS).

Abst-31

Role of Mitochondrial Dysfunction in Neuro-Degenerative Diseases

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Abstract

Mitochondria are ATP-generating organelle & contributes to many cellular functions such as bioenergetic processes, intracellular calcium regulation, oxidation-reduction potential of cells, scavenging of free radicals and activation of caspase mediated apoptosis. Neurodegenerative disease is group of heterogenous disorders which are characterized by the degeneration of structure and function of CNS or PNS. It's an irreversible neuron cell damage disorder. For E.g., Alzheimer disease, Amyotrophic lateral sclerosis (ALS) and Parkinson's disease etc. Functional defects in mitochondria before the onset of symptoms are observed in neurodegenerative diseases. Therefore, mitochondrial dysfunction plays a key role in study of neuro-degenerative diseases. Here we will discuss mitochondrial dysfunction in Alzheimer and Amyotrophic lateral sclerosis (ALS) disease. Amyloid β peptide is an important component in pathogenesis of Alzheimer disease. It negatively affects the function of mitochondria and cause mitochondrial dysfunction. Mitochondrial dysfunction and oxidative stress are the primary event in pathogenesis of Alzheimer disease. Amyloid β (Aβ) causes structural & functional changes in mitochondria. It is also involved in mitochondrial oxidative stress and bioenergetics. Amyotrophic lateral sclerosis (ALS) is a deadly neurodegenerative disease. In ALS, loss of both upper and lower motor neurons occurs. It also shows genetic linkage. In ALS, mutations occur in the SOD1 gene which encodes superoxide dismutase 1 (SOD1). In this disease, mitochondrial dysfunction occurs early before the onset of symptoms. In this review, we will discuss the effect of mutant SOD1 protein on mitochondria bioenergetics by the formation of Bcl2 (toxic complex).

Keywords: Mitochondria, Alzheimer disease, Superoxide dismutase 1, Amyotrophic lateral sclerosis.

Abst-32

Antiviral Potential of Naringenin: Current Status and Future Prospective in Related to COVID-19

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Abstract

Naringenin is a plant-based flavanone. It is aglycon of naringin, a well-known plant flavonoid present in citrus fruits. Naringenin is mainly found in citrus fruits and also some vegetables including lemon, grapefruit, orange, tomatoes and bergamot. Naringenin have been reported for its antioxidant, anti-inflammatory and antiviral properties. Also, it has been found effective against HCV, Zika virus, Chikungunya virus and Dengue virus. The COVID-19 has emerged as threat for human life all around the world. Recently, various research groups have discussed antiviral and anti-inflammatory effect of naringenin against coronavirus (COVID-19) disease. Naringenin has been found to affect the replication of the virus. Moreover, naringenin has been found to affect the immune response positively. More research on narengenin and its mechanism against viruses are required for effective use of this plant flavanone against viral infections.

Keywords: Flavonoid, Naringenin, Therapeutic potential, COVID-19, Immune Response.

Abst-33

India Celebrates 1 Billion COVID-19 Vaccine Doses

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Abstract

India praised the achievement of administering 1 billion COVID-19 immunization dosages on Thursday i.e. 21st of October 2021 in a range of nine months. The countrywide immunization drive was carried out on January 16 with health care workers (HCWs) getting vaccinated in the principal stage. The inoculation of forefront laborers (FLWs) began from February 2. The following period of COVID-19 inoculation initiated from March 1 for individuals more than 60 years old and those matured 45 or more with indicated co-morbid conditions. The nation dispatched inoculation for all individuals matured more than a long time from April 1. The public authority then, at that point, chosen to extend its immunization drives by permitting all over 18 to be inoculated from May 1. India has managed the second-biggest number of dosages on the planet, next just to China, which is said to have given over 2.2 billion portions to its residents. Almost 90% of the antibodies controlled in India have come from the Serum Institute of India (SII), which creates an authorized rendition of the AstraZeneca. India has so far detailed 34.1 million COVID-19 cases and in excess of 452,000 deaths, most during a second rush of diseases of the Delta variation among April and May. Almost 31% of the grown-up populace is presently allegedly completely immunized while 75% has accepted their first portion. The normal every day inoculation dosages conveyed, on a seven-day moving normal premise, have eased back from 8.4 million day by day toward the finish of August to around 5 million. The test is to guarantee everybody requires their subsequent portion on schedule. Notwithstanding the flow low number of contaminations, service authorities have been encouraging individuals to get inoculated quick, particularly as the continuous celebration season implies family social events and mass shopping, raising the danger of another influx of diseases. The public authority needs all grown-ups to get inoculated for this present year.

Keywords: COVID-19, SARS-CoV-2, Vaccine.

Abst-34

Preventive Role of Flavonoid Luteolin against Viral Infections: Current Status and Future Perspectives

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Abstract

Flavonoids, a collection of herbal materials with variable phenolic structures, are discovered in fruits, vegetables, grains, bark, roots, stems, flowers, tea and other plants-based sources. Flavonoids are well known for their wide range therapeutic potential. Luteolin (3′,4′,5,7-tetrahydroxyflavone) is a common flavonoid that exists in various fruits, vegetables, and medicinal herbs. It has been shown to have antimicrobial, anti-oxidant, anti-inflammatory, anti-allergic, anti-cancerous and therapeutic properties. Also, this flavonoid has been found effective against some viruses. The herbal extract of *Eclipta alba* (Asteraceae) containing luteolin has been found to inhibit the Human Hepatitis C Virus (HCV) replicase in a cell culture system. Luteolin exhibited a dose-dependent inhibition of HCV replicase. Also, luteolin from *Aspalathus linearis* (Fabaceae) has been reported to have antiviral activity against *Rehsus rotavirus* (RRV). Further research on this flavonoid, its mechanism of action against viruses is required for effective use of luteolin as alternate or complementary medicine against viral infections.

Keywords: Flavonoids, Vegetables, Antiviral, Luteolin.

Abst-35

Therapeutic Role and Antiviral Potential of Flavonoid Vitexin

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Abstract

The medicinal plants are rich in phenolic compounds, which are helpful for the treatment and management of various diseases. One of the plants based vitexin is well known for its various pharmacological properties. It has been found to have anticancer, anti-inflammatory, anti-diabetic, antioxidant, neuroprotective activities. Also, the vitexin has been reported to have antibacterial, antifungal and antiviral properties. The new viral infections are emerging and COVID-19 is one of the global threats to human life. Still, scientists are looking for safe, alternate or complementary treatment for control of COVID-19. Vitexin has been shown to have significant antiviral properties against hepatitis A virus-H10, herpes simplex virus type 1 and H1N1 influenza virus and also COVID-19. In case of novel corona virus, vitexin has significant 3-Clpro enzyme inhibition property; therefore, this flavonoid may have potential to be used as complementary or alternative medicine for the COVID-19 management. Vitexin has the potential to be used in management of various infections and diseases after elaborated and extensive research on various aspects of this falvonoid.

Keywords: Flavonoids, Vitexin, Therapeutic potential, COVID-19.

Abst-36

Role of Vitexin against Various Diseases and Infections

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Abstract

The c-glycosylated flavonoid, vitexin, is found in various crop and medicinal plants and it is of great pharmacological importance as it possesses anti-cancer, anti-oxidative, antiapoptotic, anti-inflammatory, antidiabetic, anti-hypertensive, anti-hypoxia/ischemia injury, anti-depressant-like actions and anti-viral properties. Several in vitro and in vivo studies reveal that vitexin possesses chemopreventive properties. Through proapoptotic and autophagy processes, it has been found active against various types of cancers. Vitexin has been also widely studied for its association with the various targets of antidiabetic drugs. Products with antimicrobial properties had gained the attention of researchers due to the frequent emergence of infectious diseases around the globe in the past few years. Vitexin has been shown to have antibacterial, antifungal and antiviral properties. Vitexin also exhibited a significant antiviral activity against hepatitis A virus-H10, herpes simplex virus type 1 and H1N1 influenza virus. COVID-19 possess a protease (3-chymotrypsin-like protease (3CL pro) – PDB 6LU7 and molecular docking analysis of this enzyme with vitexin revealed that vitexin has significant 3-Clpro enzyme inhibition property, thus the flavonoid upon clinical validation may be used for the COVID-19 management. Vitexin has the potential to combat with various infections and diseases and a deeper understanding of the mechanism of action is required for the development of potent drugs.

Keywords: Flavonoid, Vitexin, Therapeutic potential, Antiviral, COVID-19.

Abst-37

Graphene Nanoparticles in COVID-19 Vaccines

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Abstract

Materials (GRMs) exhibit exceptional abour-chemical, electrical, antimic, antimictal and other attractive properties that help develop high-performance wooden devices and needed warrants as potential candidate. In this article, we discuss the potential of graphene and GRMs for healthcare applications and how they can contribute to the fight against COVID-19. Graphene can be secreted naturally from the body, as there is an enzyme called myeloproxidase that apparently breaks down graphic molecules. Surprisingly, alcohol or tobacco consumption can also help increase this enzyme. So they want the population to be vaccinated every 12-12 months and to exercise restaurant. Interaction between people who were vaccinated in 5G and the graphene can be a deadly event when 5G will be fully launched in July 2021, so we must stop this frenzy and cancel the vaccination and a short time. Graphene molecules can communicate with brain neurons in remote mode using different radiofrequencies (perhaps one of 5G), they can achieve the brain and get directions from a distance. These were never "vaccines" against any virus, instead it was always a secret nanotech project designed to enter and control the brains of the human population (so far we won't know if they will work with 5G).In La Quinta, they found that people were already magnetized by masks, PCR tests, chemtrails and graphene present in influenza and covid vaccines. All vaccines are made using the same nanotechnology. In Spain it was also described as a "secret nanoparticle". These nanoparticles become magnetic when they reach the same temperature as the human body. When they are in an environment less than zero degrees, they are magnetic. The EU invests one billion euros in a project called The Graphene Flagship.

Keywords: Graphene, COVID-19, Vaccines.

Abst-38

SARS-CoV-2 Diagnosis, Therapy, and Vaccine Manufacturing Advancements: A New Perspective of Nanoparticles in COVID-19 Pandemic Strategic Combat

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Abstract

The coronavirus disease-2019 (COVID-19) is a global pandemic that has not been witnessed in recent history, having a negative effect on the healthcare system and causing severe socio-economic and human losses. Despite a massive international effort and the introduction of numerous clinical trials aimed at containing the pandemic, no effective treatment has yet been identified. The data presented in this review shows that nanotechnology has enabled the production of a variety of biosensors, Nano vaccines, and antiviral composites that are extremely efficient against closely similar viruses. Consequently, it is a useful guide for the development of SARS-CoV-2 agents. As a result, surface functionalized Nanoparticles can be used to identify and target new therapeutic targets. The study of the virus's lifecycle and the host's response will also aid in the development of efficient nano vaccines. Based on these findings, a broad-spectrum 'universal' NP-based vaccine or treatment for current and future CoV pandemics is likely to be ready. Microfluidics, with its advantages of miniaturization, quick detection, and portability, is expected to make a significant contribution to CoVs detection. Because viruses infect and propagate far quicker than vaccines, vaccines and medication research should be complementary to what has previously been accomplished in past CoV-related research. Because of the current global health emergency, the infection-to-mortality ratio has surpassed critical levels, distinguishing it from other viral diseases. Nanotechnology techniques can be customized and used to identify, cure, and prevent the spread of COVID-19. Nanotechnology provides a unique set of instruments for contributing to and understanding viral illnesses, as well as important development of therapeutic and diagnostic platforms.

Keywords: COVID-19, SARS-CoV-2, Nanomedicine, Nanovaccines, Nano based diagnosis.

Abst-39

COVID-19 and its Impact on Education, Social Life and Mental Health of Students

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Abstract

The outbreak of COVID-19 affected the lives of all sections of society as people were asked to self-quarantine in their homes to prevent the spread of the virus. The lockdown had serious implications on mental health, resulting in psychological problems including frustration, stress, and depression. In order to explore the impacts of this pandemic on the lives of students according to one survey in which they are studied different students of different age group. And they identified the following as the impact of COVID-19 on the students of different age groups: time spent on online classes and self-study, medium used for learning, sleeping habits, daily fitness routine, and the subsequent effects on weight, social life, and mental health. Also my self experience is same because I am also post graduation student Moreover their research found that in order to deal with stress and anxiety, participants adopted different coping mechanisms and also sought help from their near ones. Further, the research examined the student's engagement on social media platforms among different age categories. This study suggests that public authorities should take all the necessary measures to enhance the learning experience by mitigating the negative impacts caused due to the COVID-19 outbreak.

Keywords: COVID-19, Education system, Social life, Mental health, Students.

Abst-40

Healthcare Workers for Vaccination

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Abstract

Antibody preventable sicknesses are a huge reason for horribleness and mortality. As new immunizations are ending up being viable and as the rate of certain contaminations diminishes, inoculation rehearses are evolving. Health care workers (HCWs) are especially presented to and assume a part in nosocomial transmission, which makes them a significant objective gathering for immunization. Most antibody preventable illnesses actually convey a huge danger of resurgence and have caused episodes as of late. While numerous expert social orders favor inoculation of HCWs just as everybody, suggestions vary from one country to another. Thus, immunization inclusion differs broadly for every microorganism and for every nation, making clinics and centers helpless against flare-ups. Antibody commands and non-obligatory methodologies are the subject of progressing examination and debates. Ideal ways to deal with increment inclusion and transform the medical care labor force into a productive hindrance against irresistible illnesses are as yet being discussed.

Keywords: Vaccination, Immunization, Antibody, Inoculation.

Abst-41

Black Fungus: Side Effects and Treatment Technique of Dark Parasite in Coronavirus Patients

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Abstract

Mucormycosis, ordinarily called black fungus, is an uncommon however genuine contagious contamination brought about by a sort of growth called mucormycete, which is plentiful in the climate. It majorly influences individuals who have medical conditions or take prescriptions that bring down the body's capacity to battle germs and infection. The illness regularly shows in the skin and furthermore influences the lungs and the cerebrum. Individuals who have been unwell with COVID-19 are as yet recuperating have a compromised insusceptible framework, which means they're more in danger in light of the fact that their body can't fend off the contamination. The individuals who were hospitalized with serious COVID-19 sickness were probably going to be endorsed steroids for the decrease of disease. The steroid act by lessening the aggravation in ebody'ssafereactiontostopitassaultingthebody'ssolidcellsitpromptsthe diminished insusceptible reconnaissance. Symptoms like severe coughing, fever, red eye and restlessness were the most common one. Treatments include anti-inflammatory drugs and first gen steroids. Use of excessive harsh medicine can lead to more complications hence it is only be treated through mild medicines which give long duration of action.

Keywords: Mucormycosis, COVID-19, Steroids, Anti-inflammatory.

Abst-42

Assessment of the Biophysical Factors of the COVID-19 Epidemic

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Abstract

The biophysical causes of pandemics, such as ecosystem conversion, meat consumption, urbanisation, and connectedness between cities and countries, have become more intense in recent decades. Changes in land use and meat intake enhance the likelihood of infection transmission from animals to humans. Growing urban populations, as well as trade and travel networks within and between countries, increase the potential that such zoonotic infections will spread to become pandemics. Zoonotic overflow can be reduced through habitat preservation and wildlife trading regulations. Containing the spread of infectious diseases necessitates a high level of coordination among organisations across geographic boundaries and economic sectors, all supported by international investment and cooperation. COVID-19, a zoonotic illness that would become a global pandemic, was discovered in the Chinese city of Wuhan at the start of the New Year 2020. Evidence is mounting that its emergence as a zoonotic spill over happened before the officially acknowledged date of early December, 2019. Even at the molecular level, many similarities between SARS and COVID-19 have been discovered, so much so that the COVID-19 virus has been dubbed SARS-CoV-2. Because of these similarities, there have been multiple possibilities to treat COVID-19 patients with clinical techniques that have been shown to be helpful against SARS. Importantly, similarities in how SARS-CoV and SARS-CoV-2 reach the host, reproduce, and because life-threatening pathological abnormalities have shown chances to repurpose medications that have been shown to be effective against SARS.

Keyword: COVID-19; SARS; Zoonotic infections.

Abst-43

Patient Health Monitoring System with the Help of Internet of Things

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Abstract

Internet of Things (IOT) is the emerging technology, which contains huge amount of smart object and smart devices connected to the internet for communicating with each other. In this project to analyze and compute the patient health we are using AURDINO UNO AND ESP8266 wi-fi module. Which is the heart of this project. These smart devices are used to collect temperature, blood pressure heartbeat, lung and respiration information etc., which are used to evaluate the health condition of the patient. The IOT platform used in this project is Thing Speak. Thing Speak is an open-source Internet of Things (IOT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. This IOT device could read the pulse rate and measure the surrounding temperature. It continuously monitors the pulse rate and surrounding temperature and updates them to an IOT platform. The Arduino Sketch running over the device implements the various functionalities of the project like reading sensor data, converting them into strings, passing them to the IOT platform and displaying measured pulse rate and temperature on character LCD. On March 11, 2020, the World Health Organization declared the coronavirus disease 2019 (COVID-19) outbreak as a pandemic, with over 720,000 cases reported in more than 203 countries as of 31 March. The response strategy included early diagnosis, patient isolation, symptomatic monitoring of contacts as well as suspected and confirmed cases, and public health quarantine. In this context, Telemedicine, particularly video consultations, has been promoted and scaled up to reduce the risk of transmission, especially in widely spreader county like as in United Kingdom and the United States of America, India. This framework could be applied at a large scale to improve the national public health response. For countries without integrated telemedicine in their national health care system, the COVID-19 pandemic is a call to adopt the necessary regulatory frameworks for supporting wide adoption of telemedicine. This project may play vital role in saving the patient life at emergency time since "Time is life".

Keyword: IOT platform, Things speak, Esp8266 wi-fi module, Aurdinouno, API key, Telemedicine.

Abst-44

Population-Based Cohort Analysis of UK Primary Care Data and Linked National Death Registrations Inside the Open SAFELY Platform Found HIV Infection and COVID-19 Death

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Abstract

It's unknown whether HIV infection is linked to a higher risk of COVID-19-related death. In a large-scale population-based study in England, we wanted to look at this link. A retrospective cohort analysis was conducted. We used the Open SAFELY platform to analyse routinely gathered electronic primary care data linked to national death registries on behalf of NHS England. We included all persons (18 years and older) who were alive and in follow-up on February 1, 2020, and who had at least one year of continuous registration with a general practitioner prior to that date. People with HIV infection who had a primary care record were compared to people who did not have HIV. COVID-19 death was the result, which was characterised as the presence of International Classification of Diseases 10 codes U07.1 or U07.2 on the death certificate. The link between HIV infection and COVID-19 death was estimated using Cox regression models that were first adjusted for age and sex, then for index of multiple deprivation and ethnicity, and finally for a wide range of comorbidities. To investigate effect modification by age, sex, ethnicity, comorbidities, and calendar time, interaction variables were introduced.There were 17 282 905 adults in total, with 27 480 (0.16%) with HIV. HIV-positive people were more likely to be male, of Black ethnicity, and from a less affluent area than the general population. During the study period, 14 882 COVID-19 fatalities occurred, with 25 of those being HIV positive. After controlling for age and sex, people living with HIV had a greater risk of COVID-19 death than those without HIV: hazard ratio (HR) 2.90 (95 percent CI 1.96–4.30; p<00001). The association was attenuated, but risk remained high, after adjustment for deprivation, ethnicity, smoking and obesity: adjusted HR 2 ·59 (95 percent CI 1 ·74–3 ·84; p<0 ·0001). There was some evidence that the association was larger among people of Black ethnicity: HR 4 ·31 (95 percent CI 2 ·42–7 ·65) versus 1 ·84 (1 ·03–3 ·26) in non-Black individuals (p-interaction=0 ·044).

Keywords: SARS-CoV-2, Ivermectin, Doxycycline, Azithromycin, N-acetylcysteine, Montelukast.

Abst-45

Medicinal Plant Calotropin Milk of *Calotropis gigantean* Have a Potential to Inhibit M Pro and S Protein of Corona Virus

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Abstract

Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus. SARS: Severe acute respiratory syndrome. The virus can spread from an infected person's mouth or nose in small liquid particles when they cough, sneeze, speak, sing or breathe. The virus spread more easily indoors and in crowded settings. For the reason that is play important role in replication of viruses, the main viral proteinase has recently been regarded as a suitable target for drug design against SARS infection. The present study focused on the inhibitory activity of calotropin gigantean against M pro and Spike proteins from SARS-

CoV-2. To date there is nowork commenced on in- silico study of this compound against Mpro and Spike proteins of SARS-CoV-2. In the current analysis, molecular modelling and docking analysis was carried out using Patchdock tools. Protein-protein interaction play important role in life, predicting the protein function of target protein. The calculated parameters such as docking score specified binding of component Calotropin corona virus main proteinase and spike protein. Interactions specified that main proteinase protein and spike protein / Calotropin complexes hydrogen and hydrophobic interactions. Thus the present study Calotropin can be used as inhibitor of COVID-19 Main proteinase protein. Therefor additional research is necessary to explore their potential therapeutic use of plant.

Keywords: Corona virus, *Calotropis gigantean* milk, Herbal drug.

Abst -46

Investigation of Different Plants Extracts as Potential Larvicidal Agents against *Culex quinquefasciatus* from Thiruvarur District of Tamil Nadu, India

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Abstract

Chemical control of insects is the method followed for decades to eradicate them. Synthetic insecticides have created havoc in the environment by altering the environment as well proved toxic no non-target animals/organisms. Hence, the focus to control the insects is now shifted to naturally occurring plant based insecticides which are ecofriendly. Among the insects, mosquitoes form important vectors as they transmit vector borne diseases. The present study is carried out to investigate the larvicidal activity of four different plants against *Culex quinquefasciatus* (vector of lymphatic filariasis). There are many studies which state that the plant crude extracts act against mosquito as larvicidal, pupicidal, and adulticidal agents. As plants have antioxidant, toxic and bioactive properties they are used extensively in mosquito control. The chosen plants in this study are *Ipomoea carnea* (Leaves), *Commiphora caudate* (Leaves), *Euphorbia antiquorum* (Latex) and *Acalpulcosenna-alata* (Leaves). Ethanol, Methanol and Acetone extracts from four plants were tested against late third instar larvae of *Culex quinquefasciatus*. The larvae were exposed to different concentrations of plant crude extracts. After 24 hours the mortality rate of each dose was observed. There was no mortality in control. Among the plants screened, *Ipomoea carnea* (Leaves), crude extract showed highest mortality (100%), followed by *Commiphora caudate* (Leaves) which is 97%. The other two plants such as *Euphorbia antiquorum* and *Acalpulcosenna-alata* showed 86% and 78% mortality respectively. The chemical composition of plant crude extract was analyzed by GC-MS also. The plant extracts needs to be tested for further as an effective larvicidal under field conditions.

Keywords: Plants, Mosquito Larvicidal activity, GC-MS, Lethal concentration.

Abst-47

Enlightening the Future on the Efficacy of Using Microbes as Bio-Control Agents, Alternative to Chemical Pesticides

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Abstract

It has been estimated that approximately one third of the food crop is destroyed every year due to attack by insects, pathogenic fungi, bacteria, and nematodes. Plant pathogens causing major damages to crop plants include fungi, bacteria, viruses and nematodes. Crop losses are creating a major threat to the food production with about 27 to 42% loss in global food production attributed to plant disease caused by plant pathogens which otherwise would have been doubled if no disease management strategies are applied. Large scale application of chemical insecticides and pesticides has a deleterious effect on the health of human beings and environmental pollution. It has been estimated that approximately one third of the food crop is destroyed every year due to attack by insects, pathogenic fungi, bacteria, and nematodes. Biological disease control is an attractive and alternative strategy for the control of plant diseases. Meanwhile, it also provides practices compatible with the goal of a sustainable agricultural system. During the past four decades we have witnessed the doubling of the humanpopulation and a concurrent doubling of food production. Plant nutrition has played a key role in this dramatic increase in demandfor and supply of food. Increases in crop production have been madepossible through the use of commercial man-made fertilizers which have adverse effects to human life. Plant diseases need to be controlled to maintain the quality and abundance of food, feed, and fibre produced by growers around the world. Different approaches may be used to prevent, mitigate or control plant diseases. Beyond good agronomic and horticultural practices, growers often rely heavily on chemical fertilizers and pesticides which actually posses adverse effects to man's life. The increasing use of fertilizers and highly productive systems have also created environmental problems such as deterioration of soil quality, surface water, and groundwater, as well as air pollution, reduced biodiversity, and suppressed ecosystem function. Environmental pollution resulting from greater nutrient availability can be either direct or indirect. Directly, misuse and excessive or poorly managed use of fertilizers can result in leaching, volatilization, acidification, and denitrification. Indirectly, the production (use of fossil fuel in Haber- Bosch process) and transport (combustion of fossil fuel) of fertilizers result in airborne or carbon dioxide CO_2 and Nitrogen pollution, which will be eventually deposited into terrestrial ecosystems. A more comprehensive and complete view of the Nitrogen cycle and impacts of Nitrogen deposition at the global level can be found in. Community waste and sewage sludge provide an inexpensive and attractive alternative. One problem with the use of these sources of plant nutrition is their high content of heavy metals, which may have adverse effects on crop growth, crop consumers, or microorganisms in soil or rhizospheres. In this study, we would proffer suggestions as to how the farmers and the authorities both at National and International level can make use of bio control agents to control pests, in order to improve Agricultural production and to reduce adverse effects of chemical pesticides to man and his environment.

Keywords: Microbes, Bio pesticides, Control agent, Food.

Abst-48

Development of Macrocyclic Scaffold with Biological Importance as Anti- HIV Agent

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Abstract

In the midst of copious infectious diseases, Acquired Immune Deficiency Syndrome (AIDS) is one of most life- threatening disease. In spite of Contemporary research and development in modern medicinal and pharmaceutical chemistry, exploration in case of anti-HIV (Human Immuno-Deficiency Virus) agent need much attention as being in category of contagious disease. Macrocyclic scaffold are macromolecule with cyclic structure having heteroatomic ring of minimum nine atoms containing three or more potential donor atoms. Supramolecular macrocycles, due to their unique architecture, easy operation and flexibility, high-intensity guest-handling capabilities, as well as flexible and modular structures, have been extensively tested for their biological effectiveness. In particular, they have been shown to be useful for designing complex structures of macrocyclic ligands and complexes for the application in various anti-viral activities, Anti – HIV/AIDS potential, anti-malarial activity based on various supramolecular macrocycles, including cyclodextrins, pillararenes, crown ether, cucurbiturils, calixarenes, and other Schiff based macrocycles. In the current study, we delineated on formation of Schiff base macrocyclic complexes using template methodology. Further, Anti- AIDS activity will also be assessed against HIV-1 and HIV-2.

Keywords: Macrocyclic Scaffold; Schiff base; HIV-1; HIV-2.

Abst-49

Functional Validation of Abiotic/ Heat Stress Responsive Genes through *Agrobacterium*-Mediated Transformation in Plant Model System *(Nicotiana tabacum)*

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Abstract

Heat stress adversely affect yield of wheat plants, to cope up with stress conditions, plants respond by overexpressing their heat stress related genes and transcription factors. Enhancement of crop productivity under various abiotic stresses is a major objective of agronomic research. Wheat *(Triticum aestivum L.)* is one of the world's most staple food crops, highly sensitive to heat stress, thereby affecting both yield and quality. Plant heat shock factors (Hsfs) play a crucial role in abiotic and biotic stress response and conferring stress tolerance. In this study, we would isolate highly heat stress responsive transcription factor from wheat cultivar HD3086, after checking the gene expression using real time PCR in wheat contrasting genotypes (HD2894 and HD3086). The candidate gene would be cloned in Pjet1.2 / blunt vector and then further in binary vector. The candidate gene would be transformed in tobacco *(Nicotiana tabacum)* model plant system via *Agrobacterium.* The transgenic tobacco plants raised would be validated for heat stress tolerance through various molecular techniques such as PCR, Dot blot and southern hybridization, further by using different physiological and biochemical assays (RWC, MDA, proline content and chlorophyll content). The gene expression would be checked in transgenic plants using qRT-PCR. At T1 generation, seeds of both transgenic and wild type plants would be germinated on MS selection media to know segregation inheritance of 3:1 (resistance: susceptible) ratio to analyze

the Mendelian inheritance pattern. For future research work, the candidate genes may be taken in same/different crop plants such as wheat/crop plants which are susceptible to heat stress for sustainable development under globally changing climate conditions.

Keywords: Abiotic Stress, Transcription Factors, Gene Expression, qRT-PCR, Transgenic Tobacco.

Abst-50

Prevention and Management of COVID-19 by Early and Accurate Diagnosis through Real Time RT-PCR

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Abstract

In the history of infectious diseases, the COVID-19 pandemic is a notable global occurrence. SARS-CoV-2 is thought to have originated in bats, but it is now highly transmissible among people, primarily through droplets or direct contact. The disease is characterized by a high temperature, cough, and lethargy, which can lead to Acute Respiratory Distress Syndrome (ARDS) resulted in Respiratory failure. Early as well as accurate detection and isolation of cases have been the bedrock for curbing the rapid spread of communicable diseases. SARS-CoV-2 has been found in the gastric mucosa, stool, urine, and saliva, and some research have revealed the detection and isolation of live virus even from stool samples. To safeguard the people from illnesses, improved personal protection and hygiene management at the community level were then formally recommended. Immunoglobulin-M (IgM) and Immunoglobulin-G (IgG) tests, chest computed tomography (CT) scan, and reverse transcription-polymerase chain reaction (RT-PCR) are some of the current COVID-19 diagnostic procedures. Among them, the real time RT-PCR is found to be more sensitive than a traditional

RT-PCR assay for effective detection of corona virus causing severe acute respiratory syndrome in clinical specimens. With a possible detection limit of <10 genomic copies per reaction, the test, which is based on numerous primer and probe sets situated in different areas of the viral genome, could distinguish SARS-CoV from other human and animal corona viruses. The purpose of this review is to show how the RT PCR test can aid in the prevention and management of COVID-19 by allowing for an early and accurate diagnosis.

Keywords: COVID-19, Reverse Transcription, Communicable diseases.

Abst-51

Designing of 3D-QSAR Model and its Validation against *Candida albincans* using Coumarin Derivatives: An in-silico Approach

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Abstract

Candidiasis is the most common fungal disease caused by *Candida* species. It has been reported that *Candida albicans* causes bloodstream infections. This species is a commensal microbe but can cause hospital-acquired infection, especially in immune-compromised patients. Coumarins are naturally occurring as well as a synthetically derived product. In this work, 40 coumarin derivatives were used to develop the 3D-QSAR model by using it biological activity. MIC values of *C. albicans* active molecules were divided into training and test and developed a regression model based on statistical values. This model provides a basis for development of QSAR of coumarin derivative. Using the generated QSAR model we have designed novel structure coumarin derivatives and designed models are validated through molecular docking and MD simulation.

Keywords: *Candida albicans,* Candidiasis, QSAR, Coumarin, MD simulation.

Abst-52

Synthesis of Pyrazole Derivatives Which can be Used as Anti-Tubercular Agents

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Abstract

Out of numerous communicable diseases, Tuberculosis is one of the life-threatening diseases after HIV-AIDS infection. Despite of having various anti-tuberculosis drugs, it still needs attention due to multi drug resistance, which creates challenges in the treatment strategy. Pyrazole is a very important 5-membered scaffold, which contain 3 carbon and 2 nitrogen atom. Its derivatives were used to synthesize many drugs and have biological and pharmacological applications such asanti-tuberculosis, antiviral, anti-inflammatory, antimicrobial, etc. In the present study, we focused on synthesizing the different derivates of pyrazole using condensation reaction, which can act as a new strategy for the treatment of Tuberculosis. Till now, we have formed the intermediates from different amines and malononitrile, which will be further used for forming the pyrazolederivates. In future, we will also evaluate its activity against *Mycobacterium tuberculosis* in order to proof it as anti-tubercular agent.

Keywords: Pyrazole; HIV-AIDS; *Mycobacterium tuberculosis*.

Abst-53

Application of Crop Residues for the Sustainable Development

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Abstract

Besides, technological advances and use of machinery gadgets for crop harvesting leave behind large quantities of crop residues, which is burnt by farmers as cheap and easiest method with misinterpretations that, burning of crop residues enhances soil fertility and helps in control weeds, insects and pests. From various studies, it is concluded that burning of crop residues result in heavy loss of organic carbon as well as soil nutrients, emits large Quantity of submicron aerosols and trace gases like CO_2, SO_2, CO and smoke, thereby facing problem to environment and human health hazards. As per Ministry of India, New and Renewal Energy, about (500 Mt) of crop residues are generated annually in India, used as animal feeding, Manure, Soil mulching, composting, uses in mushroom production etc. As such, crop residues have tremendous plant nutrients, however, a large quantity of the crop residues (about 95 Mt) is burnt on-farm and primarily to clear the field for sowing of the successive crop and farmer also burn due to shortage of labour and sources farmer can't be able to manage the residues, so they simple burn it. Crop residues also act as an alternate host for many of the insect, pest and diseases. In view of above, efforts were made to collect the data and suggest various technical and policy options for crop residue management to prohibit crop residue burning, enhancing soil fertility besides prevention of environmental degradation. The major recommendations includes, incorporation of crop residue in to the soil, adoption suitable crop rotation as recommended by ICAR or in Soil Health Care provided to the farmers, promotion of alternate competitive methods of utilizing residues in Small Scale Industries for use of crop residue/rice straw in paper/board/panel and packing

material and biomass power plants establishment in Public Private Partnership mode to ensure economic return to the farmers and sustaining soil fertility and food grains production, besides prevention of environmental degradation in the country.

Keywords: Agriculture, Soil fertility, Natural resources, Mulching, Somposting, Farmers.

Abst-54

Zoonotic Helminthes Infections: Threat to Human Health and Sustainability

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Abstract

The term Zoonosis was introduced by Rudolf Virchow in 1880. Zoonoses are the category of illness and diseases which normally communicated between animal to animals, animal to human and human to animals. Thus zoonotic disease is a type of contamination that normally contagious to human beings. The main cause of zoonotic infection is ingestion of infective phase of worms or pathogens by means of skin entrance, crude or raw and uncooked food, polluted soil, water, air, droplets, bio-bubbles and or direct contact. Approximately over 60% zoonotic infection found in human individuals leads to severe life threat and some time terminated to death of the bearing individuals as well. Zoonoses incorporate zoonotic diseases which have tremendous host range and various methods of transmission including viruses, bacteria, parasitic protozoans, parasitic helminthes, fungi, etc. Zoonotic helminths are frequent human parasites that generally complete their natural life cycle in the absence of humans. The helminthes are members of 4 broadly unrelated groups of animals including nematodes (roundworms), cestodes (tapeworms), trematodes (flukes), and acanthocephalans (thorny-headed worms). Some of the most important and well-known human zoonoses are caused by worm or helminth parasites (Zoonotic helminthes infection, ZHI), including species of nematodes (trichinellosis), cestodes (cysticercosis, echinococcosis) and trematodes (schistosomiasis). Others include intestinal capillariasis, anisakidosis, eosinophilic enteritis, oesophagostomiasis and gnathostomiasis. To combat spreading of zoonotic illnesses, appropriate awareness programs about the zoonotic infections or zoonoses ought to be given among the butchers, domesticated animals proprietors, animal handlers, farmers, medical officer or clinical official and veterinarians. Zoonoses are generally successive and feared hazard to which human beings are exposed. These diseases variable level of causes and illness may terminate to death as well. These diseases can be cured at certain extent using proper preventive and therapeutic measures and some of them can be completely cured by vaccinations as well.

Keywords: Helminthiasis, Zoonoses, Parasitic helminthes, ZHI, Human Health, Zoonotic diseases.

Abst-55

Emerging Diseases of Some Reptiles with Special Reference to Snakes: Serious Threat to Snake Biodiversity and Sustainability

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Abstract

Snakes are found everywhere in the India. There are big 4 poisonous snakes found in India andother than these are usually non-poisonous. But due to fear of snakes and snake venome, peoples continuously killing them, if seen in their housing area. This type of unawareness andfear among societies populace responsible the biodiversity loss of snakes in the naturalenvironment. Along with theses, some bacterial diseases are very common in all reptiles. The septicemia is a common cause of death in most of the reptiles including snakes because ofmultiple bacterial and fungal pathogenic infections. Liver necrosis and abscessation is also very common among them. Ulcerative dermatitis (scale rot) is seen in snakes and lizards due to occurrence in unhygienic conditions with excessive humidity and moisture. All these attributes including: human fear and snake killing behavior, natural, pathogenic and environmental factorsconsecutively resulting in to a serious threat to snake biodiversity and its sustainability. As weknow that all the biological creature of this world is in food chain so it is our duty to be very careful for maintain all in live condition. This target can be achieved by the awareness to societies and populace about poisonous and nonpoisonous nature and their identification. Therefore, the objective of this talk is to save the life of all creatures for happy, healthy life and environment.

Keywords: Diseases, Reptiles, Septicimea, Snakes, Poisonous, Nonposonous, Biodiversity.

Abst-56

Ethnobotanical and Pharmacological Studies of Pteridophytes (Ferns) from Mussoorie Region, Dehradun District, Uttarakhand

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Abstract

The present paper highlights the traditional knowledge of ferns related with the use as ethno medicine. Extensive field trips were conducted in order to collect the ethnobotanical information of Mussoorie region. The data related to ferns used as ethnomedicine was collected by interaction with local people of the area. Information included local name, part used, disease treated, mode of administration and methods of preparation. Total 107 species were observed during this investigation belong to 41 genera and 23 families of pteridophytes. The present article gives a brief account of 34 plants species out of 107 species reported used as herbal remedies by local people. The pteridophytes have immense pharmacological significance such as *Woodwardiabi serrata* C. Presl., *Pteris vittata* L. Used in the treatment of diarrhea; Adiantum venustum is the single species has wide specturum which is used in different disease such as cough, fever, tumour, amtimicribial activity and for wounds, *Polystichum squarrosum* (D. Don.) Fee and *Pteris cretica* L. Show antibacterial activities; *Athyrium pectinatum* (Wall. Ex Mett) T. Moore; *Dryopteris caroli-hopei*. F Jenks are anti-heleminthic in activity; while *Asplenium adiantum-nigrum* is used in eyes, jaundice, cough, etc. Pteridophytes are used in Homeopathic, Ayurvedic, and Unani medicines and provided insecticides, antibiotics, food and ornamentation but due to habitat destruction by more than 10% of the 1200 fern species has become endangered. Therefore, the habitat conservation or in-situ conservation of fern life to maintain ecological balance is very essential. The study will be helpful in the correct assessment regarding the extent of infra specific, morphological variation, ecological relationships and distribution of pteridophytes and finally for making conservation strategies.

Keywords: Ethnomedicinal, Pharmacological, Homeopathic, Ayurvedic, Unani, Pteridophytes, Mussoorie, Uttarakhand.

Abst-57

Legal Initiatives for the Effective Environmental Governance and for the Sustenance of Sustainable Development in India

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Abstract

The word, Sustainable Development, has come in to existence from Rio Declaration (1992). But, if anyone could trace the history of the Indian culture, it can be observed that the practices we have been doing from time immemorial are towards Sustainable Development. Unfortunately, due to the introduction of western culture in to our system, it has slowly changed into consumerist culture: from the repair to remove, replace to use and throw culture. To speak strictly and judicially, even though the Sustainable Development principle has come into existence since Rio Declaration (1992), it wasin the form of soft law only, which is judicially non enforceable and non-obligatory on the part of signatories. It is needless to say India was also a partner for the Declaration; the soft law was given hard law status in India by Hon. Supreme Court in its land mark judgement in the Vellore Citizen Welfare Forum vs Union of India case in 1996. For the effective Environmental Management three "E's" are essential vide Engineering, Education and Enforcement. In Engineering point of view, to attain the sustainable development we have to have a comprehensive look and control of all the sources and types of pollution through technological input and ways and means. It is highly imperative to blend the scientific principles into the engineering and develop technology to control and manage the pollution both at the source and end pipe treatment with clean development mechanism where it is possible. The second "E" is Education –namely creating an awareness and sensitizing the people the importance of pollution control, changing the life style and behaviour of the people and practice more eco-friendly methods. In fact, Hon. Supreme Court, in one of its land mark judgements made

Environmental Education as one of the compulsory papers in college and University curriculum irrespective of the branch of study, with the same syllabus throughout the length and breaths of the country. Finally, with reference to third "E"namely Enforcement the laws play good amount of role in managing and controlling the Environmental pollution and Environmental Protection. Laws are the tools in the hands of the enforcement agencies to control and combat the pollution. Again, for the purpose of enacting the laws the Constitution has given room for the legislature. In this connection it can be very proudly said that India is one among the few countries in the world where the Environmental Protection is given the Constitutional status. We have enacted a plethora of Environmental Legislations in the last two decades in addition to the Indian Penal Code for the effective environmental management. Apart from this Legislature, Executive, the third arm and pillar of the democracy namely Judiciary, also played a very active role and paved the way for the emergence of environmental Jurisprudence. In my paper, I am going to discuss how far the Sustainable Development has been given a hard law status by the Judiciary; and more so, the higher judiciary innovatively interpreting the Constitution elevated the Environmental Right in to a Constitutional Right from the ordinary simple public nuisance under the IPC. Apart from that the judiciary, certain principles and doctrines have been ingrained into our Environmental Jurisprudence. In spite of all these, we could not achieve the requisite or expected target, why? Apart from this, the global concern for environmental crisis has led to the evolution and remarkable growth of international environmental Law.

The analysis has been made under twelve headings:

The different principles of International Environmental Law;

The Legal Status of General International Environmental Principles;

The various concepts and Principles of Sustainable Development;

Right to Development – Human Right;

Role of Human Rights Law in the Protection of Environment and the advantages and disadvantages of Human Rights Approach;

Treaties concerned with Third Generation Rights;

International Law and the Indian Constitutional Scheme;

International Law and the distribution of Legislative power;

International Law and the Constitutional Duty; and

International Law and Indian Courts

The Judicial adoption of international environmental law into domestic law in India has not been done overnight. In order to understand the Judicial process of such adoption, it is important to understand a blend of technological solution with Economic, ecological and legal regime together with political will, public participation and professional ethics. Together, they can solve the Environmental problems effectively and for the sustenance and effective management of Sustainable Development.

Keywords: Environmental governance, Waste management, Environmental laws and legality.

Abst-58

Understanding the Preliminary Progression of COVID-19 through Case Fatality Rate: From Indian Perspective

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Abstract

This manuscript tries to encapsulate preliminary data of first 100 days related to COVID-19 disease in India, tobring out insight visualization of the pandemic, so that needed steps can be taken timely, to tap the dynamics ofthis infectious disease. Matrix plots have been drawn to describe the trend of confirmed deaths and new caseson daily and cumulative basis. Double Exponential Smoothing Model has been fitted on collected data and itadditionally forecasted the death trend for next 100 days in India. Case Fatality Rate has been reviewed ascritical metric to understand the dynamics of COVID-19 and its dependency has been chalked out with Multi-Regression Model. The prediction model has forecasted more than 4,000 confirmed deaths till the end of July 2020, which can exponentially increase further. Case Fatality Rate of India has risen from 0 to 3.2 within 28 days and should be taken care of, to restrict this pandemic. Moreover, a negative relation of Fatality Rate with Maximum Temperature and Average Humidity has been erupted from the model. Present study observed aquadratic relation with time (Days), which confirmed the COVID-19 as a highly communicable disease and alsoproved that 'Total Tests Performed' is a serious factor to reduce CFR. It depicts a live forecasting practice with conceivable inferences for planning and decision making. It also implicates behavioural exploration of Case Fatality Rate with respect to some quantitatively important factors as far as Indian scenario isconcerned.

Keywords: SARS-CoV-2, Pandemic, Trend analysis, Multi-regression modeling , CFR.

Abst-59

Polymeric Nano Particles of Various Drugs: Tremendous Therapeutic Potential against Breast Cancer

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Abstract

Cancer is the uncontrolled growth of abnormal cells in the body, forming malignant tumors, and invades nearby parts of the body. Tumors that stay in one spot and demonstrate limited growth are generally considered to be benign. When a tumor successfully spreads

to other parts of the body and grows, invading and destroying other healthy tissues, it is said to have metastasized. This abnormal behavior arises out of the activation of certain specialized genes called proto-oncogenes to oncogenes in the presence of physical, chemical and viral carcinogens. Deaths from cancer worldwide are projected to continue rising, with an estimated 11.5 million deaths by 2030. Breast cancer is a cancer that starts in the tissues of the breast and noticed as most challenging threat to women life. Cancer control strategies include early detection, treatment and palliative care. The present cancer therapy should be based on the philosophy, "even a single cancer cell should not remain untreated in the body and nothing less than complete elimination of tumor from an individual can be accepted". The existing therapies have many extreme draw backs that affect adversely to the normal fast dividing cells of the body. The most common side effects include cardiotoxicity, hepatotoxicity, nephrotoxicity, ototoxicity, anemia, abour-compromising system, hemorrhage, erythema, diarrhea or constipation, hair loss, memory loss, dehydration, hematoma, dry mouth/xerostomia and sexual impotence etc. Keeping in mind these shortcomings of the available therapeutic strategies, the development and therapeutic application of polymeric nanoparticles for various drugs was tested against breast cancer and found to be many time significantly effective without and relevant side effects.

Keywords: Polymeric nanoparticles, Breast Cancer, Oncogens, Metastasis, Anticancer.

Abst-60

Artificial Light Influencing the Physiology, Behaviour and Molecular Changes on Indian Avian Fauna

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Abstract

In nature, the daily light period changes occur across the seasons. A critical day length (threshold photoperiod) is referred to as the 'minimum' day light period that will induce a photoperiodic response to half-maximum. This study was done in an experiment, to determine that artificial photoperiod (street light) disturbing the life pattern (sleep-wake cycle) and physiology of Indian avian fauna especially passerine birds. Blackheaded munia were exposed to various day lengths (9, 10, 11, 12, 13, 14, 15, 16 h) and with a particular time interval, different physiological parameters body mass (BM), molt (full body molt primaries), temperature (Body and thermal scanning), and Gonadal size (cloacal protumberance and growth) were observed, for blood profiles time to time blood samples were collected. The body molt, Molt primaries and testicular volume in L. malacca L. malacca were not changed in Short day length SD (9-13 h) photoperiods but in longer the day length LD (14-16 h) photoperiods, significant changes were observed; thus the critical day length for this avian species is 14 h. This experiment shows that the *Lonchura malacca* going to be adapting in residing of long photoperiodic response i.e. 14 h continuous light for critical day length.

Keywords: Critical day length, street light, Threshold photoperiod, Short day, Long Day, Body molt, Molt primaries, Cloacal protuberances and Testicular volume.

Abst-61

Acute Toxicity of Heavy Metals, Cadmium and Copper in Indian Major Carp, *Catla catla* Fingerlings

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Abstract

Industrial effluents are the major sources of heavy metal pollution and it is released into fresh water bodies. Under certain environmental conditions like the metals can accumulate to toxic concentrations and cause ecological damage. Heavy metals cause several ill effects to aquatic ecosystem and organisms including fish. Probit analysis is a type of regression used to analyze binomial response variables. Probit analysis is commonly used in toxicology to determine the relative toxicity of toxicant or pollutant to living organism. The acute toxicity of chosen metals (Cadmium and Copper) against Indian major carp, *Catla catla* for 24, 48, 72, and 96hr were determined by probit analysis method. The LC50 for 24, 48, 72 and 96 hours for $CdCl_2$ and $CuSO_4$ were found as 9.585, 7.463, 6.334 and 4.823 mg/L and 16.820, 13.912, 11-146 and 8.993 mg/L, respectively. The result also revealed that mortality rate depends upon concentrations of heavy metals and duration of exposure. Among the toxicants selected; $CdCl_2$ is more toxic than $CuSO_4$ in fresh water major carp. So, in order to derive sublethal concentrations and to evaluate the response of the fish at sublethal concentrations, LC50 values are of prime importance in today's changing scenario of aquatic pollution. Thus study on toxicity of heavy metal, cadmium and copper on fishes will be very useful to provide a future understanding of ecological impact.

Keywords: Probit analysis, LC50, Cadmium, Copper, *Catla catla.*

Abst-62

A Study on HPTLC Quantification for Quality Control of Myricetin a Nutraceutical from Different Plant Parts of *Myrica esculenta* Linn

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Abstract

The present study was performed to report the quantification of myricetin present in different extracts (i.e. ethanol, methanol, petroleum ether, chloroform and aqueous extract) of root, leaf, bark, stem and seed of *Myrica esculenta* using TLC densitometric method. Densitometric scanning was performed at 366 nm for the determination and quantitation of standard compounds. The compact spots were achieved at Rf 0.67 corresponding to myricetin. The content of myricetin present in different solvent extracts of *M. esculenta* was 0.2159 ± 0.002% w/w, 0.3139 ± 0.003% w/w, 0.0184± 0.004% w/w, 0.0139 ± 0.003% w/w and 0.2120 ± 0.005% w/w in ethanolic, methanolic, petroleum ether, chloroform and aqueous extract of *M. esculenta stem*, stem, bark, leaf and leaf plant parts, respectively. The highest myricetin content was found in the order of methanolic stem extract>ethanolic stem extract>aqueous leaf extract>petroleum ether bark extract>chloroform leaf extract of *M. esculenta.* The developed HPTLC method was a precise, simple, convenient and accurate for screening of large number of active compounds present in various solvent extracts. Thus, the study concluded that the developed HPTLC method for quantification of myricetin can be used for a routine quality check and analysis of any formulation and composition containing *M. esculenta.*

Keywords: Quantification; *Myrica esculenta*; Myricetin; Quality; Formulation; TLC; Densitometric method; HPTLC.

Abst-63

Prevalence of Different Species of Ticks on the Domestic Animals in Few Villages of Chamarajanagar District

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Abstract

Ticks are the ectoparasites which belong to the largest group of the invertebrates phylum Arthropoda. Ticks belong to the three different families of the class Arachnid. Ticks can be carrier of any pathogens which they transmit from host to host during sucking blood and causes a large variety of disease. Thus present study has been conducted to know the prevalence of ticks, collection, identification and rate of infestation on different domestic animals in few villages of Chamarajanagar district. This study was conducted in two taluk's of Chamarajanagar District namely Chamarajanagar and Yalandur. The survey was conducted from February 2021 to June 2021. The collection and identification of the ticks were done using standard methods. The overall result shows that the prevalence rate was more in cows (61.42%) followed by goats (50.63%), sheep (48.57%), buffalo (39.63%) and ox (37.03%). The ticks were identified on basis of their morphological features. The identified ticks is mentioned according to the rate of infestation namely *R. microplus* (29%), *H. longicornies* (18%), *R. annulatus* (16%), *Hyalomma truncatum* (13%) *H.punctata* (9%) *A. varigatum* (9%) and *R. decolaratus* (6%) respectively. R. microplus was identified as the dominant species of tick due to its highest rate of infestation. The present study is a preliminary research on the prevalence of the ticks in the study area. Further researches on the preventive measures, awareness on the zoonotic diseases caused by the ticks have to be taken.

Keywords: Ticks, Ectoparasites, *R. microplus, H. longicornies.*

Abst-64

Growth Performance and Immune Response of *Oreochromis niloticus* L. With the Effect of Marine Macro Algal Fish Feed: *Halymenia floresia* (Clemente) C.Ag.

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Abstract

Fish aquaculture has currently taken a pre-eminent position. The demanding situations confronted via way of means of the fish farmers are the cost of the fish feed and health issues for fish. Marine macro algae synthesize a huge variety of chemical compounds that could assist to shield in opposition to the infectious diseases. This study was designed to analyze the impact of *Halymenia floresia* (Clemente) C.Ag. as substitute of fish meal to promote growth and immune response of *Oreochromis niloticus* L. The proximate analysis includes the content of the total carbohydrates, total fibre, total proteins, total lipids, moisture and ash showed 39.16%, 4.95%, 7.48%, 4.48%, 8.86% and 38.06% respectively. Five unique types of experimental food regimen categorised as T1, T2, T3, T4 and T5 were prepared and enhanced, which classified consistent with the percentage of algal powder, via T1 (Control), T2 (10%), T3 (20%), T4 (30%) and T5 (40%). The average weight gain, average length, specific growth rate and value of condition factor (K) for T4 was observed to be maximum at the same time as the feed conversion ratio (FCR) of this treatment was found to be the lowest, with the ninety days of rearing period. Red blood cells (RBC), White blood cells (WBC), haemoglobin (Hb), hemotocrit (HCT), Mean corpuscle volume (MCV), Mean corpuscle haemoglobin (MCH) and Mean corpuscle haemoglobin concentration (MCHC) were all assessed to evaluate the immunological response of *Oreochromis niloticus* L. Results observed from these tests, T5 has the highest RBC and WBC count along with other blood parameters. The pathogen *Vibrio cholerae* causes major health problems in *Oreochromis niloticus* L. *Halymenia floresia* (Clemente) C.Ag. have the capability to active against *Vibrio cholerae* and analyze the maximum inhibition zone in T4. The consequences of this research work revealed that *Halymenia floresia* (Clemente) C. Ag. Had the potential source of positive impact on growth and immune system of *Oreochromis niloticus* L.

Keywords: *Halymenia floresia, Oreochromis niloticus, Vibrio cholerae,* Proximate, Fish feed.

Abst-65

Medicinal Plants Used for the Treatment of Tuberculosis

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Abstract

Tuberculosis is an age old, most commonly notified contagious disease and patients are suffering from illness, it is a serious bacterial disease that mainly affects the lungs. One third of the world's population is infected with tuberculosis. Tuberculosis is caused by *Mycobacterium tuberculosis*. Increase concern has been observed because the causing organisms of this disease become Multi-drug resistant. Multi-drug resistant tuberculosis appears due to low adherence to prescribed therapies, and at least 20 months of treatment, more toxic and decrease efficient drugs i.e. Kanamycin, amikacin, capreomycin, fluoroquinolones. So that we need urgent discovery and development of new drugs to reduce the global burden of this disease, including the multi-drug resistant tuberculosis.Many plant species, Marine organisms, fungi has been and continue to be used in various traditional healing systems to treat tuberculosis, and representing unlimited source of active ingredients. Natural products show antimycobacterial activity and can be useful in adjuvant therapy to improve efficiency of conventional antimycobacterial therapies. Crude acetone, methanol, hexane and ethanol extract obtained from some medicinal plants in South Africa. The given extracts show the ability to inhibit *Mycobacterium tuberculosis* H37Ra and a clinical strain resistant to first-line drugs and one second-line drug determine the minimum inhibitory concentration by using tetrazolium microplate assay. Tuberculosis is a serious threat as *Mycobacterium tuberculosis* produced resistant against both the first and second line drugs. Identifying plants uses and testing their extracts against multi-drug resistant strain, intracellular *Mycobacterium tuberculosis* as well as against dormant *Mycobacterium tuberculosis*. The acetone extracts of *Berchemia discolour, Bridelia micrantha, Terminalia sericea* and *Warbugia salutaris* found important sources of mycobacterial compounds against multidrug resistant *Mycobacterium tuberculosis.*

Keywords: *Mycobacterium tuberculosis*, Multi-drug resistant, Contagious disease.

Abst-66

Taxonomical and Ethnomedicinal Studies of *Ficus racemosa* L.

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Abstract

Ficus racemosa commonly known as Gular or Cluster Fig is belonging to family Moraceae of class Dicotyledonae. The study of *Ficus racemosa* showed that ethanomedicinal and medicinal value at Forest Research Institute (F.R.I.), Dehradun (Uttarakhand) India. The plant profoundly used in Ayurvedic medicine to cure various diseases such as ulcers, fever, leprosy, vomiting, dysentery, syphilis and inflammation of liver. *F. racemosa* roots, leaf, stem and fruits contain antibacterial, anti-oxidant, anti-diabetic, anti-inflammatory, anticancer, antimicrobial and immunomodulatory effects. During dry winter season *F. racemosa* tree leaves are important fodder sourcein the Himalaya region of India, Nepal, Bhutan and Bangladesh. During exploration, minimum leaf size 10x12 cm^2 and maximum size 10x14cm^2 were observed. The fig size of *F. racemosa* ranged between 2 mm to 2.5 mm.

Keyword: *Ficus racemosa*, Gular, anticancer, F.R.I., Dehradun, Moraceae and Dicotyledone.

Abst- 67

Ethanomedicinal and Taxonomical Study of *Bambusa tulda* in New Forest Dehradun

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Abstract

Bamboos are generally tall, erect and woody arborescent grasses. They are mainly distributed in the tropical and subtropical regions of the world. Bamboo grows three times faster than most other plants species. *Bambusa tulda* belongs to Poaceae family and the subfamily Bambusoideae. *Bambusa tulda* also known as Indian timber bamboo, is an evergreen in nature. Its shoots contain high nutritional contentsand polyphenols which show medicinal properties to cure cardiovascular diseases and some types of cancer. High demand for edible bamboo shoots of *Bambusa tulda* in many Asian ethnic groups has led to the need for developing intensive bamboo farming. The present studies based on survey done at New Forest, Forest Research Institute (FRI), Dehradun (Uttarakhand) India, the minimum leaf size (L×B) of *Bambusa tulda* is 19 x 2 and maximum leaf size 21 x 2.Clum height of *B. tulda* is (LxB)~ 15-20 and height of clum sheath(LxB) is 30 x 30.

Keyword: Poaceae, *Bambusa tulda*, Bambusoideae, Shoot, FRI, Dehradun

Abst-68

Significant Value of Fermented Foods to Control Ovarian Disorders

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Abstract

Ovarian disorders causesdue to hormonal imbalance or endocrine disorders in females which causes disturbances in their reproductive organs and their overall health. They are generally occur when egg fails to release from the follicle in the ovary which forms small cysts on the surface of an ovary or both ovaries and when theses cysts increases in number inhibits the growth of follicle normally and cause in severe problems like irregularities in menstrual cycle , heavy bleeding in menstruation and pain in pelvic and abdomen, always feel bloated, acne and allergy problems male pattern baldness, excessive growth of hair on face and moreover, infertility in women. There are various types of ovarian diseases or disorders such as Endometriosis, cysts such as polycystic ovarian disorder, ovarian epithelial cancer, polycystic ovarian syndrome, ovarian low malignant potential tumors and ovarian germ cell tumors. It happens because pituitary glands secret more androgens [male hormones] than female hormones in females

body which leads to imbalance hormones another reasons could be hectic lifestyle unhealthy eating habits and sometimes this could be genetic problem. According, to 2019 survey within Indian subcontinent about 20% (one in five) female suffers from one of the symptoms of ovarian disorders. If these symptoms are noticed at earlier stage could have serious impacts. Said by Gynecologists Dr. Duru Shah, founder of Polycystic ovary syndrome (PCOS) Society of India also indicates to draw attention if there is lot of hormonal issues such as acne, excessive hair fall, irregular periods and hirustism.

Keywords: Ovarian disorder, Endocrine disorders, Endometriosis, Hirustism, Follicle, Androgens, Pituitary glands.

Abst-69

Screening and Evaluation of Chromium (VI) Tolerant Microorganisms from Soils of Industrial area from Ranipet, Tamilnadu

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Abstract

Bioremediation and reclamation of Chromium contaminated soils for agricultural purposes is a challenge. Tanneries and chromium processing industries lead to agricultural environment pollution and soil degradation. Current work focused onscreening and evaluation of naturally adapted chromium resistant microbial population from highly polluted industrial area in Ranipet, Tamilnadu. In the present study a total of forty three Cr (VI) tolerant bacterial isolates were isolated, ten were identified, isolated and shortlisted based on their morphological characteristics for further studies. This study was conducted by minimum inhibitory concentration (MIC) of chromium (VI) with varied concentrations (100mg/L, 200mg/L, 300mg/l, 400mg/L and 500mg/L) and to determine their ability to tolerate different chromium concentrations. Isolates were identified based on morphological and biochemical characteristics. Minimum inhibitory concentration (MIC) serves a lowest chemical concentration required to suppress the visible growth of microorganisms on agar diffusion method. In this study chromium tolerance was studied using Potassium dichromate salt with varied concentrations in Luria Bertani agar (LBA) medium. Selected isolate discs supplemented with increasing concentration of chromium (100mg/L, 200mg/L, 300mg/l, 400mg/L and 500mg/L) were placed on LBA medium plates.100% growth was seen with all 10 isolates till 400mg/L. Isolates CRS – 3 and CRS- 2 showed resistance at 500mg/L to act as a potent bacterial strain.

Keywords: Chromium tolerance, Minimum inhibitory concentration, Pollution, Degradation.

Abst-70

Bioremediation of Cr from Synthetic Wastewater Using Bacterial Isolates

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Abstract

Heavy metals are known to persist in the environment and become a risk for organisms. Micro-organisms are present in industrial effluents. They have adopted different strategies to cope up with the harmful effects of these metals. One such strategy is bio-sorption which is binding of metal ions with metal binding proteins present on the cell wall. Bio-sorption is exhibited by bacteria, algae, fungi and yeasts. Not only living organisms, but also residuals of dead bodies of microorganisms shows bio-sorbent properties like agricultural wastes including husk, seeds, peels and stalks of different crops. Physio-chemical methods like electrochemical treatment, ion exchange, precipitation, reverse osmosis and sorption for heavy metal removal from waste stream are not cost effective, hence biological approach for heavy metal removal may be considered as an alternative approach. Cr(VI) represents a serious threat to human health, living resources and ecological system as it is persistent, carcinogenic and toxic, whereas, Cr(III), another stable oxidation state of Cr, is less toxic and can be readily precipitated out of solution. The conventional methods of Cr(VI) removal from wastewaters comprise of chemical reduction followed by chemical precipitation. However, these methods utilize large amounts of chemicals and generate toxic sludge. This necessitates the need for devising an eco-technological strategy that would use the untapped potential of the biological world for remediation of Cr(VI) containing wastewaters. Among several viable approaches, biotransformation of Cr(VI) to relatively non-toxic Cr(III) by chromium resistant bacteria offers an economical and environment friendly option for its detoxification. Various studies on use of Cr(VI) tolerant viable bacterial isolates for treatment of Cr(VI) containing solutions and wastewater have been reported.

Keyword: Heavy metal, Bioremediation, Biotransformation, Chromium, Toxicity.

Abst-71

Biochemical Changes during Solid State Fermentation of Wheat Crop Residues by *Aspergillus flavus* (Link) and *Aspergillus niger*

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Abstract

The biochemical changes during solid state fermentation of the different components of wheat residues by *Aspergillus flavus* (Link) and *A. niger* were assessed. The samples of decomposing wheat internodes, leaves, chaff and straw were collected at different stages of decomposition for 40 and 60 days. The samples were subjected to biochemical analysis and the results were compared with non-decomposed initial samples. The fungus *Aspergillus flavus* causes maximum decomposition of leaves (19.62%, 32.86%), followed by straw (18.40%, 24.02%), chaff (15.58%, 18.94%), and internodes (08.19%, 10.57%). The contribution of different fractions to the lossbeing Fat and Waxes, Simple sugars, amino acid, peptides, minerals hemicellulose, , cellulose, lignin and pectin in wheat internodes during first 40 days. The major proportion of decomposed component comprised ofwater-soluble fractions and cellulose in case of leaves. In the next 20 days, the rate of decomposition increased so that asmuch as 13.24% loss in the dry weight of leaves occurred during thisperiod.Wheat chaff and straw observed to the loss of hemicellulose, cellulose and pectin. *Aspergillus niger* caused maximum loss in the weight of leaves (20.12%, 34.95%) after 40 days and 60 days respectively in vitro followed by that in mixed straw (16.80%, 25.33%), chaff (13.30%, 23.33%) and internodes (9.85%, 15.39%). The loss in the dry weight of internodes after 40 days of decomposition was mainly due to the degradation of hemicellulose, and cellulose; and to a reasonable extent due to the loss of pectin, other fractions also contributed to the decomposition in slight quantities. Other components leaves, chaff and straw also show same trends in biochemical changes during 40 and next 20 days of decomposition. Lignin also decomposed only slightly during this period. Many useful facts are uncovered by performing suitable Descriptive and Inferential Statistics. This study also has a socio-economic relevance to manage the agricultural residues, asa valuable natural resource.

Keywords: Wheat internodes, Leaves, Chaff, Straw, *Aspergillus flavus, A. niger,* Solid state fermentation.

Abst-72

A Review on Mucormycosis: From Symptoms, Causes, to Ethnomedicinal Therapeutic Approaches

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Abstract

Mucormycosis is a rare fungal infection. This is a serious disease and if treatment not done quickly at first stage patients could die. Black fungus infect the people when immune system affected by coronavirus because uses of steroids in COVID-19 treatment. The purpose of this study is to evaluate the possible therapeutic approaches for the treatment of mucormycosis. This review is based on the current data after the COVID-19 treatment; the peoples affected with black fungus diseases. In mucormycosis acceptable drug is Amphotericin B for the treatment. Alternative therapies were used for treatment of black fungus using traditional herbal plants due to their antifungal properties according to Auyverdic guidelines. Traditional herbal plants have antifungal and medicinal properties for treatment for both human and animal mycoses. We have focused on traditional plants on their antifungal properties against pathogenic fungi. *Azidarachta indica* (Neem), *Datura stramonium* (Datura), *Zingiber officinale* (Ginger), *Curcuma longa* (Turmeric), *Withania somnifera* (Ashwagandha), *Tinospora cordifolia* (Giloy), *Cannabis sativa* (Bhang) and *Syzygium aromaticum* (Laung) are widely use of traditional plants are the immunity booster. Plants have biological functions; they produced secondary metabolites chemicals which have antifungal and antimicrobial activities.

Keywords: Mucormycosis, COVID-19, Fungus, Amphotericin B, Herbal plants, *Tinospora cordifolia.*

Abst-73

COVID-19 Impact on Women's Health Especially in Barwani District of Madhya Pradesh, India

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Abstract

Barwani is situated on the south-west part of Madhya Pradesh along with Holy River Narmada is its northern border and Satpuda in South and Vindhyachal in North forest ranges. It was carved out of West-Nimar, Khargone district and formed on 25th May 1998. The name Barwani originated from the forests of Bad which had surrounded the city in old times, Wani is the old word for the Garden. Hence the city is known as Barwani, which means the Garden of Bads.The commonest causes of death in women are now heart disease, stroke, chronic respiratory diseases, chronic kidney disease, and diabetes. Importantly, in women pregnancy related complications during COVID-19 like gestational hypertension and diabetes and kidney injury – increase the risk of developing NCDs in the affected women and their babies, which suggests the need to expand the focus, and develop a life course approach to dealing with women's health issues. The aim was to document COVID-19 impact on women's health especially in Barwani district of Madhya Pradesh, Indiahealth system related explanations for these disparities and develop approaches to overcome these.

Keywords: COVID-19, Barwani, Narmada river, Satpuda, Vindhyachal.

Abst-74

SARS–CoV-2: A study on Variant of Concerns, Variant of Interests and Vaccines

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Abstract

SARS-CoV-2 much like any other virus has genetic variants that have been circulating around the world since the beginning of the pandemic. On average, the virus evolves at a rate of 1.1 x 10^3 substitutions a year which is about once every 11 days. Multiple variants have been documented and these variants have been classified based on their transmissibility and the severity of the disease caused. Based on this, the WHO classifies them as Variants of Concern (VOC), and Variants of Interest (VOI). These variants often play an important role in the production of vaccines as there is evidence of an increase in transmissibility, severity, a reduction in neutralisation by antibodies already present in the body, reduced effectiveness of treatments or vaccines, or diagnostic detection failures among variants. Current analysis and studies by WHO recognizes 4 VOCs and 2 VOIs, however, as time passes and the virus accumulates more mutations, the chances of more variants being identified thus affecting the overall ethicacy of the vaccines and the vaccine production process as a whole. The paper highlights the VOIs and VOCs, the importance and impact of the variants and vaccine production and efficacy.

Keywords: SARS-CoV-2, Variants of Concern, Variants of Interest, Vaccines.

Abst-75

Path from Coping Strategies to Eradication of Malaria in India

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Abstract

India has a long history of success and struggles with malaria control. It currently accounts for 4% of the global malaria burden. Malaria is highly endemic in rural and tribal areas, Odisha having amongst the maximum cases. To achieve our common goal of zero indigenous cases by 2030, we need to take major steps towards diagnosis and treatment, strengthen surveillance and accelerate elimination. RDT's are widely used for diagnosis but for higher accuracy and specificity hemozoin-based magneto-optical detection device (Gazelle) and real-time micro-PCR are good alternatives. Children below age 5 and pregnant women are the vulnerable groups which need proper treatment and medication specific to species *Plasmodium vivax* and *P. falcipuram*, otherwise it can lead to resistance for drugs in the long run. Asymptomatic malaria poses a serious threat if proper attention is not warranted in children; they may act as a key reservoir of malaria infection. There is a need to develope new antimalarial drugs and modifying existing ones as they attain resistance when used for few years for example chloroquine. Today we use antimalarial drugs (sulfadoxine-pyrimethamine and mefloquine). For *P. vivax,* a 14-day course of primaquine (gametocidal drug) or Directly-observed therapy (DOT) is recommended. Further, vaccine could be a miracle but we haven't found it yet as there is limited idea regarding how a person develops Immunity against malaria. For vector control and prevention we use Long Lasting Insecticidal nets (LLINs) but these are uncomfortable therefore; Zero vector durable lining (ZVDL) are good alternatives. The role of communities like Accredited Social Health Activists (ASHA), unlicensed medical practitioners (UMP) and our media plays a important role in spreading awareness, providing basic medical help in remote areas. If we all come together and do the needful we can surely achieve our endeavour of eliminating malaria from India on time.

Keywords: Endemic, RDT's, Asymptomatic, Antimalarial drugs, Prevention.

Abst-76

Sophorolipids and their Antimicrobial, Medical and Various Industrial Applications

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Abstract

Sophorolipids are particular type of surface active glycolipids that's synthesized from a certain number of selected yeast species and bacterial species. For more than four decades, known sophorolipids have been the focus of research for biotechnology students and researchers, as they have characteristics involved non-ecotoxic, biodegradability and recyclable organic matter. Due to the antimicrobial activity of sophorolipids, they are considered to be capable of building active resistance against harmful viruses, bacteria, fungi and other microorganisms. Other than its anti-dot for diseases caused by microorganisms can be used. In addition to the microbial applications of sophorolipids, the pharmaceutical industry exists in top of the list and the cosmetic as well as petroleum industries also its multifaceted uses. As a natural biological molecule, various universities and research institutes are working tirelessly to ensure its maximum use, including innovating new utilizations. In this paper it will be explain all possible uses or applications of sophorolipids and future possibilities.

Keywords: Glycolipid, Synthesized, Ecotoxicity, Biodegradability, Sophorolipid.

Abst- 77

Permanent Petal Closure Enhances Reproductive Output of *Merremia vitifolia* (Burm. F.) Hallier F. (Convolvolaceae)

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Abstract

Flower closure is a non-morphological floral trait that plays an important role in reproductive success during the lifespan of a flower. Movements of floral petals include both temporary closure and permanent closure of flowers. Angiosperms exhibit wide range of variation in floral closure and is considered important in facilitating self- and/or outcrossing pollination. Plants exhibit floral closure in response to various environmental conditions viz. Dew, rain, temperature, wind and limited pollinators to protect reproductive organs. Pollination and successful fertilization induces petal closure to minimize the energy cost related to reproductive fitness andalso reduces intraspecific competition among un-pollinated flowers. *Merremia vitifolia* (Burm. F.) Hallier f. (family: Convolvulaceae) is an ethnomedicinally important perennial, climbing plant with twining stems can be 2.5–6 meters long and is used in traditional medicine to treat various ailments including rheumatism, headache, fever, jaundice, urinary diseases and dysentery. In the present study, we investigated the effect of floral closure on the pollen viability and reproductive success of *M. vitifolia.* We experimentally manipulated the flowers with a wire to prevent permanent floral closure. We observed that the un-pollinated flowers remained open for a longer period of time compared to pollinated flowers because the greater floral longevity may increase the chances of pollination and successful fertilization.The flowers of this plant were mostly visited and pollinated by bees and flies. Further, experimentally treated flowers showed pollen viability compared to naturally closed flowers. The present finding suggests the floral closure is an important non-morphological trait that enhances the reproductive output (fruit and seed set) by providing protection to floral organs and maintaining suitable microenvironment inside the corolla tube.

Keywords: Convolvulaceae, Floral closure, *Merremia vitifolia*, Pollination, Reproductive success.

Abst-78

Medicinal Mushrooms: A Potent Immunity Booster, Antiviral and Anti-Covid-19 Agent

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Abstract

Coronavirus (SARS-CoV-2) is a pathogen that has claimed many lives all over the world. Following the pandemic's revelation, it infected a large number of people and resulted in significant mortality in numerous nations. The prevalence of the disease, particularly in persons with weakened immune systems and those with chronic disorders, has brought to the fore several immune-strengthening treatments and supplements. In this context, mushrooms, which are significant supplements, must be evaluated. Mushrooms are natural items that have a wide range of biological functions. The antiviral activity of fungus has been highlighted in this study. Mushrooms should also be examined as supplements and natural antiviral medications against COVID-19 (coronavirus disease-2019), according to the researchers. Medicinal mushrooms have been shown to help with a variety of ailments, including infections and inflammatory illnesses. In vitro and in vivo studies have revealed that the related Basidiomycota *Agaricus blazei* Murill (AbM), *Hericium erinaceus*

(HE), and *Grifola frondosa* (GF) have antibacterial action against viral agents, Grampositive and Gramnegative bacteria, and parasites. The mushrooms should also be effective against multidrug-resistant microorganisms because the mechanism is immunomodulatory rather than antibiotical. Furthermore, because these Basidiomycota have anti-inflammatory capabilities, they may be useful in treating the severe lung inflammation that commonly occurs after COVID19 infection. An AbM-based mushroom extract (AndosanTM), which also contains HE and GF, has been found to reduce bacteremia and enhance survival in mice with pneumococcal sepsis, as well as to improve symptoms and quality of life in IBD patients through anti-inflammatory action. Mushrooms may boost T-cell immunity against virally infected cells by increasing the quantity of these antibodies. Mushrooms can also affect our immunity by binding to receptors on human immune cells, strengthening it in certain ways while calming it down in others. This feature of mushrooms may also help to decrease the negative effects of vaccines. To summarise, the literature suggests that the related medicinal Basidiomycetes mushrooms, AbM, HE, and GF, may have value as prophylactic or therapeutic add-on remedies in COVID-19 infection, particularly as countermeasures against pneumococcal superinfection, even when caused by multiresistant bacteria, as well as for the immune overreaction and damaging inflammation associated with COVID-19 infection.

Keywords: COVID-19, Coronavirus infection, Inflammation, Medicinal mushrooms, Pneumococcal infection

Abst-79

Enlightening the Future on the Effects of Zoonotic Diseases and Ways to Mitigate and Combat Them

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Abstract

Zoonotic diseases, or zoonoses, are diseases shared between animals, including livestock, wildlife, pets and Human beings. Zoonotic diseases are commonly spread at the human-animal-environment interface, where people and animals interact with each other in their shared environment. Zoonotic diseases can be food borne, waterborne, vector-borne, or transmitted through direct contact with animals, or indirectly by fomites or environmental contamination. They can pose serious risks to both animal and human health and may have far-reaching impacts on economies and livelihoods, agriculture, and environmental integrity, as very day we hear about health challenges at the human-animal-environment interface. Zoonotic diseases such as avian influenza, rabies, Ebola, and Rift Valley fever, as well as food-borne diseases and antimicrobial resistance, continue to have major impacts on health, livelihoods, and economies. Around 60 per cent of all infectious diseases in humans are Zoonotic and about 75 per cent of all emerging to be infectious diseases. On average, one new infectious disease emerges in humansevery four months. While many originate in wildlife, livestock often serve as an epidemiological bridge between wildlife and human infections. Over the lastfew years, several emerging zoonotic diseases made world headlines as they caused, or threatened to cause, major pandemics. As there are different types of zoonotic diseases based on their causative agents these include Virus, Bacteria, Fungus and Parasitic zoonotic disease agents. Examples of major Zoonotic diseases, and some other pandemic ones are Covid

19 pandemic, Ebola, bird flu, Lassa fever, Middle Eastrespiratory syndrome (MERS), Rift Valley fever, sudden acuterespiratory syndrome (SARS), West Nile virus, and Zika virus disease etc. The pathogens causing these diseases have wildlife reservoirs that serve as their long-term hosts. Therefore, principal aims of carrying out this research are to enlighten people especially rural dwellers under the following headings: Effects of zoonotic diseases, its types, causative agents, modes of transfer, what to do when one acquire zoonotic disease and general ways to mitigate and combat them.

Keywords: Zoonotic diseases, Pandemic, Economy.

Abst-80

Combating COVID-19 and Other Disease Outbreaks

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Abstract

Infectious pathogens such as viruses, bacteria, and fungus produce infectious and zoonotic illnesses that endanger human life. Most people died due to the COVID-19 disaster in recent years, and many have suffered psychologically, physically, and economically as a result. Due to insufficient understanding and awareness, sickness spread like a pandemic worldwide, killing millions of people. Infectious illnesses pass from one human or animal host to the next, spreading microorganisms that cause disease via direct or indirect contact. Contagious illnesses might be minor or severe enough to cause a pandemic. Zoonotic diseases, on the other hand, spread germs from animals to humans, resulting in sickness. The nature of an effective pathogenic human strain is to become a zoonotic pathogen and required to undergo the mutation-producing strains resistant to the parental strains. Many zoonotic disease transmission parameters remain unknown. In the old world, the bulk of illnesses and pandemics were due to the Cross-Species Transmission of Microorganisms from animals to humans. The method of Cross-Species Transmission is still not completely understood. Personal hygiene, eating a healthy and nutritional diet, and self-isolation while unwell and isolation from the sick are all simple approaches to prevent illnesses. Aside from human health, the health of domesticated animals is critical for the avoidance of disease transmission in the future. Many disease outbreaks have caused and continue to create hazards to human life and civilization throughout history. It is critical for human existence to prevent these illnesses from harming human life. This study represents the actions that may rly an imprint to avoid infectious and zoonotic diseases such as COVID-19 from causing a pandemic.

Keywords: Pathogen, COVID-19, Infection, Contagious, Zoonotic, Microbe.

Abst-81

Capability of Helminthes Parasites as Genotoxic Agents in Fresh Water Fishes of River Ganga

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Abstract

Several parasites are known to cause genotoxicity in humans and animals which turn up to cause huge economic losses worldwide. In the present study, the genotoxic potential of helminth infection in fish, experimentally infected with the parasite, has been investigated using the standard comet assay and micronucleus (Mni) test on the isolated hepatocytes, muscle and the whole blood from the infected fish. The tail length of the comet in both hepatocytes and reticulocytes from the infected animals was significantly prominent ($p < 0.05$) as compared to the controls. The specimens of *Bagarius bagarius* (Hamilton, 1822), were collected from different sites of the river Gomati and the blood samples were subjected to the alkaline Comet assay or Single Cell Gel Electrophoresis (SCGE) and Micronucleus test (MNT). It is possible that during the establishment of host-parasite relationship, the worms

might have released some products which could have contributed to the induction of cellular and DNA damage. Thus, the results of the present study revealed that parasites may induce genotoxicity in fishes.

Keywords: Helminth Parasites, Fish, Genotoxicity, Comet Assay, MNT, Ganga river.

Abst-82

Microbial Pigment Production and their Potential Applications in Industries: A Review

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Abstract

The potential of microbial pigments have gain significant interest from industries and academia. Microbial pigments have a variety of applications in various food, textile, paper and pharmaceuticalindustries. Apart of these industrial applications, microbial pigments are also known for their beneficial properties like anticancer, antimicrobial, anti-inflammatory, antioxidant and anti-allergic. Moreover, their cultivation is easy at the laboratory and industrial scale. Microorganisms produce a large variety of stable pigments such as carotenoids, flavonoids, quinones, and rubramines. The main benefit of microbial pigment is that it can be produced regardless of weather conditions and that bacteria can be cultivated on a low-cost substrate. Moreover, the pigment yield can be increased by genetic manipulation by inserting genes of interest. In food industries, various pigments produced by bacteria, algae and fungi provides promising source of food colorants. Microbial pigments can also be used as natural colourant for dyeing fabrics in textile industry. Some pigments can act as nutraceuticals having physiological benefits by preventing cancer, heart attacks and other chronic diseases. Microbial pigments are also been reported to inhibit multi-drug resistant bacteria providing promising future to biomedical research. Synthetic pigments, on the other hand, pollute the environment and have harmful toxicological side effects. This review highlights the significance of microbial pigments and their applicationsin various industries.

Keywords: Microbial pigments, Natural colourant, Food colorants, Antioxidant

Abst-83

Health Complications Associated with COVID-19: A Review

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Abstract

To understand the COVID-19 pandemic created by coronavirus, it is important to understand transmission and effect of virus on animals including humans. Initially only respiratory tract infections were observed in association with COVID-19 but current literature suggested many other health complications associated with this disease. These complications includeshematological, immunological, cardiovascular, dermatological, neurological complications and physiological responses associated with cancer. Some of these complications can be cured by the medication but some exert adverse effects on the body and in some cases even death. The long-term effects persisting two or more weeks after its onset are also associated with the disease. However, it is still unknown how sex, age, gender, ethnicity, virus dose and underlying health issues affect the risk of establishing long term effects. The progression of COVID-19 proceeds from upper respiratory tract disorders to all other parts of the body causing multi-organ failure. Many of these complications may be caused by a condition known as cytokine release syndrome or a cytokine storm. This is when an infection triggers the immune system to flood bloodstream with inflammatory proteins called cytokines. They can kill tissues and damage organs, including lungs, heart, and kidneys. This review discuss about the various health complications associated with COVID-19 and available treatment options. For the effective treatment of COVID-19, many clinical trials are still going on with little success rate.

Keywords: COVID-19, Pandemic, Cytokine storm, Health complications.

Abst-84

Currently Available and Novel Treatment Options for Multi-Drug Resistance *Klebsiella pneumoniae:* A Review

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Abstract

The spread of multi-drug resistance *Klebsiella pneumoniae* (MDR-KP) pose a rising problem worldwide. The ideal treatment option of this strain is still not available to the clinicians. High-dose meropenem, colistin, fosfomycin, tigecycline, and aminoglycosides are among the most commonly utilized combination treatments for MDR-KP, with mixed effects. *Klebsiella pneumoniae* is a gram negative, non-motile, encapsulated, lactose fermenting, anaerobic, and rod shaped bacterium. Various factors including capsular polysaccharides, lipopolysaccharides, fimbriae, adhesions and siderophores are responsible for its pathogenesis. Wide spread of this infection occur in hospital acquired pneumonia, urinary tract infections,septicemias,, and soft tissue infections known as nosocomial infections. At the hospital level, resistance is developed due to unnecessary, without monitoring or control and excessive use of antibiotics. *Klebsiella* also act as opportunistic pathogen that primarily attack immunocompromised patients with conditions like chronic pulmonary obstruction and diabetes mellitus. *Klebsiella pneumoniae* is showing resistance to a number of drugsfloroquinolones, aminoglycoside and beta-lactamase classes of antibiotics that further enhance its pathogenesis. At the molecular level, resistance mechanism isdue to the production of enzymes including beta-lactamases, oxacillinases, carbapenemases; resistance plasmid, transposon of genes; biofilm production on the catheters and overexpression of genes encoding efflux pumps that extruding multiple drugs administered for the treatment. In this review, we discussed about the mechanism of pathogenesis, resistance mechanism, currently available and noveltreatment options to prevent the spread of infection.

Keywords: *Klebsiella pneumoniae*, Multi-drugresistance, Nosocomial infections, Resistance mechanism.

Abst-85

Bioremediation Approaches for Efficient Degradation of Pesticides- A Review

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Abstract

Chemical pesticides are widely used in agriculture to protect the crops from insects and microbial pests. But the unregulated and improper applications of these pesticides cause adverse effects on the human health, different life forms and the ecosystem. These effects are due to their fat solubility and bio-magnification in target as well as non-target organisms. Bio-magnification cause both acute and chronic health effects in humans and other animals. This toxicity depends on the quantity and the ways in which a person is exposed to the pesticides. Most commonly used pesticides include organophosphate and carbamate that directly affects the central nervous system. Other pesticides can cause damage to skin and eyes and even some of them are carcinogenic. Pesticides in the soil are degraded by soil microflora to some stable by products that do not affect serious health disorders. Therefore, microbial degradation of pesticides become a promising area for the degradation of pesticides. Bioremediation involves conversion of organic contaminants of pesticides into simple, inorganic and harmless compounds that are safe for environment.But microbial degradation of pesticides further dependent on many factors ranging from type of pesticide and soil temperature. Furthermore, bioremediation rely on pure culture isolates, laboratory enrichment cultures and in contaminated field sites. Some pathways of microflora can mineralize the pesticides on their breakdown but other pathways may produce byproducts that have toxic effects to non-target organisms. Presence of pesticides in freshwater system cause a serious threat, therefore the need for better understanding of the fate of these pesticides is crucial for their effective management. This review discussed about different classes of pesticides, their environmental issues, mechanism of microbe mediated remediation and eco-friendly biodegradation approaches for efficient bioremediation.

Keywords: Pesticides, Bioremediation, Bio-Magnification, Organophosphate.

Abst- 86

Microbial Pigment Production Using Eco-Friendly and Inexpensive Agro-Industrial Wastes: A Review

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Abstract

Industries from the agriculture and food processing sector generates a variety of waste products like bagasse, rice husk, cassava, peels, seeds, waste liquids, molasses and so on. These waste products are rich in nutrients and can be employed for the cultivation of microorganism producing variety of industrial useful products. Among such products are microbial pigments having importance in food, textile and pharmaceutical sector. Microbial pigments are secondary metabolites that play range of biological roles such as anti-microbial, antioxidants, anti-cancer and anti-inflammatory etc. Mainly two approaches has been employed for microbial pigment production; first is to find new strains to enhance the productivity and second is to do strain improvement and process development of already known strains. Public opinion has also been increased for the use of natural pigments due to their safety, non-toxicity and biodegradability. In contrast, synthetic pigments are also available in the market but they are facing problems due to their toxicity and other harmful effects on the human body. Moreover, synthetic pigments are produced from petroleum-based precursors, which are non-renewable energy sources. These problems can be overcome by the use of natural pigments. However, microbial pigments also have some challenges associated with them as less stability and limited number of shades. Therefore, more focus has to be done to produce microbial pigments, which can resist heat, acid and light. To enhance the more stable pigment production using process development through fermentation, its parameters needs to be adjusted that includes several substrates, macro and micronutrients, pH and temperature. Among the substrates, synthetic laboratory media are not economical for pigment production. Therefore, low cost and easily available substrates need to be identified. In this review, substrates from agro-industrial wastes have been employed to reduce the overall cost of pigment production.

Keywords: Microbial pigments, Agro-industrial wastes, Fermentation, Synthetic pigments.

Abst-87

Azithromycin : A Comprehensive Drug

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Abstract

Azithromycin is the most crucial and effective drug of macrolide class of antibiotics. Traditionally antibiotics are used to treat bacterial infections. AZM cures skin related complications such as acne vulgaris and other respiratory infection develops from various bacteria one of them is *Mycobacterium avium* complex. The drug works on the principle of binding – drug binds to the ribosomal subunit of the susceptible bacteria and which inhibits the protein synthesis of bacteria and resulting in the death of causing element (bacteria). This drug efficiently enhances the treatment of uncomplicated typhoid fever. Recently, during Covid– pandemic, AZM proves to be a potent drug in the treatment of the disease. Covid is a viral infection but AZM is an antibiotic however here because of its immunomodulatory action it inhibits protein synthesis of the disease causing organism and it's experimentally shown that it also reduces inflammation and viral replication, possibly because cytokines and viruses are both made of proteins and utilize cellular ribosomes for protein translation. Therefore, it prevents the virus production and minimizes the viral transmission to other people. Moreover, AZM has long therapeutic half-life, and also enhances the efficiency for the expression of anti-viral pattern recognition receptors and induction of anti-viral type I and III interferon responses.

AZM also possess anti-inflammatory properties like suppression of IL-1beta, IL-2, and TNF. It inhibits T cells by preventing calcineurin signalling, mammalian target of rapamycin activity and it targets the granulocytes where it concentrates in lysosomes, specifically affects accumulation, adhesion, degranulation and apoptosis of neutrophils. AZM also proves itself a potential cure for sexually transmitted diseases. A random survey on 182 patients was done to test the safety and efficiency of AZM and approximately 99% of patients with chlamydial infections and about 92% of gonorrhoea patients were cured with azithromycin. In conclusion it can be said that AZM has potential to be a cure for several diseases like typhoid fever, bacterial infections related to skin and respiratory tract. Recent studies have shown that AZM can be a potent drug for the treatment of COVID. More investigations and clinical trials are required to disclose the applications of AZM in treating various diseases.

Keywords: AZM-Azithromycin, Antibiotic, Viral infection, Sexually transmitted disease, Dengue, COVID.

Abst-88

Parasitic Biodiversity in Certain Cat Fishes of Gomti River, Lucknow

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Abstract

Fish which is a good source of a protein can be helpful in accomplishing the problem of nutrient deficiency which is one of the major challenges that is being faced by our country in the present scenario. Parasites inhabiting fishes can cause serious threat to their health which will further affect the health of consumers of fishes. In this view, the present study was carried out to determine the parasitic biodiversity in catfishes of Gomti River, Lucknow. A total of 300 fishes consisting of 135 *Bagarius bagarius*, 8 *Wallago attu*, 37 *Heteropneustes fossilis* and 120 *Mystus tengara* were screened using standard parasitological procedures. Maximum parasitic infestation was found more in females as 33% in *Wallago attu*, 44% in *Heteropneustes fossilis* and 25% in *Mystus tengara*, except in *Bagarius bagarius* which had highest infestation in males i.e., 27.2%. In Wallago attu and *Mystus tengara*, cestodes were found to be most prevalent. Highest infestation of nematodes and trematodes were found in *Bagarius bagarius* and *Heteropneustes fossilis* respectively.

Keywords: Parasite diversity, Cat fish, Nematodes, Trematodes, Gomti river.

Abst-89

Management of Diabetic Mellitus through Nano-Particle Based Drug Delivery System : A Future Application and Challenges

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Abstract

Diabetes mellitus is chronic metabolic disorder and is a major health issue worldwide. In present days, the prevention and treatment of diabetes mellitus and its complications have brought problems to Humans. It is fast growing global problem with physical, mental and economic consequences. In recent days, nanotechnology is used to diagnose, treatment and research of diabetes mellitus. These nanoparticles are produced on nanoscale level and are very safe to introduce into the patient body without using any syringes. It increases the efficiency of drug delivery to those areas where macromolecules are not effective. Nanotechnology in diabetes research gives us easy methods for the delivery of insulin to specific area. It hold potential to make quality of life for diabetic patients.

Keywords: Diabetic mellitus, Nanotechnology, Drug delivery system, Insulin.

Abst-90

Development of Metal Nanoparticles Impregnated Dressing Material for Chronic Wound Healing : A Novel Approach

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Abstract

Wounds are structural and functional disruptions of the skin that occur as a result of anaccident. Chronic wounds are caused by a breakdown in the finely coordinated cascade of events that occurs during wound healing. Wound healing is a long process that split into at least three continuous and overlapping processes: an inflammatory response, a proliferative phase that leads to tissue repair, and third is tissue remodeling. Several growth hormones and cytokines secreted at the wound site tightly regulate wound healing processes. Metal nanoparticles (e.g., silver, gold, zinc) are increasingly being employed in dermatology due to their positive effects on wound healing, as well as treating and preventing bacterial infections. Wound dressing is one of the most important external effectors in wound healing. Our review focus on the currenta dvancement in wound healing process by various nanoparticles material impregnation with dressing material.

Keywords: Wound, Impregnated materials, Nanoparticle, Dermatology.

Abst-91

A Preventive and Control Strategy for COVID-19

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Abstract

COVID-19 has become a huge threat for India corona vim can abour-affect who having respiratory problem and who have been aged older than sixty. The world pandemic threat COVID-19 mitigation is crucial to the human life. Most of the affected peoples had reached India from different part of the world as a carrier. Owing to this India made several precautionary measures to neglect the disease in beginning stage. Since, attacked several nations have been worried mostly for their people life. As we are an Indian, we have interacted and seen many peoples who all are not bothered about the life threatening COVID-19 calamity. Indian government announced some monetary schemes for their daily needs.

Keywords: COVID-19, Pandemic, Precautionary measures.

Abst-92

Influence of Autoimmune Thyroid Disease on Recurrent Pregnancy Loss: A Retrospective Study

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Abstract

Thyroid autoimmunity is related to recurrent miscarriages as well as primary and secondary infertility. Infertility and reproductive outcomes can occur if there are abnormalities in both the endocrine and the immune systems by thyroid hormones and thyroid antibodies. To study the association between anti-thyroid peroxidase antibodies and infertility among female patients,2). To determine the correlation between anti-TPO antibodies, and T3, T4, TSH levels in females with infertility. Cross-Sectional study was done from Jan. 2015 to Dec. 2015. 100 infertile females and 100 age-matched controls were selected. Serum anti-TPO antibodies, T3, T4 and TSH levels were evaluated. Out of 100 infertile patients, 39 were of primary and 61 had secondary infertility, out of which anti-TPO Ab was elevated in 55 cases. An increase in the amount of anti-TPO Ab with age was seen. Highly significant increase of TSH and anti-TPO Ab levels was found in cases of primary infertility. Highly significant increase in T4 and anti-TPO Ab levels was seen in secondary infertility. Pearson's correlations of T3 with T4, T4 with TSH, TSH and anti-TPO Ab with duration of infertility, anti-TPO Abwithinfertility were highly significant, T3with TSH, anti-TPO Ab with T3, TSH with age, T4 and TSH withinfertility were significant. Autoimmunity and thyroid disturbances are related with infertility. Anti-TPO Abs are independently associated with infertility irrespective of thyroid hormones levels and can be used for screening as well as the marker for identifying the risk factor of infertility

Keywords: TPO-Ab, Infertility, Autoimmunity, Thyroid.

Abst-93

Impact of Pollution on Fishes of Fresh Water Lake Taal Ratoi

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Abstract

The impact of pollution on fishes of Taal Ratoi has received considerable attention over the past 15 years, and this is partly due to the fact that there appears to be circumstantial evidence that certain diseases in lake fishes may be associated with anthropogenic activities. Several harmful substances such as pesticides, insecticides and domestic sewage are often released into the fresh water lakes. When large quantities of pollutants are released there may be an immediate impact as measured by large-scale sudden mortalities of lake organisms, e.g. fish kills resulting from contamination of water with agricultural pesticides domestic activity. Lower levels of discharge may result in an accumulation of the pollutants in fishes of lake. The end results, which may occur long after the pollutants have passed through the environment, include immunosuppression, reduced metabolism, and damage to gills and epithelia. The present study indicated that some of the diseases caused by *Aeromonas, Flavobacterium* and *Pseudomonas* resulted from generally degraded water quality, i.e. higher than usual quantities of organic material, lower value of D O, changes in pH values and enhanced nitrate nitrogen and ammoniacal nitrogen, total phosphorus. Some infections with Serratia and Yersina may well have reflected contamination of waterways with domestic sewage, e.g. leaking septic tanks. There are one disease i.e vibriosis was linked to high concentrations of copper, which may have debilitated the fish making them more susceptible to disease.

Keywords: Pesticide, Water pollutants, Gills, Liver.

Abst-94

Outbreaks of Communicable Diseases in India: Effectiveness of Various Strategies

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Abstract

In the recent years, the World population faced several epidemics or outbreaks of communicable diseases. These epidemics had a significant impact resulting in loss of life, livelihood, economic losses etc. To not only the individuals but also countries as a whole. In India, Healthcare systems have been successful in discovery and production of effective drugs and drug delivery systems. However, in spite of such progress, healthcare agencies were not successful in identifying, combating and controlling these outbreaks due to lack of preparedness, proper knowledge and integration between these agencies. This paper discusses the effectiveness of various strategies required to combat such outbreaks in future.

Keywords: Epidemics, Healthcare systems, Strategies.

Abst-95

Coronavirus Cell Entry Mechanisms Mediated by Spike Protein and Requires Cholesterol

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Abstract

An enveloped positive stranded RNA; coronaviruses induce envelope fusion to the cell membrane of the host to transfer its enclosed nucleic acid capsid. Virus entry through the spike glycoprotein here it will act as primary variation of host tropism and infection. Signified by fusion protein class 1 and accountable for attaching to the receptor on to the host cell also mediating fusion of host and membranes of the virus. Coronaviruses entry mechanisms rely on compulsive conformational changes of the spike glycoprotein. This set off to the activation of conformational changes unto the proteolytic initiation, low pH revelation, and being hold by receptor and this commonalty bestow on distinct tropism and pathogenicity. Syncytium formation followed by enveloped viruses or fusion justified by this same tool through entry of virus. These syncytia are idea to doubling and eluding of the resistant system of the host. To evaluate the process of spike glycoprotein which were seen during the viral entry through the specified membrane fusion, this will be quantified by cell biological proceed towards to the revelation of the necessary concepts for biological phenomenon facets of membrane, especially cholesterol signified regions, in spike glycoprotein moderated by fusion to the host cell.

Keywords: Coronavirus, Cell biology, Spike glycoprotein, Syncytia, Viral entry, Fusion.

Abst-96

Protozooplankton Studies in a Tropical Reservoir (Konam) Andhra Pradesh- India

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Abstract

Protozooplankton are important consumers of hetero and autotrophic nannoplankton and play important key role in energy flow among microzooplankton of aquatic ecosystems. Present investigation on protozooplankton composition was first of its kind in a minor irrigation project Konam reservoir which is catering the irrigation potential of 12,274.10 acres of agricultural land in Visakhapatnam district. The study revealed two major groups of free living protozoa namely flagellates and ciliates. The qualitative and quantitative analysis of the reservoir waters were studied by following standard protocols for a period of one year in 5 transects from catchment area to dam side. During the study it was noticed that numerically flagellates (13,476/ml) outnumbered ciliates (3,390/ml). The predominant genera among flagellates were *Peridinium* sp, *Euglena acus, Phacustortor* and among ciliates *Colepshirtus, Halteria* sp., *Strobilidiu mgyrans* and *Vorticella* sp. comprised nearly 80% populations. Statistical analysis between water quality variables and the plankton populations showed significant inference which indicated the reservoir waters are becoming mesotrophic and there is need for the reservoir management in due course of time.

Keywords: Protozooplankton, Flagellates, Ciliates.

Abst-97

Natural Antioxidant as Radioprotector to Medical Injuries Arising due to Radiation Overexposure

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Abstract

In the era of increasing radiation applications in medicine, industries, anddefense ammunition, Nuclear disaster is one of the greatest international security threats and prompted us to develop necessary management. A combination of clinical syndromes to various tissues and organs is expressed; decide the survivability and quality of life after radiation exposure. However, hematopoietic system is most sensitive toward radiation; therefore, a potential radioprotective agent is desired to lower radiation-induced DNA damages in hematopoietic system. Natural antioxidants have drawn attention due to their properties like strong free radicals scavenging, DNA repair, anti-apoptotic, anti-mutagenic, immunomodulator, and low toxicity and availability in different forms. In the drug development process, we have attempted to investigate the radioprotective potential and efficacy mechanism of sesamol and melatonin in the hematopoietic system of gamma-irradiated mice at sublethal radiation dose. The study protocols were adopted as per the different regulatory guidelines of drug development. The results showed that pre-administration of sesamol and melatonin (100mg/kg b. wt.) decrease the radiation-induced micronuclei (MN) frequency near to its normal range of control group within 15th and 30th day of post-irradiation.The efficacy of sesamol and melatonin was studied using their different doses and revealed their optimum i.p. dose 20mg/kg b. Wt. Which reduces radiation-induced MN frequency and chromosomal aberration (CA) in bone marrow cells by 50% and 57%, respectively in comparison to radiation group.

Further, the role of sesamol and melatonin against radiation-induced DNA damages and its repair kinetics were studied and simultaneously compared with amifostine using alkaline comet assay and γ-H2AX assay. The results depicted that both sesamol and melatonin show similar level of protection as amifostine. The analysis of differential leucocytes count revealed an interesting observation; both sesamol and melatonin significantly increased the granulocyte count in mice after 0.5h of their administration compared to control ($p \leq 0.05$). The gene expression results of G-CSF and its pathway-related apoptotic and pro-inflammatory genes i.e., Bcl2, BAX and IL-6 TNF-α revealed a mechanism of such increase in granulocytes count and potential role of sesamol and melatonin in cell proliferation, anti-apoptosis, immunomodulatory, and mobilization of hematopoietic cells apart from their known radical scavenging property. These findings strongly suggest that sesamol and melatonin have strong radioprotective potential and can be accelerated in drug development journey for their further validation in NHP model.

Keyword: Antioxidant, Radioprotector, Radiation, DNA damages.

Abst-98

Factors Responsible for Virulence of *Klebsiella pneumoniae* and Mechanism of Antibiotic Resistance : A Review

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Abstract

Klebsiella pneumoniae is a gram negative, non-motile and encapsulated bacterium that causes a number of infections and antibiotics resistant. *Klebsiella* species are the example of Enterobacterales commonly found in the human gut that becomes carbapenem resistant and thus become difficult to treat. The pathogenesis of the bacterium is provided by a number of factors starting from the capsule that evade this from the opsonization immune reaction of the host. Another factor is lipopolysaccharide that coats outer layer of gram-negative bacteria and responsible for the highly infectious condition of the body like sepsis and may lead to septic shock. Fimbrae and siderophores are other virulence factor, former allow the bacterium to attach to the host while latter capture iron for the host to propagate its infection. Infections caused by *Klebsiella pneumoniae* are mostly nosocomial or occur in patients who have an intrusive device in their body (device contamination), such as catheters, neonates, ventilators, and so on. Although the infection is notspread by air but can be through direct contact like contaminated hands of healthcare personnel in healthcare settings. Some strains of *Klebsiella pneumoniae* become highly resistant to a number of antibiotics including wide range of beta-lactam antibiotics, including cephalosporins, fluoroquinolenes, aminoglycosides like Gentamycin, and carbapenems because these strains produce carbanemase that can degrade the antibiotic. The resistance mechanism of *Klebsiella pneumoniae* involves the production of enzymes and biofilm formation. The emergence of multidrug resistant strains of *Klebsiella pneumoniae* becomes a challenge for healthcare personnel to treat. Therefore, this review discussed about the factors responsible for virulence and mechanism of drug resistance so that it will become accessible to diagnose for its effective treatment.

Keywords: *Klebsiella pneumoniae* , Antibiotic resistance, Carbapenem, Virulence factors.

Abst-99

Future of the Life Sciences Industry

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Abstract

The life sciences industry is the umbrella term for companies, businesses, and research institutions dedicated to improving organism life. The various life sciences industry branches may include pharmaceuticals, biotechnology, environmental sciences, biomedicine, nutraceuticals, neuroscience, cell biology, biophysics, and many others. Any aspect of science that has something to do with the research and improvement of human, plant and animal life can be defined as a subcategory of the life sciences industry. In terms of human health, this industry is essential in understanding the nature of diseases. We also benefit from environmental science as this subcategory helps preserve our environment. Pharmaceuticals and nutraceuticals deal with the research and creation of ailment-fighting medicines and supplements. As the life sciences industry's research body becomes increasingly expansive, many experts discover that some conditions are inherited through genetic coding. This implies that healthcare can be more customized based on DNA information or other genome features. These ushers a new era of personalized medicines and healthcare procedures. The life sciences industry is continuously developing thanks to its collaborative nature. In 2022, we can expect biotech companies to join forces with other related health sciences organizations to push the boundaries for development. An example of this happened in May of 2019 when four companies, namely Arzeda, Twist Bioscience, Labcyte, and TeselaGen, have partnered to create a state-of-the-art assembly platform for the DNA. The purpose of doing this is to create food items such as sweeteners and other industrial needs. This will hopefully reduce the need for harvesting or mining supplies as DNA will be constructed in laboratories. Digital transformation of businesses has been around for years. This has paved the way for better access for consumers and improved marketing strategies for companies. In 2022, there will also be an increase in digitalization in the life sciences industry through online assessment, diagnosis, and treatment of patients.

Keywords: Life Science, Industry, Collaborations, Health Sciences, Digital transformation, Development.

Abst-100

Study on CNS Depresant Drug Ketamine on Testicular Functions in Albino Rats

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Abstract

In the present work, study on CNS depressant drug Ketamine administration on testicular functions like biochemical, gravimetrical and histological analysis has been studied. Three groups of healthy adult colony breed male albino rats having six rats maintained in each group for the experimental studies. The rats of groups II and III were administered intraperitoneally Ketamine at the dose level 1 and 3 mg/100 gm body weight respectively daily between 10:00 and 11:00 am for 21 days and group I was maintained as control. After the experimental duration, the rats were sacrificed and studied their gravimetric, biochemical and histological analyses of testis. In the results, testicular weights of the rats of group II and III showed significant reduction, histological, biochemical changes also observed marked cytotoxicity and inhibition of testicular functions. Histometric changes of testis diameter and surface epithelial cell height were reduced significantly. Biochemical changes are analogous to the gravimetric results, the protein and cholesterol contents are elevated significantly with the graded dose of Ketamine administration. While, in the gravimetric analysis of accessory organs like epididymis, vas deferens, seminal vesicle and prostate gland were decreased significantly due to the administration of Ketamine and exhibited as endocrine disruptive drug.

Keywords: Accessory organs, Biochemical, Histormetric, Gravimetric, Ketamine, Testis

Abst-101

Impact of COVID -19 on Agriculture System of Dhar District of Madhya Pradesh, India

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Abstract

The present work showed impact of COVID-19 on agriculture system of Dhar, Madhya Pradesh, India. Dhar district of Madhya Pradesh, India is located between the latitude of 22° 00 to 23° 10′ North and longitude of 74° 28′ to 75° 42′ East. Dhar located in the Malwa region in the west of the state of Madhya Pradesh in India. COVID-19 pandemic has disrupted the agricultural system extensively. An investigation was conducted from 2019-2021 for impact of COVID-19 on agriculture system and was put on records through periodic interviews with farmers and farm labours. Present study revealed that, the shortage of labor, migration of labours, and fear of infection to perform farm operations, disruption to input supply, logistic disruption, thruway prices, distress sale, and restricted movement. Survey findings indicate that the pandemic has affected production and marketing in Dhar as well as all over state.

Keywords: COVID-19, Dhar, Malwa plateau, Narmada river.

Abst-102

Immuno-Regulatory Mechanisms: Innovative Therapeutic Approaches for Cancer Chemoprevention

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Abstract

The immune system and cancer coexist in close relationship which is an indispensable part of the processes of tumorigenesis, tumor growth, and metastatic spread. Immunological thought is exerting a growing effect in cancer research, Immunotherapy has revolutionized cancer treatment and rejuvenated the field of tumor immunology. During the past decade, a new general consensus has emerged among all cancer researchers that inflammation and immune escape play crucial causal roles in the development and progression of malignancy. Several types of immunotherapy, including adoptive cell transfer (ACT) and immune checkpoint inhibitors (ICIs), have obtained durable clinical responses, but their efficacies vary, and only subsets of cancer patients can benefit from them. Immune infiltrates in the tumor microenvironment (TME) have been shown to play a key role in tumor development and will affect the clinical outcomes of cancer patients. Comprehensive profiling of tumor-infiltrating immune cells would shed light on the mechanisms of cancer–immune evasion, thus providing opportunities for the development of novel therapeutic strategies. However, the highly heterogeneous and dynamic nature of the TME impedes the precise dissection of intra-tumoral immune cells. Here, we outline the recent progress in cancer immunotherapy, particularly by focusing on landmark studies and the recent single-cell characterization of tumor-associated immune cells, and we summarize the phenotypic diversities of intratumoral immune cells and their connections with cancer immunotherapy. This chapter offers a historical perspective on the development of immunological thought in cancer, a discussion of some of the fundamental challenges to be faced, and an overview of the progress in cancer immunotherapy, elucidation of immune cell modulation in tumor progression, and thus guide the development of novel immunotherapies for cancer treatment.

Keywords: Immunotherapy; Tumor microenvironment; immune cells; Phenotype

Abst-103

Method of Detecting Diseases and Pest over Plants Using an AI Based Drone

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Abstract

A method of detecting plant diseaseand pest over plants using an Artificial Intelligence (AI) based drone. The method includes capturing plurality of high-definition (HD) images of a targeted plants using a camera embedded in the AI based drone, it includes pre-processing the HD images of the targeted plant to detect a presence of pest on the targeted plant using a deep-learning analysis model embedded in the AI based drone. Further includes the post-processing an analyzed HD images of the targeted plant to predict the presence of disease using a trained machine learning model in the AI based drone, classifying and grading the disease predicted by observing a morphological change on the targeted plant using the trained machine learning modeland uses AI sensors todetermine a type of herbicide to be used and time buffer within which the targeted plant is to betreated and the AI based drone is designed to spray the disinfectants after detecting the disease and pest over targeted plants in the field.

Keywords: Plant diseases, AI based drone, Deep learning analysis.

Abst-104

Impact of Lockdown on Animal Behaviour during COVID-19

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Abstract

Our environment has always been affected by the influence of human activities. We have been generally negligent of our behavior which has caused many serious irreversible changes to our surroundings. All living organisms co-evolve with humans and adapt accordingly. However they face lot of discomfort in their activities. Humans effect the environment both positively and negatively. By positive effect on environment we mean to protect endangered species, protecting forests, cleaning water bodies. Negative effects include deforestation, various types of pollution and damages to the environment. Our changing surroundings have compelled animals to take steps to adjust and maintain balance. This has led to many remarkable adaptations in them. During lockdown industrial wastes were reduced to bare minimum. This has led to improve water quality which has caused tremendous growth in sea weeds. This also led to increase in growth of fish and fisheries, water birds swimming freely and enjoying urban peace. During lockdown local streets dogs, cats, monkeys, crows and others birds and animals which were usually dependent upon domestic persons could not get proper food. This resulted in food crises and sometimes fights with each other for their survival. In some areas it resulted in roaming of wild animals in residential areas in search of food.

Keywords: COVID-19, Lockdown, Behaviour, Animals.

Abst-105

Binding Studies of Graphene Oxide Based Decontaminants with Model Proteins: Spectroscopic and Molecular Modeling Analysis

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Abstract

The conflicts between military and terrorism often involve the use of chemical warfare agents (CWAs) and toxic industrial chemicals (TICs). The exposure leads to toxicity. So, due to its harmful exposure, there must be an effective decontamination strategy for removal. For this purpose, graphene-based derivatives are widely used for decontamination studies. The present study was aimed to investigate the binding interactions of graphene-based nano-composites (NCs) (CBRN01/02/03) with BSA and pepsin in-vitro using multi spectroscopic techniques. The binding interaction studies were performed using UV-vis absorbance, steady-state fluorescence, synchronous fluorescence, enzyme activity assay, and in-silico molecular docking. It was observed in UV-vis absorption study, the absorbance of BSA at 280 nm increases with a slight blue shift in the presence of CBRN01 indicated a complex formation between CBRN01 and BSA. While in the case of CBRN03, there is no interaction with either BSA or pepsin. Fluorescence quenching studies also state that there was dynamic quenching in case of CBRN01 and little quenching in case of CBRN03. In-vitro pepsin and BSA enzyme activity were evaluated and found that CBRN01 is decreasing activity of pepsin up to 60% while CBRN03 was not interacting with pepsin. The binding interactions were modeled in binding pockets using molecular docking calculations. So, it can be concluded that the decontaminant is not interacting with either of the proteins and can be said biocompatible with biological system. It also increases locomotors activity in FA treated mice and decreases defecation activity.

Keywords: Decorporation, Protein-binding, Fluorescence quenching, Molecular docking.

Abst-106

Glucose Metabolism in Aging and Neurodegenerative Diseases

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Abstract

Aging is a spontaneous, ineludible process described by a time-dependent diminution in a variety of physiological and metabolic capabilities, which is driven by two primary categories: programmed functioning loss and cellular damage-concomitant deviations. Although the exact rationale of ageing is anonymous, metabolomics has the impending to provide substantial perception by giving a complete metabolite profile and changed metabolomic functions as people age. Metabolomics is the principally the study of a broad range of metabolites involved with physiological and pathological processes in order to acquire an integrative depiction of an organism's current metabolic status. Using metabolomic tools, researchers can quantify a large number of metabolites, both endogenous and exogenous, that are the end product of gene and protein regulation. This information can be used to determine different physiological and/or pathological states, as well as depict the complexity of the ageing process. A number of studies have suggested that, in addition to brain volume, microstructure, and cognitive performance, the brain's metabolism alter with age. The non-invasive proton magnetic resonance spectroscopy (1H MRS) technology could be used to detect such variations. 1H MRS is one of the most well-known procedures for assessing brain biochemistry in vivo and has been extensively employed in clinical diagnostics of people of all ages since it offers information on tissue metabolism. As a result, it's critical to distinguish between metabolic alterations in the brain induced by healthy ageing and those caused by pathological conditions. Although metabolomics has just recently been applied to ageing research, many attempts have been made to understand the biology of ageing using a quantitative metabolite profile. Despite many advances in metabolomics and metabolite analysis, providing conclusive ageing marker remains a serious difficulty. More research is needed to find ageing biomarkers that can predict biological age rather than chronological age, because biological age takes into account an individual's physical and mental health. Regardless of disease or disease progression, desirable biomarkers must have a large strong connection with age. Understanding the ageing process and the mechanisms that underpin it is vital to increasing one's quality of life and ageing healthily and disease-free. Besides oxidative damages functional decline at the molecular, cellular, and tissue levels, have resulted in increasing susceptibility to and frequency of disease, making advancing age the leading risk factor for age-linked disorders. Maintaining proper neural function necessitates glucose metabolism and mitochondrial activity. Disruption of normal glucose metabolism, as well as its connection with cell death pathways, creates the pathophysiological basis for many brain illnesses, consistent with its crucial role for physiological brain function. An aberrant glucose metabolism, including mitochondrial dysfunction, reduces the energy supply to the neurons, potentially exacerbating the progression of neurodegeneration, according to a growing body of research. As a consequence, targeting defects in the energy metabolism in neurodegeneration represents a rational therapeutic strategy. Therefore, primarily it is necessary to understand the glucose metabolism in brain especially astrocyte- neuron interaction.

Keywords: Aging, Neurodegenerative Diseases, Glucose metabolism, Astrocyte.

Abst-107

Aeromonas hydrophila Infection after Hirudo Therapy

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Abstract

Aeromonas hydrophila are found in the mucous secretions, suckers, and gut of the medicinal leech and hence infection could result from the use of these animals. *Aeromonas hydrophila* have been reported to progress to cellulitis, myonecrosis, abscess formation, endocarditis and sepsis. Similarly, the *Aeromonas hydrophila* infections following leech use have resulted in abscess formation and tissue necrosis 20 % incidence of infections complication in their patients treated with leeches.The risk of *Aeromonas hydrophila* should prohibit the clinical use of leeches so the infectionis the primary cause of concern when using hirudo therapy. Infection is a constant possibility until the sore heals. The risk of bacterial, viral and parasitic cross infection precludes the recycling of leeches. Historical accounts transmission of hog cholera, syphilis, HIV or hepatitis viruses after reapplication of leeches used on infected patient.

Keywords: *Aeromonas hydrophila,* Wound infection, Hirudotherapy.

Abst-108

Bat Flu Pose a Threat to Human Health

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Abstract

Bats are natural reservoirs for many viruses several of that are zoonotic. Bats are a novel animal species that could be a source of flu viruses, the discovery of bat flu is significant for public health. Other animals that have been known to contract flu viruses include domestic and wild birds, pigs, horses, and dogs, with infrequent outbreaks in seals, whales, ferrets, and cats. In India Nipah virus outbreak was traced in the fruit batslocalized in Kozhikode and Malappuram districts of Kerala. Because past pandemics in the twentieth century, as well as the 2009 H1N1 pandemic, were caused by flu viruses in animals that obtained the ability to infect and disseminate easily in humans, disease experts around the world watch flu viruses that circulate in animals. As a result, zoonotic disease research is crucial.

Keywords: Bat flu, Zoonotic diseases, Human health.

Abst-109

Serotonin Drugs for COVID-19?

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Abstract

A global pandemic is presently underway due to the novel coronavirus disease 2019 (COVID-19), a systemic illness that could affect various organs and functions. COVID-19 appears to have a mortality rate of 3.4–5.5 percent, which is much greater than seasonal influenza caused by the influenza virus (1 percent). This unexpected and speedy pandemic has resulted in major psychological problems like anxiety (paranoia and post-traumatic stress disorder) and despair. Ferosity of COVID-19 is mostly determined by immunology and the mediators of inflammation such as cytokines and chemokines. Regretfully, there has yet to be developed an effective treatment for the prevention from this deadly disease. Due to its urgent need, repositioning of existing drugs is a best and cheaper way to uncover therapeutic potential. Based on existing knowledge of SARS-CoV-2, drugs having both anti-inflammatory and antiviral properties with low risk of side effects should be the most promising treatment options for combating this virus. The clinical symptoms documented in SARS virus infection, suggests that the virus influenced mood by modifying the 5-HT pathway. As a result, 5-HT receptor targeting medicines should be regarded as a viable treatment option for mild depression brought on by the COVID-19 infection. 5-HT receptors are found in a variety of human and rodent immune cells (classes 5-HT1 to 5-HT7). So, drugs effective for 5-HT hase a direct impact on innate and acquired immunity. Also, Serotonin inhibits proviral DNA synthesis by 51percent in human macrophages. According to these researches, pharmacological control of the serotonergic system may influence immunological function and viral infections. So, the use of 5-HT-modulating drugs in combination with other therapies could result in more beneficial outcomes due to their immune-regulatory, anti-inflammatory, and anti-viral actions.

Keywords: COVID-19, SARS- CoV-2, Serotonin, Anti-depressants, Anti-inflammatory, Antiviral.

Abst-110

Impact of COVID-19 and its Best Possible Solution – Wash Technique and Sudarshan Kriya

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Abstract

COVID-19 is the most serious health crisis the world has experienced since March 2020. World statistics as well as Indian statistics reveal that number of infected people are 253 million (world wide) and 34 million (India) while the number of death cases are 5 million (world wide) and 0.5 million (India). Suitable environment is a necessity for survival of the entire biota including humans. In India, Vaccination drive, maintenance of social distance and use of masks have curved down the number of infectious cases as well as lowered the number of deaths also. The Covid-19 and Lockdown had exerted negative impact on Economy, Education, Employment as well as Physical and Mental health of human. However, they also had positive impact on Climate change, Global Warming, Biodiversity and Environment. It is observed that in extreme cases people suffer from depression characterised by low mood, tiredness, pessimism, poor sleep and appetite. This leads to them feeling helpless, guilty and hopeless with a gradual reduction in work output.

Keywords: COVID-19, Wash technique, Sudarshan kriya.

Abst-111

Redescription of *Chauhanellus indicus* Rastogi et al., 2004 from the Gills of *Wallgo attu* at Ghaziabad.

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Abstract

Present communication deals with a known species of genus *Chauhanellus* (Young, 1967) Bychowsky & Nagibina, from freshwater fish Wallago attu (Bloch. and Schn.). C. indicus has been collected from the host Wallago attu (Bloch. and Schn.). Rastogi et al. (2004) described *Chauhanellus indicus* from the gills of *Mystus tengara* (Ham.) and *Wallago attu* (Bl. and Schn.) at Meerut. Later Mishra D. (2009) described the same from the gills of Wallago attu (Bl. and Schn.) at Meerut. Earlier accounts lack some morphological details regarding reproductive system and structure of egg and additional hard structure in haptor. Therefore, a brief redescription of the species, based on fresh material collected by the author. These worms are elongated and elliptical in shape. Bilobed prohaptor is equipped with nine pairs of head organs and two pairs of eyespots. Pharynx is small, muscular and spherical to oval structure. Oesophagus is short. Intestinal crura simple and bifurcates after its origin and terminate blindly, slightly anterior to the peduncle. Male reproductive system comprises of testis, vas-deferens, seminal vesicle, vasa efferentia and cirrus. Testis is single, pre - equatorial, post -ovarian, intercaecal, elongated and elliptical in shape with blunt posterior end. Vas deferens dilates into a bipartite sigmoid seminal vesicle in the pre-equatorial, inter-caecal region. Seminal vesicle opens at the base of male copulatory organ through vasa efferentia or ejaculatory duct. Male copulatory apparatus consists of 'Straight' type cirrus proper and accessory piece. Accessory piece of cirrus consists of two pieces. Female reproductive system consists of ovary, oviduct, ootype complex, receptaculum seminis, uterus, vagina and vaginal duct. Ovary is pre-equatorial, intercaecal, pre-testicular and oval in out-line. Ovary opens into ootype complex through oviduct. Receptaculum seminis is fusiform shaped, post bifurcal, intercaecal and dextral in position. Female gonopore is post - bifurcal, pre-ovarian, funnel shaped. Eggs in different stages of development are visible in uterus. Vagina is post - bifurcal, intercaecal, pre - ovarian. Vaginal duct takes a U - turn before entering vagina. Opisthaptor is fairly set-off from body proper by a narrow peduncle. Dorsal anchors are 'Pterocleidus' type. Dorsal transverse bar, connecting the dorsal anchors, is 'Wunderoid' type. It is a wide 'V' shaped bar with tapering ends. Ventral anchors are stout 'Merus' type with a broad base. Ventral transverse bar is 'Widened' type with stout shaft, and an antero-median conical protuberance. Terminal ends are bifurcated and backwardly directed. Marginal hooklets are 'Definitive' type.

Keywords: Monogeneans, *Chauhanellus indicus.*

Abst-112

A General Study of Post Covid Complications in Patients: A Review

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Abstract

Although most people with COVID-19 get better within weeks of illness, some people experience post-COVID conditions. During present review of recent publications, post COVID complications appeared in the recovered patients has been studied. Post-COVID conditions are a wide range of new, returning, or ongoing health problems people can experience four or more weeks after first being infected with the virus that causes COVID-19. These may include: difficulty breathing or shortness of breath Tiredness or fatigue, symptoms that get worse after physical or mental activities, difficulty thinking or concentrating (sometimes referred to as "brain fog"), cough, chest or stomach pain Headache, fast-beating or pounding heart (also known as heart palpitations) Joint or muscle pain, pins-and-needles feeling Diarrhea, sleep problems fever, dizziness on standing (lightheadedness) Rash, Mood changes, change in smell or taste Changes in period cycles. Early reports suggest residual effects of SARS-CoV-2 infection, such as fatigue, dyspnea, chest pain, cognitive disturbances, arthralgia and decline in quality of life.The multi-organ sequelae of COVID-19 beyond the acute phase of infection are increasingly being appreciated as data and clinical experience in this timeframe accrue. Necessary active and future research include the identification and characterization of key clinic serological, imaging and epidemiologic features of COVID-19 in the acute, subacute and chronic phases of disease, which will help us to better understand the natural history and pathophysiology of this new disease entity.

Keywords: COVID-19, Complications, Post treatment.

Abst-113

Orientation Direction in Redheaded Bunting, *Emberiza bruniceps* at 29°N, Meerut (India)

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ABSRACT

Migratory orientation in migratory species is dependent on multiple cues including Celestial cues such as a galaxy, sun/polarized light pattern, moon, stars, star-patterns, and magnetic cues from the geomagnetic field of the Earth. Migratory avian species use one or more than one of these cues through their compass system to find their migratory orientation direction and navigation. To investigate the orientation direction of a Palearctic- Indian migratory species we tested redheaded bunting, *Emberiza bruniceps* during spring migratory season in orientation experiments under civil twilight period in the eveningand night using orientation behavior as an indicator. The ratio of birds that are active and inactive during twilight, and night in the orientation experiment are 72.22%-27.78% and 33.33%-58.33% respectively. We analysed that the birds are well active and oriented in the civil twilight period in the eveningto East and West direction to the ratio of 38.46-38.46 %, along with North, South, and South-West direction in the ratio of 11.53%, 03.84%, 07.69% respectively at 29°N. On the other hand the birds are less active and disoriented from the seasonally orientation direction in the night experiment. The active birds in night experiments shows orientation towards East, North-east and West direction in the ratio of 75%, 16.66%, 08.33% respectively. The final mean orientation direction Northwest is calculated with the help of circular statistics tools. The study concludes that redheaded bunting show seasonally appropriate Northwest migratory orientation direction in the experiment under the civil twilight period but disoriented in night experiment.

Keywords: Avian Migration, Orientation, *Emberiza bruniceps.*

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