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ENVIS Newsletter on 'Microorganisms and Impact on Public Health', a quarterly publication, brings out original research articles, reviews, reports, research highlights, news-scan etc., related to the thematic area of the ENVIS Centre. In order to disseminate the cutting-edge research findings to user community, ENVIS Centre on Microorganisms and Impact on Public Health invites original research and review articles, notes, research and meeting reports, details of forthcoming conferences / seminars / symposia / trainings / workshops for publication in the newsletter.

The articles and other information should be typed in double space with a maximum of 8 - 10 typed pages. Photographs/line drawings and graphs need to be of good quality with clarity for reproduction in the newsletter. For references and other details, the standard format used in the newsletter may be followed.

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Cover page : Scanning electron microscopic image of *Staphylococcus aureus* bacteria, enmeshed in a human white blood cell.

(Source: www.phys.org/news/2020-06-staph-blood-clotting.html

CONTENTS

From the Coordinator's Desk!

Dear Readers,

Greetings!

I hope everyone is doing well and fine during this COVID-19 Pandemic. Most people who fell sick with COVID-19 experienced mild to moderate symptoms and recovered without any special treatment. However, aged people and people of all ages with pre-existing cor medical conditions (such as diabetes, high blood pressure, heart disease, lung disease, or cancer) developed serious illness more often than others. Hence, follow the Government guidelines and maintain personal hygiene at all times. I am glad that our Country is doing well in controlling the disease by imposing lockdown and people are staying safe as best as they could. During the lockdown it is important to stay physically active, eat healthy diet and have sound mental health. Listen to advice and recommendations from our national and local authorities. Keep up with daily routines as far as possible, or make new ones. Follow trusted news channels, such as local and national TV and radio, and keep up-to-date with the latest news on awareness of COVID-19.

This newsletter has some interesting contents, an article regarding factors in containment of COVID-19 virus in India providing insights on our traditional medicine, food habits, etc. along with other topics such as how researchers measure cancer cell mechanics in living animals using nanoparticles, sensitive new test to detect antibodies against SARS-CoV-2 in just 10 minutes and many more. Hope you find these information interesting!

Dr. C. Arulvasu

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REVIEW ARTICLE (Published in '*International Journal of Virology*')

FACTORS IN CONTAINMENT OF COVID - 19 VIRUS IN INDIA –AN INSIGHT

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A B S T R A C T

The disease COVID – 19 is caused by a novel Corona virus SARS-CoV-2 orginated from Wuhan, China. The disease became pandemic spreading in more than 213 countries. The first report on COVID – 19 in India was recorded on 30th January 2020 from Kerala followed by other countries such as Russia, Spain, Brazil, UK, Italy, Turkey and Iran either on the same day or later. India being the most thickly populated country with 17.7% of total population of world, the number of cases recorded in India was 106,886 as of 20th May 2020. However, in other countries infection exceeded the number than in India with their meager population. Therefore the researchers throughout the world developed an interest to know the methods of containment of the disease in India and this article highlights perspectives on the role of factors like air handling systems, mode of transport, nutritional facts and traditional medicine which are unique to India. The role of insects like cockroach and housefly in spreading the virus and other body fluids of infected person is also discussed and conducting joint studies representing different geographical zones at International level on these aspects is also suggested. Bringing policies in containment of SARS-CoV-2 virus as well as for other microbes in all countries is recommended.

Introduction

The disease COVID-19 is caused by a novel virus SARS-CoV-2[1], similar to the virus causing common cold, Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS) belonging to family Coronaviridae[2]. The virus was first reported from Wuhan the capital of Hubei Province in China[3] during December 2019. The virus was first reported as an epidemic in Wuhan, China and later declared as Pandemic on 30th of January 2020 by World Health Organization (WHO). The viral spread was recorded in 213 countries worldwide. Approximately 5 million persons around the world were infected by this virus, which is the highest record for any virus belonging to the family Coronoviridae. The symptoms of COVID-19 includes sore throat, dry cough, muscle and joint pain, fever, headache, formation of sputum, shortness in breath, fatigue, nausea and vomiting in few cases[4]. The disease symptom develops into multi organ failure resulting in fatality depending on the immune status of the patients. Fatality was mostly recorded among immunocompromised patients.

The disease was first reported in India from the State of Kerala on 30th of January, 2020. Three students from Wuhan, China travelled to Kerala were found to carry the infection of SARS-CoV-2. India even though being the most populated country with 17.7% of total population of the world, only 106886 confirmed cases were recorded as on 20 May, 2020. However, in other countries infection exceeded the number than in India with their meager population. When compared with top 11 countries infected with the virus, India was successful in containment of COVID-19. The success behind the containment of this disease in India developed an interest for researchers throughout the world. Apart from climatic factors like temperature, moisture and wind, other unique factors played major roles in containment of the virus in India. This includes uniqueness in air handling systems, mode of transport, nutritional facts and usage of traditional medicine. An insight on different non-pharmacological factors involved in the containment of the disease is provided in this article. All the data such as infected, fatality and recovery rates discussed in this article are based on values published by WHO, CDC and other organizations during May 2020.

Global Scenario

As far as the prevalence of the Corona disease is concerned, United States (US) was found to be on top with more than 1.57 million cases recorded. 31.48% infection was in US, 6.05% in Russia, followed by Spain and Brazil with 5.58% and 5.44% respectively. India has recorded only around 2.14% of infection among the world population infected with SARS-CoV-2. Nearly 73% of infection was caused in 11 different countries and all other countries (202) shared the remaining 27% of infection (Fig. 1). The fatality recorded due to this disease was around 0.325 million.

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The fatality recorded worldwide was around 6.52% among the infected subjects. Maximum fatality was recorded in France (15.49%) followed by Italy and UK (14.2% each) and Spain (9.96%). The least fatality was recorded in Russia (0.94%). India recorded around 3.09% of fatality among the infected subjects[5]. The fatality recorded for top 11 infected countries is presented in Fig. 2.

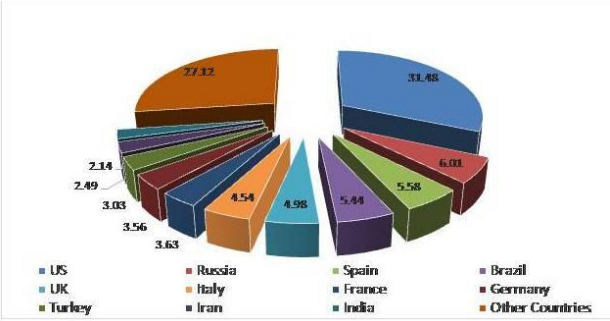

Fig. 1. Covid-19 infection (%) in different countries (as on 20 May 2020).

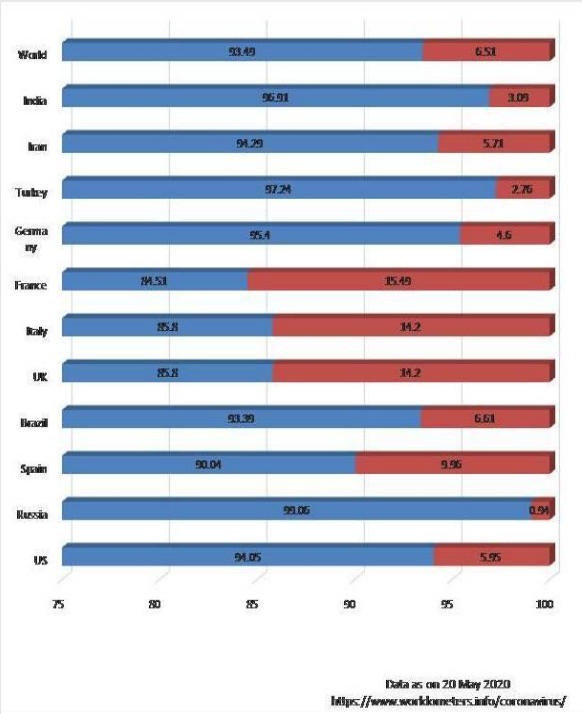

Fig. 2. Fatality of Covid 19 (In %) in top 11 countries.

Total number of cases recorded per million population was maximum in Spain (5963/million population) followed by US (4748/million) and Italy (3749/million). Nearly 640 people per million population was recorded for world on an average as of 20 May 2020. However, the cases recorded in India was only at 78/million population. The number of cases recorded per million of population for top countries infected with COVID-19 is presented in Fig. 3. The disease spreading rate (In days) from 100 cases to 100 thousand cases revealed that only 25 days were required in US, 31 days in Spain and 37 days in Germany. In Iran it took more than 75 days to reach 100 thousand cases from 100 cases and in India it took 64 days. Number of days required for different countries to reach 100 thousand cases from 100 cases is represented in Fig.4.

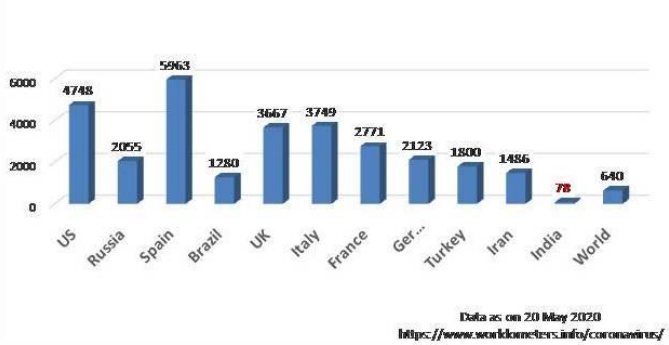

Fig. 3. Covid – 19 infected persons per million in different countries.

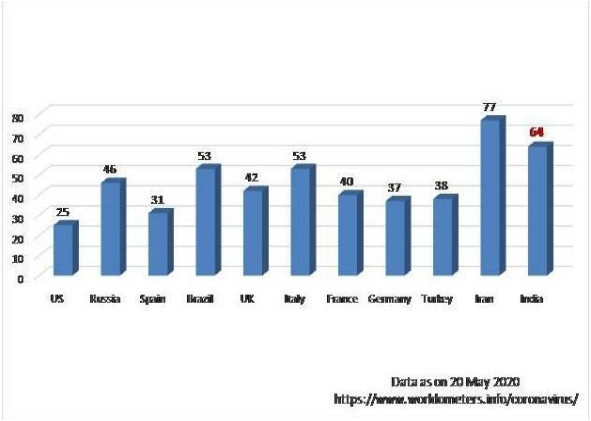

Fig. 4. Covid-19 Disease progression rate from 100 to 100 thousand subjects (In days)

SARS-CoV-2 Transmission

Aerosols of SARS-CoV-2 are generated through sneeze and cough of the infected subjects usually released as droplets particles at higher levels. These particles are also released from larynx, mouth, throat during exhalation while breathing and talking.. Millions of aerosol particles are generated while sneezing causing nasal secretions and mucus present in respiratory system thrown into the atmosphere at greater speed[6]. The morphological features of virus such as spherical or elliptical shape and their size 60-140nm in diameter[7] functions as a Bio-nanomaterial and helps in their transmission through air. Due to their size and morphology they are buoyant in the atmosphere, sustain for longer time

and easily transported to longer distance and this airborne nature of SARS-CoV-2 was highlighted by Morawska and Caw[8]. In India spitting is a common habit. It is found that India, China, and South Korea are significant spitting nations in the world[9]. The spitting in common place by infected subjects serve as an inoculum source of the virus. This moisture rich sputum along with mucus and saliva become dry and virus becomes airborne. The airborne viral particles are carried to longer distances depending upon the air temperature, wind, and humidity. It is noticed that airborne transmission is most potential when compared to transfer of virus through direct contact. This raises the doubt that insects like housefly, cockroach etc. sitting and feeding on the spitted phlegm, mucus and sputum may spread the disease. Thus, their role needs to be probed. The spread of virus through contact and isolation of virus from even sewages proves that they may be transmitted through bodily fluids.

Air Handling Systems

The air circulation in other countries are maintained by centralized system using Air Handling Units (AHUs) and not with open windows. Theatres, malls, shopping complexes, corporate offices, and other residential buildings and apartments in other countries are maintained by centralized AHUs which are termed as Air Tight Buildings. The diseases associated with such buildings are widely reported as Building Related Illness (BRI) or Sick Building Syndrome (SBS). The air circulation maintained by AHUs are having a single point of source and air is continuously circulated within buildings[10]. Thus, if any subject occupying the building infected with SARS-CoV-2 sneeze or coughs within indoor, the inoculum is dispersed within and is circulated throughout the building which in turn affects the other occupants. Thus, exposure to the virus is manifold in such buildings. However, in India, majority of the buildings use open windows for air circulation. Few possess air condition systems as a single unit. In India, except malls, theatres and few corporate offices all other buildings rarely possess AHUs for air handing. Even in those buildings, attention was paid to clean the surfaces. These offices were closed by the Federal Government as Lockdown from the date of 24th March 2020. Thus, the spread of SARS-CoV-2 in India is contained.

Transport

The countries which report more number of COVID-19 use Flight, Buses, and Trains provided with central air conditioned systems for their transport. Huge number of population use personal car switched on with Air condition system. These transport systems are considered as air tight as there is no external transaction of air as their doors are closed. This develops a microenvironment within the transport system and exposure risk associated with the nature of microbe present within[11]. Thus, transmission of virus is easy and exposure to SARS-CoV-2 virus is more when co traveler is infected with the virus in such modes of transport. However, in India, the commuting system used by the general public is often of open type. Majority of population, i.e. nearly 70 % in India use two and three wheelers like scooters, mopeds, bikes, and autos as a mode of transport when compared to Japan (17%), Germany (10%), and USA (2-3%)[12]. Remaining population use public transport system like Non A/c buses and Non A/c coaches in train which are of open types. This helps in air transaction between outdoor air along with the atmosphere within trains and buses. Even if any passenger positive for COVID either sneezes or coughs, the inoculum will be diluted and dispersed outward. Very few among the population use buses with Air conditioned system and A/c train coach. Usage of flight for transport is far less in India when compared with other countries due to economic status of general public. This favors the containment of virus in India.

Food Habits

India is the most populated country with vegetarians due to religious belief and caste system followed. The number varies from 300 to 400 million people being vegetarian[13]. Other 40% consumes non vegetarian meats with less frequency which is attributed to economic status. However uncooked or raw meat are never consumed in India. The style of consuming meat in India is different from other countries as they are well cooked and added with more spices and condiments. The spices and condiments used in Indian culinary is widely found to possess antiviral properties and boosting immune system. To mention a few, 1) Star anise is found to possess antioxidants and rich in Vitamins A and C Effective as an antiviral and easing sore throats and cold, 2) Curcumin is a well-known antiviral compound present in

Turmeric which is an effective antioxidant and anti-inflammatory in nature, 3) Fenugreek is used to treat sore throat as they are antiviral in nature, 4) Nutmeg used in Biriyani as a flavoring agent is found to boost immune system, 5) Cinnamon found to possess rich antioxidants and mixed with ginger to treat common cold, 6) Black pepper contains various anti-oxidants, 7) Cloves are found to possess anti-inflammatory, antiseptic, and pain relieving properties, 8) Mustard for common cold, 9) Cardamom rich in antioxidants, vitamins, and minerals, 10) Ginger is widely used which provides immunity against common cold, 11) Onion is rich in antioxidants and anti-inflammatory activities, and 12) Garlic is used as antiviral and against common cold. Thus, the immune system of the Indian population in general is strong when compared to other countries which recorded morenumber of SARS-CoV-2 viral infections. Further, the leaves of Murraya (Curry leaf) and Coriander are reported as antiviral culinary herbs. These herbs are used widely in Indian culinary. To name, Rasam (A boiled aqueous extract of different spices, condiments and culinary herbs) is unique culinary item of India which is not prepared in other countries. Thus, it is predicted that food habits of the Indian population provide innate or acquired immunity against SARS-CoV-2 when compared with other countries.

Traditional Medicine

India is rich in its own traditional system of medicine in healing the patients. This is also popularly termed as an alternative system of medicine. The Indian system of medicine has three major divisions namely Ayurveda, Siddha, and Unani based on their origin. The Ayurveda system of medicine dates back to 1500 BC. It is a well-developed system of medicine with two major divisions as school of medicine and school of surgery. The other system is Siddha, which originates in southern part of India. This system has a specialty in usage of drugs of metals and minerals in origin along with that of vegetation (Herbs) dependent drugs as Ayurveda. Unani system of medicine came into existence in India by the time period of 1350 AD[14]. All the above system use plants in general.

The following plant species are widely used throughout India for the treatment of cold, flu, and asthma related (Cold and Flu); *Piper longum* and *P. nigrum* (Cough, Asthma, and Fever); *Clerodendrumserratum*, *Saussurialappa*, and *Solanum xanthocarpum* (Asthma); *Zingiber officinale* (Asthma and Fever); *Ocimum sanctum* (Immunomodulator); *Allium sativum*, *Boerhaviadiffusa*, *Calotropis gigantea*, *Curcuma longa*, *Eugenia jambolana*, *Ficus religiosa*, *Myristica fragrans*, *Rubia cordifolia* and *Vitex negundo* (Anti-inflammatory). The plants like, *Lycoris radiata*, *Artemisia annua*, *Ocimumbasilicum*, *Terminalia chebula*, *Polygonum cuspidatum*, *Curcuma longa*, *Melia azadirach*andmany species of *Phyllanthus*, *Calophyllum*, *Caesalpinia* and *Cajanus* are found to possess antiviral properties[15]. Due to wide practice of traditional system of medicine in India and plenty of usage of antiviral plants provide protection to the population thus, preventing the infection of COVID-19.

Conclusion and Recommendations:

The article provides the insight on non-pharmacological factors behind the successful containment of the infection of virus SARS-CoV-2 in India which is attributed to the following reasons, i.e. a) the uniqueness of buildings and maintenance of air circulation system as an individual units rather than centralized AHUs, b) Timely intervention and declaration of lock down by the Government of India which arrested the spread of virus through Indoor Air, c) Mode of Transport used by the general public in India, d) Food habits and the culinary system of India, and e) Massive usage of Traditional System of Medicine in India when compared with other countries. Policy on studying SARS-CoV-2 as airborne virus, their spread through other body fluids, role of insects in dispersion of disease causing virus is recommended. Expansion of such policy to other microbes will prevent future challenges. Based on the insight provided on the non-pharmacological factors in containment of COVID-19, few recommendations are made:

a) Government of India and Government of different states need to develop a policy to monitor indoor for the presence of SARS-CoV-2. This has to be expanded to other microbes too.

b) The spread of SARS-CoV-2 through perspiration or other body fluids of the subjects having COVID-19 need to

virus will not spread through sweat or other body fluids

c) The role of insects like housefly and cockroaches on spreading the viral inoculum of COVID -19 from the sputum and phlegm spitted on common places by the infected people need to be established.

d) To combat the spread of COVID-19 it is strongly recommended that each individual building, malls, theatres, corporate offices of India need to be monitored for the presence of SARS-CoV-2 on surfaces, indoor air, air ducts, air vents, and AHU filters. People must be allowed to occupy such buildings only after getting clearance certificates from the Government bodies.

e) Specialized individuals or IAQ specialists must be appointed for regular monitoring of indoor environments.

f) Involvement of Aerobiologists, Environmentalists, Microbiologists, Occupational hygienists, IAQ specialists, Epidemiologists, Medical Councils, Pollution control boards, Environmental bodies, Department of Science and Technology, and Department of Biotechnology in studying SARS-CoV-2 in the atmosphere. The study can be carried as a Multicenter study throughout the world.

Funding

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Researchers measure cancer cell mechanics in living animals using nanoparticles

A first-of-its-kind nanoparticle-based *in vivo* imaging technique that may one day be used to help diagnose and even treat cancer has been developed by researchers collaborating from Michigan State, Johns Hopkins and Stanford universities. The technique captures mechanical properties in living subjects that probe fundamental relationships between physics and *in vivo* (in a living organism) biology. The results were published in the journal *Materials*.

Bryan Smith, associate professor of biomedical engineering at MSU, worked with colleagues to develop the tiny particles, which once inside living cells, can reveal important information about cell structure including how tumor cells physically change as they form into tumor. Researchers have engineered the ability to measure and quantify the nano mechanical properties of individual living cells within the body of a living animal for the first time. In an earlier study, Smith and his team designed nanoparticles that helped to eat away atherosclerosis, the plaque buildup in arteries that can lead to heart attack. The particles selectively enter immune system cells known as macrophages, delivering a drug instructing cells to devour the harmful plaques. Now, they have created a technique using different nanoparticles that can be embedded into various cell types, including cancerous breast cells, in live animals. Analyzing how the particles move within the cell can reveal a lot about its internal physical properties.

Smith said there is no method to examine mechanical properties in living subjects for example, in mammals with high spatial resolution and such techniques promise to open entirely new avenues of inquiry for both disease diagnosis and treatment. The mechanical properties of biological tissues have been known to play a major role in many disease states, including heart disease, inflammation and cancer as well as normal physiology such as cell migration and organism development. Smith and his team used nanoparticles to first compare the mechanical properties between cells in culture both standard 2-D and 3-D and in live animals. Tracking the movement of the nanoparticles revealed that the environment in which the cells are observed greatly affects their mechanical properties which could mean that certain cell models may not be such valid representations of live animals.

The next part of the experiment looked at what actually happens to the internal structure of cancer cells as they begin to form tumors. Previous methods couldn't answer the question because they were too invasive to test in living subjects. Again, observing the movement of the nanoparticles within the cells, the team measured how compliant or soft, the cells were. Importantly, they found that normal cells pliability remained steady over time, but as cancer cells formed a tumor over the period of a week, they stiffened.

"We found that as a tumor begins to form in a living mouse, individual tumor cells mechanically stiffen. This is a fundamental finding which is ultimately likely to have implications for cancer spread (metastasis) and tumor lethality," Smith said. "The discovery was made possible by integrating state-of-the-art imaging and particle tracking technologies from our and our collaborators' labs.“

The research has a number of promising applications in medicine. One of these is simply evaluating which cell culture methods are enough like living organisms to provide meaningful information. Another is measuring the cell mechanical properties of common biological functions, including organ development, in living organisms. Perhaps the most exciting application may be in disease diagnosis and treatment as Smith said. Nanoparticles might be used to monitor the health of cells and the types of changes they undergo in disease processes and may even alter that course. Smith and his colleagues plan to look at the formation and dissemination of cancer metastases, which cause about 90% of cancer deaths.

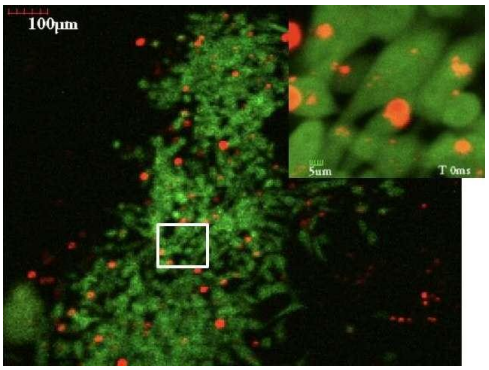


Figure: An early tumor (in green are tumor cells) with nanoparticles (in red) in them were used to quantify the mechanical properties using microrheology. The first image from a video taken within a living mouse and the inset shows individual tumor cells and nanoparticles at a higher resolution.

Image credit: Bryan Smith

Source: www.msutoday.msu.edu

Sensitive new test detects antibodies against SARS-CoV-2 in just 10 minutes

Just like other animals, insects also have ACE proteins, but insects are evolutionarily so distant from mammals that their ACE proteins are so different from mammalian ACE2 that it is highly unlikely that these ACE proteins of insects can bind the coronavirus SARS-CoV-2. Moreover, extensive analyses of the micro-organisms present in insects, that have been executed in recent years have never recorded a virus from the wider group of coronaviruses. As the COVID-19 curve shows signs of flattening in the U.S. and elsewhere, public health officials are trying to grasp just how many people have been infected. Now, a proof-of-concept study in American Chemical Society (ACS) Analytical Chemistry describes a quick, sensitive test for antibodies against the coronavirus in human blood. The test could help doctors track a person's exposure to the disease, as well as confirm suspected COVID-19 cases that tested negative by other methods.

Because COVID-19 symptoms range from mild to severe, with some people apparently having no symptoms, the number of people who have been infected with the SARS-CoV-2 virus at some point is likely much higher than the number of confirmed cases. As U.S.A begin to ease lockdown restrictions, widespread testing of the general population will be important to identify people at early stages of disease, or people who lack symptoms but can still infect others. Also, although more research needs to be done, it is possible that people with antibodies to the virus could be immune to future COVID-19 outbreaks. To help identify people with current or past exposure to SARS-CoV-2, Lei Yu, Yingsong Wu, Guanfeng Lin and colleagues wanted to develop a fast, sensitive antibody test.

The researchers based their test on a technique called a lateral flow immunoassay (LFA); a home pregnancy test is an example of this kind of assay. They attached a viral coat protein to a specific region on a strip of nitrocellulose, and then added human serum. The serum flowed from one end of the strip to the other, and any antibodies against the viral protein bound to that region on the strip. Then, the team detected the anti-SARS-CoV-2 antibodies with a fluorescently labeled antibody. This fluorescence-based detection is much more sensitive than some other LFAs, such as pregnancy tests, that can be read by the naked eye. The researchers tested the new assay on seven serum samples from COVID-19 patients and 12 samples from people who had tested negative for the disease by reverse transcriptase-polymerase chain reaction (RT-PCR), a common diagnostic test that occasionally fails to detect positive cases. The new assay correctly diagnosed all seven samples as positive as well as an additional negative case that had suspicious clinical symptoms in only 10 minutes per sample. The immunoassay could be helpful in confirming negative diagnoses, monitoring a patient's recovery, studying past exposures, and identifying recovered individuals with high levels of antibodies as potential convalescent plasma donors.

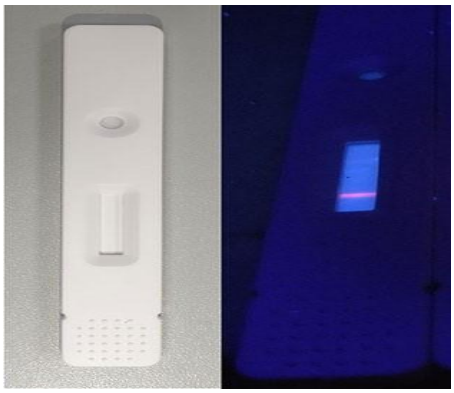


Figure: A new lateral flow immunoassay can detect antibodies against SARS-CoV-2, which appear as a bright orange line when placed on a fluorescence reader (right).

Image Credit: Guanfeng Lin

Source: www.acs.org

ONLINE REPORTS

Algae in the oceans often steal genes from bacteria

Algae in the oceans often steal genes from bacteria to gain beneficial attributes, such as the ability to tolerate stressful environments or break down carbohydrates for food, according to a Rutgers University co-authored study.

The study of 23 species of brown and golden-brown algae, published in the journal “Science Advances”, shows for the first time that gene acquisition had a significant impact on the evolution of a massive and ancient group of algae and protists (mostly one-celled organisms including protozoa) that help form the base of oceanic food webs. These photosynthetic species produce about 70 percent of the oxygen we breathe and some of them, such as diatoms, are responsible for about 45 percent of global primary production of organic matter.

Debashish Bhattacharya, a distinguished professor in the Department of Biochemistry and Microbiology in the School of Environmental and Biological Sciences at Rutgers University, New Brunswick and corresponding author of the study said the vast group of species called CRASH, including algae such as diatoms and dinoflagellates, as well as members of the group alveolates that includes the malaria parasite and another group oomycetes that includes the potato blight pathogen, creates and consumes immense amounts of organic matter. He added that there are hundreds of thousands of CRASH species and they have thrived on Earth for more than a billion years.

Scientists, led by researchers at the Chinese Academy of Fishery Sciences, created a massive genomic dataset of more than 524,000 protein sequences from 23 CRASH species and used sophisticated methods to analyze the data. The results showed that gene stealing or acquisition (known as horizontal gene transfer) varies substantially among different CRASH species, with 0.16 percent to 1.44 percent of their genes (an average of 1 percent) coming from bacteria.

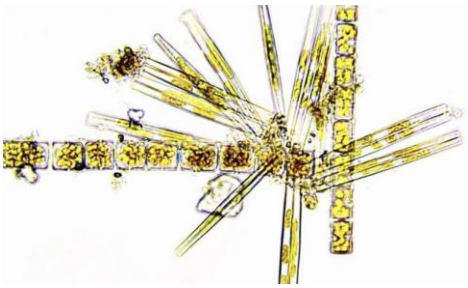


Figure: The diatoms in this image are members of the CRASH lineage that have stolen many genes from bacteria. CRASH species have become dominant phytoplankton in both marine and freshwater environments.

Image Credit: Julia Van Etten

Source: www. eoas.rutgers.edu

New insight into bacterial structure to help fight against superbugs

Scientists from the University of Sheffield have produced the first high-resolution images of the structure of the cell wall of bacteria, in a study that could lead to further understanding of antimicrobial resistance.

The research published in *Nature* revealed a new and unexpected structure of the outer bacterial layers of the bacterium *Staphylococcus aureus*. The findings set a new framework for understanding how bacteria grow and how antibiotics work, overturning previous theories about the structure of the outer bacterial layers. The images give unprecedented insight into the composition of the bacterial cell wall and will inform new approaches to developing antibiotics in order to combat antibiotic resistance. There are no other examples of studies of the cell wall in any organism at comparable resolution, down to the molecular scale.

Laia Pasquina Lemonche, a Ph.D. Researcher from the University of Sheffield's Department of Physics and Astronomy, said "Many antibiotics work by inhibiting the bacteria's production of a cell wall, a strong but permeable skin around the bacteria which is critical for its survival. We still don't understand how antibiotics like penicillin kill bacteria, but this isn't surprising because until now we had remarkably little information about the actual organisation of the bacterial cell wall. This study provides that essential stepping stone which we hope will lead to both a better understanding of how antibiotics work and to the future development of new approaches to combat antimicrobial resistance”.

The team used an advanced microscopy technique called Atomic Force Microscopy (AFM), which works by using a sharp needle to feel the shape of a surface and build an image similar to a contour map, but at the scale of individual molecules.

Professor Jamie Hobbs, Professor of Physics at the University of Sheffield, said "It is by physicists and biologists working together that we've been able to make these breakthroughs in our understanding of the bacterial cell wall“.

The researchers are now using the same techniques to understand how antibiotics change the architecture of the cell wall and also how changes in the cell wall are important in antimicrobial resistance.

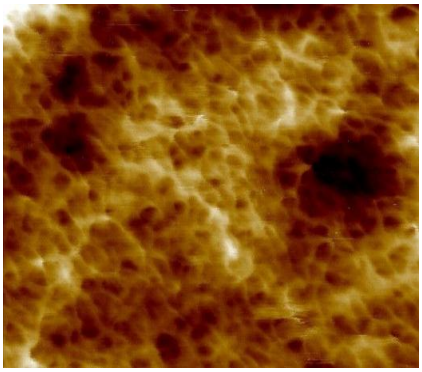


Figure: Internal sacculus structure.

Image Credit: University of Sheffield

Source: www.thestar.co.uk

NEWS

Evolution of bacterial movement revealed

An international team with researchers from Leiden University revealed how a bacterium repurposed an internal system to control its movements. Movement control is very important in host invasion, which can lead to disease published in the journal *Nature Communications.*

Bacteria from nose to tail

Cells are full of complex systems of which the origins are a mystery. In bacteria, nineteen different systems based on smell are known, socalled chemosensory systems. In the study published, the researchers found an ancestral chemosensory system of the model species of the bacterium *Escherichia coli* in several other bacteria like the pathogenic bacterium *Pseudomonas aeruginosa* and in *Vibrio cholerae*, the bacterium that causes cholera. Furthermore, the study revealed the origin of the chemosensory system of *E. coli*, including the evolutionary steps that led to the modern *E. coli*. These findings may help in the development of anti-microbial remedies using the chemosensory system as a target. From Leiden co-corresponding author Ariane Briegel, Professor of Ultrastructural biology at the Institute of Biology and Ph.D. student and second author Wen Yang were involved in the study.

Bacteria move based on chemosensory signals in their surroundings. The smell signals reach the bacterium through its nose activating a system within the bacterium to control the spinning direction of the flagella. Flagella are rotating tails that many bacteria use to navigate their environment. They guide the bacterium towards something attractive and away from something repelling. These smell signals are very important for pathogenic bacteria to be able to invade their host.

System under stress

When the researchers looked at the bacteria under stress conditions by starvation, they discovered that under these conditions, a different form of the chemosensory system appeared in the Vibrio cholerae and *Pseudomonas aeruginosa* bacteria. Tracing the evolutionary history of the system, it turned out to be the ancestral form of the system that is present in *E. coli*. The researchers discovered that this ancient form took over another chemosensory system in a series of evolutionary steps and gained control of the flagellar motor. The combination of the two systems now makes up the chemosensory system in modern E. coli bacteria. This finding shows an example of how complex systems were being repurposed during evolution.

Ice-cold microscopy

The researchers were able to study the bacteria with the use of cryo-electron microscopy and bioinformatics. Inside a cryo-electron microscope, the temperature is almost 200°C below zero. By freezing microbes very quickly they are pristinely preserved in a glass-like ice. With cryotomography, the researchers take hundreds of photos of bacteria in different stages and are able to reconstruct the microbes in three dimensions at macromolecular resolution. Briegel and others collected the data at Caltech, Pasadena, California. Leiden holds similar cryo-electron microscopy facilities at the Netherlands Center for Electron Nanoscopy (NeCEN), where Briegel holds a position as co-director.

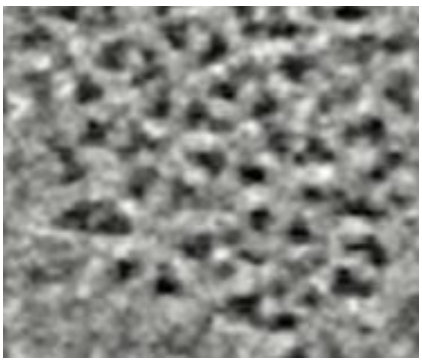


Figure: Image of the nose of an *E. coli* bacterium. The pattern looks a bit like a honeycomb.

Image Credit: Wen Yang.

Source: www.universiteitleiden.nl/

Researchers identify new approach to turning on the heat in energy-burning fat cells

Researchers have discovered a new set of signals that cells send and receive to prompt one type of fat cell to convert fat into heat. The signaling pathway, discovered in mice, has potential implications for activating this type of thermogenic fat in humans. Thermogenic fat cells, also called beige fat or beige adipocytes, have gained attention in recent years for their potential to curb obesity and other metabolic disorders, due to their ability to burn energy stored as fat. But scientists have yet to translate this potential into effective therapies.

The challenge of activating beige fat in humans arises, in part, because this process is regulated through so-called adrenergic signaling, which uses the hormone catecholamine to instruct beige fat cells to start burning energy. But adrenergic signaling also controls other important biological functions, including blood pressure and heartbeat regulation, so activating it in humans with agonists has potentially dangerous side effects.

A team of researchers led by the University of Michigan Life Sciences Institute describe a pathway that can regulate beige fat thermogenesis independently of adrenergic signaling. It operates through a receptor protein called CHRNA2, short for Cholinergic Receptor Nicotinic Alpha 2 Subunit.

"This pathway opens a whole new direction for approaching metabolic disorders" said Jun Wu, an assistant professor at the LSI and the study's senior author. She added "Of course, this cholinergic pathway also is involved in other important functions, so there is still much work to do to really figure out how this might work in humans. But we are encouraged by these initial findings.“

For their study, Wu and her colleagues blocked the CHRNA2 pathway only in adipocytes in mice and then fed the mice a high-fat diet. Without the CHRNA2 receptor proteins, the mice showed greater weight gain than normal mice and were less able to activate thermogenesis in response to excess food intake.

Wu believes the findings are particularly exciting in light of another research team's recent discovery of a new type of beige fat that is not regulated by catecholamine. This newest study indicates that this subpopulation of beige fat, called glycolytic beige fat or g-beige fat, can be activated through the CHRNA2 pathway.

Wu said many patients with metabolic disorders have catecholamine resistance, meaning their cells do not detect or respond to catecholamine. So even if it could be done safely, activating that adrenergic pathway would not be an effective treatment option for such patients. This new pathway, with this new subtype of beige fat, could be the beginning of a whole new chapter for approaching this challenge.

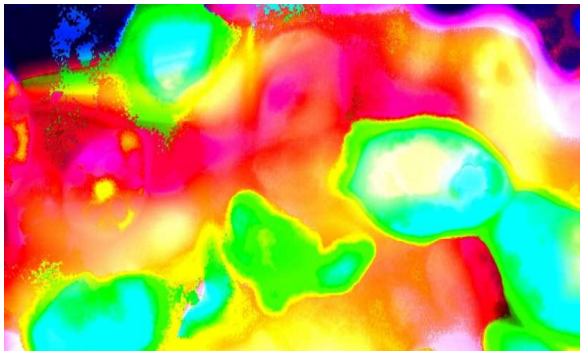


Figure: Heat map of thermogenic fat cells (artistic rendering).

Image Credit: Life Sciences Institute multimedia designer Rajani Arora.

Source: www. lsi.umich.edu.

Abstracts of Recent Publications

01. Cell, 2020, 182 (6), Pages: 1419-1440.e23.

Severe COVID-19 Is Marked by a Dysregulated Myeloid Cell Compartment.

Jonas Schulte-Schrepping, Nico Reusch, Daniela Paclik, Kevin Baßler, Stephan Schlickeiser, Bowen Zhang, Benjamin Krämer.

Life and Medical Sciences (LIMES) Institute, University of Bonn, Germany.

Coronavirus disease 2019 (COVID-19) is a mild to moderate respiratory tract infection, however, a subset of patients progress to severe disease and respiratory failure. The mechanism of protective immunity in mild forms and the pathogenesis of severe COVID-19 associated with increased neutrophil counts and dysregulated immune responses remain

unclear. In a dual-center, two-cohort study, we combined single-cell RNA-sequencing and single-cell proteomics of whole-blood and peripheral-blood mononuclear cells to determine changes in immune cell composition and activation in mild versus severe COVID-19 (242 samples from 109 individuals) over time. HLA-DR^{hi}CD11c^{hi} inflammatory monocytes with an interferon-stimulated gene signature were elevated in mild COVID-19. Severe COVID-19 was marked by occurrence of neutrophil precursors, as evidence of emergency myelopoiesis, dysfunctional mature neutrophils, and HLA-DRlo monocytes. Our study provides detailed insights into the systemic immune response to SARS-CoV-2 infection and reveals profound alterations in the myeloid cell compartment associated with severe COVID-19.

Keywords: COVID-19, SARS-CoV-2, monocytes, neutrophils, dysfunctional neutrophils, emergency myelopoiesis, immune profiling, scRNA-seq, mass cytometry.

02. Vascular Pharmacology, 2020, 135, Pages: 106805.

RAAS inhibitors are not associated with mortality in COVID-19 patients: Findings from an observational multicenter study in Italy and a meta-analysis of 19 studies.

Augusto Di Castelnuovo, Simona Costanzo, Andrea Antinori, Nausicaa Berselli, Lorenzo Blandi, Marialaura Bonaccio, Roberto Cauda, Alessandro Gialluisi

UOC Immunodeficienze Virali, National Institute for Infectious Diseases "L. Spallanzani", IRCCS, Roma, Italy

Objectives

The hypothesis that been set forward that use of Renin Angiotensin Aldosterone System (RAAS) inhibitors is associated with COVID−19 severity. We set-up a multicenter Italian collaboration (CORIST Project, ClinicalTrials.gov ID: NCT04318418) to retrospectively investigate the relationship between RAAS inhibitors and COVID−19 in-hospital mortality. We also carried out an updated meta-analysis on the relevant studies.

Methods

We analyzed 4069 unselected patients with laboratory-confirmed SARS-CoV-2 infection and hospitalized in 34 clinical centers in Italy from February 19, 2020 to May 23, 2020. The primary end-point in a time-to event analysis was angiotensin-receptor blockers (ARB) with patients who did not. Articles for the meta-analysis were retrieved until July 13th, 2020 by searching in web-based libraries, and data were combined using the general variance-based method.

Results

Out of 4069 COVID−19 patients, 13.5% and 13.3% received ACE-I or ARB, respectively. Use of neither ACE-I nor ARB was associated with mortality (multivariable hazard ratio (HR) adjusted also for COVID−19 treatments: 0.96, 95% confidence interval 0.77–1.20 and HR = 0.89, 0.67–1.19 for ACE-I and ARB, respectively). Findings were similar restricting the analysis to hypertensive (N = 2057) patients (HR = 1.00, 0.78–1.26 and HR = 0.88, 0.65–1.20) or when ACE-I or ARB were considered as a single group. Results from the meta-analysis (19 studies, 29,057 COVID−19 adult patients, 9700 with hypertension) confirmed the absence of association.

Conclusions

In this observational study and meta-analysis of the literature, ACE-I or ARB use was not associated with severity or in-hospital mortality in COVID−19 patients.

Keywords: Angiotensin converting enzyme inhibitors, ACE-I, Angiotensin receptor blockers, ARB, Sartans, COVID−19, Mortality.

8th JUNE 2020

15th JUNE 2020

E - Resources

NATIONAL

ICAR-National Academy of Agricultural Research Management

https://naarm.org.in/home/

Department of Agricultural Research and Education (DARE)

http://dare.nic.in/

National Centre for Biological Sciences

https://www.ncbs.res.in/

Indian Institute of Ecology and Environment (IIEE)

http://www.ecology.edu/

INTERNATIONAL

National Research Council Canada

https://nrc.canada.ca/en

Inter-American Biodiversity Information Network (IABIN)

https://www.oas.org/en/sedi/dsd/iabin/

Center for Microbial Ecology

https://www.canr.msu.edu/cme/

Federation of European Microbiological Societies

https://fems-microbiology.org/

EVENTS

Conferences / Seminars / Meetings 2020

16th World Congress on Virology, Emerging Diseases & Vaccines. November 02 - 03, 2020. Rome, Italy. **Website: https://virology.infectiousconferences.com/**

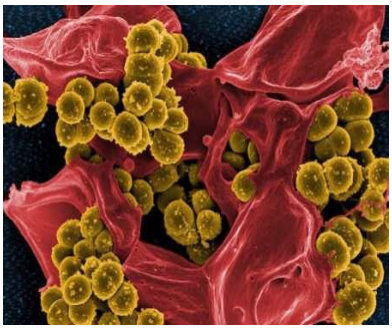
2nd International Conference on Environmental Microbial Biofilms and Human Microbiomes. November 19 – 20. Bali, Indonesia. **Website: https://microbialbiofilms.conferenceseries.com/**

8th International Conference on Parasitological & Microbes. December 03 - 04, 2020. Singapore. **Website: https://parasitology.microbiologyconferences.com/**

International Conference on Molecular Microbiology. December 07 - 08, 2020. **Website: https://molecularmicrobiology.conferenceseries.com/**

Staph's activation of blood clotting

Acute bacterial endocarditis is an infection of the inner lining of the heart, most often caused by the bacteria *Staphylococcus aureus* and has up to a 40% mortality rate.



Staph bacteria circulating in the blood adhere to heart valves and secrete the virulence factor staphylocoagulase (SC), which activates the clotting factor prothrombin to build clot-like vegetations on the valves. A previous structural study indicated that the first few N-terminal amino acids in the SC protein insert into a pocket of prothrombin.

Ashoka Maddur, Ph.D., Ingrid Verhamme, Ph.D., and colleagues have now characterized a series of SC fragments with changes in the N-terminal amino acids. They found SC variants that activated prothrombin with similar and higher efficiency compared to wild-type SC and defined the structural requirements of the prothrombin binding pocket.

Image: Scanning electron microscopic image of *Staphylococcus aureus* bacteria, enmeshed in a human white blood cell.

Image credit: National Institute of Allergy and Infectious Diseases (NIAID)

Source: www.phys.org

Covid-19 awareness & World Environment day celebration – 5th June, 2020