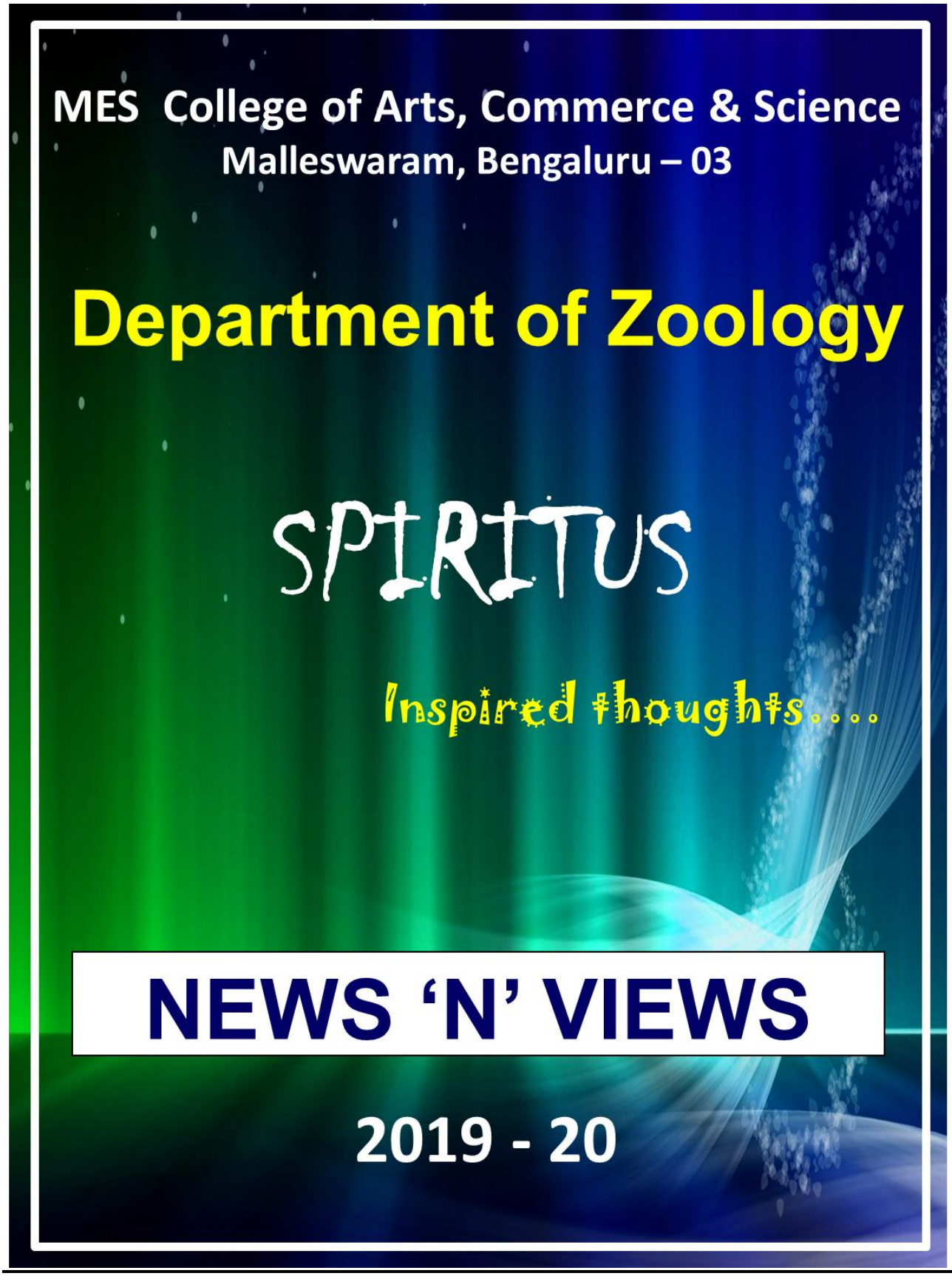
MES College of Arts, Commerce & Science
Malleswaram, Bengaluru – 03
Department of Zoology
SPIRITUS
Inspired thoughts....
NEWS 'N' VIEWS
2019 - 20

PREFACE

What began as a humble activity within the department in the year 2007, supported by the enthusiasm & contribution of students, has today transformed into a notable knowledge disseminating initiative.

We at the Department of Zoology take this opportunity to share with you readers a unique collection of articles under the name "SPIRITUS" meaning "life" in Latin. These articles are authored by our students from I, II and III B.Sc. in the form of contributions to the bulletin board maintained by the department called News "N" Views.

The bulletin board was envisaged as an ideal platform to share recent and intriguing developments, dialogues and discussions in the stream of life sciences. Any student of Zoology at the undergraduate level is welcome to contribute to the bulletin board. As a small token of appreciation & encouragement, the Department selects the top three articles at the end of every semester and awards them cash prize.

With this **sixth edition** of our **e-newsletter "SPIRITUS",** we bring to our readers, 1**2 articles** from the month of August 2019 to March 2020. We hope this small initiative grows into a mutually rewarding experience, for us at the Department, our students and you, dear readers!

RELEASE OF THE SIXTH EDITION OF "SPIRITUS"

E-NEWSLETTER OF THE ZOOLOGY DEPARTMENT

The release of the inaugural edition of "SPIRITUS" the e-newsletter of the Zoology Department, MES College, was held on 23rd November, 2020. The newsletter is a consolidation of the contributions featuring on the Department bulletin board, "NEWS 'N' VIEWS".

During the programme, prizes were awarded to the best 3 articles for the academic year 2019 - 20.

The winners were –

- Pavithran G II BSc B section 1st Prize
- Anusha V H II BSc B section 2nd Prize
- Hurshitha Vasudevan III BSc I section 3rd Prize

This is Sixth edition of "SPIRITUS" has **12 articles**, written by students of life sciences of 1st, 2nd & 3rd year B.Sc.

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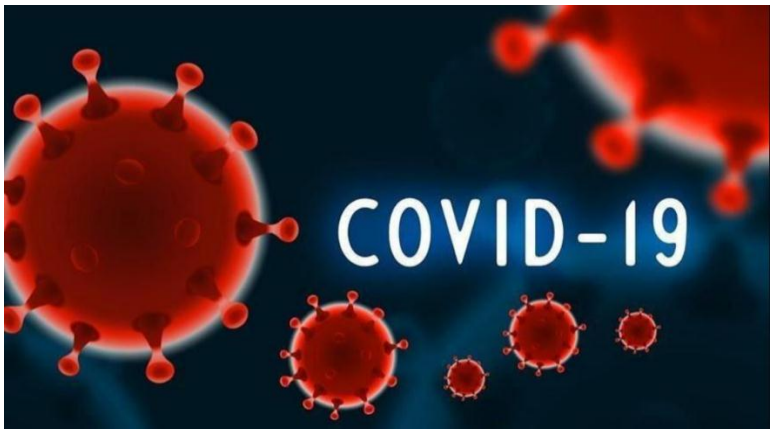
COVID-19 (Corona Virus Disease-2019)

Introduction



The world has been battling Coronavirus since months. Since the first case originated in late 2019 In the city of Wuhan, China. The virus has made its way across the globe causing economic decline, quarantine and death. The World Health Organisation has officially raised the Global alert to the highest possible level. This Novel Corona Virus is a cause for global concern because how little we know about it and how quickly it is spreading. Tait- Burkard, associated Professor at the Roslin Institute of Edinburgh, said that what makes this Novel Coronavirus Unique is that it is much severe than SARS and MERS viruses, it also means that a lot of people remain undetected as its looks like a normal common cold and they don't develop very severe symptoms and infected people are already sharing the virus while they look healthy.

Now firstly, the Novel Coronavirus has been named as **SARS – CoV-2(Severe Acute Respiratory Syndrome-Coronavirus-2)**, while the disease it causes is called **COVID 19** short for **"Coronavirus disease 2019"**. As of now, the WHO estimates that the death rate of COVID–19 is around 3.4%, which is higher than the Flu (<0.1%). SARS-CoV-2 has so far infected less than a flu has, and estimation between the two change as time moves on. However, in the comparison now, it is still evident that lives are its stake from COVID-19 which is why scientists are working vigorously on understanding its transmission, behaviour and how they can stop it.

Since, this disease is a pandemic, what we have learned about it and how fearful should we be?

Coronavirus is a family of viruses which are named for their structural elements. They have this very prominent protein on their surface called **"Spike protein"**, we can see them very prominently in the microscope. The viruses which belonging to this family are known to cause Pneumonia like symptoms. In most cases Coronaviruses are respiratory RNA virus which affects animals such as Bats, Cats and Birds. But when they make a jump to Humans these viruses are known as Zoonotic. There are 7 known Coronaviruses causing infection to humans, they are

1. 229E (alpha coronavirus)
2. NL63 (alpha coronavirus)
3. OC43 (beta coronavirus)
4. HKU1 (beta coronavirus)
5. MERS-CoV (beta coronavirus that causes Middle East Respiratory Syndrome or MERS)
6. SARS-CoV(beta coronavirus that causes Severe Acute Respiratory Syndrome or SARS)
7. SARS-CoV-2 (the novel coronavirus that causes Coronavirus Disease 2019 or COVID-19)

SARS and MERS are previous known outbreaks from the last few decades. In 2002 there was SARS outbreak and in 2012 there was MERS outbreak. The each took less than 1000 lives, but both are known to cause severe causes of pneumonia and lung injury. Death rate of these infections are higher than COVID-19 from 11% to more than 30%. So, what we see with this virus is that it is much milder than SARS and MERS. In fact, mortality rates from COVID-19 vary on age and previous health of the patients. Since it is not the Coronavirus itself, but how your immune system responds. For any viruses to cause a human disease they need to get into human cells, different viruses like to grow in different cells of the body. This new coronavirus likes to grow in lung cell. The spike protein which is present on the surface of the SARS-CoV-2 binds to a specific protein in the cell wall like lock and key mechanism, which directs the cell to take off this virus so that it can eventually hijack the cell machinery and use it to make more of its replica. This virus binds to a protein called **ACE2 (Angiotensin-Converting Enzyme 2)** present in the host's cell wall which is a receptor. So, the virus has to bind with the receptor to be able to get inside the cells. ACE2 is found throughout the respiratory tract and SARS-CoV-2 likes the cells of both upper and lower part of our respiratory system. The lower respiratory tract includes trachea, bronchi, bronchioles and alveoli. The upper respiratory tract includes the nostrils, nasal cavity, mouth, throat, and voice box. When we have an infection in our lungs, a lot of immune cells accumulate in the infected region to defeat the virus. The infected cells can no more take oxygen and because of the damage there is an accumulation of fluid in the infected part of the lung and that's what is called **pneumonia**. Most of the COVID-19 patients have died because of pneumonia. The other symptoms of this disease include **fever, tiredness, and dry cough**. Some people may also experience **aches and pains, nasal congestion, runny nose, sore throat and diarrhea**. The CDC has added six new symptoms to its official list of COVID-19 symptoms, they are **chills, repeated shaking with chills, muscle pain, headache, sore throat and new loss of taste or smel**l. On average it takes 5-6 days from when someone is infected with the virus for symptoms to show, however it can take up to 14 days. Some people may also remain asymptomatic and continue to spread the virus. There are other factors that can make this disease a lethal disease. According to the data available, it seems that most of the people died because of this COVID-19 disease so far were either elderly or they had underlying disease condition. If our immune system is compromised for some reason, then we have higher chances of getting severe infection.

To understand the origin of SARS-CoV-2 and its transmission, scientists sampled its genomes in 53 individuals back in January 2020. They converted the viruses' nearly 29000 nucleotide bases into workable DNA, which was shared with Labs across the globe. Based on the DNA they were able to distinguish that the Virus was roughly **96.2% similar to a Bat Coronavirus and 79.5% similar to SARS-CoV**. SARS-CoV-2 seems to have started in bats but there need to be a link between how the coronavirus lived in bats is slightly different to the coronavirus which leaves in humans and the link is still unknown. Despite the early theories that COVID-19 disease originated in seafood market in Wuhan, there is evidence that it might not be the case. As per February 2020, teams in China and US's National Institute of Allergy and Infectious disease are already testing an antiviral drug called Remdesivir to combat the spread. Created by US based Biotech company named Giliet, the experimental drug was shown to block the activity of a protein that helps coronavirus to make copies of themselves. Lab tests showed promises for animal models like SARS and MERS and the treatment was also successful when used on a US patient with COVID-19 infection. While the FDA has not approved this drug, clinical trials has started with 270 patients at Beijing's China-Japan friendship hospital, roughly 1000 patients spread throughout Asia and US has also administered similar treatment.

A lot of future efforts are going to be focusing on drug development because it is very clear right now that these viruses might continue to jump from animals to humans, so we should be ready to face another outbreak in the future and the antiviral drug and vaccine development are way to go.

Structure of SARS-CoV-2

Viruses are essentially protein packages surrounding genetic material. They cannot survive without a host and it is debatable whether they are living or non-living. The structure of viruses and other microbes help us to understand their various properties like how they survive, how they infect and also help us to deduce methods for detecting them and also develop ways to prevent and treat the infection. Viruses can only survive within a host cell. Viruses have a genetic material which enables them to reproduce, however they do not have enzymes required for protein as well as nucleic acid synthesis. So, they require a host cell so that they use their machinery and produce proteins and enzymes necessary for their production as well as for their multiplication.

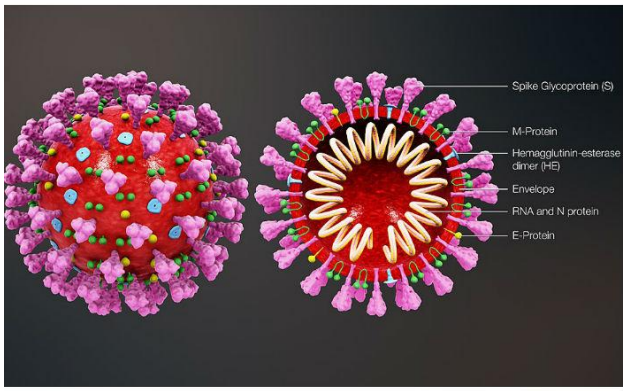
Basic structure of virus.

All viruses have a genome which is surrounded by a protein coat known as **capsid** which are arranged in a symmetrical manner to form a protective shell for the **nucleic acid**. The symmetry maybe either icosahedral (i.e. has 20 triangular faces) or helical. Some viruses maybe enveloped, or some may not be enveloped (naked viruses). The envelope is made up of lipoproteins (lipids and proteins). The lipids are derived from the host cell membrane which the virus infect, and they acquire it while they are leaving the cell and the proteins are synthesised by the viral genome using the host cell machinery.

Viruses have been broadly classified into 6 types based on their genome,

1. 1^{st} class includes viruses with double stranded DNA.
2. 2^{nd} class includes viruses with single stranded DNA.
3. 3^{rd} class includes viruses with double stranded RNA.
   4^{th}, 5^{th} and 6^{th} class are single stranded RNA viruses with some difference,
4. 4^{th} class includes viruses with positive strand, single stranded RNA i.e. RNA same as that of mRNA which can be directly translated into proteins.
5. 5^{th} class includes single stranded RNA viruses with RNA of opposite polarity to that of mRNA are present i.e. negative stranded RNA.
6. In 6^{th} class, single stranded RNA viruses are included in this class, but these viruses have the capability to synthesise DNA from their RNA using an enzyme called Reverse Transcriptase.

Structure of SARS-CoV-2.



Coronaviruses belong to **4th class i.e. they have single stranded positive sense RNA with a protein coat**. Coronavirus genome is very large in fact it is among the largest mature RNA virus molecules known and second the nucleocapsid has helical symmetry. Also, Coronaviruses are enveloped viruses i.e. apart from the protein coat, they also have lipoprotein envelope.

The lipoprotein envelope has lipids derived from the host cell membrane and the protein in this envelope are synthesised from the viral genome. One of these proteins known as **'Spike protein'** forms a kind of rim out around the membrane. The rim gives it an appearance similar to corona of the Sun and that's why this virus is named as Coronavirus. Presence of this Spike protein is the characteristic feature of Coronavirus. This spike protein is the one through which the virus attaches to a receptor and then the viral membrane fuses with the host cell membrane causing the viral genome to enter the cell.

The spike protein is also called **S protein**. The spike protein is less triangular and roughly cylindrical in shape. This protein is heavily glycosylated. During replication it uses our body's own enzymes to covalently attach sugars to the genes near protein surface. This glycosylase protects the virus from our immune system. The spike protein is made up of three intertwined chains that have identical amino acid sequences.

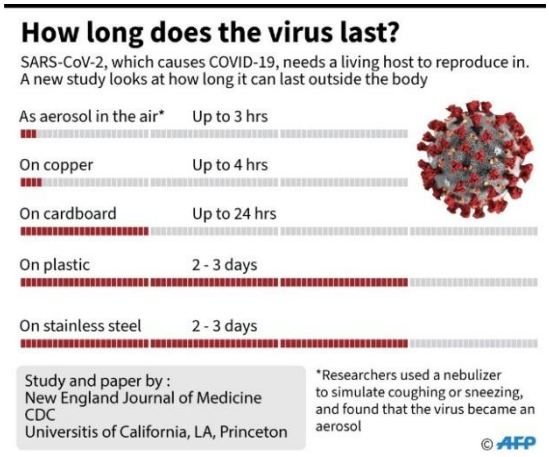
There is a **"receptor binding domain (RBD)"** in the spike protein which is critical to the viral life cycle. The RBD is where this virus binds to an enzyme on the host cell's surface enabling it to fuse with the cell and transport viral genetic material inside the host cell. Two of these RBD's are in down conformation in its structure, however one of these RBD is flipped up. This up conformation is higher energy designed to bind to cellular receptor and result in fusion. When the spike protein binds each of the RBD, it shifts into less stable up conformation. Our own peptide bond breaking enzymes called proteases can cut the spike protein at specific sites and conformational changes in the spike protein enable fusion to occur.

A different research group published a crystal structure of just the RBD of spike protein. It showed that the RBD binds to **Angiotensin-converting enzyme-2** also called **ACE2** which is a receptor in our cell surface to which Coronavirus binds to cause fusion. These structures are heavily glycosylated. There is an extensive Hydrogen bonding network at the RBD-ACE2 interphase involving two Tyrosine (Tyr) residues [Tyr-489 from RBD and Tyr-83 from ACE2]. The tyrosine side chain is also hydrogen bonded to the carbon of Asparagine (Asn-487) side chain of RBD and this intern bonds to the carbon of Glutamine (Gln-24) of ACE2 through its N-H bond's hydrogen atom. Moving along the ACE2 α-helix, we have a Glutamic acid side chain(Glu-35) and a Lysine residue(Lys-31) which carries a positive charge. These residues are both involved in hydrogen bonding with Glutamine (Gln-493) sidechain. This H-bonding is

relatively short. There is another where there is extensive H-bonding, some between amino acid backbone atomsand some additional hydrogen bonds among polar charged residues. Overall characterisation of spike protein is super important because this paves the way for vaccine development. If we introduce small harmless peptides that resemble the spike protein our immune system can recognize and build up antibodies against it and thus protecting us from COVID-19 infection in the future. Also knowing to what RBD binds to could help us develop treatments that tie up the virus by binding it outside of the cell before it's able to fuse and cause infection.

In addition to spike protein there are two other proteins, one is known as **Membrane protein** or **M protein** which gives the virus envelope its shape and the other one is **Envelope protein** or **E protein**. They have roles in the assembly of the virus genome, capsid and the envelope as the virus leaves the host cell.

If the virus undergoes fusion, the viral genetic material is injected into the cell. In case of coronaviruses this piece of RNA travels to our own ribosome and Hijack them to create its own viral proteins. Viral translation using our ribosomes makes the proteins that the virus needs to assemble the additional copies of itself which will eventually be released from the cell and they are called as **virions.** These virions infect other cells. SARS-CoV-2 protease is a dimer made up of two identical protein chains and it must dimerise to become a functional protease. The iconic interaction between the two amino acids called Arginine (Arg-4) and Glutamine (Glu-290) drive the dimerization.



let us address how long a virus can linger on surfaces and what we should be wiping down to keep our self and others safe as much as possible. First of all, the scientific literature on this subject is very limited. The novel coronavirus is just as it means, New. So, some of this information is still in the preprint phase and maybe changed. But this information is much more vigorously tested than the information flying in the social media. One study from the National Institutes of Health in US examined how long can the coronavirus that causes COVID-19 can remain viable on a few common **"fomites"** or materials that can transmit infections. The fomites that were tested includecopper, stainless steel, cardboard and one of the most common plastics called polypropylene, which is used to package food and it also exists in our kitchen.

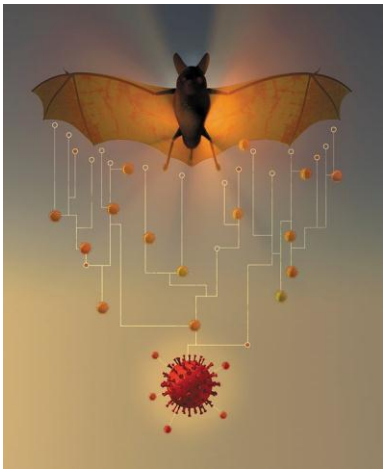
The researchers found copper was the toughest for the virus to survive, 4 hours after exposure they couldn't find any that were viable or capable of infecting a person. Cardboard was the next toughest for the virus with none found viable after 24 hours. Stainless steel and plastic were much more accommodating with viable examples detected even after 72 hours of exposure. Just because there were

viable viruses that doesn't mean their concentration was dropping. In fact, their concentration dropped a bit and it did so faster on stainless steel than in plastic. That is because more viruses degrade out of their living host. So, one may not get infected by contacting contaminated surface days after the virus was deposited there, it is not as risky as contacting the contaminated surface within few hours after contamination.

The study also examined how long the virus was viable while suspended in aerosols. The experiment lasted three hours and the virus remained viable in entire time with not much concentration. But that doesn't mean that the virus is airborne. The researchers aerosolised the virus artificially by spraying it into a mist and keeping it inside a special rotating drum. In contrast when an infected person exhales or coughs, the virus is typically carried in larger droplets which don't stay suspended in the air for a long time. If the droplets land on a person then it is a problem.Theseare the results from tightly controlled laboratories. In the real world it is possible that UV light from the sun disinfects the contaminated surfaces faster. It is also possible that even in the packages that were transferred over 24 hours was just sneezed before it was left on the door.

Hopefully what this information makes you clear that why you are asked to wash your hands frequently and avoid touching your face while going out. SARS-CoV-2 spreads most effectively from person to person, so if you touch surfaces which can be contaminated avoid touching your face because it may infect you through mouth, nose and eyes. Washing your hands with soaps destroys virus effectively and as a bonus soap also envelops fragments of virus and carry them away. This makes soap more effective than hand sanitisers. Hand sanitisers and alcohol wipes are more effective if they contain more than 60% alcohol in them. So, you should wipe down frequently touched surfaces like doorknobs, switchboards, and remotes. One should also not miss to wipe mobile phones which frequently touches hands and face. Most importantly don't panic and at a time like this good information saves life.

Origin of SARS-CoV-2.



So far, we know that the outbreak originated in the city of Wuhan, China. But as of now how the outbreak began has not been solved. We have heard seafood, snakes and a whole lot of conspiracy theories

surrounding the virus origin. But it seems that preliminary evidence is pointing all to a familiar source, Bat.

When scientists looked at the genetic sequence of the virus, they could match it with every other known coronavirus. There is one particular Coronavirus that was found in China which was isolated from the Bats and this Bat Coronavirus was similar to SARS-CoV-2. SARS-CoV-2 has 96.4% similar genetic sequence to that of Bat Coronavirus. And this is not the first time that Bats have been identified as potential source of the outbreak, in fact studies have found that Bats host a larger proportion of zoonotic virus than any other mammal which makes them the disease reservoirs. Viruses which cause Ebola, SARS-CoV and MERS-CoV is also zoonotic, meaning they can cross from animals to Humans. To better understand these zoonotic viruses a team in Southern China has worked on more than 10,000 Bats and they significantly discovered more than 5000 new Coronavirus in past 10 years.

Now to eventually understand how the SARS-CoV-2 can potentially cross between species researchers are looking at it on a cellular level. When scientists found the Coronavirus in Bats, they recognised the spike protein in its surface and they studied how they can bind to Human cell surface receptors, eventually hijacking the cell. So how exactly can Bats harbour all these viruses and not be affected? The answer could be in how Bats evolved to fly. Bats are the only mammal capable of flying long distances and it uses tremendous amount of energy to do so. But a by-product of this high energy demands is believed to be an increased number of free radicals in their cell, which in turn can damage the Bat's DNA. So, to overcome these harmful effects it seems that Bats have evolved genes to strengthen their immune response, so that they don't react to free radical damage caused by flight. Bats have unique adaptation in their immune system which allows them to harbour these viruses without causing any disease. So, Bats may not get sick but when the viruses make jump from species to species with the same immune strength, like say to Humans the mortality rates can be high. Environmental threats like deforestation could act on the animal's stress level, causing them to shed viruses through their saliva, urine and faeces which can later infect other mammals.

Bats maybe the host for many viruses, but we cannot forget their crucial role in regulating insect population and as important pollinators. With many plants depending on them for their survival, they are also an important part of our ecosystem.

Face masks at the time of a pandemic.

How useful are face mask during Coronavirus crisis? Experts can't really agree on this. Should we wear them? If so, who should wear them? Does wearing mask protect the wearer or does it protect the

other person? And which type of mask makes sense at all? In many Asian countries face masks are regarded as a major weapon to fight COVID-19.

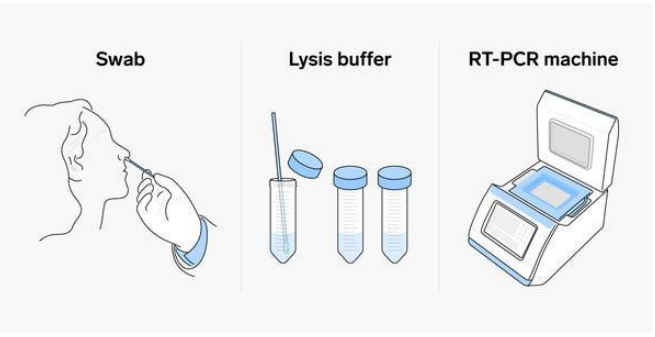
We can generally distinguish masks into three main types. So called **Filtering Face Piece masks** or **FFP** masks fits perfectly around the nose, mouth and chin and they filter out tiniest particle. They let no viruses in or out. An exhalation valve makes breathing more easier, but it increases the risk of escaping of viruses. So, an unvalved mask protects both the wearer and the person they encounter. **N95 mask** or **N95 respirator** is a particulate filtering face piece respirator. It filters at least **95%** of airborne particles. It is an example of a mechanical filter respirator, which provides protection against particulates (air borne particles) but not against gases or vapour. FFP masks and N95 masks are short in supply worldwide. So, they should be mainly reserved for medical personals and infected patients. A mask that's often seen nowadays is a simple protective face piece for the mouth and nose called **surgical mask**. It consists of several layers of paper or non-woven fabric and a thin wire to make it fit over the nose. When the wearer coughs or sneezes, the surgical mask block the large droplets. But on inhalation, air also flows by the sides. So, the surgical mask protects others from the infection rather than the wearer. Once the mask is wet from breathing after 8hours of wearing time at the most it must be discarded.

In COVID-19 crisis, manufactured masks are in short supply. That has led to a flourishing cottage industry to stitch cloth masks. A textile mask functions rather like a protective mask made of paper and it blocks only $1/3^{rd}$ of the droplets as that of a surgical mask does. However, a cloth mask can be washed and reused. The literature on how well different homemade masks block particles or aerosols or droplets from both coming in and going out is still unclear. So, teams of scientists are now informally trying to determine how good certain materials are at blocking droplets or particles and are sharing their research publicly. The key is to find a material or combination of materials that blocks particles but one can still breath through.

One team from Jeremy Howard, a University at San Francisco tested different kind of air filters, like **furnace filters** and said **when these filters are added in two layers their filtering efficacy was about 94% and in six layers the efficacy was 95%.** But these filters are not safe to be worn directly next to our face, as they could shed particles that are harmful to breath. So, a filter like this should be sandwiched between two layers of fabric. This group also tested some common fabrics**. Four layers of 600 thread count sheet filtered out 60% of microparticles, two layers of thick woollen scarf filtered out 48.8% of microparticles, three layers of coffee filters filtered out 50% but turned out to be less breathable and a cotton bandana by itself only filtered out 19.5% even when four layered**.

Another study indicated that high thread count cotton in a double layer could perform almost like a surgical mask and they also cautioned that homemade masks using a less thick fabric has filtration rate less than 1%. So, materials must be chosen wisely. These results has not been previewed or published and it is also necessary to mention that the filtration rates mentioned are from highly controlled laboratories that tested just the materials by themselves and didn't test the protection for actual Coronavirus but for particles of that size. When worn in a mask form depends on if one is wearing the mask properly. Importantly, one should remember that reducing the risk of infection mainly depends on not touching your mask and face with unwashed hands. Masks can give you a full sense of security, but social distancing and hand washing are number one tactics for slowing this pandemic. No matter which mask you wear it can only be effective if you implement hygiene measures like hand washing and social distancing.

Diagnosis of COVID-19



Antibody Test RT-PCR Test

As the COVID-19 infection spread around the globe, WHO asked all countries to act quickly. There are two important tests for COVID-19, one that can confirm if you are currently infected **(RT-PCR test)** and another that can tell you if you are immune **(antibody test)**, both are critical for collective recovery.

After pneumonia cases started to rise in Wuhan, researchers in China worked quickly to identify the virus, sequence it and publish its genome immediately. Shortly after a team in Germany designed the world's first COVID-19 diagnostic test which is **Polymerase Chain Reaction (PCR) test**. It is a standard molecular biology technique that scientists are using for decades. To find out whether one is infected by this virus, the doctor will give him/her a **RT-PCR test (Reverse Transcriptase-Polymerase Chain Reaction test)**. It a molecular photocopying technique that can detect the presence of a virus's genetic material in a sample. Since SARS-CoV-2 is a single stranded RNA virus, a RT-PCR test uses chemicals and special enzymes to convert that RNA into DNA and then make billions of copies of it to confirm if there is an infection. It all starts with a Nasopharyngeal swab which is inverted through the nose and pushed all the way back to the sinuses. All the mucus and cells from that swab are broken up. Then the RNA is extracted, then that extracted RNA is transferred into DNA using an enzyme called reverse transcriptase as the PCR test requires DNA. Once we have that DNA made from the swab then PCR is done. The viral DNA thus obtained is broken and that bits of DNA that binds to that viral DNA is added and polymerase chain reaction takes place as a result of which more copies are made only if they are present. If the viral DNA is present the PCR reaction will then amplify the viral DNA and it is a positive test. The WHO published the protocols for the German team's PCR test and distributed it worldwide. This PCR test is important for detecting current infection but only for a specific period of time. Because once a patient starts recovering his immune system will clear out the viruses.

In such case there is another test called **antibody test**, it is also called **serological test** and it looks for the presence of antibodies in the blood sample. This would help the experts to track the full scale and the spread of the virus and also confirm who ever is immune. The antibody test uses a diagnostic technique called **ELISA (Enzyme-Linked Immunosorbent Assay)**. This test uses a plate inside which are wells within which there are tiny pieces of virus. So, when a patient's blood is added and if any Coronavirus fighting antibody is there it will bind to those pieces. Specialized enzymes and substrates are then added, which changes the colour of the well if antibodies are present. This is an important test that could find asymptomatic carriers, clarifies who is safe to work on the front lines, help for future treatment and could be a key indicator for when we can re-enter the society. But this test is not a quick fix, we don't know yet if testing positive for antibodies means a patient is fully immune to the virus. Researchers are moving fast here, but there is only been so much time to study COVID-19.

Treatment modalities.

Antiviral drugs are medications used to treat viral infections. Antiviral inhibits a virus's ability to duplicate, this also means they are most effective when administered shortly after infection, that is before the virus has infected too many of the host cells. Unlike vaccines which serve out immunity by training our body's immune system to fight pathogens. Antivirals are administered to people who are already infected with the virus. Another key difference is antivirals are effective only at that time when they are administered, so essentially antivirals are an effective near-term solution to prevent viral infections from getting worse. But the action of vaccine stays effective throughout the life once after administration. It means, if you have vaccine against a pathogen or an antigen you will not be infected by the same throughout your life, since your immunity is being trained to fight the same. Nearly since six decades when first antiviral drug has been approved for use, antivirals have been used to treat a number of viral infections including HSV, Chickenpox, Hepatitis etc. to name a few.

In January China shared the genomic sequence of SARS-CoV-2. Till now researchers have had only few months to study this virus. Fortunately, researchers can use other Coronaviruses which we are known to us like SARS-CoV and MERS-CoV to study this virus. Researchers believe that SARS-CoV-2 follows the same process of replication as other Coronaviruses do. Once the spike protein present in the surface of the Coronavirus binds to ACE-2 receptor of the Human cell, the virus fuses with the cell and releases a copy of its RNA genome. Then through transcription and translation it makes copies of itself. These copies of infectious particles are called the Virions. Finally, these virions are released to infect the adjacent cells. Different antiviral drugs are designed to target different steps in the process of viral replication. Some antivirals target receptors early in the process to stop fusion to the host cell, others stop replication of the genome and others disrupt the assembly of new copies or stop the release of virions. And when experts are saying it'll take more than a year for a vaccine to come into market, researchers worldwide are trying to find a near term solution in the form of an effective antiviral treatment. Instead of developing a new drug, specifically for COVID-19 which will take a decade to come into market,many are looking to repurpose antivirals that have already gone through vigorous trial and approval processes to treat other diseases. Two examples are **antimalarial Chloroquine** and **its derivative Hydroxychloroquine**, which is also used to treat Rheumatoid arthritis. Now, just to be clear there is currently no defendative evidence that either of these antivirals are effective treatment for COVID-19. Researchers still need to fully evaluate the efficacy of these drugs against COVID-19. But some researchers think these drugs could potentially stop SARS-CoV-2 by disrupting binding, by interfering in

the process of depositing its genome into the host cell, stopping the virus early in replication. Chloroquine and Hydroxychloroquine also inhibit dangerous overreaction from the immune system.

Dr. Otto Yang, associate chief, Infectious Disease UCLA and his team are looking at another antiviral**Remdesivir**. This is an experimental antiviral that have been developed to treat Ebola, which inhibits viral replication by disrupting RNA transcription process. But there is a chance that it might also suppress the immune reaction and inflammatory response that has been a known cause of death for COVID-19.

There is also **Favilavir**, a drug that is used in Japan and China to treat Influenzas and it is currently being doubted as the first approved Coronavirus drug. The reality is there is no defendative evidence that any of these antivirals are effective treatments for COVID-19. So, for now there is no FDA approved drug, specifically for the treatment of COVID-19. The FDA has approved emergency use of Chloroquine and Hydroxychloroquine for the treatment of COVID-19. But in the same statement released on March 28th the FDA stated that Chloroquine phosphate andHydroxychloroquine sulphate are not FDA approved for treatment of COVID-19. So, it is a little unclear that when and how these drugs can be administered, which makes the patient feel difficult to understand what therapies are available to them. Most researchers are exited about repurposing the antivirals to fight COVID-19, they need more time to confirm what dosage is most effective against SARS-CoV-2, they should also confirm what dosage is most effective and safe for public consumption. The pandemic has motivated and united the medical community to find an effective near-term treatment and many governments and companies around the world are fast tracking testing trials and approvals to find one.

Plasma therapy.

Blood Plasma

Discovered by German physiologist Emil von Behring, plasma therapy was first used in 1890. This therapy was used to treat diseases like Ebola, H1N1 etc. China, where Coronavirus outbreak first emerged, had used this treatment to treat critical COVID-19 patients. Two trials of plasma therapy were conducted on 15 patients having COVID-19 infection and they showed improvement. Several countries across the globe have started plasma therapy trials.

The process of donating plasma is similar to blood donation and takes about an hour. Plasma donors are hooked up to a small device that removes plasma while simultaneously returning RBCs. Plasma can be donated more frequently, as often as twice a week. The plasma drawn from one recovered person can help two infected people.

The idea behind this therapy is that immunity can be transferred from a healthy person to a sick patient using convalescent plasma. This therapy uses antibodies from the blood of a recovered COVID-19 patient, plasma to be particular about, and it is transfused to another COVID-19 infected patient. Therecovered COVID-19 patient's blood would have developed antibodies to battle against SARS-CoV-2. Then plasma from the blood of this recovered patient is extracted and transfused to infected patient. Once

the plasma of the recovered patient is infused into the blood of infected patient the antibodies present in that plasma will start fighting against SARS-CoV-2 in the infected patient.

Vaccine for COVID-19.

Researchers are working endlessly to produce a sustainable and reliable vaccine to finally end this crisis. There are teams globally working on vaccine solutions. As of 8thApril 2020 there are 115 vaccine candidates in varying stages of research. Everyday there seems to be a new development. Private companies like **Moderna** and **Inovio** are making headlines as they are quickly progressing in the first stages of the vaccine approval process, a process that usually takes years is being pushed in a matter of months. That is the question, with urgency looming like this how viable are any of these fast vaccines, and is it possible that we will have a solution within next year?

In under normal circumstances, taking vaccines from the lab to licencing for public distribution not only takes time but money. Roughly one billion dollars' worth or more. But a large part of the acceleration of the vaccines we are hearing about have to do with an international organization that launched in 2017, called **"Coalition for Epidemic Preparedness Innovations"** or **"CEPI"**. CEPI gave the funds to organizations like **Moderna, CureVac, Innovio pharmaceuticals** and **University of Queensland**. And while funding helps to speed up the process, the teams chosen by CEPI are also already heading towards vaccine research. Teams already having experience in previous outbreaks like MERS are working on novel vaccine methods that could significantly reduce the development timeline, was selected for the development of vaccine for COVID-19.

Eventually a vaccine can be made in a few different ways. We have inactivatedand live attenuated, both known as **whole-pathogen vaccines**, **subunit vaccines**including recombinant polysaccharide and conjugate vaccines which are using a piece of pathogen and the new method of **nucleic acid vaccines** using the DNA or the RNA of the pathogen. When injected into our bodies, vaccines aim to mimic the infectious agent. Typically, vaccines are given to boost the immune response. After the injection this response sounds the alarm in our body and begins the accumulation of WBCs like killer T cells and specific proteins called antibodies. Killer T cells destroy the pathogen in the infected cells and the antibodies neutralise the pathogen.In SARS-CoV-2's case the antibody will head towards the recognizable spike proteins on the outer shell and block the proteins from connecting to the receptors of our cells (ACE2).

This whole process of vaccination helps the immune system to get trained by the vaccine and retain the memory of infection. So, when a vaccinated person encounters a real virus they can quickly recover. So basically, our body comes up with a preventive measure it needs to fight the pathogen, we just need to initiate the exposure.

Rightnow, CEPI has many funded candidates in their portfolio, out of those funded platforms we are hearing mostly four of them, **two mRNA vaccine** from Moderna and CureVac, **one DNA vaccine** from Inovio pharmaceuticals and a **protein vaccine** from Australia's University of Queensland/GlaxoSmithKline. Giving the urgency to find the vaccine during this pandemic, we are looking for new approaches like DNA and RNA vaccines because they can be developed quickly. However, that doesn't mean that work on other promising solutions stops. As experts are advocating various approaches when it comes to developing a vaccine, we also need many candidates as we have to pass the vigorous approval phases, but what exactly are these phases?

For example, once a viable Coronavirus vaccine candidate has been identified in pre-clinical studies, then it can move on to the highly anticipated Phase 1 of the approval process. **Phase1** studies involve tens of volunteers in batches. Moderna vaccine is being tested in US and it has reached phase1 approval involving 45 people. In phase1 approval process researchers find out whether this vaccine produce immune response in Humans and does it appear to be safe or not. Once the vaccine passes phase1 approval, it enters **Phase2** which involves hundreds of volunteers. In this phase, the dosage, method of administration and quantity of vaccine is found out precisely, we might also get hints about effectiveness and researchers will also get a clear cut about the safety of using this vaccine. The distance between the phase2 and phase3 is called the **"valley of death"** and the reason for it is a vast majority of vaccines and drugs will not make it to pass phase2. And if the vaccine passes phase2 it passes to **Phase3** where it involves more than 10,000volunteers in a trial. In this phase researchers look for efficacy of the vaccine, that means researchers test weather the vaccine actually works by preventing the disease or it just create an immune response. Here the FDA collects all the data of the three phases and if all looks good, they will give the final approval of licencing and manufacturing of vaccine.

Researchers are looking at 12-18 months to effectively produce a viable vaccine by overlapping all the three phases. They may overlap phase2 to phase1 partially and see for better results and rather than waiting to get all the data to the very end of the trial, they may wait for a month for the best responses and based on those best responses the CEPI or government or company will ask to move on. But even if this ambitious timeline is accomplished, researchers will need to find the means of manufacturing it for 8 billion people on our planet. But if they overcome all these challenges, we'll be looking at a vaccine that was developed at a historical speed, one with a potential to save millions of lives.

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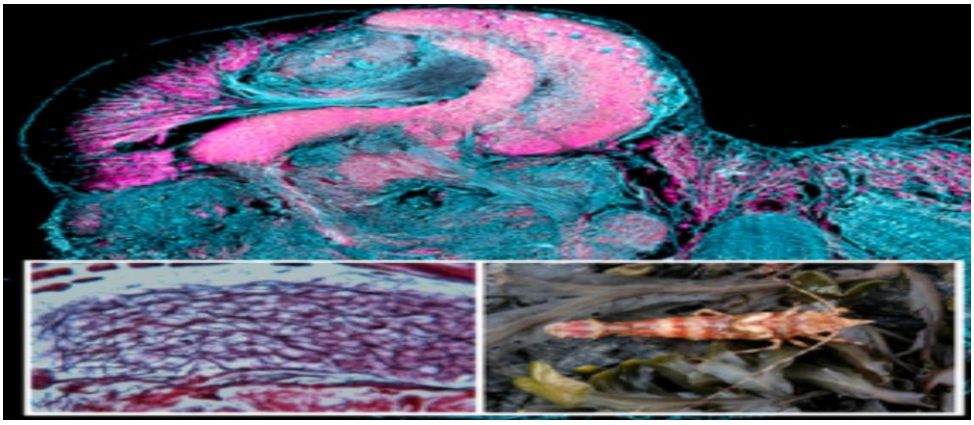
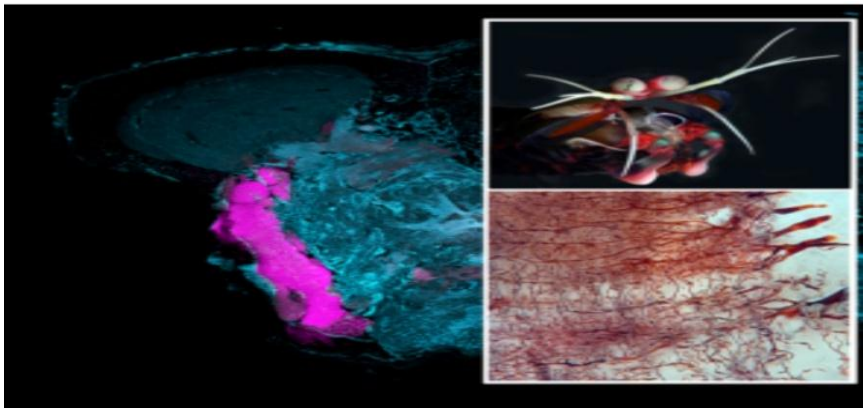
THE BRAINS OF SHRIMPS AND INSECTS ARE MORE ALIKE

Date: March 3,2020
Source: University of Arizona

Both insects and crustaceans possess mushroom shaped brain structures known in insects that led by University of Arizona neuroscientist NicholasStransfeld.
The research, published in the open-access journal elife, challenges a widely held belief in the scientific community that these brain structures called "mushroom bodies" are conspicuously absent from crustacean brains.
In 2017, Stransfeld's team reported a detailed analysis of mushroom bodies discovered in the brain of the mantis shrimp, squilla mantis.
Crustaceans and insects are known to descend from a common ancestor that lived about a half billion years also and has long been extinct.
Mushroom bodies in the brain have been shown to be the central processing units where sensory input converges. The information is passed to neurons that supply thousands of intersecting nerve fibres in the lobes that are essential for computing and storing memories.
"The mushroom bodies contain network where interesting association are being made that give rise to memory "Strausfeld said.
A more evolutionary "modern "group of crustaceans called Reptantia,which includes many lobsters and crabs, do indeed appear to have a brain centres that don't look at all like the insect



mushroom body.
Brain analysis of crustaceans has revealed that while the mushroom bodies found in crustaceans appear more diverse than those of insects, their defining neuroautomical and molecular elements are all of there Using crustaceans brain samples,the researchers applied tagged antibodies that act likes probes, homing in on and highlighting proteins that have been shown to be essential for learning and memory in fruit flies.



"We know of several proteins that are necessary for the establishment of learning and memory in fruit flies", strausfeld said," and if you use antibodies that detect those proteins across insect species ,the mushroom bodies light up every time".

Using this method revealed that the same proteins are not unique to insects;they show up in the brains of other arthropods, including centipedes,milipedes and some arachinids.Even vertebrates , including humans ,have them in a brain structure called hippocampus,a known center for memory and learning. Strausfeld and his co-authors have a theory: crustacean species that inhabit environments that demand elaborate, three dimensional areas are precisely the ones whose mushroom bodies most closely resemble those in insects,a group that has also mastered the three dimensional world by evolving to fly.

OUR REVIEWS : From this article we realised that the brain of shrimps and insects are more alike. Since the brain is the most complex and arguably it is the seat of consciousness and concerns with memory , this study of mushroom bodies over a greater expanse of space will aid in resolving number of unanswered questions like ' how brain would have evolved? ' & 'what environmental conditions shaped the progress? '.This research takes us to a closer look at the brief answers that are yet unrevealed. It is the way of nature.

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UNHEARD ROARS OF THE SMALLER WILD CATS: PALLA'S CAT

Source: Panorama section of Deccan Herald titled "Unheard roars of the smaller wild cats" by Marianne De Nazareth.

Did you know that India is home to more cats than any other country in the world?
The Tiger, Snow Leopard, Leopard and the Lion are powerful, enigmatic and iconic species and these big cats are commonly connected immediately with India. But there are a number of India's small cats that have lived in the shadow of their larger cousins. Some of them the elusive fishing cat (Prionailurus viverrinus), jungle cats (Felischaus), the clouded leaopard (Neofelisnebulosa), Palla's cat (Otocolobusmanul).
Palla's cat, also known as Manul, is a small wildcat known for its unusual grumpy look. A flattened and rounded face, a stocky build and fluffiness makes it appear stout and plush. They live throughout central Asia, from western Iran to western China. Within this range, Pallas' cats prefer the cold and arid environments of rocky steppes and grasslands at elevations up to about 15,000 feet. Pallas' cats make their dens in burrows of marmots and other burrowing animals, as well as in mountain crevices. Their diet consists mainly of small animals - pikas, rodents, and birds. The Pallas' cat is a solitary, nocturnal animal, mostly active at dusk and in the night. In event of danger it conceals itself skillfully among rocks and dry grass. Mating occurs in February and March;birth is given in April-May.
More research on this cat led to the SWCCF page which is the Small Cats Conservation Foundation. ''Pallas'Cat Study and Conservation program' is one among their many partner projects for 7 big cats and 33 small cats where they closely follow them in their natural habitat, publish research papers and collect data pertaining to its true conservation status and assistance in conservation of this species. Each small cat is given a IUCN rank according to their population status in the wild. Pallas's Cat currently falls under the Near Threatened (NT) category with a decreasing population trend.

The most important reason in the decline of small cats is that they receive very little conservation funding.Funding is important and helps reduce and mitigate threats. Unfortunately, less than 1% of conservation funding for all wild cats is invested in 33 species of small cats. Research on their population size, distribution & trends, life history & ecology and population trends are also in much need.

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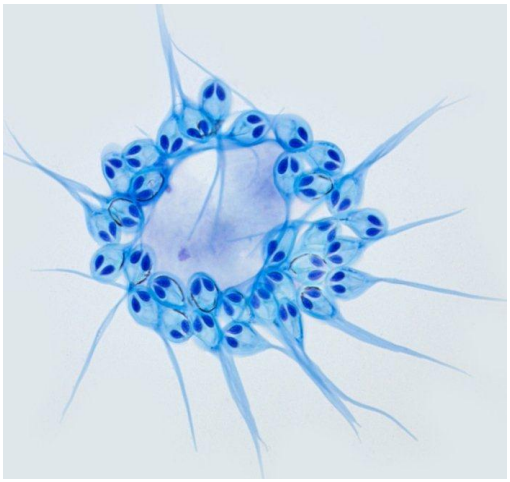
UNIQUE ORGANISM WHICH DO NOT NEED OXYGEN TO BREATH

Date of publishtion of this article is 24th February 2020



Some veracity about this world and our experience in it seem immutable. Like life arises from pre – existing life, all living organisms made up of cell etc; but some unexpected finding changes one of science's assumptions about animal world like as we all know Multicellular life needs oxygen to live but it is not true for all organisms recently professor DorontheeHuchon of Tel aviv university(TAU) faulty of life science and Steinhardt museum of natural history discovered an multicellular organism which do not need oxygen for its survival.

Scientists have discovered a jelly fish like parasite that dosen't have a mitochondrial genome – the first multicellular known to have this absence. that means it does not breath ; in fact , it lives its life completely free of oxygen dependency that is anerobic in nature.

The parasites anerobicbehaviour was an accidental discovery. While assembling the Henneguya genome prof.Huchon found that it did not include a mitochondrial genome. The mitochondria is a powerhouse of the cell where oxygen is captured to make energy,so its absence indicated that the animal was not breathing.

We know the there are adaptations that allow some organisms to thrive in low oxygen or hypoxic conditions. some single celled organism have evolved mitochondria related organells for anaerobic metabolism ; but the possibility of exclusively anerobic multicellular organism has been subjected to some scientific debate.

It is a tiny less than 10 celled parasite known as henneguyasalminicola lives in salmon muscle. It is a mycozoancnidarian , a type of animal related to jellyfish and corals.it lives inside the salmon for its entire life cycle and steals readymade nutrients from it and can survive quite hypoxic conditions. But exact mechanism cannot be known by just looking at the creature's dna ; so what researchers did was they conducted keen observation of this organism with a fluroscent microscope and got to know that the it has lost its mitochondrial genome , in addition it has also lost its capacity for aerobic respiration and lost almost all of nuclear genes involved in transcribing and replicating mitochondria. exactly how it survives is still a mystery. It could be leeching adenosine triphosphate from its host but that is yet to be determined! But the loss is pretty consistent with an overall trend in these creatures - one of genetic simplification. Over many, many years, they have basically devolved from a free-living jellyfish ancestor into the much

more simple parasite we see today.They've lost most of the original jellyfish genome, but retaining - oddly - a complex structure resembling jellyfish stinging cells which helps them to cling to their host .an evolutionary adaptation from the free-living jellyfish's needs to the parasites.

“it’s not yet clear to us how the parasites generate energy,” Prof. huchon says.

“it may also drawing its energy from surrounding fish cells, or it may have a different type of respiration such as oxygen-free breathing, which typically characterisesanerobic non-animal organisms.”

According to Prof. Huchon, the discovery bears enormous significance for evolutionary research.

"It is generally thought that during evolution, organisms become more and more complex, and that simple single-celled or few-celled organisms are the ancestors of complex organisms," she concludes. "But here, right before us, is an animal whose evolutionary process is the opposite. Living in an oxygen-free environment, it has shed unnecessary genes responsible for aerobic respiration and become an even simpler organism."

Stephan Atkinson the senior research associate at Oregon states of university’s department of microbiology and co-author of paper henneguyasaliminicola that appeared on PNAS journel states that he assumes it absorbs molecules from its host that have already produced energy.Atkinson and his team don't think this species is the last oxygen-free animal, either. He said he expects to discover many more species that can survive without oxygen -- and probably "even weirder modes of existence."

According to me the parasite has lost its mitochondrial genome because may be it was of no use for it and it may be drawing energy from its host itself so according to Darwin’s theory of natural selection the natural conditions operating on the individual act as selective forces in allowing the organism with favourable variations to survive. Organisms adapted to their respective environments and transmit their variations to their offspring. So may be that’s why it has evolved to become a multicellular organism without mitochondria.

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MITOCHONDRIA, NOW ALSO, 'CANARY IN THE COAL MINE' IN CELLULAR STRESS

This article was published in the 'Science and Environment' section of DECCAN HERALD newspaper dated December 21,2019.

Life cannot exist without energy. For us to move, think, withstand stress and infections, the cells in our body must generate energy from the food we eat. This process occurs in the dynamic 'powerhouses' and the so called 'Energy currency of the cell' called Mitochondria.

Mitochondria, tiny structures present in most of the cells, which are know for their energy generating machinery, is now also found to be involved in cell signaling and immunity pathways that are starting to be identified. In this new research by Salk Institute, researchers have found that the mitochondria set off molecular alarms when cells are exposed to stress or chemicals that can damage DNA, such as chemotherapy. Such results, published in one of the popular online journals: Nature Metabolism, says that it could lead to new cancer treatments that prevent tumors from becoming resistant to chemotherapy.

Mitochondria is the only organelle in animal cell having its own DNA which is maternally inherited unlike the DNA found inside the cell's nucleus, packaged in chromosomes, is inherited from both the parents. Such small circled DNA found in the mitochondria is called mitochondria DNA or mtDNA.

On studying the basic biology of mtDNA, researchers have identified novel ways that mitochondria contribute to disease adding and immune system. mtDNA, due to its bacterial origin, can trigger innate immune responses if exposed to the rest of the cell, causing antiviral and other defensive responses. It participates in a broad range of immune pathways, including RIG-I-like receptor (RLR) signaling, antibacterial immunity and the sterile inflammatory response. It occurs by generating reactive oxygen species and contribute to innate immune activation following cellular damage and stress.

One of the researchers says that since mtDNA is present in so many copies in each cell, and has fewer of its own DNA repair pathways, makes it a very effective sensor of DNA stress.

Therefore, in addition to their well-appreciated roles in cellular metabolism and programmed cell death, mitochondria appear to function as centrally positioned hubs in innate immune system. Thus, uncovering new function of mitochondria has made possible for a greater understanding of these complex organelles. This is indeed essential to unravel their role in human diseases and aging.

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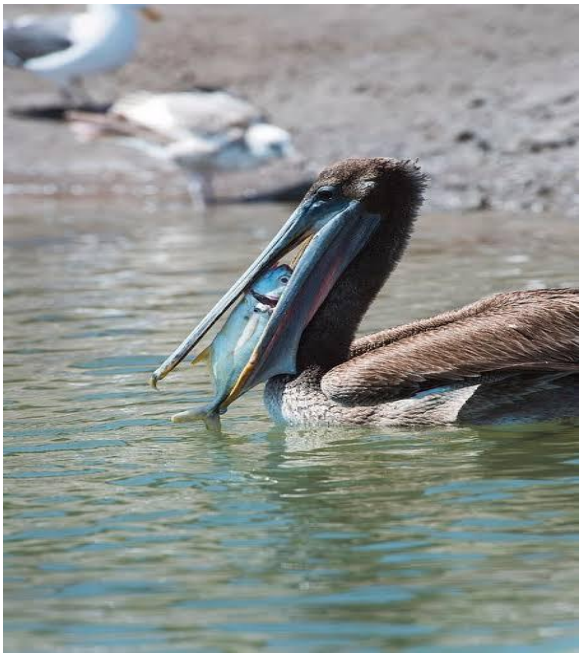
II B.Sc. I sect

HOW DO PELICANS SURVIVE THEIR DEATH DEFYING DIVES



Brown pelicans rocket down from the sky, plunging toward the ocean from as high as 65 feet a certain characteristics enable them to survive their death defying dives.

A number of anatomical adaptations enable the bird to take these dives in stride. The shape of its bill is essential, reducing "hydrodynamics drag"- buckling forces, caused by the change from air to water almost 0. its something like the difference between slapping the water with your palm and chopping it karate style.

And while all birds have fight, air filled bone, pelican skeletons take it to an extreme, so they dive , they inflate special extra air sac around their neck and belly, cushioning their impact and allowing them to float.

How does this takes place?

~ Wings sheet back during the dive, to safeguard the delicate bones of the wings, at the same time powerful muscle tense around the spide keeping the bird from snapping its neck.
~ while sheet called nictitating membrane slide over the eye like para swim bubbles but most of the credit goes to that magnificent scwered shaped beak.
~ pelicans are the surface hunters not the divers. When they hit the water they also hit their beak reaching with their snap fish. Later they slow down , a special network of air sacks under their skin around their neck and belly and even their bones.

When it plunges the pelican takes a breath and air rushes into tiny structures called pneumatic foramina, that air, cushions the impact and allow them to float. And this bird also has a another special structures called the gular pouch. It pops open like a parachute and also helps the bird to slow down.it is made of super stretching skin reinforced with oxalitin fibers that keeps it from breaking .

It as extra flexible jaws that can open side ways and not only up and down ,a pelican pouch holds much more than its belly can about 3pounds of water as to be squeezed out before it swallowed. The whole team takes practice.

Brown pelican hit the water at beak neck speed when they catch fish performing such dangerous plunges require technique, equipment, and 30 million years of practice. Behind the pelicans remarkable resilience lies 30 million years of evolutionary stasis meaning they haven't changed much over time.

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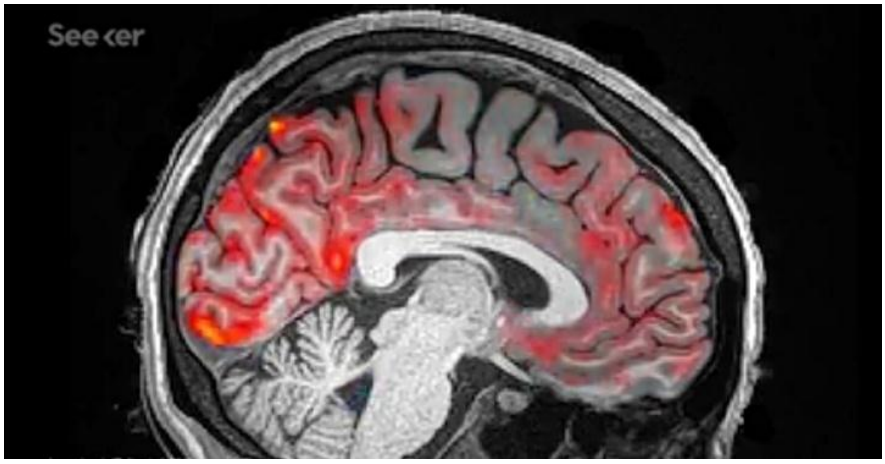
SCIENTISTS DISCOVERED HOW SLEEP CLEANS TOXINS FROM HUMAN BRAIN



As we do more research into the brain, we are increasingly realizing that sleep is one of the most essential things which we need in functioning healthy human beings. And new research looks into how sleep helps us to maintain clean brains. But what does that mean? And why is that important?

To understand this latest news, we have to go back to 2013, when a study of mouse brains found that while those rodents slept neurotoxic waste products got swept away. Some kind of cleaning crew comes in overnight and gets rid of built up stuff like Beta – Amyloid which is a sticky peptide that aggregates into blocks and disrupt brain function. Amyloid plex are highly associated with occurrence of diseases like Alzheimer's and the "Amyloid hypothesis" suggest that Amyloid plex is the primary cause of that devastating disease.

That 2013 study saw an interesting relationship while the mice slept their lymphatic systems opened up this lead a big wash of cerebrospinal fluid (CSF) which seems to clear these waste products away. As we know CSF is a watery clear substance that surrounds the brain and spinal cord, which also acts as a cushion to protect the brain and also provides nutrients. A team at Boston University took this 2013 research finding and wanted to know exactly how. In this new study that they published in science the researchers' dealt into what about sleep was so special? Why did a sleep state in particular allow for these changes in the brain?

The team got human participants fall asleep inside an MRI machine, which led the team measure both blood oxygen level and the flux of cerebrospinal fluid in the brain of participants. They also measured the electrical currents in subjects' brain using EEG caps. The results gave the team pretty clear answers.

We have been finding out more over the past several years about the phases our brain goes through while we sleep and how those phases are essential for information processing and memory. It is not just during "REM Sleep (Rapid eye movement sleep)" that our brains are consolidating information and committing it to our long term memory but they are doing it during "Non REM sleep" too. And in humans these two phases, REM and Non REM alternate throughout the night. Non REM sleep is divided into 3 stages and the third stage is the deepest state of sleep called "slow wave sleep ". During slow wave sleep electrical activity slows down and sinks up. So, our neurons start to fire in sink with one another at quiet low frequency that neuroscientists call "Delta Waves". And since slow wave sleep is shown to be essential to memory formation, latest study is the first to demonstrate exactly how those slow waves keep our brains clean and healthy.

From all of their many measurements the team saw that during slow wave sleep the brain was actually being washed by waves of cerebrospinal fluid (CSF). When neurons start to fire in sink they are all electrically active at the same time and they require more oxygen and more blood flows into the brain when the electrical activity slows down, i.e., when the neurons aren't firing they need less Oxygen so less blood is flowing to the brain but the CSF come in and fills that extra space. So the pattern of CSF flow is intrinsically linked to neuron firing. When the CSF flows into the brain it clears all the build-up neurotoxic waste products like Beta – Amyloid.

This study not only found out direct relationship between electrical activity in the brain and this CSF cleansing mechanism but also confirmed that increase in CSF is linked to increased clearing of neurotoxins. This indicates that sleep and slow wave sleep in particular is essential in clearing out all the built up waste products in our brain i.e., our brain garbage. And the thing is we still don't understand a whole lot about neurodegenerative diseases like Alzhiemers. We know that these build ups of Amoloidplex, and a protein called Tau causes damage to our neurons but so far our effort in developing treatments that target those variables haven't been very fruitful. So, improved understandings like this new study provides how our brain clears up toxic build up naturally, could help us combat neurodegenerative diseases in innovative ways.

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ARTIFICIAL LEAF TECHNOLOGY COULD ONE DAY POWER OUR WORLD

Scientists at the University of Waterloo in Canada have come up with a new design for an artificial leaf. That means a whole new way of making cleaner burning fuel using a process that mimics photosynthesis. But what is an artificial leaf? And could it really help us move away from fossil fuels that are getting us into so much trouble?

We have always been interested in figuring out how to copy plants. Because they do a great job by creating energy from the bare minimum. They take in water from their environment, and absorbs carbon-di-oxide (CO_2) from the atmosphere and add the energy boost of sunlight and make glucose that they can use for their energy, plus oxygen (O_2) and some left over water (H_2O). But instead of producing glucose and oxygen like plants do, artificial leaf tech aims to alter that process to produce fuel that we can use. The idea behind this bio inspired technology is to produce cleaner burning fuels, well also removing CO_2 from the air and producing O_2. So it's no wonder that scientists have been trying to create one since 1970s. But there's also a really good reason why they haven't quiet managed to make a fully functioning commercial one yet.

There are many steps involved in photosynthesis that is really hard to do if not a plant and one of them is a uniated catalyst that interacts with light energy to split H_2O into Hydrogen and O_2. This process is called photolysis (splitting up by light). Plants do this in their chloroplast which is a little energy producing factories inside their cells which also hold the pigments which makes them green. Some teams have pursued this rapt, creating systems that just take light energy and make Hydrogen which can then be used as a fuel. But that's slightly problematic not only because the actual process is really difficult but also because we do not actually use hydrogen to power all that much yet.

That's why other teams are working not only to tackle photolysis, but to also come up with catalyst for the second hard thing, converting that resulting hydrogen and CO_2 from the air into an alternative fuel. Many groups around the world are vying to be the first to really figure this out or at least add something new to this growing body of knowledge. Researchers at Cambridge University uses Cobalt to turn H_2O and CO_2something called Syngas, an industrial product that's essential for making plastics, medicines and alternative fuels. They hope to continue refining this process to eventually produce Ethanol (C_2H_5-OH) in just one step from only CO_2 and H_2O. But the latest breakthrough comes in red not green. A Waterloo university based team uses Cuprous oxide as a catalyst that when mixed with CO_2 and H_2O and then exposed into light turns into methanol (CH_3-OH) with a little O_2 on the side. We can use CH_3-OH as a fuel and we do use it often. It's used in race cars etc. and importantly this whole reactions occurs with no input of electricity, which makes it different from some previous efforts that have required electricity which was so expensive to scale up. This artificial leaf itself doesn't take energy to make fuel and it

absorbs CO_2 from the atmosphere and CH_3-OH, the fuel produced emits far fewer greenhouse gases and pollutants than Gasoline. This latest artificial leaf tech is 10 times more efficient than plant photosynthesis and is relatively simple.

So the team hopes it could be easily scaled up. They also hope to start using this tech to capture CO_2 from industrial power plants making CH_3-OH. Hence removing CO_2 from the atmosphere and giving us an alternative fuel. Not only does research like this provide us with alternatives to petroleum and petroleum by-products, but it could also decrease the demand for them all together.

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‘DARK DNA’ IS THE LATEST MYSTERY IN THE WORLD OF GENETICS

Dark matter is one of the biggest mysteries of astronomy. There are a lot of evidence that it is there, but we have not been able to find it. In biology there is a similar problem ‘Dark DNA’. When scientists were exploring sequence genome of certain birds and rodents they noticed something odd. A sequence genome means everything is laid bare and yet certain DNA sequences were missing which was weird because these DNA sequences were very important. They controlled the production of leptin in the birds or the secretion of insulin in rodents. These were the genes that scientists knew that it had to be there otherwise they would have had dead rodents and obese birds in their hand.

Scientists studying the rodents found the products of the missing DNA sequences in their cells. So they concluded that the genes went missing but were somehow hidden. They called these

sequences as ‘Dark DNA’. The reality is that dark DNA maybe more of a blind spot in our DNA sequencing technology than anything else. A closer look at the rodents’ genome found a heavily mutated section with a normally high amounts of Guanine and Cytosine, two of DNA’s four base molecules called G and C for short. It turns out that G-C rich sequences are difficult to detect, so the researchers missed this mutated pocket of DNA at first. The dark DNA raises questions about how quickly mutations occurs and what genes we may have missed when we sequenced other genomes like our own, which is crazy to think that there could be more DNA in us than we have realized. Especially when we consider that we only know about 1-2% of the genomic sequence we have found and these known sections code proteins that have function and the other 98% does not make anything, so we don’t know why it’s there. This vast amount of genetic code has also been referred to as ‘DNA’s dark matter’. Apparently biologists love the dark matter analogy. Instead of knowing what a gene does but not finding it, biologists have found a lot of genes but have no idea what they do.

It appears that a lot of this non-coding DNA is still helpful for regulating gene expression making sure that the right cells have the right hardware. For example the haemoglobin in RBC’s and ion channels in neurons. Some of these sequences are almost identical across different species like Humans, Mice and Chickens. Consider we have been evolving separate from that species for up to 200 million years, researchers concluded that these sequences must somehow be vital to our survival. When researchers deleted four of these genes in Mice, they found abnormalities in the Mice’s brains and wondered if mutations in these overlooked non-coding sections of DNA which could be responsible for brain diseases like Alzheimer’s. So there’s a lot of DNA to pass through and there could be even more that we just

haven't found because of limitations in our sequencing techniques. Our genomes are still pretty dark and mysterious place and more research is needed.

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JELLYFISH LASERS ARE REVOLUTIONIZING QUANTUM PHYSICS

When lasers were first invented they were called 'a solution looking for a problem'. In the decade since then we have found a number of ways to make lasers useful like in barcode scanners, industrial cuttings, surgeries etc. Now physicists and bio-engineers are collaborating to help us make new and even more specialised lasers, thanks to proteins from Jelly fish.

Laser was first theorised in 1917 in a paper by Einstein and it was first accomplished in 1960 by a person named T. H. Maiman. Laser is an acronym for "Light Amplified Stimulated Emission of Radiation." Lasers make light but not like regular light bulb tube. In regular light bulb electrons are pushed through a filament causing them to get excited, that excitement causes them to emit photons of light and heat energy. Lasers are far more precise. A laser takes the same principle of emitting light, but instead of spreading out, it is an organized and tightly packed beam of photons. This organization requires specific substances to emit their photons in a specific way so that the photons are 'monochromatic, coherent and directional.'

Different substances produce different wavelengths of light and different types of lasers are good for different things. Red laser light for example can be used in sensors, spectrometers, CD players etc. and it's made by excited Helium and Neon gas. Blue or violet lasers can be used for data storage application,

in medical technologies etc. and it is made by exciting Gallium nitride. One of the most advanced laser type yet invented is 'Polariton lasers'. It is created by exciting the atoms of a super cooled Bose Einstein condensate (which is a state of matter) to create half matter and half qasi particles. These polariton lasers can be used in quantum physics to target cancer cells or to make data transfers fasters. But these are so hard to make because they require super cooled particles or super cooled medium.

In 2011 Scientists pulsed low energy light on to lab grown cells containing 'green fluorescent protein (GFP)' from the *Aequoreavictoria*jellyfish. By putting them into mirrored chamber the cells created an organised beam of monochromatic photons, the green laser light. These were the first ever biological lasers. Now in this new 2016 study the researchers took that GFP and grew it on a bed of *E. coli* bacteria creating enhanced GFP called EGFP which glows much brighter. They created a 500nm thin film off this EGFP, then they placed that into a mirror, pulsed it with light and a polariton laser for quantum applications was obtained. This process took placed at room temperature and no super cooling was required. The reason they needed super cooled lasers in the first placed was too keep the photons from moving around too much. Super cooled particles behave better. But the jellyfish proteins are barrel shape, which causes photons to align perfectly. It only makes green light at the moment but the hunt is on for more glowing proteins.

From jellyfish to laser to bio-engineering to quantum physics, our science is finding its best applications. Researches like this is helping us to find out more and more applications of biology in the field of physics, especially quantum physics.

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Corona: The King of Virus

Introduction:

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-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV). Coronavirus disease (COVID-19) is a new strain that was discovered in 2019 and has not been previously identified in humans. Coronaviruses are zoonotic, meaning they are transmitted between animals and people. Detailed investigations found that SARS-CoV was transmitted from civet cats to humans and MERS-CoV from dromedary camels to humans. Several known coronaviruses are circulating in animals that have not yet infected humans.

Research Study: Presumed Asymptomatic Carrier Transmission of COVID-19

A familial cluster of 5 patients with COVID-19 pneumonia in Anyang, China, had contact before their symptom onset with an asymptomatic family member who had travelled from the epidemic center of Wuhan. The sequence of events suggests that the coronavirus may have been transmitted by the asymptomatic carrier. The incubation period for patient 1 was 19 days, which is long but within the reported range of 0 to 24 days.4 Her first RT-PCR result was negative; false-negative results have been observed related to the quality of the kit, the collected sample, or performance of the test. RT-PCR has been widely deployed in diagnostic virology and has yielded few false-positive outcomes.5 Thus, her second RT-PCR result was unlikely to have been a false positive and was used to define infection with the coronavirus that causes COVID-19. One previous study reported an asymptomatic 10-year old boy with COVID-19 infection, but he had abnormalities on chest CT.6 If the findings in this report of presumed transmission by an asymptomatic carrier are replicated, the prevention of COVID-19 infection would prove challenging. The mechanism by which asymptomatic carriers could acquire and transmit the coronavirus that causes COVID-19 requires further study

My Views:

COVID-19 Which has played a major impact in the world economy and health is not only a communicable disease but with multiple research studies like these based on sample present in Wuhan, China indicate rapid spreading of this virus. Unlike Nipah Virus Infection outbreak which was limited to only India, COVID-19 has been declared Pandemic Virus. We Human beings generally have tendency to only stay away from people who show symptoms of corona, but these studies indicate how anyone with travel history to China or at present any part of this world can be asymptomatic and carry the virus while this affects anyone above aged 65 severely the chances of anyone being an asymptomatic carrier puts the world at a global crisis, proper and severe preventive steps need to be taken to control this outbreak. The mass affect of this virus on the Italy people and Economy has indeed helped us understand, this is not another, ebola or similar to a war. IT is much more dangerous, health professional all around need to assemble and try to find a cure but more importantly normal citizens like us, need to take preventive steps to curb transmission of this virus.

Reference:

(Published in Times of India February 21 2020)

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https://timesofindia.indiatimes.com/world/europe/italy-reports-349-new-virus-deaths-taking-total-to-over-2000/articleshow/74662051.cms (Reference to present day scenario in Italy)

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AYURVEDIC TREATMENT FOR COVID-19

INTRODUCTION:

COVID-19 is also known as Corona Virus is an infectious disease caused by a newly discovered virus known as Coronavirus which was firstly observed in China. Most people infected with the COVID-19 will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness. The best way to prevent and slow down transmission is to protect yourself and others from infection by washing hands with soap or alcohol based sanitizers and not touching your face. This Virus spreads primarily through droplets of saliva or discharge from nose when an infected person sneezes, so it is important that you also practice respiratory etiquette like coughing using a tissue paper or into a flexed elbow. At this time there is no specific treatment or vaccines for COVID-19. However, there are many ongoing clinical trial and Ayurvedic Treatment to boost your immunity to fight against COVID-19 Virus**.**

AYURVEDA TIPS TO BOOST IMMUNITY:

As the world scrambles to find a cure for COVID-19, health experts have suggested boosting the body's immune system may help minimize the effects and hasten the recovery for the disease.

They say ayurvedic herbs such as Tulsi, Cinnamon, Black Pepper, shunthi (dry ginger) and raisins and regular Yoga are potent aids to increase the body's immunity against harmful viruses.

The ministry's protocol outlined measures to build a robust immune system, and it included: consuming water, practicing yogasanas, pranayama and meditation for 30 minutes every day. It also advises usage of Turmeric, Cumin, Coriander, and Garlic in cooking, besides taking 10 gm of chyavanprash in the morning. Jaggery, fresh lemon juice too can be helpful in the fight against COVID-19.

The firm offers immunity enhancer herbal drug Fifatrol, a multi-drug combination of classical ayurvedic medicines and herbs like Mrityunjay rasa, Sanjeevinivati, tulsi and Giloe. These herbs also help increasing the production of interferons i.e. proteins and antibodies to generate an immune response against virus and increase the rate of phagocytosis to destroy microorganisms, thus, increasing immunity from containing viral infections, said former CSIR scientist A K S Ratwat. Ayush ministry also recommended 150 ml of hot milk with half a teaspoon of Turmeric powder once or twice in a day. Application of sesame oil or coconut oil or ghee in both the nostrils in the morning and evening.

HERBS, SPICES, AND SWEETERENS TO ACTIVATE IMMUNE SYSTEM:

Consume this healthy tonic for an immune system boost. It is crafted from ingredients proven to support immune system function:

1. Astragalus root
2. Angelica root
3. Honey
4. Ginger

About the herbs:

Astragalus root: is a prominent herb in Chinese medicine, has anti-inflammatory and antibacterial properties. Research suggest that the root can boost resistant to infection. Studies performed on animals indicate that it can regulate the body's immune responses. A March 2020 study even revealed that taking astragalus to prevent infection with the new Coronavirus SARS-CoV-2 is common in China.

Angelica root: it is native to Russia and many parts of Scadinavia. The root has been used in Chinese medicine to modulate the immune system and treat respiratory ailments and cold symptoms.

Other key ingredients:

Both honey and ginger are powerful antioxidants that also have anti-inflammatory and antibacterial properties.

Honey: it activates the immune system's response to infection and prevents call proliferation. Controlling call proliferation is key to stopping pesky viruses.

Ginger: it is has anti-inflammatory effects as well and may be able to help with muscle pain.

This recipe also contains small amount of:

1. Chamomile
2. Orange peel
3. Cinnamon
4. Cardamom seeds

Finally the all over ingredients are:

1. 1 tbsp of honey
2. 1 oz dried astragalus root
3. 1 oz dried angelica root
4. ½ oz dried chamomile
5. 1 tbsp dried ginger
6. 1 tbsp dried orange peel
7. 1 cinnamon stick
8. 1 tbsp cardamom seeds
9. 10 oz alcohol (recommended: 100 proof vodka)

Directions:

1. Dissolve the honey in 2 teaspoons of boiling water. Let cool.
2. Combine the honey and the next 7 ingredients in a mason jar and pour alcohol on top.
3. Seal tightly and store the bitters in a cool, dark place.
4. Let the bitters infuse until the desired strength is reached. It'll take about 2-4 weeks. Shake the jar regularly.
5. When ready strain the bitters through muslin cheesecloth or coffee filter. Store it in airtight container at room temperature.

How to use it: mix this-bitters into hot tea or few drops first thing when you wake up for protection.

PROCEDURES DURING DRY COUGH:

i. Steam inhalation with fresh pudina (mint) leaves or Ajwain (Caraway seeds) can be practiced.

ii. Lavang (Clove) powder mixed with natural sugar or honey can be taken 2-3 times a day in case of cough and throat irritation

iii. These measures generally treat normal dry cough and sore throat. However it is best to consult doctors if these symptoms persist.

LIST OF HERBS AND THEIR PROPERTIES TO BOOST IMMUNITY:

1) **Holy Basil:** the leaves of these are easily available, plants are rich in phytonutrients such as antioxidant and flavanol, chlorophyll, vitamins, and minerals, as well as Eugenol, a bioactive compound that has anti-microbial, anti-fungal, and anti-bacterial properties and reduces stress and plasma glucose levels. You can chew 4-5 leaves every morning or infuse them with your morning tea.
2) **Ginger:** it is well known for its anti-inflammatory, anti-fungal and anti-cancer properties. In traditional medicine, ginger has been extensively used for curing cold, coughs nausea, asthma, gastrointestinal complaints, arthritis and even depression. Crushed ginger should be boiled with tea leaves and water mixed with cloves and cardamom.
3) **Fenugreek:** is a well-known herb in Ayurvedic system of medicine which acts as a natural antioxidant and strengthens immune system. Herbal tea made with fenugreek, honey and lemon is a traditional remedy to cure fever.
4) **Garlic:** has potent antioxidant properties and helps in reducing stress and high blood pressure. It also helps in enhancing Thiamin (vitamin B1) absorption in body and prevent Beriberi.it is always best to chop or crush garlic before consuming it because it works better in when contact with oxygen.
5) **Turmeric:** contains a bioactive compound known as curcumin, which acts as an anti-inflammatory agent. Commonly used in India for curries and other dishes, it can also be consumed as a decoction made from grated ginger, tulasi and turmeric once daily to improve immunity as recommended By Ayush.

IMMUNITY BOOSTING TIPS AGAINST COVID-19:

- **Vitamin C:** is a well-known immunity boosting properties. A regular intake of vitamin ensures a better defense mechanism. Taking 1000 mg of vitamin C or ascorbic acid as the best nutritional supplement for increasing one's immunity. National pharma pricing authority has put it under a list of essential medicines. You can find vitamin C in a very simple household ingredients like Lemon Zest.
- **Kadha or decoction:** spent just 15 minutes in the kitchen to make one of the best immunity booster shot. Kadha is an ayurvedic drink which has various herbs and spices that have been boiled in water for about 15-20 minutes, allowing all the medicinal benefits to be extracted. Boil in a saucepan 1 inch of turmeric root, ¾ inch of ginger root, a dash of ground black pepper, cinnamon powder, a bunch of tulasi leaves, 4 cloves and a bunch mint leaves. You can add honey and lemon juice for a good taste before consuming.
- **Neem chutney:** neem has a bitter taste but the leaves are a reservoir of goodness. Neem helps reduce inflammation in the body, improve liver health, cardiovascular health, eyesight, and basically just give your immune system a boost. Crush it into a chutney paste and add jaggery and ginger and honey to balance the bitter taste.
- **Intermittent fasting:** intermittent fasting or not eating anything for a maximum of 12-16 hours is very helpful to prevent infection from multiplying. Fasting enhances autophagy which means our immune system starts metabolizing damaged proteins in our body.

MEDICINAL HERBS TO BOOST IMMUNITY:

- **Kutki:** it is widely used ayurvedic and Unani traditional medicine systems in India since the rhizomes are valued for their effectiveness as an antibiotic. The rhizomes of a plant is also used in the treatment of high blood pressure, intestinal pain, eye disease, gastritis, bile disease, sore throats, blood and lung fever and also boots your immunity.
- **Emblica:** is a well-known herb in the Ayurveda. It is used to treat disorders of the liver and upper respiratory tract, chronic diarrhea and scorpion sting. Emblica exhibits strong antioxidant activity. It is one of the most important plants in the traditional ayurvedic medical system for immune-modulatory, anti-inflammatory, anti-ulcer, hepatic protective.
- **Gudchi:** it is used for high cholesterol, allergic rhinitis (hay fever), upset stomach, gout, lymphoma, and other cancers, rheumatoid arthritis, hepatitis, peptic ulcer disease, fever, gonorrhoea, syphilis, and to boost the immune system.
- **Ashwagandha:** is well known for increasing the immune system through a substantial rise in energy and longevity in times of health crisis. The roots of the plant are turned into powder and used for cardiovascular problems, high cholesterol and stress management. The roots are also used for making tea which has medical value.
- **Chyavanprash:**chyavanprash has unique ability to make your immunity strong. Not only this, eating this ayurvedic formulations daily helps to fight against cough, cold, fever, and other seasonal allergies.
- **Golden milk:** taking milk with turmeric is good to fight cough, cold and viral infections. It is also beneficial to strengthen the immunity.
- **Ajwain tea:**ajwain tea is known for pungent smell. Ajwain tea is beneficial for cold, cough, asthma, and gaseous problems. It is known for antiseptic, antipyretic and expectorant. Ajwain steam inhalation can be practiced once in a day.
- **Coriander chutney:** coriander is full of minerals and vitamins, especially rich on micro-nutrients. It has adequate amount of vitamin A, B, C, and E along with minerals like calcium, phosphorous, iron and magnesium. Coriander is beneficial in pain, cold, cough, throat pain, and antiseptic in nature. The presence of many phytochemicals helps to develop the immunity of the body.
- **Garlic chutney:** garlic chutney has many health benefits. Garlic chutney increases the energy level of the body. It is good against cold and cough and helps to over-come respiratory problems. It boost immune system and also good for asthma.
- **Clove:** clove is full of antioxidant i.e. eugenol, vitamin E, vitamin C etc. it enhances immunity and helpful to increase the count of white blood cells.
- **Giloy:**giloy has many health benefits such as anti-inflammatory, anti-arthritic, anti-allergic, anti-malarial, anti-diabetic, anti-impotency. It is proven anti-endotoxic potential, bolsters host defense and decreases incidence of sepsis, stimulates phagocytosis, proven efficacy immune-compromised condition. It is full of immunogenic properties and it is great for immunity.
- **Triphala**: triphala boosts your immunity thus prevents you from many diseases and disorders. Helps in boosting your immunity.
- **Amla**: also known as Indian gooseberry, amla is a rich source of immune-boosting vitamin C. it is used in various ayurvedic immunity boosters.
- **Broccoli sprouts**: packed with power anti-oxidant properties and other nutrients, broccoli sprots are optimal for boosting immune health.
- **Olive leaf**: while you might not fine an olive leaf in your pantry, it is readily available via herbal supplementations. These substances block the production of enzymes that allows viruses to replicate, which is why a olive leaf is grate for its immunity-boosting properties.

- **Propolis**: propolis is a compound produced by bees from the sap on evergreen trees. Current research suggests that it may also possess anti-viral properties.
- **Pepitas**: pepitas contains a wide array of vitamins and minerals known to support immune health. The lignins in pumpkin seeds have also been shown to have anti-microbial and especially anti-viral properties. To maintain potency pepitas should be eaten raw.

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