



ENVIS NEWSLETTER

MICROORGANISMS AND IMPACT ON PUBLIC HEALTH

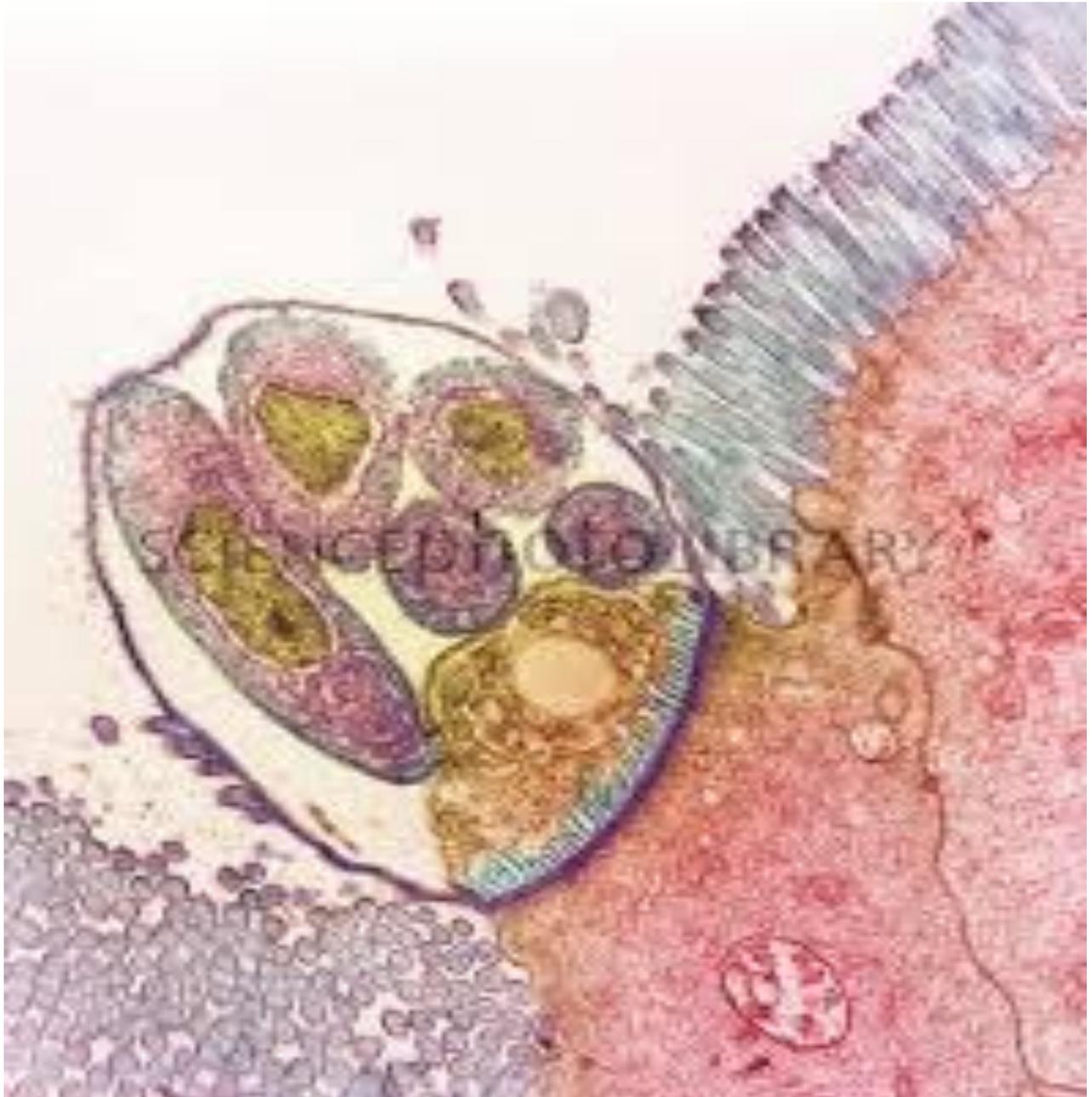
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INSTRUCTIONS TO CONTRIBUTORS

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 knowledge on 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 / 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 refereed journals may be followed.

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Cover page : *Cryptosporidiosis, Cryptosporidium Protozoa*, TEM photograph

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EVENTS

From the Coordinator's Desk!

Dear Readers,

Greetings!

Water is life. It is vital and supports immense diversity of life on Earth. It's a source of food, health and energy. Fresh water makes civilization possible. But fresh water, in turn, is not possible without a healthy planet and human actions are putting a healthy planet at risk. Over two thirds of Earth's surface is covered by sea and less than a third is taken up by land. As Earth's population continues to grow there is an ever-increasing pressure on the planet's water resources. Our oceans, rivers, and other inland waters are over exploited by human activities. In the process we take more and give back less to the nature and reduce the quality and poor water quality means water pollution. Clean water is essential for life, but most people don't think much about this precious resource. In developing nations the search for safe drinking water can be a daily crisis. Millions of people die each year particularly children from largely preventable diseases caused due to lack of clean water and improper sanitation. In the planets history pollution is recent problem due to industrial revolution in the 19th century as before that people lived more in harmony with their immediate environment. The pollution of environment spread relatively with increase in human population and other industrial developments. When Earth's population was much smaller, no one believed pollution would ever pose a serious problem. It was once popularly believed that the oceans were far too big to pollute. Today, with around 7 billion people on the planet, it has become apparent that there are limits. Pollution is one of the signs that humans have exceeded those limits.

In this context, present issue contains a scientific article on bacteriological analysis of potable water from North Chennai along with other interesting topics such as use of eco-friendly water borne semiconductor inks, effect of climate change on sun's ability to disinfect lakes and coastal waters, converting a smartphone into a microscope and many more. Hope this issue will bring awareness on water conservation and provide insights technology developments.

Dr. C. Arulvasu

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21st NOVEMBER, 2017

Quality of potable water from North Chennai environs, India – A bacteriological study

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Keywords:

Fresh water
Coliforms
Enteric diseases
Contamination

ABSTRACT

Drinking water samples collected from various sources such as sump, tanks, hand pump, bore wells and metro water from North Chennai area were analyzed randomly by multiple tube fermentation for bacteriological quality analysis. The results were expressed as most probable number (MPN) as the total or presumptive coliform count. Of ten water samples from various sources tested only two from bore well and one from hand pump were found with MPN value < 3 suitable for consumption. Five samples had MPN value in the range of 23 to 240 and rest of the samples had values > 1100 which makes all these samples unfit for drinking. Thus 70 % of the water sources tested was unsafe which highlight the poor quality of drinking water available. Hence necessary measures have to be taken to improve the quality of water and avoid enteric diseases.

Introduction

Water is the most essential commodity for the survival of human beings next to oxygen. Nearly 71% of earth's surface is covered with water but the availability of safe drinking water for consumption is becoming scarce (Malathy *et al.*, 2017). In human body, water plays a central role in the regulation of nutrient transport, toxic waste removal, thermal regulation, digestion, organ functioning and metabolic activities (Kumar *et al.*, 2013). However, if water is polluted it spreads diseases to a great number of people consuming it. World Health Organization (WHO) estimated about 1.1 billion people drink unsafe water globally; hence, perhaps water is the major route of massive outbreaks of pathogenic infections (Anbazhagi *et al.*, 2007). India with more than 1.2 billion citizens suffers water shortage with its increasing population and economic growth, and lack of adequate infrastructure. Among various diseases caused due to contamination of drinking water, diarrhea is the third most common cause of death in children under the age group of five years and contributes to 13% of death killing 300,000 children every year in India (Bassani *et al.*, 2010).

Groundwater is an important source of drinking water and its quality may vary due to various factors such as discharges from sewage works and runoff from informal settlements and contamination by faecal waste of human and animal origins. Contaminated water may harbour infective and parasitic agents that can cause infectious diseases. Presence of these microorganisms could be

detected by testing for the presence of Fecal coliforms (FC), the most commonly used bacterial indicator for fecal pollution and hence used to assess the microbiological quality of drinking water (Malathy *et al.*, 2017). As per WHO standards, any microorganism known to be pathogenic or any bacteria indicative of fecal pollution should not be present in drinking water (Wright *et al.*, 2004).

Microorganism such as *Micrococcus*, *Pseudomonas*, *Serratia*, *Flavobacterium*, *Chromobacterium*, *Acinetobacter* and *Alcaligenes* are present naturally in water. Similarly soil bacteria such as *Bacillus subtilis*, *B. megaterium*, *B. mycoides*, *Enterobacter aerogenes* and *E. cloacae* may also be present in the water. Apart from these pathogenic microorganisms such as *Escherichia coli*, *Enterococcus faecalis*, *Clostridium perfringens*, *Salmonella typhi*, *Vibrio cholerae*, *Proteus vulgaris*, *Zoogloea ramigera*, *Sphaerotilus natans*, *Haliscomenobacter hydrophila*, *Nostocoida limicola*, *Microthrix parvicella*, *Flexibacter*, *Microscilla* and *Nocardia* may be present if the water is contaminated with faeces.

Chennai one of the largest cities in India has two major rivers Cooum and Adyar connected by Buckingham Canal and has many lakes in and around Redhills, Poondi, Sholavaram, Chembambakkam etc. Due to industrialization and urbanization almost all the freshwater bodies surrounding Chennai is polluted. Even the coast of the Chennai is also affected by the pollution carried by these rivers into the sea. Many studies have shown that the water around Chennai are affected by heavy metals,

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chemicals, organic and inorganic pollutants. Besides these there is also contamination due to sewage, household and commercial waste, and many more because of anthropogenic activity. Hence as a preliminary study, an attempt was made to determine the bacteriological quality of drinking water samples collected from North Chennai through random water sampling from various sources.

Materials and methods

Water samples of 200ml from various sources such as sumps, borewells, metropipes, Water tanks and hand pumps were collected in sterile glass containers. Bacteriological examination was done by multiple tube fermentation tests using MacConkey's broth to find the total or presumptive coliform count. Results of the test were expressed through most probable number (MPN) (Table 1) (Garg, 2003). The water samples (10 ml) from the bottles were aseptically transferred into three tubes containing 10 ml of double strength MacConkey's broth and water samples (1 ml) into three tubes containing 10 ml of single strength MacConkey's broth. Similarly, 0.1 ml of water sample was transferred into three tubes containing single strength MacConkey's broth. All the tubes were

Table 1: Determination of most probable numbers by multiple tube test (Garg, 2003)

Number of tubes giving positive reaction out of			MPN index / 100 ml
3 of 10 ml each	3 of 1 ml each	3 of 0.1 ml each	
0	0	1	3
0	1	0	3
1	0	0	4
1	0	1	7
1	1	0	7
1	1	1	11
1	2	0	11
2	0	0	9
2	0	1	14
2	1	0	15
2	1	1	20
2	2	0	21
2	2	1	28
3	0	0	23
3	0	1	39
3	0	2	64
3	1	0	43
3	1	1	75
3	1	2	120
3	0	2	93
3	2	1	150
3	2	2	210
3	3	0	240
3	3	1	460
3	3	2	1100

incubated at 37 °C for 48 hours and observed for colour change from red to yellow, indicator for the presence of pathogens and checked gas production which is considered as positive for the presence of fecal coliforms.

Results and Discussions

The water samples for the test were inoculated and incubated in respective MacConkey broth tubes and looked for acid and gas production. The number of tubes with acid and gas production for each volume of water added i.e. 10 ml, 1 ml and 0.1 ml (each volume in 3 tubes) were noted and the results obtained were compared to the probability table (Table 1). Of the 10 water samples from different sources tested only three samples, one from hand pump and two from borewell, were showing MPN values < 3 implying that they were fit for consumption. The bore water is ground water that is accessed by drilling into the underground aquifers and pumped to the surface. These bore wells are confined or deep aquifers, which are usually covered by more than 20 meters of rock or clay which act as natural filter preventing microbial contamination. Similarly hand pumps are unconfined and shallow aquifers, which are not protected by thick layers of rock or clay as they are present closer to the surface and are susceptible to both chemical and microbiological contamination. Each sample of hand pump and bore water were recorded with MPN of 23 implying they were mildly contaminated by microorganisms. Similarly tank water filled with borewater from the same region had MPN value of 23. The microbial contamination in these regions may be due to the leachate of sewages and other contaminants.

Three water samples were collected, two from metro water taps and one from metro water tank, for microbial quality testing. These are supplied from the water reserves around the city after proper treatments for drinking. The MPN values determined for the various samples are listed in Table 2. The microbial load was high such as MPN value of 240 for metro water collected from tap at East cemetery road, MPN of 1100 for water collected from somuchetty street and highest MPN index of > 1100 at metro water tank at MC road. The water tank constantly receives the treated water which is then transferred through taps to the public for drinking. The water tanks are not cleaned regularly and there is continuous supply of water to the tanks as the water is spent. Depending on the source of the water received each time' the microbial load gets varied but it

records the highest MPN value. Meanwhile in taps the scenario is almost same as the water which is stored in the tanks is distributed through them everyday hence the microbial load here also varies. The other possible ways to the get contamination is through break or leak of drinking water pipes, mixing of sewage into the source, waste dumped near water reservoirs, poor water sanitization procedures or improper maintenance of water bodies and supply systems etc.

Table 2: MPN values of water samples collected

Source	Area	NUMBER OF POSITIVE TUBES			MPN
		10 ml	1 ml	0.1 ml	
Sump water	West cemetery road	3	2	0	150
Water tank	MC road	3	3	3	> 1100
Hand pump	West cemetery road	0	0	0	< 3
Bore water	Kalmandabam	0	0	0	< 3
Metro water	East cemetery road	3	3	0	240
Bore water	Singara garden	3	0	0	23
Bore water	West cemetery road	0	0	0	< 3
Metro water	Somuchetty street	3	3	2	1100
Tank water	Singara garden	3	0	0	23
Hand pump	Solaiappen street	3	0	0	23

It is clear that 70% of the fresh water source is contaminated by microorganisms. The water supplied by the corporation is highly contaminated and it is the responsibility of the corporation board to provide safe drinking water to the community. There should be standards set for adequate chlorination and safe distribution of water from the storage point to the receiving end. The safety standards should be checked regularly and updated according to the needs of the situation to prevent outbreaks of enteric diseases. Use of non-corrosive pipelines; replacing broken pipelines

earliest, plugging the leakages etc. for avoiding contamination would ensure safe delivery of water. This preliminary study reveals that the water available to the public is of low quality and they should be educated about the spread of water borne diseases and its control measure through awareness programmes. Only a part of the city was covered for the study and extensive studies are required to do a complete assessment of bacteriological quality of water for the entire Chennai.

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RESEARCH REPORTS

Eco-friendly waterborne semiconductor inks using surfactant

A research team of Energy Science and Engineering at DGIST has developed a technology to produce environment friendly waterborne semiconductor inks, using surfactants which are additives that mix substances of different properties and a component of soap.

Polymer semiconductors are carbon compounds showing the electrical properties of semiconductors. It has been highlighted as a next-generation material of wearable smart devices etc. not only because they are flexible and light in weight, but also they can be processed in a wide area at low cost through the solution process. However, there is an issue that it causes significant environmental pollution as toxic organic solvents are used in the process.

Despite the limitations, the research team has developed a semiconductor surface control technique using surfactants for environment friendly semiconductor manufacturing processes that do not use toxic organic solvents and has produced waterborne semiconductor inks.

In the study, the newly developed waterborne semiconductor ink by the research team has small colloidal particles and less surfactant micelles compared to the waterborne semiconductor inks in the previous studies. As a result, it has a relatively flat surface than the conventional waterborne semiconductor inks. The black and white image in the figure shows the comparison of the surface of the thin film made with the waterborne semiconductor ink developed in this study and conventional one. According to the research team, the technique is expected to be applied in various electronic devices such as P-type and N-type transistors as well as PN diodes, complementary inverters, photodiodes as high-quality thin films.

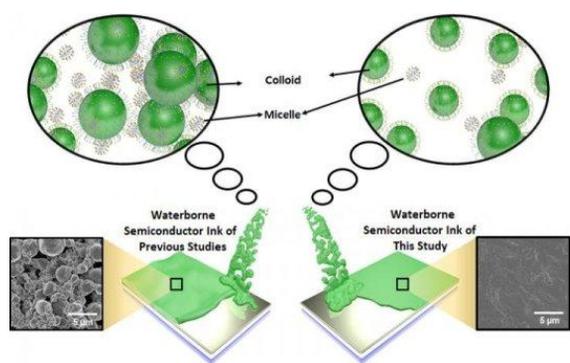


Fig. Comparison of the waterborne semiconductor ink of this study and that of the previous studies.

Image credit: Daegu Gyeongbuk Institute of Science and Technology (DGIST)

Professor Chung, author of the study stressed the significance by stating that his research has fundamentally solved the environmental pollution problem generated during the production of organic semiconductor, which is spotlighted as the core material of wearable electronic devices. They have the

technology that can disperse various semiconductor materials into water through the simple chemical modification. They expect that it can be used in various optoelectronic devices ranging from transistors to solar cell, composite circuit, and image sensor.

Source: www.sciencedaily.com.

Climate change could decrease sun's ability to disinfect lakes, coastal waters

One of the largely unanticipated impacts of changing climate may be a decline in sunlight's ability to disinfect lakes, rivers, and coastal waters, possibly leading to an increase in waterborne pathogens and the diseases they can cause in humans and wildlife. A new study published in the journal *Scientific Reports* outlines how a rise in the amount of organic matter washed into bodies of water can stunt the ability of pathogen-killing ultraviolet rays from the Sun to penetrate the water's surface.

Scientists have already measured an increase in browning of the world's waters, a phenomenon caused by more organic matter washing from the surrounding land. This trend is expected to continue as a warming climate leads more extreme rainfall and thawing permafrost, both of which contribute to the problem.

In the study led by Miami University in Ohio, researchers had analyzed water samples and used a model, based at the National Center for Atmospheric Research (NCAR) and quantified for the first time, the impact of dissolved organic matter on the potential for UV radiation from the Sun to kill pathogens in the water.

“Much of the research emphasis up to this point has been on the browning itself, not the ecological consequences” said lead author Craig Williamson, an ecologist at Miami University. He said that they were able to determine that, in some cases browning decreases the ability of sunlight to disinfect water by a factor of 10. This could have serious implications for drinking water supplies and coastal fisheries across the globe.

The study was an outgrowth of collaboration among multiple scientists from different disciplines who serve on the United Nations Environment Programme Environmental Effects Assessment Panel (UNEP EEAP). The data collection and modeling used in this study were funded by multiple grants

from the National Science Foundation, NCAR's sponsor.

For the study, Williamson and his colleagues relied on water samples collected from lakes around the world, from Pennsylvania and Wisconsin to Chile and New Zealand. The water samples were tested to determine how much dissolved organic matter each contained, as well as the wavelengths of light including ultraviolet wavelengths absorbed by that organic matter.

Then NCAR scientist Sasha Madronich used this information as well as modeling results from the Tropospheric Ultraviolet-Visible model to calculate the Solar Inactivation Potential (SIP) for each lake. SIP is an index of the expected disinfecting power of UV light in a particular body of water, based on its dissolved organic matter and other characteristics. The NCAR Tropospheric Ultraviolet-Visible model which simulates how UV light is scattered and absorbed as it passes through Earth's atmosphere was used to determine how much UV light hits the surface of the lakes throughout the year. Madronich also analyzed reflection and refraction of each lake's surface to calculate how much light penetrates the lakes and then, finally, how deeply it reaches. Because scientists already have some understanding of which wavelengths of UV light do the most damage to which waterborne pathogens, the scientists were able to use the model output to calculate the SIP for each lake. In some cases, they also calculated this measure of expected disinfecting power across different parts of or for different time periods in the same lake.

The results allowed scientists to quantify the impacts of dissolved organic matter. For example, the summertime SIP for one lake in northeastern Pennsylvania which, along with other regional lakes has undergone significant browning in recent decades dropped by about half between 1994 and 2015.

In California's Lake Tahoe, the SIP can be as much as ten times lower at Tahoe Meeks Bay, an area at lake's edge that is heavily used by humans and has a much higher level of dissolved organic matter, than in the relatively pristine center of the lake.

The scientists also showed how SIP can dramatically decrease after a heavy rainfall event, using water samples collected from the region where the Manistowic River flows into Lake Michigan, which supplies drinking water to more than 10 million people. Modeling based on samples taken before and after a strong storm moved through on June 21, 2011 showed that the SIP may have dropped by as much as 22 percent due to the extra dissolved organic matter that washed into the area in this single storm event. Additionally, the results for all lakes showed a significantly

stronger SIP during the summer when the Sun is higher in the sky than winter. Lakes at higher elevations also had higher SIPs during all times of the year.

Williamson said that the study highlights possible challenges for water supply managers and public health workers as the climate continue to warm and extreme precipitation events become more common. Not only does an increase in dissolved organic matter make it more difficult for sunlight to disinfect bodies of water, it also makes it more difficult for water treatment plants to work effectively. In the United States, 12 to 19 million people become ill from waterborne pathogens annually.

“The research also underscores the importance of working across scientific disciplines to fully understand the impacts of climate change across Earth system” said Madronich, who is an atmospheric chemist. He added what happens in the atmosphere affects what happens in lakes and these are not separate compartments of the world, these things are all connected.



Source: www.news.rpi.edu

Scientists release a how-to for building a smartphone microscope

Add one more thing to the list of tasks your smartphone can perform. University of Houston researchers have released an open-source dataset offering instructions to people interested in building their own smartphone microscope. The researchers describe the process in a paper published in *Biomedical Optics Express*, demonstrating that a basic smartphone equipped with an inexpensive inkjet-printed elastomer lens can be converted into a microscope capable of fluorescence microscopy, able to detect waterborne pathogens and perform other diagnostic functions.

Wei-Chuan Shih, associate professor of electrical and computer engineering, told fluorescence microscopy is “a workhorse,” used in biology, medical diagnostics and other fields to reveal information about cells and tissue that cannot otherwise be detected. The technique allows more information to be harvested from fluid, tissue and other samples and not everyone has access to an optical microscope that can use fluorescence. This could extend sophisticated imaging techniques to rural areas and developing countries. It also could have more widespread applications, such as allowing backpackers an easy way to test for pathogens in rivers and streams. “We really hope anyone who wants to build it can,” he said. “All the pieces can be made with a 3-D printer. It’s not something that belongs just to the lab”.

The work was partially funded with a \$100,000 grant from the National Science Foundation’s citizen science initiative, which encourages scientists to find ways to expand knowledge and access to research. Shih’s lab created an inexpensive lens that can turn a smartphone into a microscope in 2015; he and members of the lab created a company to produce and distribute the inkjet-printed lenses, which attach directly to a smartphone camera lens.

They continued their efforts to improve on that process, and in an article published earlier in *Applied Optics* they reported engineering a platform constructed with low-cost parts including LEGO bricks and plastic imaging components to ensure high-throughput quality inspection of the inkjet-printed lenses. The lenses were used in the work reported in *Biomedical Optics Express*, which details how the researchers combined simple LED lighting with a 3-D printed cartridge designed to hold a conventional glass slide. The light and cartridge attach to the smartphone. While conventional tabletop microscopes shine light through the sample from above, the Shih lab’s technology launches the light from the side of the slide, which is about one millimeter thick. The LED light travels through the glass, refracting to allow the observer to view cell nuclei and structure.

It is both less expensive and less complicated to operate. Shih said that to pursue ultra-simplicity for open-source do-it-yourself fluorescence smartphone microscopy, they have reported the development of an integrated single lens add-on for multi-color fluorescence imaging. In addition to Shih, those involved with the project include Yulung Sung, a doctoral student in the Department of Electrical and Computer Engineering at UH, and undergraduate Fernando Campa.

Results from testing water samples for pathogens including *Giardia lamblia* and *Cryptosporidium parvum* using the technology were compared with results obtained using a tabletop optical microscope. Resolution was slightly higher with the optical microscope, but the researchers reported resolution of two microns with the smartphone technology.

KNOW THE SCIENTISTS

Dr. Max Delbrück, Dr. Alfred D. Hershey & Dr. Salvador E. Luria



Max Delbrück (1906-1981), Alfred D. Hershey (1908-1997), and Salvador E. Luria (1912-1991) received the Nobel Prize in Physiology or Medicine for founding the phage group and stimulating hundreds of scientists to study molecular biology. That's not exactly what the citation says but nobody is fooled. This is an unusual Nobel Prize. While the work that these three men did is impressive there's no real breakthrough or discovery that links all three. In a sense, they are getting the Nobel Prize for being teachers and mentors. That is entirely fitting and proper.

Their influence was enormous. Delbrück especially was the man behind the curtain throughout most of the 50's and 60's. His name comes up repeatedly in biographies and memoirs. Recall that the book *Phage and the Origins of Molecular Biology* was dedicated to him.

Shih said he looks forward to seeing the device used by people outside the scientific community. "I feel more and more excited about seeing people adopt simple basic scientific gadgets," he said. "I think it will have more impact if we let people play with it, rather than trying to hold it as a secret. We should make it as easy and accessible as possible for everyone."

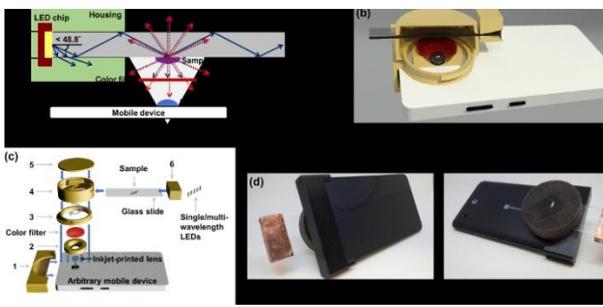


Fig. (a) Slide-launched TIR-guided illumination: elastically scattered photons are blocked by the filter, while fluorescent photons can reach the smartphone camera, (b) Photorealistic cut-out rendering, (c) Assembly procedure: inkjet-printed lens attached onto smartphone camera, smartphone adapter (1) fitted on smartphone, adhesive ring (2) attached to remove stray light, color filter attached on adhesive ring for fluorescence imaging, base ring (3) attached to adapter, threaded barrel (4) with slot enabled z-axis focusing and sample insertion, lid (5) attached to block ambient light, LED module (6) provided illumination, (d) System attached to smartphone.

Source: www.sciencedaily.com.

Sun's role in mitigating fungal disease of mango fruits

Mango fruits host some economically damaging fungal diseases, especially during ripening and storage; but mango growers and suppliers have a new ray of hope in the form of sunlight. In a recent *Phytobiomes* journal article, Noam Alkan and colleagues at the Agricultural Research Organization, Volcani Center in Israel show some promising new research that explores the role of sunlight in boosting the levels of beneficial microorganisms in mango fruits to combat stem end rot.

The researchers showed that high sunlight exposure in an orchard has the effect of turning the mango's skin red. Mango fruits with less sunlight exposure remain green. Using a novel deep sequencing technique, they studied the dynamics in the microbial and fungal community inside the stem end tissues of both red and green mango fruits during storage.

They found that both fungal and bacterial community changes were dependent on fruit peel color, storage duration, and storage temperature. The pathogens commonly associated with stem end rot are *Alternaria alternata* and *Lasiodiplodia theobromae* both colonize the phloem of the fruit's stem end. As the fruit ripen, they switch to a pathogenic stage and branch into the fruit's softer internal tissue. Colonies of yeast, bacteria, and

other fungi that do not cause symptoms were also found.

Interestingly, exposure to sunlight in the orchard contributed to a healthier composition of fungal and bacterial communities and therefore reduced post harvest rots, while long storage reduced the community variation and led to more pathogenic fungi and rots. Thus, in fruit that were not exposed to sunlight or in fruits stored for long period, they found an increase in specific pathogenic fungi and an increase in bacteria that are known to degrade fungal cell walls.

The researchers also discovered diverse and dynamic microbial communities that not only contained pathogenic microorganisms but beneficial ones that one day could be used in agriculture, food industry and biomedicine.

Alkan one of the authors of the Shely said that this is one of the first articles to offer a deep insight into microbiome of harvested fruits. The authors believe that healthier microbial composition is going to be a major topic of interest to everyone dealing with food safety and food waste in the near future.

Source: www.phys.org

ONLINE REPORTS

Sleeping sickness can now be cured with pills

For the first time, researchers have cured the deadly neurological disease sleeping sickness using pills instead of a combination of intravenous infusions and pills. The investigators presented the results from final clinical trials at the European Congress on Tropical Medicine and International Health in Antwerp, Belgium, providing hope that the treatment will help to eliminate the malady within a decade.

The oral therapy called fexinidazole cured 91% of people with severe sleeping sickness, compared with 98% who were treated with the combination therapy. It also cured 99% of people in an early stage of the disease who would typically undergo a spinal tap to determine whether they needed infusions. The relative ease of the treatment with fexinidazole means, that if approved, it might save more lives than the current option, say the investigators leading the phase 3 trial, the final phase of testing before the drug goes to regulators for approval.

Sleeping sickness is endemic to Africa and generally infects extremely poor people who live in remote regions. The

sick often suffer from the disease for years before seeking treatment, causing them and those caring for them to miss work and spend their savings on traditional medicines. Trekking to a hospital and remaining there for intravenous infusions is costly as well.

“It’s not just the person with sleeping sickness, it’s the family that takes care of them during years of this neurological, very serious disease, whatever money they have, they’ll spend on this instead of anything else” says Philippe Büscher, a sleeping-sickness specialist at the Institute of Tropical Medicine in Antwerp, Belgium, who was not involved in the study. Büscher commends the team for conducting a quality clinical trial under extraordinary circumstances in countries hit hardest by the disease, the Democratic Republic of the Congo and the Central African Republic. Investigators had to carry equipment to remote clinics over rugged terrain; one study site was repeatedly robbed; and early on in the trial, some participants fled armed conflict. “I need to congratulate them for the beautiful work,” says Büscher.

Sleeping sickness also known as human African trypanosomiasis is spread through the bite of tsetse flies carrying parasites, most commonly *Trypanosoma brucei gambiense*. The organism infects the central nervous system and patients can experience confusion, daytime sleepiness, night-time insomnia and various psychiatric symptoms, including manic episodes and aggression. If left untreated, they enter a coma and die. For decades, the only treatment was a toxic arsenic-based drug that killed one in 20 patients.

In 2009, researchers introduced a safer option: nifurtimox eflornithine combination therapy, or NECT, which consists of pills and 14 intravenous infusions. For the first time in 50 years, the incidence of sleeping sickness slipped below 10,000 new cases per year; it’s currently around 2,200 according to the World Health Organization. But the need for infusions, along with the spinal tap required to qualify a patient for the treatment, still present obstacles in regions where sterile equipment, electricity and doctors are in short supply.

The group that developed NECT, a non-profit research organization based in Geneva, Switzerland, called the Drugs for Neglected Diseases initiative (DNDi) continued searching for a better therapy. In 2007, it discovered fexinidazole, a compound that had been shelved by Paris-based pharmaceutical company Sanofi. With the firm's agreement, the DNDi took the drug through clinical trials. It estimates that developing the therapy

through to approval will cost a total of around US\$50 million a fraction of what pharmaceutical companies often spend on new drugs.

Sanofi will soon submit an application for drug approval through the European Medicines Agency, whose sign-off could pave the way for regulators in the Democratic Republic of the Congo. The drug might get a green light by the end of next year, says Nathalie Strub Wourgraff, the DNDi’s medical director. Because it is a simple oral treatment, she suggests that patients might even be treated at home, which would save them and their families the expense of hospital stays.

However, Büscher argues that home treatments could be dangerous because people who don’t respond to fexinidazole could die of the disease if not seen immediately by medical staff. He said that it is imperative that patients follow up with health workers, and suggested offering people incentives to return to the clinic, such as money or staples including salt or sorghum. “This is a success”, he said, “but it is not the end”. DNDi researchers and their colleagues are currently working on what they hope will be an even better oral treatment to cure the disease in a single dose, and more reliably than fexinidazole.



Fig. Health workers screen people in a remote village in the Democratic Republic of the Congo for sleeping sickness.

Source: www.nature.com

Scientists reveal superbug's artillery

Monash University's Biomedicine Discovery Institute (BDI) researchers have created the first high-resolution structure depicting a crucial part of the 'superbug' *Pseudomonas aeruginosa*, classified by the WHO as having the highest level threat to human health. The image identifies the 'nanomachine' used by the highly virulent bacteria to secrete

toxins, pointing the way for drug design targeting this.

P. aeruginosa is one of a number of bacteria developing an alarming resistance to multiple drugs, raising concerns worldwide about the emergence of pan-resistant organisms. Its virulence is largely due to the ability of the bacteria to secrete a suite of toxins and enzymes infecting the host environment. In a paper published in the online journal *mBio*, BDI researchers investigated a protein nanomachine on the surface of the bacterial cells responsible for the secretion of these toxins. The nanomachine, called the Type II secretion system, is responsible for the secretion of *P. aeruginosa's* most toxic virulence factor, Exotoxin A.

Dr. Iain Hay, first author of the study said this is the first time they have seen how *Pseudomonas aeruginosa* secretes this important toxin. "This kind of first look is exciting and tells us that the next step of drug design may be feasible" he said. "If you know the structure of this pore in the bacterial membrane that's pumping out the toxins that are important for virulence, you could design a molecular 'cork' to plug it" he added. Such a drug could potentially reduce virulence by stopping the secretion of toxins while other drugs worked at clearing the infection itself said Dr. Hay.

The researchers, led by Monash BDI's Professor Trevor Lithgow, used cutting-edge electron microscopy based at the Ramaciotti Centre for Cryo-Electron Microscopy (Monash University) to visualise the nanomachine pore. They used tens of thousands of images created by the microscope's beam to reconstruct a near-atomic resolution 3-D map of the 14-nanometre pore. A nanometre is a millionth of a millimetre.

"The Titan Krios microscope at Monash allowed us to see important molecular details of this nanomachine which have proved elusive for decades," Dr Hay said. The methodology developed by the researchers would be applicable to other related bacteria surface nanomachines.

Source: www.phys.org

Study suggests dangerous crop fungus produces toxic chemical to repel insects

A team of researchers from Cornell and North Carolina State Universities has conducted a study examining a possible connection between a toxin produced by a crop-damaging fungus and insects that may attempt to feed on it. In their paper published in *Proceedings of the Royal Society B*, the group

HIV: Targeting host genes for therapy

By inactivating any one of five human genes, scientists can prevent HIV from entering and growing in immune cells.

Antiviral therapies targeting host genes that the virus depends on, rather than targeting the virus itself, are promising because these genes do not mutate as frequently as viruses do. This could avoid the development of drug resistance. Bruce Walker at the Ragon Institute of MGH, MIT and Harvard in Cambridge, Massachusetts, and his colleagues screened the genome of human T cells and identified five genes not essential to cell survival whose inactivation protected cells from HIV infection. Cultured cells lacking these genes resisted HIV infection. The genes encode proteins that facilitate virus entry into human cells, and one that mediates cell aggregation, which allows the virus to spread between cells. The authors say their approach could also be used to find drug targets for other pandemic viruses.

Source: www.nature.com

described their study and what they found.

Aspergillus flavus is a type of fungus that lives on plants, many of which are crops. Prior research has shown that many types of *A. flavus* also produce a toxin called aflatoxin that is harmful to crops such as corn, cereals, nuts and rice. Even worse is the impact, the toxin has on animals and humans that consume it and doing so can cause stunted growth in children and liver cancer in adults. If consumed in high enough concentrations, it can kill directly. One of the ways that farmers try to combat the fungus is by spreading variants of *A. flavus* that do not produce the toxin, hoping it will crowd out the kind that does. In this new effort, the researchers believe they may have found a new approach by getting rid of the bugs that feed on the fungus. Because just two-thirds of *A. flavus* produce the toxin, the researchers considered that there was likely something that caused them to produce the toxin and in its absence, they would not need it, so they would not produce it.

The researchers guessed that the cause might be insects that either eat the fungus or compete with it for food. To find out if this might be the case, the group collected *A. flavus* samples and a group of fruit flies and brought them into their

lab for study. They started out by noting that the fruit flies and fungus do eat the same food and that the larvae sometimes actually ate the fungus. After running several experiments, the researchers found that the toxin produced by the fungus protected them from being eaten by the larvae. They also found that the types of fungus that produced the toxin grew more when the flies were present than when they were not. They also found that the fungus that made the toxin produced more of it when there were larvae in the vicinity.

Taken together, the researchers suggest, the evidence indicates that the reason for the fungus to make the toxin is to defend itself from fruit flies. This finding suggests that a way to combat the fungus on the farm would be to combat the insects that are causing it to produce the toxin.



Fig. A conidiophore of *A. flavus*.

Image credit: Medmyco/Wikipedia

Source: www.phys.org

NEWS

How fungi helped create life as we know it

Today our world is visually dominated by animals and plants, but this world would not have been possible without fungi, say University of Leeds scientists. Researchers have carried out experiments where plants and fungi are grown in atmospheres resembling the ancient Earth and by incorporating their results into computer models, have shown that fungi were essential in the creation of an oxygen-rich atmosphere. Humans and other mammals require high levels of oxygen to function, and it is generally thought that the planet developed an oxygen-rich atmosphere around 500 to 400 million years ago, as carbon dioxide was gradually photosynthesized by the first land plants.

The research team: Dr. Katie Field from the Centre for Plant Sciences, Dr. Sarah Batterman from the School of

Geography and Dr. Benjamin Mills from the School of Earth and Environment, showed that fungi played a critical role in establishing the breathable atmosphere on Earth by mining the nutrient phosphorus from rocks and transferring it to plants to power photosynthesis. The new research showed that the amount of phosphorus transferred could have been very large under the ancient atmospheric conditions and using an Earth system computer model, the team showed that fungi had the power to dramatically alter the ancient atmosphere.

While many modern plants can gather their nutrients direct from soils through their roots, the earliest forms of plant life faced an entirely different climate and did not have roots and were non-vascular, meaning they could not hold water or move it around their system. The soil they came into contact with was a mineral product lacking in organic matter, which is why their relationships with fungi were so important. Fungi have the ability to extract minerals from the rocks they grow on through a process known as biological weathering. The fungi express organic acids which help to dissolve the rocks and mineral grains they grow across. By extracting these minerals and passing them on to plants to aid the plants growth, the fungi in return received the carbon the plants produced as they photosynthesized carbon dioxide from the atmosphere.

Lab experiments undertaken by the Leeds team have shown that different ancient fungi which still exist today conducted these exchanges at different rates which influenced the varied speeds at which plants produced oxygen. In turn this affected the speed at which the atmosphere changed from being much richer in carbon dioxide to becoming similar to the air we breathe today.

Dr. Field said they used a computer model to simulate what might have happened to the climate throughout the Palaeozoic era if the different types of early plant-fungal symbioses were included in the global phosphorus and carbon cycles. They found the effect was potentially dramatic, with the differences in plant-fungal carbon for nutrient exchange greatly altering Earth's climate through plant-powered drawdown of CO₂ for photosynthesis, substantially changing the timing of the rise of oxygen in the atmosphere.

Dr. Mills said that photosynthesis by land plants is ultimately responsible for about half of the oxygen generation on Earth, and requires phosphorus, but we currently have a

poor understanding of how the global supply of this nutrient to plants works. The results of including data on fungal interactions present a significant advance on understanding of the Earth's early development. Their work clearly showed the importance of fungi in the creation of an oxygenated atmosphere.

Dr. Batterman added: "Our study shows tiny organisms such as fungi can have major effects on the global environment. Our critical finding was that the nature of the relationship between fungi and plants could have transformed the atmospheric carbon dioxide, oxygen and ultimately global climate in very different ways, depending on the type of fungi present".

The full paper, "Nutrient acquisition by symbiotic fungi governs Palaeozoic climate transition," is published in *Philosophical Transactions of the Royal Society B*.

Source: www.phys.org

Abstract of Recent Publications

01. Food Science and Technology , 2017, Vol. 77, Pages: 15 - 20.

Physicochemical characterization of chitosan nanoparticles and nanocapsules incorporated with lime essential oil and their antibacterial activity against food-borne pathogens

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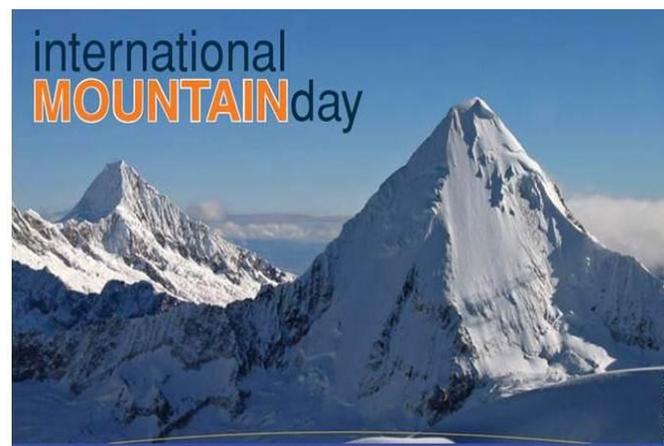
Lime oil has recognized fungicidal and antibacterial properties. Nanoparticles and nanocapsules are structures that have been developed to overcome the high volatility of essential oils. Chitosan nanoparticles and chitosan nanocapsules incorporated with lime essential oil were synthesized by nanoprecipitation and nanoencapsulation methods, respectively. The samples were characterized by transmission electron microscopy (TEM) and Fourier Transform Infrared Spectroscopy (FTIR), and Z potential was

measured. Also, particle size distribution was analyzed by dynamic light scattering (DLS) and the antibacterial activity was studied. According to TEM, the average size of nanocapsules was higher than for nanoparticles. When lime essential oil was incorporated, the particle size increased. Lime essential oil incorporation was evidenced by FTIR. Chitosan nanocapsules showed higher Z potential value compared to chitosan nanoparticles. The antibacterial activity was tested against four food-borne pathogens, being higher for nanoparticles than for nanocapsules. The highest antibacterial activity was observed for chitosan nanoparticles incorporated with lime essential oil applied against *Shigella dysenteriae*, attaining an inhibition halo (IH) value of 3.5 cm for 40 µL of minimum inhibitory volume (MIV). The novelty of incorporating lime essential oil into chitosan nanoparticles and nanocapsules and the study of their enhancing effect on antibacterial activity are shown in this paper.

Keywords: Antibacterial activity; Chitosan nanoparticles; Chitosan nanocapsules; Lime essential oil; Food-borne pathogens



5th DECEMBER, 2017



11th DECEMBER, 2017

NATIONAL

National Institute of Science Communication and Information Resources
<http://www.niscair.res.in>

The Integrated Taxonomic Information System
<https://www.itis.gov>

Industrial Toxicology Research Centre (ITRC)
<http://www.iitrindia.org>

Patent facilitating centre for microorganisms
<http://www.pfc.org.in/ach/micro.htm>

INTERNATIONAL

British Mycological Society
<https://www.britmycolsoc.org.uk>

Marine Biological Laboratory
<http://www.mbl.edu>

Belgian Society for Microbiology
<http://belsocmicrobio.be>

International Federation for Cell Biology
<http://www.ifcbiol.com>

EVENTS**Conferences / Seminars / Meetings 2018**

Metabolomics Bioinformatics for Life Scientists. February 05 - 09, 2018. **Venue:** Cambridge, **UK.** **Website:** <https://www.ebi.ac.uk/training/events/2018/embo-practical-course-metabolomics-bioinformatics-life-scientists-4>

Proteomics in Cell Biology and Disease Mechanisms. February 28 - March 2, 2018. **Venue:** Cambridge, **UK.** **Website:** <https://coursesandconferences.wellcomegenomecampus.org/events/item.aspx?e=674>

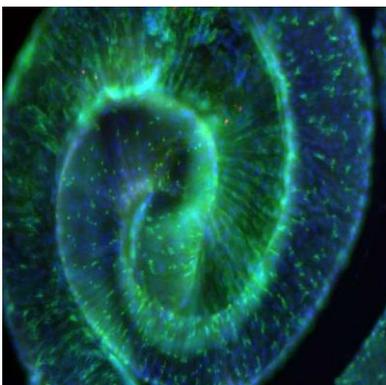
Microbiome, Host Resistance and Disease. March 04 - 08, 2018. **Venue:** Banff, Alberta, **Canada.** **Website:** <https://www.keystonesymposia.org/index.cfm?e=web.Meeting.Program&meetingid=1521>

Microbiology Society (SGM) Annual Meeting 2018. April 10 - 13, 2018. **Venue:** Birmingham, **UK.** **Website:** <https://microbiologysociety.org/event/annual-conference/annual-conference-2018.html>

Applications of plant pathology: from field to clinic. April 18 - 18, 2018. **Venue:** London, **UK.** **Website:** https://member.sfam.org.uk/SfAM/Events/Event_Display.aspx?EventKey=SM2018&WebsiteKey=2cbdaa23-1541-4299-b298-d19cd2427ed1

Gut bacterium indirectly causes symptoms by altering fruit fly microbiome

CagA, a protein produced by the bacterium *Helicobacter pylori*, can alter the population of microbes living in the fruit fly gut, leading to disease symptoms, according to new research published in *PLOS Pathogens* by Tiffani Jones and Karen Guillemin of the University of Oregon.



Microbes living in the human gut normally help keep people healthy, but disruptions to this microbial community can promote disease. Infections with specific microbial species can disrupt the gut microbiome, but it is unclear how such disruption occurs and whether it promotes disease.

In the new study, Jones and her colleagues used *Drosophila* fruit flies to test the effects of infection with *H. pylori*, which can cause gastric cancer in humans. They hypothesized that a protein associated with *H. pylori* called CagA disrupts the fruit fly gut microbiome and contributes to disease.

To test their hypothesis, the researchers genetically engineered fruit flies to express the CagA protein in their intestines, without being infected by *H. pylori*. This allowed them to disentangle the specific effects of CagA from the overall effects of *H. pylori* infection. They found that CagA expression in the fruit fly gut caused excess growth of intestinal cells and promoted immune system responses that are associated with *H. pylori* infection.

Source: www.Phys.org

Swachh Bharat Mission - 2017

