# MICROZONE

2017

## Dear Readers,

Shivranjani Baruah, Third year, CBM

Indian mythology describes senses in terms of "Panch Indriyan" which controls the five most basic elements of nature- space, air, fire, water and earth. Three of these elements namely air, water and earth are inhabited by living organisms which range from the smallest to the largest and from the weakest to the strongest. These characteristics however, do not define the ecological status of organisms. The largest may be the least in number whereas the smallest may be the strongest. Contribution of every form of life is significant for survival of the earth as we know it. The ones which can be seen are appreciated and well accounted for but the unseen ones create some of the most magical phenomena which make life possible on this planet. We take this opportunity to acknowledge few of those magnificent contributions made by our friendly foes; the micro-organisms.

The greatest diversity of life comes from within the microbial world. Microbes inhabit the widest range of habitats from sub-freezing temperatures, to water hotter than boiling, from the rocks beneath our feet, to the atmosphere miles overhead;from between our toes, to the tops of mountains and to the bottom of the deepest ocean trenches.

Microbial ecology forms the backbone of all major nutrient cycles in the atmosphere, facilitates treatment of water for consumption, nourishes plants by making elements in the soil available to them, naturally leaches minerals out of ores and cleans up polluting substances from the environment. Biotechnology may be used alongside microbial ecology to address a number of environmental challenges. This edition of the newsletter focuses on the microbial world living within the three elements of nature- air, water and soil. We hope to enlighten you with sides to nature's story which shall never fail to surprise humanity.

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# CHILDHOOD LESSONS

Aisha Saleem, First Year, CZM

As little kids, we often found joy in the simple things, like dancing in the rain, or playing with dirt, even when we were warned against it, on the sole basis that we would end up falling sick.

However, you would be surprised to know that playing with dirt can actually have a positive impact on your mental health.

Serotonin is a chemical found in the human body. It carries signals along and between nerves - a neurotransmitter. Serotonin is regarded as a chemical that is responsible for maintaining mood balance. Low levels of serotonin are linked with a number of disorders including aggression, anxiety, depression, obsessive compulsive disorder (OCD), bipolar disorder, irritable bowel and fibromyalgia.

A recent study showed that "friendly bacteria" present in the soil, can naturally increase the levels of serotonin in the brain. Researchers from University College London and Bristol University found that a benign, naturally-occurring soil bacteria called *Mycobacterium vaccae* has a proven mood-boosting, antidepressant effect. When mice were treated with *Mycobacterium vaccae* it was found that a particular group of brain neurons that produce serotonin were activated. This was proved by measuring the amount of c-Fos' in the area, a biochemical marker whose presence indicates that serotonin releasing neurons have fired. Antidepressants work by increasing serotonin levels in particular areas of the brain. The friendly bacteria have a similar antidepressant effect by increasing the release of serotonin, thereby lifting your mood.

So the next time you feel a little low, go ahead and relive your childhood days - Go get dirty!

Colonies of *Mycobacterium vaccae*

# MULTIFACETED MUSHROOMS

*Swathi Biradar, Second Year, CZM*

The very first thought that would strike anyone when they hear the word mushroom is those tiny little umbrella like structures that arise soon after the rain or the image that we always see in fairytale. And one cannot forget the extensive use of mushroom as food. But not all mushrooms are edible. There are many poisonous mushrooms that cannot be consumed. But apart from these exceptions, the rest are very nutritious and have a wide range of use.

Mushrooms are eukaryotes and are classified under fungi and are commonly called as macro fungi. Since there is a rapid development of research in biological sciences, scientists have shown keen interest in studying the mushroom in detail. Several experiments have been conducted to discover the uses of mushroom.The most useful discovery that has become a boon to mankind is the discovery of **antimicrobial activity** of the mushrooms and its **medicinal use**.

Mushrooms have been shown to produce several biologically active compounds that are usually associated with cell wall, and these have been suggested to contribute to the enhancement of immunity and tumor-retarding effects. Among the local communities, mushrooms may represent potential sources of antibacterial drugs, since in the early days, screening for antibiotics started with mushrooms and proved to be successful. Multiple-drug resistance in human pathogenic microorganisms has developed due to indiscriminate use of commercial antimicrobial drugs commonly used in the treatment of infectious diseases. This situation has forced scientists to search for new antimicrobial substances from various sources to be used as novel antimicrobial chemotherapeutic agents. Sixty antimicrobial compounds have been isolated from mushrooms; however, only the compounds from microscopic fungi have been present in the market as antibiotics until now. Two scientists **Ch. Ramesh** and **Manohar G. Pattar** collected 6 wild mushrooms from Western Ghats of Karnataka and tested for antimicrobial properties, antioxidant activity and bioactive compounds. Methanolic extracts of 6 wild edible mushrooms isolated from the Western Ghats of Karnataka were used in this study. *Lycoperdon perlatum, Cantharellus cibarius, Clavaria vermiculris, Ramaria formosa, Marasmius oreades, Pleurotus pulmonarius* were isolated. The steps followed were:

- Preparation of methanolic extracts
- Determination of bioactive components
- Scavenging activity on DPPH for antioxidant assay
- Determination of antimicrobial efficacy
- Microbial test organisms
- Antimicrobial activity
- Minimum inhibitory concentration (MIC) assay

Preparation of methanolic extracts of mushrooms was done based on procedures described by Barros et al with some modifications and the Phenolic compounds in the mushroom methanolic extracts were estimated by a colorimetric assay. The bacterial test organisms used were two gram-positive species *Staphylococcus aureus* (ATCC 25923), *Bacillus subtilis* (ATCC 6633); gram-negative species *Escherichia coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC 27853). Antimicrobial activity of methanolic extract of mushrooms was determined by the agar well diffusion method, after the incubation period, zone of inhibition was measured in millimeters. All the tests were carried out in triplicate and their means recorded. In this study, only 4 species (*L. perlatum, C. vermiculris, M. oreades and P. pulmonarius*) showed significant and satisfactory results when compared to the other 2 isolates and the isolates in the research work found in recent literatures.


*Lycoperdon perlatum*


*Cantharellus cibarius*


*Clavaria vermiculris*


*Ramaria formosa*


*Marasmius oreades*


*Pleurotus pulmonarius*

**JOKE FOR THE DAY!** "Two scientists, a diagnostic microbiologist and a molecular biologist specializing in yeast genetics, are on a plane taken over by terrorists. The terrorists tell them that to make their point, they will have to kill one of them and toss the body out of the plane before making any demands or dealing with the authorities. They tell the two men that they will have 10 minutes to convince the terrorists that they other man should be shot, as the speaker is more important, and mankind would suffer if he were shot." "The microbiologist stands up and speaks for 10 minutes, talking about bacteriology, and parasitology, and virology. He tells the terrorists that he is vital to the medical field, as he supplies clinical data that is sorely needed to make decisions on patient care. His ten minutes pass quickly, and the terrorists listen quietly, nodding to themselves." "The geneticist stands and says 'I would like to take a few minutes to discuss with you the power of yeast genetics —', at which point the microbiologist jumps up and yells "Shoot me now! Shoot me now!"

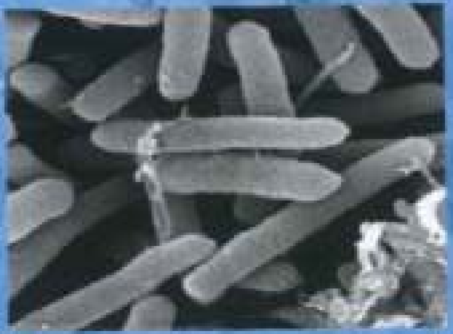
# MICROBIAL ICE MAKERS

Shikha Ramdas, First year, CBM

Bacteria are found everywhere,from the lower atmosphere to the Amazon rainforest, and may help form ice by manipulating the forces between water molecules, new research suggests.

ICE MAKERS : *Pseudomonas syringae* is a rod shaped ,Gram negative bacteria with polar flagella. It is a plant pathogen and is one of the most widely dispersed species on the planet, found everywhere from the soil to the clouds in the troposphere, the lower layer of the atmosphere. Ski resorts use the bacteria to produce artificial snow when the weather won't cooperate. The bacteria also create frost damage on vegetables.

*P. syringae* uses a special cell-wall protein as a mold for arranging water molecules into ice, even at temperatures above water's normal freezing point.



*Pseudomonas syringae* as seen under a SEM

Specifically, the protein, called inaZ, has alternating water-repelling and water-attracting regions, which push and pull on water molecules into an ice-like crystal. In the lab, *P. syringae* was able to crystallize water at 4° C; in nature, the bacteria are able to freeze water at around –2° C. Proteins alternatingly repel and attract water molecules, squishing the $H_20$ molecules into high- and low-density patches. This patchy organization sort of "confuses" the water molecules so that they form ice at much higher temperatures and under other conditions . This kind of re-arrangement was just right for nudging water molecules to morph into the crystalline pattern of solid ice, the researchers speculated. They also found that the bacteria could pull heat out of the surrounding water molecules, making the water colder.The new findings could have implications for atmospheric chemists, who want to understand rainfall and ice formation around the world.

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# HOOKED!

Meenakshi R, First Year, CZM

*Marinomonas primoryensis* latches onto ice floes in the Antarctic Ocean.

Scientists have found a bacterial antifreeze protein (AFP) called MpIBP that is hundred times larger than other AFPs. It is the first bacterial adhesion molecule discovered that sticks to ice. MpIBP is a protein which is shaped like a fishing line with a hook on one end and it enables bacteria to cling to ice floes in oceans. When MpIBP is disabled, the bacteria slide off the ice.

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# A Prelude to AIR MICROBIOLOGY!

Nidhi Hegde, Third Year, CZM

Study of air borne microorganisms by **exposure plate method** was conducted as a part of practical syllabus for the **Third year Microbiology students**. Three plates of Potato Dextrose Agar (for fungi) and three plates of Nutrient Agar (for bacteria) were exposed to air for varying time periods. Each of the PDA and NA plates was exposed for 5, 10 and 15 minutes respectively. The exposure was done in the basketball court of **Mount Carmel College, Bengaluru.** The 5, 10 and 15 minutes exposed NA plates (for bacteria) had 162, 180 and 325 colonies respectively. After Gram staining, it was revealed that there were 3 different kinds – Gram positive cocci, Gram positive bacilli and Gram negative bacilli. Colonies from the PDA plates were subjected to wet mount preparation and *Aspergillus*, *Trichoderma* and *Fusarium* were identified.

NA plates kept for air exposure

PDA plates showing fungal growth

# A NEW APPROACH TO SCIENCE- MICROBES+SPACE!

Annapoorna R, Second Year, CZM

Microorganisms can be found almost anywhere from boiling hot springs to frozen snow field. There is always been a question of microorganism in space. ASTROMICROBIOLOGY is an interdisciplinary approach which incorporates both microbiology and astrobiology. Astromicrobiology helps to understand the origin of life on earth and search of life on another planet. The search for microbial life in extra-terrestrial location has been less successful. The first attempt occurred through NASA in 1970s through "THE VIKINGS PROGRAMME" in MARS for life on MARS. In 2008, a Russian astronaut reported findings of sea plankton living outside the surface of international space station. There are many studies conducted on the response of microorganism to the isolated factors of outer space like microgravity, galactic cosmic radiation, solar UV radiation and space vacuum. There are many missions such as Phoenix lander, Mars Science Laboratory, EXO MARS and Cassini: Mission to Saturn. These missions are a hope to further explore the possibilities of life on another planet. There are many microorganisms that are exposed to the outer surface. Mostly extremophiles are selected as they have adapted to extreme environment on earth. One of the best studied model system in space microbiology is gram positive model organism *Bacillus subtilis*. Upon nutrient deprivation *B.subtilis* forms spores which are highly resistance to the environmental factor of space and enables them to survive in the harsh conditions of space.

Astrobiology addresses the question of whether life exists beyond earth. It takes the help of physics, chemistry, biology, astronomy and molecular biology to investigate the possibilities of life in another world. Astrobiology helps to resolve one major question of science ***'How Life Originated on Earth'*** and ***'Life Beyond Earth.'***

## The bacteria that grows better in SPACE!

Akhila Prashanth, Second Year, CBM

Does the space contain life other than that on Earth? Well, the answer to this is yes! Space may not contain macro beings, well it definitely contains microbes. Recently, a certain strain of bacteria was found to be developing faster in microgravity than on Earth. *Bacillus safensis* JPL-MERTA- 8-2 grew 60% better on the ISS (International Space Station). The reason why is still unknown. A collection of 48 harmless strains of bacteria were sent to the ISS and measured. This experiment shows that microgravity has effect on bacteria. The samples were measured every 24 hours for four days by astronauts as well as lab workers. According to sources, *B. safensis* was first discovered on one of the Mars Exploration Rovers at the Kennedy Space Centre in 2004.

# JELLYFISH AGAINST BIOTERRORISM

Aishwarya B S, Third Year, CZM

Different possible pathogens can use terrorists like **anthrax**, **plague** and **smallpox** against humans. Experts from different streams are naming it likely targets of **bioterrorism**. But according to a report, **jellyfish** are helping prevent these kinds of attack. An innovate biosensor developed by scientists and engineers can identify harmful bacteria or viruses in the air in less than two minutes. It is believed that it is at least ten times faster than any other automated sensor that is available. In the lab **CANARY SENSOR** was developed using jellyfish DNA and a high voltage electrical charge. One of the scientists combined mouse cells with jellyfish DNA. The jellyfish DNA went inside the cells and the cells started to glow. The presence of a targeted pathogen was detected by glowing cells. But still there was no way to test air samples for pathogens until **PANTHER** was created. Scientists say that it's operation is as simple as the DVD player. Disk containing 16 chambers are loaded into the PANTHER. The machine pulls air through the disk to collect and test any pathogen that might be in the air. Alerting anyone who could be in harm's way; the sensor goes off; if a dangerous pathogen is detected. This technology can eventually be used for medical diagnostics to test patient samples.It may also be used in food processing to identify contaminants like *Salmonella* or *E.coli*.

## DID YOU KNOW?

Shradha Sikaria, Second Year, CZM

What if instead of inhaling oxygen and exhaling carbon dioxide, humans exhaled lightening?

That is a lot to expect out of humans. The catch is though, that micro-organisms can do just that. Respiration by humans occurs on two levels. First, the physical inhalation of oxygen, which is transported to individual cells. After sugars are degraded to create energy, the individual electrons that result are transferred to oxygen and hydrogen molecules to generate water. When we talk about types of organisms, one classification groups them into two broad categories namely aerobic and anaerobic organisms. This is based on the various "terminal electron acceptors" which a particular living being may possess. While humans being aerobic use oxygen, anaerobic organisms may use a variety of inorganic substrates. *Shewanella oneidensis* is a bacterial species known as a Dissimilatory Metal-Reducing Bacteria (DMRB) as it makes use of poorly soluble, metal-containing minerals as electron acceptors. However, importing such insoluble compounds is a difficult feat. To compensate for this, *S. oneidensis* must somehow transfer electrons extracellularly, thus "exhaling" electricity. During a research study, it was observed that when *S. oneidensis* was grown anaerobically, the bacteria produced pilus-like structures on the cell surface capable of conducting electricity. The nanowires lost their ability to conduct electrons in the absence of two c-type cytochromes or a secretion system component responsible for positioning c-type cytochromes correctly at the cell surface. These cytochromes act as extensions of the electron transport chain, shuttling electrons out of the cell and down the nanowire. The researchers co-cultured *Pelotomaculum thermopropionicum* with *Methanothermobacter thermautotropicus* and found nanowires connecting them. It was hypothesized that the function of nanowires may extend beyond mineral electron dumps to symbiotic electron-transfers, even occurring within single-species biofilms. By studying the electron-stripping properties of spent media, they identified the culprits-two enzymes. These enzymes adhere to the metal surface, pulling off electrons and pairing them with either a proton to generate hydrogen, or carbon dioxide and a proton to generate formate. The resulting products are soluble and taken up by the bacteria so quickly that researchers can't even measure the creation of hydrogen or formate in the media unless they remove the bacterial cells. By pairing the right bacteria (or bacterial enzymes) with the right conditions, it's possible to create safer, cheaper, and renewable batteries. This isn't quite as dramatic as nanowires, but just as fascinating. The question remains what will microbes come up with next?

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## A YEAR IN A NUTSHELL....

**CDP-AWARENESS CAMPAIGN ON PERSONAL HYGIENE- 'The right way to wash your hands'**

**Movie screening- "CINE-SCIENCE"**

So, what happens when bacteria die?

Where do their tiny dead bodies go?

When bacteria are sterilized by the [illegible] (for example, which uses moist heat to kill bacteria) their bodies are still there. This concept is of utmost importance when it comes to sterilizing medical instruments and pharmaceuticals.

**The blog team –**

**SMALL THINGS MATTER**

Our presence at Cul-ah!, CulWeek, Freshers Week and Science fest

Field trip to Nandini Dairy KMF

Journal Club

## Your time starts……….NOW

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### YOUR WORDS!!!!

**Inoculum, Genome, Autoclave, Yoghurt, Pasteurisation, Cocci, Microscope, UV, Flagella, Micron, Agarose, Aspergillosis, *Haemophilus*, Contamination, Wet -Mount, Prokaryote, Staining, Mycoplasma, ETC, Acidophile, Electrophoresis, Micrometry, Incinerate, AMP, Colony, Pipette, Butterpaper, Media, Streaking, Nichrome Wire loop, Transduction, Endoplasm, Apoptosis and Alexander Flemming.**

*A special thanks to our sponsors…*

*Mr.Jai Kishore Prasad; We are extremely grateful to you Sir..*

Presenting to you...

# THE GRADUATING CLASS OF 2017

**Individually we are ONE DROP, but together we are an OCEAN.**

Sarayu Ma'am, looking forward to see you back in college soon.

**EDITORS NOTE**

We hope you enjoyed being a part of the "World of Soil, Water and Air Microbiology" as much as we did in every step of working on the Newsletter.

A Very special thanks to..

Dr.Sarayu Mohana(HOD), Ms.Anu Mariam Kurian(Co-ordinator), Ms.Chetana Ammanagi and Ms.Deepika Koushik

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