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# ENVIS NEWSLETTER

## MICROORGANISMS AND ENVIRONMENT MANAGEMENT

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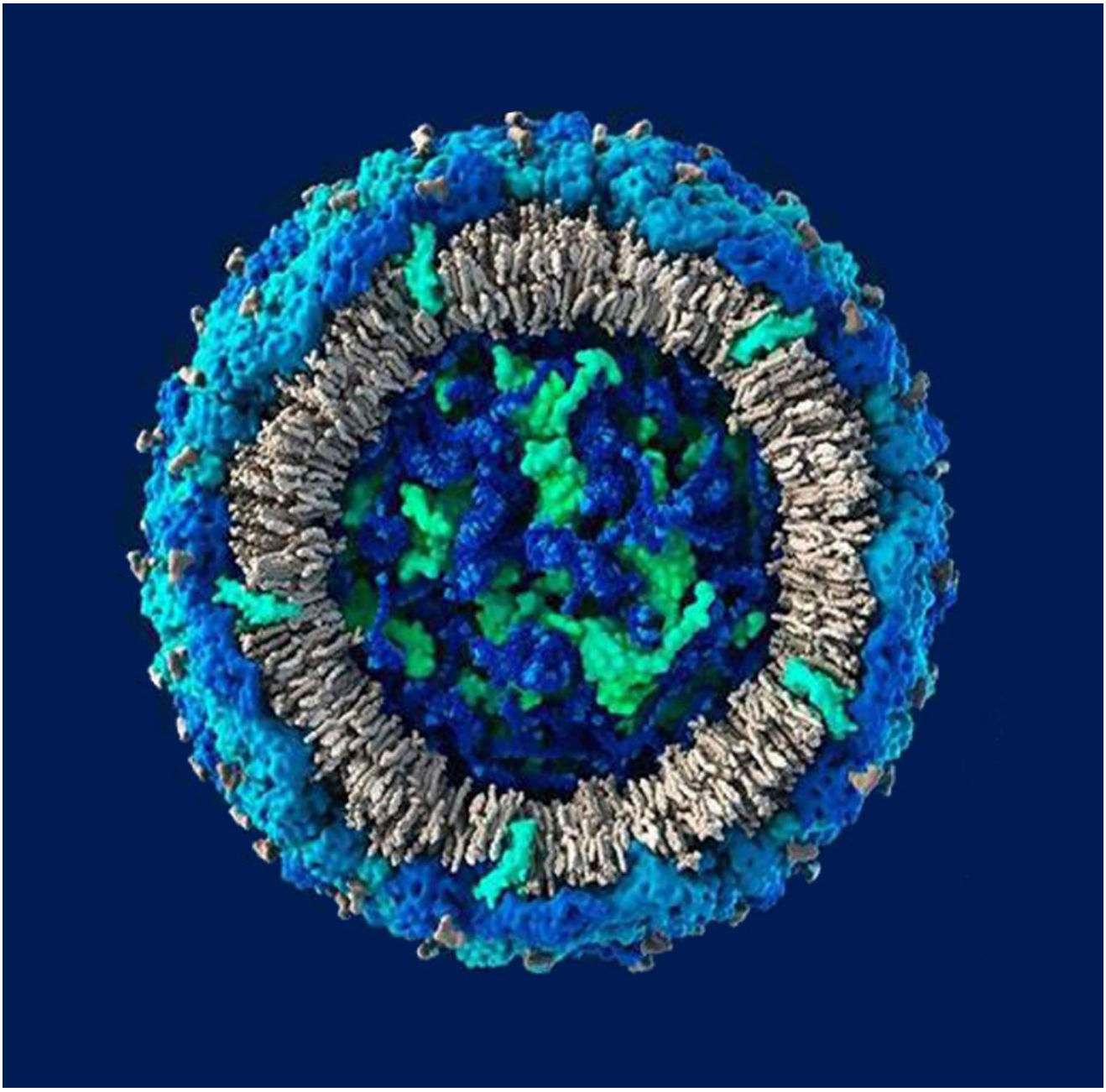

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ENVIS Newsletter on 'Microorganisms and Environment Management', a quarterly publication, brings out original research articles, reviews, reports, research highlights, news-scan etc., related to the thematic area of the ENVIS Centre. In order to disseminate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

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

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Cover page : **The Zika virion measures approximately 50 nanometers across and contains multiple protein types (shown in blue and green) both within and at the surface of the lipid membrane.**

# ENVIS Newsletter
# on
# Microorganisms and Environment Management

## Contents



***Dear Readers,***

Greetings!

Biodegradation is nature's way of recycling wastes, or breaking down organic matter, carried out by living microorganisms such as bacteria, fungi, insects, worms etc., into nutrients. In nature, the waste products from one organism become the food for others. Thus everything gets recycled and there is no waste. The term biodegradation is often used in relation to ecology, waste management and mostly associated with environmental remediation.

In the last few decades, highly toxic organic compounds, like fuels, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), pesticides, dyes and heavy metals, have been synthesized and released into the environment for direct or indirect application. Biological processes play a major role in the removal of contaminants and take advantage of the catabolic versatility of microorganisms to degrade or convert such compounds. In this issue, a review of microbial degradation of cyanide waste is included.

In addition, other interesting topics such as plastic-munching bacteria, oil degrading bacteria, discovery of CRISPR like immune system in virus are included.

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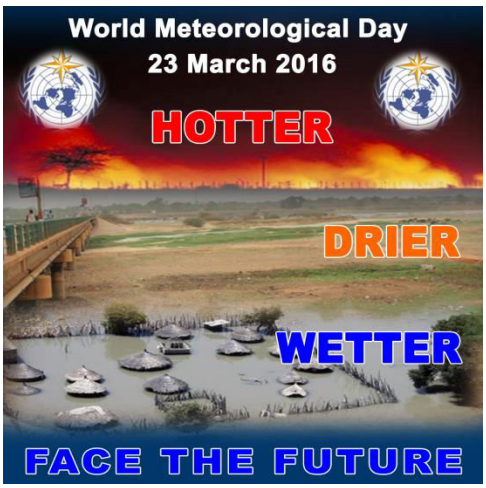
**Prof. N. Munuswamy**

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SCIENTIFIC ARTICLE

# Prodigious action of microbes on poisonous ravage waste degradation

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## Abstract

Cyanide is highly toxic for most living organisms because it forms very stable complexes with transition metals (ie. Iron), that is essential for protein function, as in cytochrome oxidase, haemoproteins as well as other metal–containing oxidases or oxygenases. The removals of cyanide by the physical and chemical methods are more expensive and thus alternative process like biodegradation technologies are under focus. The microorganisms utilize potassium and sodium cyanide as a sole source of carbon and nitrogen for the degradation process. Cyanide degrading bacteria are noted to produce pteridines, a cofactor for the activation of cyanide monooxygenase which is needed for cyanide degradation. Peridines being a potential therapeutic agent, the production of pteridines by these organisms are needed to be explored in future.

**Keywords**: Biodegradation, Cyanide degradation, Cyanide Monooxygenase, Pteridine

## Introduction

In the wake of Technology development and Industrial revolution, rapid industrialization has resulted in amassment of waste in the form of both solid and liquid. While addressing the global challenge in sustainable development, the waste degradation must be given priority over the production process. The product would fulfill certain needs of human kind but the waste accumulation deprives the whole community of healthy environment by piling up the pollutants. If improperly managed, this waste can pose dangerous health and environmental consequences. In this context, biodegradation is found to be the best approach to retract the adverse impact and reduce the pollution effect. Biodegradation is the nature's way of cleaning up the environment by breaking down the complex toxic matter to simple nontoxic matter for the utilization of the biota.

## Cyanide waste

Cyanide is an ancient molecule that might be involved in the prebiotic synthesis of different nitrogenous compounds, including amino acids and nitrogenous bases. Cyanides include a type of chemicals that present the cyano (−C≡N) group and they can be found in nature in many different forms owing to the chemical properties of this group. Cyanide is generated as a natural compound by some bacteria, algae, fungi, higher plants and even by insects, either as a biomolecule for guarding mechanism or as repulsive molecule. Plants are the main source of cyanide in the biosphere because they cogenerate cyanide with ethylene (Peiser *et al.*, 1984) in addition to generating cyanoglycosides and cyanolipids. Moreover, cyanide has also been shown to be produced as part of active iron-cyanide complexes of catalytic proteins (Reissmann *et al.*, 2003). Even though natural processes generate cyanide, the human activity is the major contributors which tip the balance in nature creating environmental havoc.

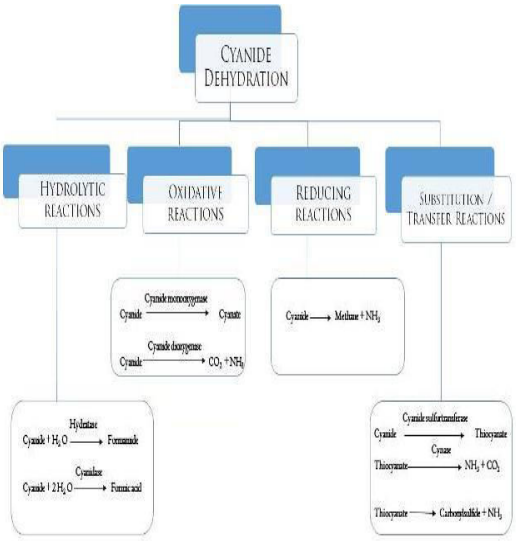
## Toxicity of cyanide waste

Cyanide can enter the human system either by inhalation or ingestion or adsorption. The fatal doses for human adults have been prescribed as 1-3 mg/kg body weight if ingested, 100-300 mg/L if inhaled, and 100 mg/kg body weight if adsorbed (Huiatt, 1984). Cyanide released from industries worldwide has been estimated to exceed 14 million kg per year which is an alarming quantity (Naveen *et al.*, 2011). A short-term exposure of cyanide, causes rapid breathing, tremors and other neurological effects, and long-term exposure to cyanide causes weight loss, thyroid effects, nerve damage, and even death. Skin contact with cyanide-containing liquids may produce irritation and sores (Dash *et al.*, 2009). Cyanide is also known as a major inhibitor of the enzyme cytochrome oxidase as well as haemoproteins and other metal–containing oxidases or oxygenases (Knowles, 1976). As cyanide is a metabolic inhibitor of terminal cytochromes of electron transport chains (Dumestre *et al.*, 1997; Yanase *et al.*, 2000), cyanide pollution causes great damage to ecosystems.

## Microbial degradation of cyanide waste

In India, Central Pollution Control Board has set a minimal national standard limit for cyanide in wastewater as 0.2 mg/L. In the current scenario wastewater treatments for cyanide removal physical and chemical methods are employed which are often expensive and involve the use of additional hazardous

reagents (chlorine and sodium hypochlorite) for alkaline chlorination, ozonization, wet-air oxidation and sulfur-based technologies (Watanabe *et al.*, 1998**,** Patil and Paknikar, 2000). Further each of these technologies has its own cost and disposal considerations (Saarela and Kuokkanen, 2004). Thus cyanide treatment hollered out for an alternative treatment process capable of achieving high degradation efficiency at low costs. Biodegradation technologies are scrupulously appealing for cyanide wastes with added organic supplements for microbial growth which results in production of eco-friendly products like $CO_2$, formate, formamide and methane (Dubey and Holmes, 1995; Raybuck, 1992). It was earlier contemplated that cyanide was the pioneer organic compound on earth, from which the chemical building blocks of life evolved (Oparin, 1957; Rawls, 1997). Many microorganisms can use potassium or sodium cyanide as a sole source of carbon and nitrogen. Despite the toxicity of cyanide towards living organisms, biodegradation of cyanide bank upon the easy adaptation and enrichment of indigenous microorganisms which can utilize cyanide as substrate (Dash *et al.*, 2009).




## Propitious omen of cyanide degradation by oxidation

The oxidative pathway of cyanide conversion involves oxygenolytic conversion to carbon dioxide and ammonia. There are two types of oxidative pathway involving three different enzymes. The first oxidative pathway involves cyanide monooxygenase and cyanase. The second oxidative pathway utilizes cyanide dioxygenase to form ammonia and carbon dioxide directly (Ebbs, 2004). Between the two pathways the first pathway involves a positive product named pteridine which has several biological implications both in prokaryotes and eukaryotes.

Cyanide monooxygenase in the first oxidative pathway (Raybuck, 1992; Ebbs, 2004) converts cyanide to cyanate. The cyanate is then catalyzed by cyanase resulting in the conversion of cyanate to ammonia and carbon dioxide. Cyanases have been identified in numerous bacteria, fungi, plants and animals. Cyanide monooxygenase (CNO) is located in the cytosolic fraction of cells induced with cyanide and requires both reduced pyridine nucleotide (NADH) and a source of reduced pterin as a cofactor (Kunz *et al.*, 1992; Fernandez *et al.*, 2004). Cyanide monooxygenase is a pterin-dependent hydroxylase which means this enzyme requires pterin as a cofactor (Cabuk *et al.*, 2006). It is usually observed that cyanide-grown cells contain elevated levels of both cyanide mono- oxygenase and formate dehydrogenase (Kunz *et al.*, 1992). It was hypothesised that the cofactors production also increase with increased production of metabolic enzymes and it was proposed that cyanide degrading bacteria produces pteridines in large amounts (Nisshanthini *et al.*, 2015).

Owing to the therapeutical importance of pteridines, the production of pteridines by cyanide degrading bacteria using cyanide waste as substrate is a typical process of wealth from waste which needs to be explored in detail.

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## RESEARCH REPORTS

### CRISPR-like 'immune' system discovered in giant virus

Gigantic mimiviruses fend off invaders using defences similar to the Clustered regularly-interspaced short palindromic repeats (CRISPR) system deployed by bacteria and other microorganisms, French researchers reported. They say that the discovery of a working immune system in a mimivirus bolsters their claim that the giant virus represents a new branch in the tree of life.

Mimiviruses are so large that they are visible under a light microscope. Around half a micrometre across, and first found infecting amoebae living in a water tower, they boast genomes that are larger than those of some bacteria. They are distantly related to viruses that include smallpox, but unlike most viruses, they have genes to make amino acids, DNA letters and complex proteins.

This means that they blur the line between non-living viruses and living microbes, says Didier Raoult, a Microbiologist at Aix-Marseille University in France, who co-led the study with his Microbiologist colleague Bernard La Scola. Raoult says that he doesn't consider the mimivirus to be a typical virus; instead, it is more like a prokaryote microbes, including bacteria, that lack nuclei.

Like prokaryotes, mimiviruses are plagued by viruses known as virophages, Raoult, La Scola and their colleagues reported in 2008. Six years later, in 2014, they found a virophage named Zamilon that infects some kinds of

mimivirus but not others. Raoult hypothesized that these infections, which sap a mimivirus's capacity to copy itself, could have led to the evolution of a defence system much like CRISPR.

## Immune defence

In bacteria and another kind of prokaryote, called archaea, CRISPR systems store a library of short DNA sequences that match those of phages and other invading DNA. When a foreign DNA sequence with matching sequences in this library attacks a cell, specialized 'Cas' enzymes unwind the intruder DNA and chop it into pieces, stopping an infection. Biologists have now repurposed CRISPR as a technology to edit genomes.

To determine whether mimiviruses have a similar defence system, Raoult's team analysed the genomes of 60 mimivirus strains and looked for sequences that match those of the Zamilon virophage. Mimiviruses that were resistant to Zamilon also harboured a short stretch of DNA that matched that of the phage.

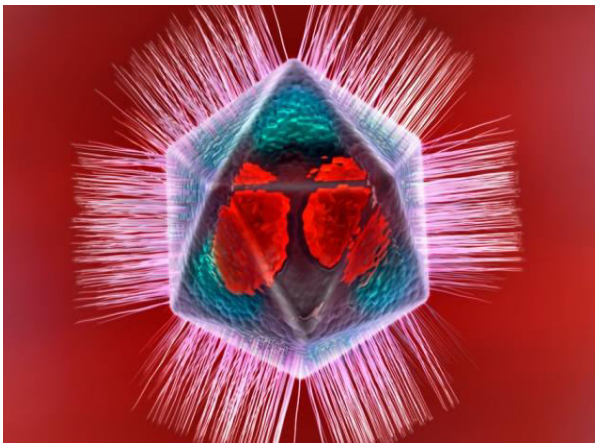
Adjacent to these sequences, Raoult's team found genes encoding enzymes that can degrade and unwind DNA. In CRISPR immunity, too, the genes encoding the Cas enzymes sit beside the sequences that recognize the virus. Blocking activity of different components of the system made the mimiviruses susceptible to Zamilon virophage attack. The findings were published in *Nature*.

It makes sense for mimiviruses to have an immune system because they must compete for resources against other microbes and viruses, says Raoult. "They are facing the same kind of challenge that prokaryotes have when they live in communities: they need to fight against viruses and prokaryotes. I even suspect they secrete antibiotic compounds."

Raoult has argued, somewhat controversially, that mimiviruses constitute a fourth domain of life alongside bacteria, archaea and eukaryotes. He sees their defence system, which he has named MIMIVIRE, as a very ancient adaptation that further supports them having their own branch on the tree of life.

Francisco Mójica, a microbiologist at the University of Alicante in Spain, who identified CRISPR sequences in prokaryotes in the 1990s, notes that CRISPR components have been found in other viruses, but it is not clear whether the systems function. He suspects that an ancestor of mimiviruses picked up MIMIVIRE from another microbe. "It will certainly be of great interest to identify the mechanism involved in MIMIVIRE immunity," says Mójica; he expects that it will be very different from CRISPR.

Luciano Marraffini, a bacteriologist at the Rockefeller University in New York, says that Raoult's team makes a good case that MIMIVIRE is a viral defence system, but agrees that it will be important to work out how it stops virophage infections.



**Computer artwork of a particle of the giant mimivirus.**
(**Image credit:** Jose Antonio Penas/Science Photo Library)

Just as unravelling how CRISPR immunity works led to its repurposing as a genome-editing tool, studying mimiviruses could hold surprises, Marraffini says. "The giant viruses most likely enclose a whole lot of new biology, some of which, including the MIMIVIRE, could find novel application. Maybe in genome editing, maybe in other fields."

**Source:** www.nature.com

## New plastic-munching bacteria could fuel a recycling revolution

We manufacture over 300m tonnes of plastics each year for use in everything from packaging to clothing. Their resilience is great when you want a product to last. But once discarded, plastics linger in the environment, littering streets, fields and oceans alike. Every corner of our planet has been blighted by our addiction to plastic. But now we may have some help to clean up the mess in the form of bacteria that have been found slowly munching away on discarded bottles in the sludge of a recycling centre.

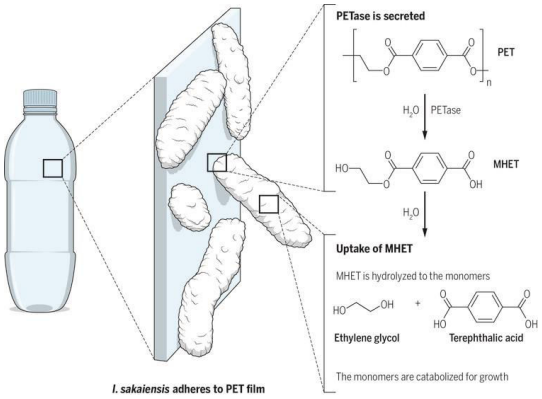
Plastics are polymers, long thin molecules made of repeating (monomer) building blocks. These are cross-linked to one another to build a durable, malleable mesh. Most plastics are made from carbon-based monomers, so in theory they are a good source of food for microorganisms.

But unlike natural polymers (such as cellulose in plants) plastics aren't generally biodegradable. Bacteria and fungi co-evolved with natural materials, all the while coming up with new biochemical methods to harness the resources from dead matter. But plastics have only been around for about 70 years. So microorganisms simply haven't had much time to evolve the necessary biochemical tool kit to latch onto the plastic fibres, break them up into the constituent parts and then utilise the resulting chemicals as a source of energy and carbon that they need to grow.

## Enzyme innovation

Now a team at Kyoto University have, by rummaging around in piles of waste, found a plastic munching microbe. After five years of searching through 250 samples, they isolated a bacteria that could live on poly-ethylene terephthalate (PET), a common plastic used in bottles and clothing. They named the new species of bacteria *Ideonella sakaiensis*.

You may think this is the rerun of an old story, as plastic-eating microbes have already been touted as saviours of the planet. But there are several important differences here. First, previous reports were of tricky-to-cultivate fungi, where as in this case the microbe is easily grown. The researchers more or less left the PET in a warm jar with the bacterial culture and some other nutrients, and a few weeks later all the plastic was gone.




**Bottle breakdown**

**(Image credit:** P. Huey. Reprinted with permission from U.T. Bornscheuer, Science 351:1154 (2016).

Second - and the real innovation - is that the team have identified the enzymes that *Ideonella sakaiensis* uses to breakdown the PET. All living things contain enzymes that they use to speed up necessary chemical reactions. Some enzymes help digest our food, dismantling it into useful building blocks. Without the necessary enzymes the body can't access certain sources of food.

For example, people who are lactose intolerant don't have the enzyme that breaks down the lactose sugar found in dairy produce. And no human can digest cellulose, while some microbes can. *Ideonella sakaiensis* seems to have evolved an efficient enzyme that the bacteria produces when it is in an environment that is rich in PET.

The Kyoto researchers identified the gene in the bacteria's DNA that is responsible for the PET-digesting enzyme. They then were able to manufacture more of the enzyme and then demonstrate that PET could be broken down with the enzyme alone.

**KNOW A SCIENTIST**

**Dr. Barry J. Marshall**

A Nobel Prize laureate, **Barry James Marshall** is an Australian physician, who along with Dr Robin Warren made the historic scientific discovery, which stated the presence of bacterium ***Helicobacter pylori*** as the **root cause for most peptic ulcers**. The discovery came at a time when the world believed in the fact that stress, spicy foods, and too much acid caused peptic ulcer.

It was a ground-breaking discovery as it helped in establishing the link between *H. pylori* infection and stomach cancer then learned could be cured by antibiotics. Marshall and Warren shared the **2005 Nobel Prize in Physiology or Medicine** for their work. Marshall was also honored in 2007 by being named a Companion of the Order of Australia, the highest civic honor in the country.

## First real recycling

This opens a whole new approach to plastic recycling and decontamination. At present, most plastic bottles are not truly recycled. Instead they are melted and reformed into other hard plastic products. Packaging companies typically prefer freshly made "virgin" plastics that are created from chemical starting materials that are usually derived from oil.

The PET-digesting enzymes offer a way to truly recycle plastic. They could be added to vats of waste, breaking all the bottles or other plastic items down into into easy-to-handle chemicals. These could then be used to make fresh plastics, producing a true recycling system.

Manufactured enzymes are already used to great effect in a wide range of everyday items. Biological washing powders contain enzymes that digest fatty stains. The enzymes known as rennet that are used to harden cheese once came from calfs' intestines but are now manufactured using genetically engineered bacteria. Maybe we can now use a similar manufacturing method to clean up our mess.

Source: www.theconversation.com

## ONLINE REPORTS ON MICROORGANISMS

### New method for converting solar energy into electrical power using photo-bioelectrochemical cells

A new paradigm for the development of photo-bioelectrochemical cells has been reported in the journal *Nature Energy* by researchers from The Hebrew University of Jerusalem, Israel, and the University of Bochum, Germany.

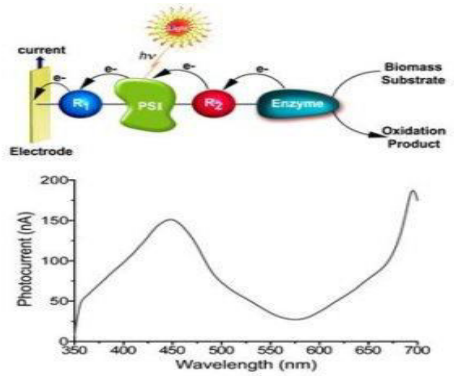
The design of photo-bioelectrochemical cells based on native photosynthetic reaction is attracting substantial recent interest as a means for the conversion of solar light energy into electrical power.

In the natural photosynthetic apparatus, photosynthetic reaction is coupled to biocatalytic transformations leading to $CO_2$ fixation and $O_2$ evolution. Although significant progress has been achieved in the integration of native photosystems with electrodes for light-to-electrical energy conversion, the conjugation of the photosystems to enzymes to yield photo-bioelectrocatalytic solar cells remains a challenge.

Now, researchers report on the construction of photo-bioelectrochemical cells using the native photosynthetic reaction and the enzymes glucose oxidase or glucose dehydrogenase. The system consists of modified integrated electrodes that include the natural photosynthetic reaction center, known as photosystem I, conjugated to the enzymes glucose oxidase or glucose dehydrogenase. The native proteins are electrically wired by means of chemical electron transfer mediators. Photoirradiation of the electrodes leads to the generation of electrical power, while oxidizing the glucose substrate acting as a fuel.

The system provides a model to harness the native photosynthetic apparatus for the conversion of solar light energy into electrical power, using biomass substrates as fuels. In contrast to numerous bioelectrochemical systems using electrical power to oxidize glucose, the present study introduces the implementation of the native photosystem to produce electrical power using light as the energy source.

The novel photo-bioelectrochemical cells point to a new method to photonically drive biocatalytic fuel cells while generating electrical power from solar energy.




**A new Method for converting solar energy into electrical power using photo-bioelectrochemical cells.**

(**Image Credit:** Prof. Itamar Willner)

"The study provide a general approach to assemble photo-bioelectrochemical solar cells with wide implications for solar energy conversion, bioelectrocatalysis and sensing," said Prof. Itamar Willner, at the Hebrew University's Institute of Chemistry.

The research was headed at the Hebrew University by Prof. Itamar Willner, Institute of Chemistry and Minerva Center for Biohybrid Complex Systems, in collaboration with Prof. Rachel Nechushtai, Alexander Silberman Institute of Life Sciences and Minerva Center for Biohybrid Complex Systems; and at Ruhr-Universität Bochum, by Prof. Wolfgang Schuhmann, Analytical Chemistry, Center for Electrochemical Sciences (CES).

The Hebrew University of Jerusalem is Israel's leading academic and research institution, producing one-third of all civilian research in Israel.

**Source:** www.sciencedaily.com

### Oil dispersants can suppress natural oil-degrading microorganisms, new study shows

The use of chemical dispersants meant to stimulate microbial crude oil degradation can in some cases inhibit the microorganisms that naturally degrade hydrocarbons, according to a new study led by University of Georgia marine scientists. Their findings are based on laboratory-simulated conditions that mimic Gulf of Mexico deep waters immediately following the Deepwater Horizon oil spill.

The study, published in the *Proceedings of the National Academy of Sciences*, examined microbial oil degradation in

the Deepwater plume, simulating oil concentrations and dispersants concentrations observed during the incident. The team found that the presence of dispersants significantly altered the microbial composition of Gulf deep water by promoting the growth of Colwellia, a group of microorganisms capable of dispersant degradation.

However, when oil alone was added to parallel samples in the absence of chemical dispersants, the growth of natural hydrocarbon-degrading *Marinobacter* was stimulated.

"These compelling results show the naturally occurring communities of oil-degrading microorganisms, especially *Marinobacter*, are quite proficient at degrading oil and that oil biodegradation was more efficient in the absence of chemical dispersants," said the study's lead author Samantha Joye, Georgia Athletic Association Professor of Arts and Sciences.

"During the spill, *Marinobacter* were not abundant in deep-water plume samples, possibly as a consequence of dispersant applications," said study co-author Sara Kleindienst, junior group leader at the University of Tübingen in Germany. "Whether natural hydrocarbon degraders were outcompeted by dispersant degraders or whether they were directly affected by dispersant-derived compounds needs to be resolved in future studies."

Widely used in emergency responses to oil spills in marine environments as a means of stimulating microbial degradation of oil, chemical dispersants were applied in an unprecedented volume to the sea surface and deep waters of the Gulf of Mexico after the 2010 spill. As a "first line of defense," 7 million liters (about 1.8 million gallons) of chemical dispersants were applied to increase the use and breakdown of oil compounds by microorganisms.

The uncontrolled oil well blowout released more than 750 million liters of oil into the Gulf.

"Our results showed preferential degradation and enrichment of distinct organic compounds when dispersant is used to chemically break up oil," said study co-author Patricia Medeiros, an assistant professor of marine sciences at UGA. "In the future, it will be important to further study these compounds and possibly include them when tracking the fate of oil-dispersant mixtures in the environment.“

The study addresses fundamental questions about the use of chemical dispersants and how they affect both the oil discharge from accidents and the indigenous microbial community. This comprehensive data set, including direct measurements of oil biodegradation rates, raises concerns about whether chemical dispersants stimulate microbial oil degradation in the ocean.

**Samantha Joye, a Professor of Marine Sciences in the University of Georgia Franklin College of Arts and Sciences, studies the oil plumes generated by the 2010 Deepwater Horizon blowout.**

(**Image credit:** Todd Dickey/University of Georgia)

"The fact that dispersants drove distinct microbial community shifts that impacted oil degradation efficiently came as a big surprise," Joye said. "It is critical to quantify the factors that influence the efficiency of oil biodegradation in the environment, and that includes dispersants."

This research was supported by the Ecosystem Impact of Oil and Gas Inputs to the Gulf (ECOGIG) research consortium, which is funded by the Gulf of Mexico Research Initiative.

"This research was made possible through the interdisciplinary collaborative network that a program like ECOGIG creates," Joye said. "This team effort allowed us to make critical progress toward identifying and understanding how dispersants impact microbial hydrocarbon degradation in the oceans, including the potential role of dispersants in facilitating the formation and sedimentation of microbially derived 'marine oil snow.'"

**Source:** www.sciencedaily.com

## NEWS

### Alcohol allows bacteria to infiltrate into liver: study

"Alcohol appears to impair the body’s ability to keep microbes in check. When those barriers breakdown, bacteria that does not normally colonise the liver end up there” Alcohol allows gut bacteria to migrate to the liver, promoting alcohol induced liver disease, a new study has warned.

Researchers from University of California (UC), San Diego in U.S. conducted the study in mice and in laboratory samples.

They previously found that chronic alcohol consumption is associated with lower intestinal levels of REG3 lectins, which are naturally occurring antimicrobials.

In the new study, researchers discovered that REG3G deficiency promotes progression of alcohol—induced liver disease. Mice engineered to lack REG3G and fed alcohol for eight weeks were more susceptible to bacterial migration from the gut to the liver than normal mice who received the same amount of alcohol.

REG3G deficient mice also developed more severe alcoholic liver disease than normal mice. To find methods for stemming the tide of liver damaging microbes, researchers tried experimentally bumping up copies of the REG3G gene in intestinal lining cells grown in the lab.

They found that more REG3G reduced bacterial growth. Likewise, restoring REG3G in mice protected them from alcohol induced fatty liver disease, a condition that precedes end stage cirrhosis.

Liver cirrhosis is also known as end stage liver disease. Approximately half of the deaths from this condition are related to alcohol consumption.

Human small intestine samples supported some of the researcher's finding in mice. Not only do patients with alcohol dependency have lower levels of REG3G than healthy people, they also have more bacteria growing there, the study found.

"Alcohol appears to impair the body's ability to keep microbes in check. When those barriers breakdown, bacteria that does not normally colonise the liver end up there, and now we have found that this bacterial migration promotes alcohol liver disease," said Bernd Schnabl from UC.

"Strategies to restore the body's defences might help us treat the disease," Mr. Schnabl said. The findings were published in the journal *Cell Host & Microbe*.

**Source:** www.thehindu.com

## Subsurface carbon dioxide storage: Risks for biogeochemical cycles in the soil

The more clearly the dimensions of global warming become visible, the greater is the pressure to find possible ways to avoid a further increase in the concentration of carbon dioxide ($CO_2$) in the atmosphere. At the same time the stripping and subterranean storage of this greenhouse gas is being discussed. But what would the impact and the risks of such storage be?

The result of what would happen if such storage leaked can be demonstrated by practical experiments. Therefore in the last few years a small valley in the Czech spa triangle became

## Deodorants and antiperspirants are changing your body's bacteria

Wearing an antiperspirant or deodorant doesn't only affect an individual's social life, and it substantially cuts down the microbial life that survives on a person, says a new study.

Thousands of bacteria species have the potential to live on human skin, and in particular in the armpit, the researchers said, adding that anti-perspirant and deodorant can significantly reduce the influence of both the type and quantity of bacterial life found in the human armpit's "microbiome".

"Just which of these species live in any particular armpit has been hard to predict until now, but we've discovered that one of the biggest determinants of the bacteria in your armpits is your use of deodorant and/or antiperspirant," said Rob Dunn, professor at North Carolina State University in the US.

The study, published in the journal the PeerJ, focuses on the effect that antiperspirant and deodorant have on the microbial life that lives on our bodies, and how our daily habits influence the life that lives on us, the researchers said.

To learn about the microbial impact of antiperspirant and deodorant, the researchers recruited 17 study participants. They then launched an eight-day experiment in which all of the participants had swabs taken of their armpits.

**Scientists fear that the by killing off these bacteria, we may be making room for others that could harm us. (Source: Thinkstock Images)**

On Day 1, participants followed their normal hygiene routine in regard to deodorant or anti-perspirant use. On Days 2-6, participants did not use any deodorant or anti-perspirant. On Days 7-8, all participants used antiperspirants.

The researchers then cultured all the samples to determine the abundance of microbial organisms growing on each participant and how that differed day to day.

The researchers found that once all participants began using antiperspirant on Days 7-8, very few microbes were found on any of the participants, verifying that these products dramatically reduce microbial growth.

**Source:** www.sciencedaily.com

a kind of open air laboratory. Here is why: In this location, $CO_2$ streams in so-called mofettes in large amounts naturally from the depths. The impact of high $CO_2$ concentrations can be studied based on the after-effects of volcanicity, without human beings having to interfere with nature. Health spas like Karlovy Vary (Karlsbad), Mariánské Lázne (Marienbad) or Františkovy Lázně (Franzensbad), and also the spa towns of Bad Elster and Bad Brambach in Saxony owe their existence to the volcanic activity of earlier times.

A team of scientists under the leadership of Prof. Kirsten Küsel from the chair for Aquatic Geomicrobiology of the Friedrich Schiller University Jena (Germany) had a close look at the soil area around a mofette, in which the air consisted of nearly pure $CO_2$. From 2012 to 2014 the researchers collected samples three times per year. They then compared them with samples from a comparative soil without increased $CO_2$ concentration that was only a few meters away. "In the soil of the mofette we found significantly more organic material -- remains of dead plants and animals, which are normally decomposed by small soil animals and single-cell organisms, bacteria and fungi," reports Dr. Felix Beulig of the Friedrich Schiller University Jena, who meanwhile works at the University Aarhus in Denmark. By means of modern chemical and molecular biological methods the researchers were able to discover the mechanism which triggered this change: The $CO_2$ had changed the living conditions in the soil so much, that the soil animals were excluded and the community of microorganisms had moved towards less manifold but more highly specialised species. Thus the food web in the soil became less efficient in the degradation of organic material which then had accumulated in the ground. Moreover, isotopic measurements were able to show that in the organic soil material large amounts of carbon originated from Earth's mantle. Plants and microorganisms had earlier absorbed this from the leaking $CO_2$.

So-called 'omics'-methods allowed the researchers to take into account the whole genetic information of all soil creatures (DNA and RNA) in their analysis. Moreover the team could assess which genetic information was actively used at the time. Thus conclusions could be drawn considering those biogeochemical cycles in the soil which influence the storage and the degradation of organic carbon. "From our results we can draw the conclusion that extremely high concentrations of

**Algae to clean up oil refinery waste water**

Microalgae can be successfully harnessed to clean waste water from industry, say researchers who are growing microalgae in a 5,000 litre photobioreactor at a Chevron oil refinery in Hawaii.

The researchers are taking advantage of the algae's appetite for chemical nutrients to clean the waste water from the refinery water, removing noxious chemicals including 90 percent of the ammonia-nitrogen and 97 percent of the phosphorus.

As the microbes feed, they grow and multiply, providing a wealth of algae-based biomass for producing bio-energy and high-value bio-based chemicals and specialty products, researchers said.

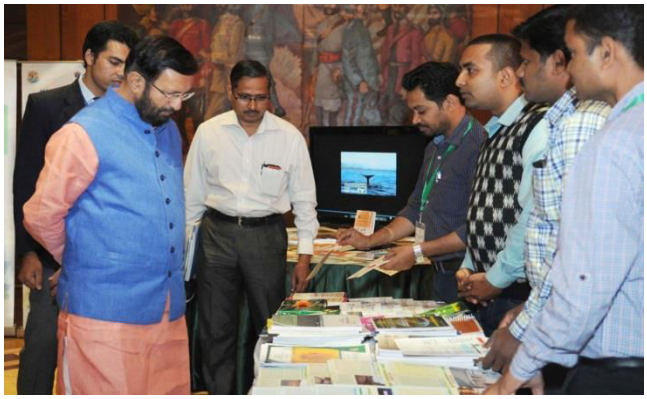
The bioreactor contains a mixed microbial consortium that is enriched for Scenedesmus algal species.

The authors also described experiments evaluating the ability of Chlorella and Scenedesmus algae species to grow on the sugars derived from waste wood obtained from pulp and paper mills and pre-treated using enzymatic hydrolysis to release the pentose and hexose sugars.

They tested and compared the algae biomass production from three types of waste wood pine softwood, southern hardwoods and northern hardwoods.

"This is an exciting story on how the engineering of microbial consortia can lead to the development of robust waste management processes," said professor Larry Walker, co-editor-in-chief of Industrial Biotechnology the journal in which the study appeared.

**Source:** www.indianexpress.com



Honorable Union Minister Prakash Javadekar, Ministry of Environment, Forest & Climate Change interacting with ENVIS Staff during National Evaluation Workshop at New Delhi during 17th to 19th February, 2016.

Mr. P. Thirumurugan, Information Officer of our ENVIS Centre, explaining and showcasing our ENVIS activities to the public and school students in Science Express Climate Action Special Train at Tirunelveli from 13th to 16th March, 2016.

carbon dioxide will change the food web and the metabolism in the soil in the long term," Prof. Kirsten Küsel of the University of Jena and the iDiv explains. The comprehensive analysis with a combination of 'omics'- and biogeochemical methods was also pointed out by Prof. Joshua Schimel from the University of California (USA) in a commentary, which was published in the same edition of *Nature Microbiology*.

**Felix Beulig of the Friedrich Schiller University Jena examines in winter in Bohemia a mofette.**
(**Image Credit:** Anke Haedrich)

The analyzed mofette is an extreme habitat that was long considered as being hostile to life. As early as last year, though, the research team was able to show that strongly adapted organisms quite like it there. The new study offered insights into the complex correlations between communities of organisms and the carbon dynamic in the soil. The results of the study will help to evaluate the environmental risks of the subterranean $CO_2$ storage.

**Source:** www.sciencedaily.com

## Ocean acidification takes a toll on California's coastline at night time

A new study, based on the most-extensive set of measurements ever made in tide pools, suggests that ocean acidification will increasingly put many marine organisms at risk by exacerbating normal changes in ocean chemistry that occur overnight. Conducted along California's rocky coastline, the study from Carnegie's Ken Caldeira and Lester Kwiatkowski shows that the most-vulnerable organisms are likely to be those with calcium carbonate shells or skeletons. It is published by *Scientific Reports*.

When carbon dioxide emissions from cars or power plants are absorbed by the oceans, it changes seawater chemistry and makes it more acidic, a process called "ocean acidification." Increasing ocean acidity makes it difficult for organisms that construct their shells and exoskeletons out of calcium carbonate, such as mussels and oysters, to continue to build these protective layers. In high enough concentrations, carbon dioxide can even cause these shells and skeletons to dissolve entirely.

Tide pools along California's rocky coast are isolated from the open ocean during low tides. During the day time, photosynthesis--the mechanism by which plants convert the Sun's energy and atmospheric carbon dioxide into sugar, giving off oxygen in the process--takes up carbon dioxide from the seawater and acts to reverse ocean acidification's effects. However, at night, plants and animals respire just like we do, taking up oxygen and releasing carbon dioxide. This adds carbon dioxide to the seawater and exacerbates effects of ocean acidification, causing the increasing risk to calcifying organisms.

**This image shows sampling pump and a device to measure temperature, salinity and depth in a tide pool of the UC Bodega Marine Reserve.**
(**Image credit:** Lester Kwiatkowski)

Observing a variety of California's natural rocky tide pools on the UC Bodega Marine Laboratory, the authors found that the rate of shell and skeletal growth was not greatly affected by seawater chemistry in the daytime. However, during low tide at night, water in the tide pools became corrosive to calcium carbonate shells and skeletons. The study found evidence that the rate at which these shells and skeletons dissolved during these night time periods was greatly affected by seawater chemistry.

"Unless carbon dioxide emissions are rapidly curtailed, we expect ocean acidification to continue to lower the pH of seawater," said Kwiatkowski, the study's lead author. "This work highlights that even in today's temperate coastal oceans, calcifying species, such as mussels and coralline algae, can dissolve during the night due to the more-acidic conditions caused by community respiration."

Caldeira added: "If what we see happening along California's coast today is indicative of what will continue in the coming decades, by the year 2050 there will likely be twice as much nighttime dissolution as there is today. Nobody really knows how our coastal ecosystems will respond to these corrosive waters, but it certainly won't be well."

Their paper is a collaborative effort by the Carnegie Institution for Science, the University of California Davis and the University of California Santa Cruz.

**Source:** www.sciencedaily.com

## Abstracts of Recent Publications

**01.** Process Biochemistry, 2016, Vol. **51**(3), Page: 399–407.

**Biodegradation of a high-strength wastewater containing a mixture of ammonium, aromatic compounds and salts with simultaneous nitritation in an aerobic granular reactor.** Carlos Ramos, María Eugenia Suárez-Ojeda, Julián Carrera

GENOCOV Research Group, Department of Chemical, Biological and Environmental Engineering, School of Engineering, Universitat Autònoma de Barcelona, Edifici Q, 08193 Bellaterra, Barcelona, Spain.

Long-term operation (390 days) of a continuous airlift reactor with aerobic granular biomass was successfully applied to treat a highly complex wastewater composed of: ammonium (1000 mg N $L^{-1}$), *o*-cresol (100 mg $L^{-1}$), phenol (100 mg $L^{-1}$), quinoline (50 mg $L^{-1}$) and salts (16 g salts $L^{-1}$). High nitrogen loading rate (1.1 g N $L^{-1}$ $d^{-1}$) and organic loading rate of 0.7 (g COD $L^{-1}$ $d^{-1}$) were achieved for the simultaneous nitrification and complete biodegradation of the aromatic compounds. The successful operation of the granular airlift reactor can be related to (i) the growth of specialized microorganisms in the aerobic granules and (ii) the continuous feeding regime. Aerobic granules were maintained stable in spite of the high salinity conditions. Dissolved oxygen (DO) concentration and DO/ammonium concentrations ratio were the key parameters to select a suitable effluent for anammox or heterotrophic denitrification via nitrite. Besides, nitrous oxide emissions were related to the DO concentration in the reactor. **Keywords:** Partial nitrification; Phenolic compounds; Salinity; Nitrous oxide.

**02.** Environmental Toxicology and Chemistry , 2016.

**Determination of biodegradation rates for surfactants and a fatty alcohol in aerobic sediment using a simplified test system.** Kathleen McDonough, Nina Itrich, Erin Schwab, Thomas Federle

The Procter and Gamble Company, Mason, Ohio, USA.

The development of specific regulatory persistence criteria and a growing need to conduct risk assessments in sediment has increased the need to better understand fate in this compartment. A simplified test approach was developed to assess the fate of chemicals in aerobic sediments and was used to evaluate the biodegradation of $^{14}C$-labeled representative analogs of alcohol sulfate (AS), alcohol ethoxylate (AE), alcohol ethoxy sulfate (AES), linear alkylbenzene sulfonate (LAS) and tetradecanol in two different sediments. The method provides kinetic data on primary and ultimate biodegradation in sediments as well as information on biodegradation pathways and metabolites. All the test materials exhibited extensive biodegradation in both sediments and disappearance of parent exhibited biphasic kinetics, described by a two-compartment model, and mineralization was coupled to parent disappearance with little accumulation of metabolites. The first compartment decay rates ranged from 10.8 - 17.1 $d^{-1}$ for tetradecanol, 2.54 - 24.8 $d^{-1}$ for AS, 0.17 - 0.75 $d^{-1}$ for AE, 0.41 - 0.71 $d^{-1}$ for AES, and 0.26 - 1.25 $d^{-1}$ for LAS. These rates corresponded to half-lives ranging from 0.041 to 4.35 d. This method's simplicity and focus on only sediment associated processes offers potential benefits over the current OECD 308 aerobic sediment-water test.

## E - Resources on Microorganisms

### NATIONAL

National Collection of Industrial Microorganisms (NCIM)
http://www.ncl-india.org/files/NCIM/

National Collection Of Dairy Cultures(NCDC)
http://www.ndri.res.in/ncdc/

National Centre For Cell Science
http://www.nccs.res.in/

National Institute for Interdisciplinary Science and Technology (NIIST)
http://www.niist.res.in/english/

### INTERNATIONAL

Advanced Biotechnologies Inc
https://abionline.com/contact-us/

Belgian Coordinated Collections of Microorganisms
http://bccm.belspo.be/

Canadian Collection of Fungal Cultures
http://grbio.org/institution/canadian-collection-fungal-cultures

Culture Collection of Algae and Protozoa
http://www.ccap.ac.uk/

## EVENTS
## Conferences / Seminars / Meetings 2016

Tumour Microenvironment and Signalling. April 03 - 06, 2016. **Venue:** EMBL Heidelberg, **Germany. Website:** http://www.embo-embl-symposia.org/symposia/2016/EES16-02/index.html?_ga=1.228198365.1743239917.1448866451

Bioinformatics and genome analyses. May 02 - 14, 2016 **Venue:** Izmir, **Turkey. Website:** http://events.embo.org/16-genome/

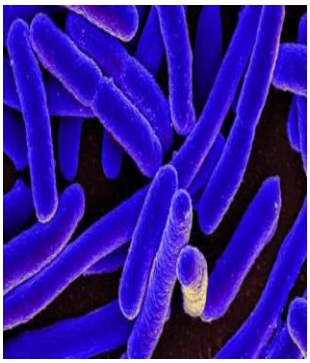
International Conference on Biodiversity and Ecosystems. June 01 - 03, 2016. **Venue:** Vienna, **Austria. Website:** http://www.istdst.org/BE

Advanced Bacterial Genetics. June 08 - 28, 2016. **Venue:** Cold Spring Harbor Laboratory, **USA**. **Website:** http://meetings.cshl.edu/courses.aspx?course=C-ABG&year=16

Marine Microbes. June 19 - 24, 2016. **Venue: Spain. Website:** http://www.grc.org/programs.aspx?id=13275

### Nutrient-Control for GM Bacteria

Genetically modified bacteria that don't survive unless given an unnatural amino acid could serve as a new control measure to protect wild organisms and ecosystems against accidental release.



Genetic and CRISPR-based kill switches have made headlines recently, as researchers engineer ways to prevent organisms built or modified in the lab from escaping to the wild. Now, Andrew Ellington of the University of Texas at Austin and his colleagues propose a new solution: limit the growth of a genetically modified (GM) *E. coli* strain when the environment lacks unnatural, or noncanonical, animal acids (NCAAs). NCAAs have been used to expand or alter the genetic code of various organisms. But by reengineering the antibiotic resistance gene *TEM-1 β-lactamase* to only produce a protein in the presence of an NCAA, Ellington and his team created a bacterium that can be killed should it ever escape the lab. When provided with the necessary NCAA, however, the *E. coli* can live for hundreds of generations.

"We need to have biosafety features that allow you to ensure that when you've made something it's not going to escape from the lab, or if it does it won't be able to prosper," Ellington told *New Scientist*. "In the presence of antibiotics and the absence of the [artificial] amino acid, there's very little way for our circuitry to leave the lab." The researchers published their results this week (January 18) in *Nature Chemical Biology*.

**Source:** www.the-scientist.com

## Sick? Could it be Zika?

* See your healthcare provider.
* Your healthcare provider may order tests to look for Zika or similar diseases, like dengue or chikungunya.

### Zika is preventable, but not treatable

* No vaccine to prevent or medicine to treat infection is available.
* Mosquitoes that spread Zika bite aggressively during the day. Avoid infection by preventing mosquito bites.
* Use insect repellents. Repellents containing DEET, picaridin, IR3535, and some oil of lemon eucalyptus and para-menthane-diol products provide long-lasting protection.
  * Use air conditioning or window/door screens.
  * Wear long-sleeved shirts and long pants or permethrin-treated clothing.
  * Once a week, empty and scrub, turn over, cover, or throw out items that hold water, such as tires, buckets, planters, toys, or trash containers. Check inside and outside your home.

### If you are sick with Zika:

* During the first week of infection, Zika virus can be found in your blood. If a mosquito bites you, it can become infected and spread the virus to other people through bites.

* To prevent others from getting sick, protect yourself from mosquito bites during the first week of illness.


## Climate change warming world's lakes at alarming rate

Researchers have for the first time demonstrated that the production of a plant hormone by a beneficial microbe is protecting a plant from a pathogenic microbe by inducing plant resistance. The application potential within integrated plant protection strategies is significant.

Plant beneficial microbes mediate biocontrol of diseases by interfering with pathogens or via strengthening the host, but the microorganisms' production of the plant hormones phytohormones, including cytokinins, has not been considered as a biocontrol mechanism before.

"But now we have identified a novel mechanism of how bacterial production of cytokinin contributes to the microbe's ability to control plant diseases. More specifically we identified the ability of a bacterium to efficiently control a pathogen infection in a model plant by producing cytokinin, allowing the plant to maintain tissue integrity and ultimately biomass yield," explains Post doc Dominik Kilian Grosskinsky from the Department of Plant and Environmental Sciences at University of Copenhagen.

**He sees great potential in the findings:**

"These results demonstrate a novel microbe based, hormone-mediated concept of biocontrol. And this mechanism provides a basis to potentially develop novel, integrated plant protection strategies combining promotion of growth, a favourable physiological status and activation of fine-tuned direct defence and abiotic stress resilience."

**Source:** www.sciencedaily.com