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From the Editor's Desk

Once more, it is with immense pleasure that I was given the opportunity to work on the First Edition of the Department News Letter. As we all know, a newsletter mirrors a department-its vision and mission. It also highlights events, activities and academic prowess and achievements. In this edition, I have tried to capture last six months excitement and activities. I do hope that the newsletter encourages many more including students to use it as a platform to express their creativity. I sincerely hope that this edition makes for an interesting read. Please feel free to offer any suggestions for the improvement.

Chemosynthetic Symbionts of Marine Invertebrate Animals are capable of Nitrogen Fixation

On Earth, ocean is one of the conventional divisions of the World which covers almost 71% of its surface. The oceans community is a wide array of marine symbioses, where different organisms depend on one another for survival - although both organisms don't always benefit from the arrangement. Some examples of apparently mutualistic symbioses include the relationship between zooxanthellae, dinoflagellate, algae and the range of organisms that host them, including hard and soft corals, giant clams, and anemones. Chemosynthetic symbiosis means symbioses between animals and chemosynthetic bacteria that are spread throughout the Earth oceans. Various creatures from more than seven phyla have formed such symbioses, and even more chemosynthetic bacterial lineages have evolved symbioses with animal hosts. Chemosynthetic symbionts can use a wide range of chemicals which includes sulfide, methane, hydrogen and carbon monoxide, to power their metabolism. To date, most studies have been focused on inorganic carbon fixation by the symbionts and the transfer of fixed organic carbon compounds to the hosts. But, nitrogen fixation by chemosynthetic symbionts has long been hypothesized, but so far not yet shown.

Microbiologist Jillian Petersen and colleagues from the University of Vienna and the Max Planck Institute for Marine Microbiology now proved the chemosynthetic symbionts of marine invertebrate animals have the ability to fix nitrogen. *Loripes lucinalis*, a marine bivalve was having the ability to fix nitrogen. The nifH gene is commonly used as a functional marker for nitrogen fixation, all nifH sequences from *L. lucinalis* symbionts were between 92 and 100% identical at the nucleotide level (97–100% identity at the amino acid level). Among symbionts of different *lucinid* species, the nifH sequence identity ranged from 83 to 88% (91– 98%at theamino acid level). The presence of the nifH gene raises the possibility that the symbionts of many lucinid species might be capable of nitrogen fixation. To check whether nitrogen fixation genes are actively expressed by the lucinid symbionts when living in their hosts, they have sequenced the gill metatranscriptomes of five individuals and analysed gill metaproteomes of another six individuals of *L. lucinalis* from Elba. They have identified nitrogenase proteins from five of these individuals. Also they have checked Stable isotopes nutrition value. The variability in $\delta^{15}N$ signatures between individuals might reflect differences in the relative contribution of nitrogen fixation, the uptake of alternative nitrogen sources such as ammonium, urea or nitrate by the lucinid symbionts, and filter feeding by the host. From these results, nitrogen fixation by chemosynthetic symbionts could contribute a source of new nitrogen to the ecosystems they inhabit.

Reference

Jillian M. Petersen et al. Chemosynthetic symbionts of marine invertebrate animals are capable of nitrogen fixation. Nature Microbiology, 2016; 2: 16195

DOI: 10.1038/NMICROBIOL.2016.195.

Ajilda. A

Ph. D Research Scholar

Polycyclic Aromatic Hydrocarbons (PAHs) In Baby Food

Joint Research Centre (JRC) scientists assessed the feasibility for the production of baby food certified reference materials (CRMs) containing a number of polycyclic aromatic hydrocarbons (PAHs) at low level concentrations. The study revealed that thermal sterilization is a suitable method of choice to ensure long-term stability (shelf life) of the product.

PAHs are a large class of chemical compounds and some of them are toxic to humans. Food can be contaminated by PAHs through environmental pollution and by industrial and domestic food production. Legislation in the Europe and worldwide sets maximum limits for certain PAHs. In 2005, the European Commission listed 16 PAHs to be monitored by the Europe Member States. As young children are a relatively vulnerable group of consumers, it is highly important to include baby food in the monitoring programme. To ensure the quality of data produced by the Member States' laboratories, the latter need to use appropriate methods and other quality assurance tools, such as participation in proficiency tests and the use of (certified) RMs.

For purpose of the feasibility study, a commercially available baby food, containing carrots, potatoes, tomato, white beans and meat was spiked with the 16 EU priority PAHs at a mass fraction level of 1 µg/ kg. The contaminated baby food was further processed by autoclaving, freezing or freeze-drying. The homogeneity of the three materials (bottle-to-bottle variation) and their short-term (4 weeks) and long-term (18 months) stability at different temperatures were assessed. To this end, an analytical method based on a solid–liquid extraction followed by cleaning up with gel permeation chromatography (GPC) and solid phase extraction (SPE) and GC-IDMS determination, was validated in-house.

It could be demonstrated that the analytical procedure fulfilled the demands for application to the homogeneity and isochronous stability studies for the candidate baby food reference materials. All three processing methods proved suitable for the production of sufficiently homogeneous materials. Measurements on the autoclaved material provided the most promising results in terms of envisaged shelf life. Moreover, thermal sterilization is also applied for the production of real baby food samples.

Reference: J.F. Huertas-Pérez et al.: "PAHs in baby food: assessment of three different processing techniques for the preparation of reference materials" Analytical and Bioanalytical Chemistry, (2015) 407:3069-3081, doi: 10.1007/s00216-015-8490-z

T. Boobalan
Ph. D Research Scholar

Multidrug-resistant bacteria from chickens risk to human health

Chickens are used as a major source of food proteins worldwide. In India, consumption of poultry meat is growing at about 12 percent a year, making it one of the fastest growing markets in the world (National Sample Survey Office - NSSO, India - report 2014). In order to fulfil high demand of chicken meat, poultry farmers or feed manufacturers could resort to the use of growth promoters including various antibiotics, sometimes indiscriminately, for faster weight gain in chickens. Epidemiological investigations suggest that majority of food borne bacterial infections caused by different enteric pathogens majorly spread through foods of animal origin.

Helicobacter pullorum is a urease negative, bile-resistant Helicobacter species that was found to colonize predominantly in the caecum. Presence of *H. pullorum* on poultry carcasses due to contamination during poultry rearing, handling and slaughtering processes. Helicobacter species, such as *Helicobacter hepaticus, Helicobacter bilis, Helicobacter canis, Helicobacter cinaedi*, as well as *Helicobacter pullorum* produce a common, well characterized bacterial virulence factor, the cytolethal distending toxin (CDT). This bacterial protein triggers G2/M cell cycle arrest in a wide range of mammalian cell lines, leading to enlarged or distended cells dying with apoptosis. A recent finding also highlighted that CDT in *H. pullorum* is responsible for major cytopathogenic effects in vitro, reinforcing its role as a major virulence factor in pathogenesis. Infectious disease burden is very high globally, and inappropriate and irrational use of antimicrobial agents against these infectious diseases has already resulted in the emergence of multidrug-resistant (MDR) bacteria.

Prevalence of MDR organisms in livestock and their products has traditionally been linked to disproportionate use of antimicrobials in veterinary practice and animal husbandry settings in the form of prophylactic agents and growth promoters. These drug resistant bacteria greatly reduce treatment efficacy and cause increased morbidity and mortality in livestock as well as in humans. The problem of antimicrobial resistance (AMR) is even more complex in developing countries due to high population density, poor sanitation and less stringent antibiotic policies. In addition to this, there are only a few novel antimicrobial agents that are expected 79 to be available for use in the next few years. The problem of antimicrobial resistance is one of the greatest threats to public health. The resistant bacteria and their associated genes can move within and between populations of humans and animals which make AMR a contentious issue. Therefore, with the risk of zoonosis together with its ability to spread antimicrobial resistance, *H. pullorum* could be an emerging foodborne human pathogen that needs to be deciphered at genomic and molecular levels, particularly by elucidating its zoonotic potential.

Reference: https://www.asm.org/index.php/journal-press-releases/94704-g-

G.H. Dinesh

Heavy chocolate consumption may be linked to heart health, study suggests

High levels of chocolate consumption might be associated with a one third reduction in the risk of developing heart disease, a new study suggests, that high levels of chocolate consumption might be associated with a one third reduction in the risk of developing heart disease.

The findings confirm results of existing studies that generally agree on a potential beneficial link between chocolate consumption and heart health. However, the authors stress that further studies are needed to test whether chocolate actually causes this reduction or if it can be explained by some other unmeasured (confounding) factor. The findings were presented at the European Society of Cardiology Congress in Paris. The World Health Organisation predicts that by 2030, nearly 23.6 million people will die from heart disease. However, lifestyle and diet are key factors in preventing heart disease, says the paper. A number of recent studies have shown that eating chocolate has a positive influence on human health due to its antioxidant and anti-inflammatory properties. This includes reducing blood pressure and improving insulin sensitivity (a stage in the development of diabetes).

However, the evidence about how eating chocolate affects your heart still remains unclear. So, Dr Oscar Franco and colleagues from the University of Cambridge carried out a large scale review of the existing evidence to evaluate the effects of eating chocolate on cardiovascular events like heart attack and stroke. They analysed the results of seven studies, involving over 100,000 participants with and without existing heart disease. Differences in study design and quality were also taken into account to minimise bias. Five studies reported a beneficial link between higher levels of chocolate consumption and the risk of cardiovascular events. They found that the "highest levels of chocolate consumption were associated with a 37% reduction in cardiovascular disease and a 29% reduction in stroke compared with lowest levels." No significant reduction was found in relation to heart failure.

The studies did not differentiate between dark or milk chocolate and included consumption of chocolate bars, drinks, biscuits and desserts. The authors say the findings need to be interpreted with caution, in particular because commercially available chocolate is very calorific (around 500 calories for every 100 grams) and eating too much of it could lead to weight gain, risk of diabetes and heart disease. However, they conclude that given the health benefits of eating chocolate, initiatives to reduce the current fat and sugar content in most chocolate products should be explored.

Reference: A. Buitrago-Lopez, J. Sanderson, L. Johnson, S. Warnakula, A. Wood, E. Di Angelantonio, O. H. Franco. Chocolate consumption and cardiometabolic disorders: systematic review and meta-analysis. BMJ, 2011; 343 (aug 26 1): d4488 DOI: 10.1136/bmj.d4488

Availability and sustainability of feedstocks at a local and global level

Biofuels offer a number of benefits to society, there has been a global debate in recent years regarding the impacts of biofuels (bioenergy) on food production and prices, carbon stores (in forests), land use, and related issues. At the same time, biodiversity (species of plants and animals) need to be conserved, and forested areas must be protected as they act as important habitats and carbon sinks. In other words, the forests store large amounts of carbon in vegetation and soil. If areas are cleared for logging, grazing, crop production or construction, the carbon is released into the atmosphere and habitat is lost.

Growth in production and use of biofuels worldwide

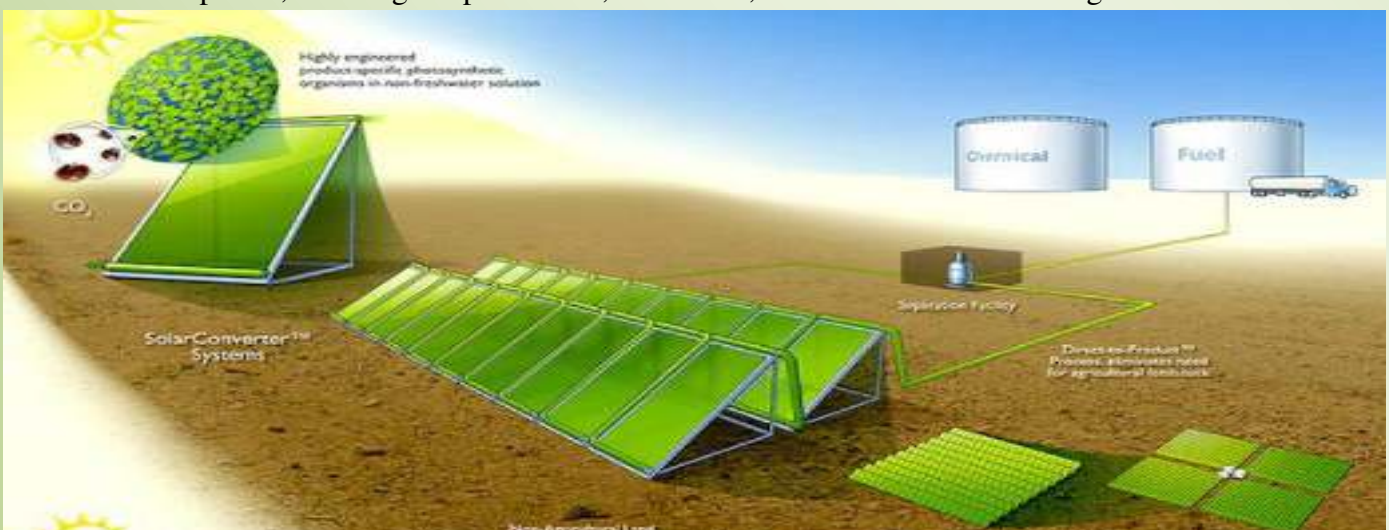
An overview of global biofuels is provided by a number of reports (included in the EBTP Reports Database), for example: The State of the Biofuels Market: Regulatory, Trade and Development Perspectives, published by the United Nations Conference on Trade and Development in September 2014. In August 2013, the Global Renewable Fuels Alliance GRFA announced an interactive map showing the current mandate and planned targets for biofuel production in countries across the globe. The GRFA forecasts that global fuel ethanol production will exceed 90 billion liters in 2014.

Why Struggle with Biofuels?

Though demand reductions are usually the cheapest, cleanest, and fastest way to reduce greenhouse gas emissions, there is no single, easy solution to low-carbon transportation. We will need increases in vehicle efficiency beyond recent increased CAFE standards, reductions of vehicle miles travelled (VMT) via smart growth, further development of plug-in (electric) cars, and a significant amount of biofuels. This scenario is based on very aggressive forecasts for efficiency, VMT and electricity, illustrating how important it is that we figure out how deploys a significant quantity of truly low-carbon biofuels.

India

The 'National Biofuel Policy' (September 2008) aimed to meet 20% of diesel demand in India with biodiesel. On the small scale Jatropha oil has been used as an alternative to diesel by remote communities in India for many years. In February 2009, India and the US exchanged a memorandum for cooperation on biofuels development, covering the production, utilization, distribution and marketing of biofuels in India.



Mexico

In 2007, Mexico introduced legislation to promote and develop bioenergy. In 2010, the government established a two-year project for bioenergy and in 2012, Biomex announced plans to invest $135m in a sorghum-based ethanol plant in the state of Tamaulipas. In 2015, Pemex, the Mexican state oil company, awarded four 10-year purchase contracts for 123m litres of domestic ethanol, which will be blended at 5.8% [Source: Ethanol Producer Magazine].

South Korea

Under the 2012 Joint Call on "Green Technologies" of KORANET (Cooperation between Korea and the European Research Area), the PROMOFUEL Project focuses on new feedstock's for advanced biodiesel production, using 'rubber seed oil' and fish oil as representative of novel non-food feedstock's with high unsaturation. The project involves a collaboration between University of Coburg, Germany and the Korean Institute oif Energy Research. In particular, promofuel aims to improve stability of novel biodiesel feedstocks as well as study the influence of feedstock type on engine emissions.

Russia

Information on biofuels in Russia is provided by the Russian National Biofuels Association. In May 2013, SEKAB, Sweden, announced a partnership with Wine & Agro LLP to sell Russian bioethanol in Europe. In Spring 2011, it was announced that state corporation, Russian Technologies, will begin construction of a biobutanol factory in the Irkutsk region. The facility planned ot use wood chips and other timber byproducts as feedstock. Camelina species are being investigated for production of biofuels in the Caspian region and neighbouring countries.

Australia

In depth information about biofuels production in Australia is available from the Biofuels Association of Australia. In June 2013, Qantas and Shell published a report Australian feedstock and production capacity to produce sustainable aviation fuel, concluding that significant public subsidies will be required for commercial development of aviation biofuels to be economically viable.

Japan and Asia Pacific - Indonesia, Malaysia, Thailand

The biofuels industry in Japan is less developed than that in Brazil, the US and Europe. However, the Japanases government has announced a number of measures to accelerate use of bioethanol (E10) (including increased collection of biomass resources and improvement of the bioethanol fuel station infrastructure). [Source: Asia Biomass Energy Cooperation Promotion Office].Asia accounted for 12% of global biodiesel production in 2010, the majority from palm oil in Indonesia and Thailand.

Africa

Africa offers siginificant potential for biofuel feedstock production, for example in Sub-Sharan Africa where bioenergy projects offer opportunities for investment and infrastructure improvements. However, sustainable biofuels and other bioproducts offer a means to generate incomes and reduce reliance on fuel imports.

G. Siva prakash
Ph. D Research Scholar

Symbion-VAM

Symbion-VAM is a Vesicular *Aurbuscular mycorhizal* preparation contains spores (asexual resting Clamydospores), fragments of Mycorrhizal fungal filaments and infected roots bits.

Symbion-VAM preparation is made on exfoliated vermiculite carrier contains mainly *Glomus fasciculatum* and other endo-mychorhizal species at 1000 infective propagules per gram of the product.

Dosage: 10 kg/ha

Shelf life: Two Years

Mode of Action

Mycorrhizae are obligate and saprophytic in nature which are totally biotroph and hence, requires a living host for its survival. Endomycorrhizal means mutualistic association of fungi and plant roots in which the fungus surrounds the root tip with a sheath. The Symbion-VAM by associating symbiotically with root of the plants helps in the greater absorption of phosphorous, water and other important macro and essential micro elements and making them available to the plants in an easily usable organic farm (resistance to plants against drought and soil borne fungal pathogens and nematodes, used in annual crops like cereals, pulses, oil seeds and fruit crops but it cannot be used in cruciferous plants).

Dose and Method of Application

Soil Application: Symbion-VAM in required quantities (10 kgs / ha) has to be mixed with organic fertilizer / peat / moistened vermicuilite / field or jungle soil (1000kgs) which are rich in organic matter. This blend is applied by a process of broadcasting as soil application during last ploughing followed by first irrigation.

Symbion-VAM can be mixed with Bio fertilizer of different categories (N, P, K and S - fixers and solubulisers).

Greenhouse Potted Plants: Planting medium and potting medium can be mixed with VAM at desired proportion (i.e. 30-50gms/10kgs of planting medium approximate) and used.

Optimal watering is preferred to maintain the effectiveness of VAM.

Normally Symbion-VAM must be worked / forked into the soil.

Benefits

- Symbion-VAM makes the plant root system to get easily access to the usable form of nutrients.
- Symbion-VAM acts as accessories to the root hairs in the process of nutrient absorption and mobilization.
- Symbion-VAM facilitate nutrient translocation from the soil and root cortical parenchyma to xylem elements.
- Symbion-VAM also function as supplement to root hairs in water absorption, hence prevents reduction in relative water content of cells and thus helps plants to overcome drought.

D. Mohana Priya

Exploring biodegradable polymers production by marine microbes

Petroleum derived plastic is the human invented extraordinary versatile synthetic polymer with many advantages for humans. In 2010-2015, 300 million tons of plastic was produced yearly worldwide. China is the topmost plastic producer with 23.9% production all over the world. The use of plastics is rapidly increased in modern life due to various advantages like cheap, light weight, very stable in harsh condition especially resistant to the microbial decomposition and chemical degradation. As most plastics are retaining in environment, it would take 100 years to degrade and during the degradation it releases toxic substances that affects the survival of many species. Carpenter et al., 1972 first alarmed against the utilization of plastic and its deposition of pellets in surface of North Atlantic Sea.

Recently increasing awareness of environmental plastic pollution led towards research discovering novel material for a replacement of conventional plastics in many countries. Bio-based plastics are the better alternatives over the conventional petroleum based plastic as the cost is rising day to day and numerous ecological concerns identified with plastic contamination. Bio-based plastics are generally produced from four types of renewable source agro-resources (polysaccharides, protein and lipids), from microbial production, chemically synthesized monomers (using agro resources) and chemical synthesis from fossil resources.

Microbial based bio-plastic polyhydroxyalkanoates (PHAs) are identified as alternative to polypropylene and polyethylene. They are linear polyester compounds which are naturally produced by about 75 different genera of gram-positive and gram negative bacteria. Provided these are completely biodegradable, biocompatible and produced from renewable resources. PHAs are produced as carbon and energy reserves or reducing power storage materials by bacteria when carbon is available in surplus and especially when other essential nutrient such as oxygen, nitrogen or phosphorus is deficit or with a shift in pH. These are accumulated as granular inclusions in cell cytoplasm with up to 80% of the cell dry weight. Biodegradable plastics still have a minimal market share because of the high cost compared to fuel - based polymers. One of the largest drawbacks of production of bio-plastic by bacteria is the requirement of media sterilization and reactor maintenance which accounts for nearly 11% of total production costs. Further development in pure culture fermentation and commercialization of the PHA increase their 4–9 times cost higher than that of the conventional plastics. Another efficient method to reduce the operational cost is by using mixed culture from waste water which eliminates the need of sterilization and reactor maintenance with the advantage of presence of several PHA producing organisms utilizing variety of substrates.

The marine environment which is rich in organic nutrients (0.29 mg/mL of lipids) as well as other inorganic nutrients with one of the most important environmental conditions, where the inhabiting are continuously exposed to the ever-changing physicochemical factors such as, sea surface, pH salinity, temperature, provides a new resource for novel bacteria and possibly, the polymers they produce. This would lead towards use of marine resources as “green” alternative for sustainable development of our oceans in terms of maintenance them free of toxic hazardous.

K. Mohan Rasu

Photo Gallery

Departmental activity: International Conference on Recent Trends in Microbiology- Dec,

Departmental activity: **National Level Workshop on Gas Chromatography- Dec, 2016**