Science Last Fortnight

Surprise Blooms in the Southern Ocean

In the Indian Ocean sector of the Southern Ocean, there is an extensive submarine topographic high: the Kerguelen Plateau. It stands against a major ocean current, the Antarctic Circumpolar Current, which flows clockwise from west to east around Antarctica. The mightiest ocean current on Earth!

The presence of the plateau allows a mixing process developed through turbulence and eddies which can bring up iron-rich water from shallow Plateau to the sea surface, fertilizing the mixed layer. Once the mixed layer on the Plateau is fertilized, the waters flow eastward along with the Antarctic Circumpolar Current.

These physical processes create a zone of upwelling nutrients in the waters around the Kerguelen Plateau and its downstream sections. This leads to growth of phytoplanktons – microscopic plants in the ocean. These tiny plants which feed on organic micronutrients are at the base of a huge food chain in the oceanic ecosystem. The surge in phytoplankton population results in an abundance of oceanic food chains including fish, whales, seals, penguins, albatrosses and a wealth of other species of economic and ecological importance.

Observation of biophysical parameters by ocean cruises over vast areas of the southern ocean does not supply sufficient data to analyse this phenomenon adequately. However, the data from satellite remote sensing datasets are well suited to observe and quantify the seasonal areal extent of phytoplankton blooms in the Kerguelen Plateau ecosystem. Jena B from the National Centre for Antarctic and Ocean Research, Goa, therefore used the satellite datasets to analyse the phytoplankton blooms. Analysis of monthly oceanographic satellite data revealed that the Kerguelen Plateau blooms are pronounced only during the austral spring-summer period in a year: November to February.

Besides the economic and ecological aspects, phytoplanktons have global impact on climate. They absorb the CO_2 from the ocean surface and transmit it into the ocean ecosystem. The associated food chain may transport the CO_2 deeper into the ocean and directly affect the biogeochemical cycle of the region.

We now have the capability to look at the southern ocean, sitting far away in Goa. With the launching of more dedicated satellites to map ocean wealth, we hope to unravel more oceanic mysteries in the times to come.

Frontiers of Ear. Sci., **10**(3), 479–486
Geophys. Res. Lett., **29**(23), 49.1–49

Drought can't stop us

Nitrogen fixing species for drylands

Drought affects plant growth and productivity. The critical stages affected are seed germination and seedling establishment. Inadequate soil moisture results in irregular seed germination. This leads to asynchrony in seedling emergence, resulting in poor yield. The effect is more pronounced in degraded lands. To restore vegetation, we need to know which species can tolerate harsh conditions.

Kiran Bargali and S. S. Bargali from Kumaun University, Nainital, looked into the drought-withstanding ability of fifteen leguminous species. They tested the germination capacity of the seeds in response to water deficit: up to moisture levels as low as –20 bars. Seed germination reduced with increasing water deficit. Some species were specific in moisture requirements, while a few others retained their germination capacity at higher gradients.

Moisture is a key factor controlling germination in field conditions. It is the initiator of germination. Seeds of leguminous plants have seed coats with low permeability to water. During favourable conditions, the seeds imbibe moisture and germinate.

These species are easier to establish in the field as they can tolerate prolonged dry spells in the field. They can be directly seeded on degraded sites with low moisture content. Their nitrogen-fixing ability would further hasten the recovery of degraded lands.

Tropical Ecology, **57**(3), 445–453

Stomach and liver infections

Helicobacter identification

Helicobacter is causal agent in many human diseases. But it is quite difficult to identify different species of this genus using conventional approaches. Among this genus, *Helicobacter pylori* is the most common, responsible for about 50% of the infections by *Helicobacter*.

There are various approaches available for the initial diagnosis of *H. pylori* infection. Urease testing is most rapid and cost-effective. However, it has limitations. The same is true for other tests, misleading the detection of this pathogen.

A team of researchers from Delhi University analysed genes from 45 species of this genus. Their goal was to develop a systematic method for strain characterization with efficient accuracy. So they used different approaches, by using the internal features of 16S rRNA genes, phylogenetic tree construction, *in silico* restriction enzyme study, species-specific conserved motifs and assessment of genetic variability. They also employed another housekeeping gene hsp60 for result validation.

Phylogenetic analysis emerged as a strong tool for assessing the classification of *Helicobacter* despite a few limitations. Analysis showed significant heterogeneity among the species. 624 restriction enzymes were taken for *in silico* restriction enzyme study. 72 of these are specific to seven species. Later, they identified unique motifs for 6 clinically significant species. Thus they were able to characterize different species of *Helicobacter*, including *H. pylori.* The group also identified Hsp60 as an authenticate marker, a result corroborated by the analysis of 16S rRNA results.

This systematic approach can help us identify prevalent *Helicobacter* pathogens quickly. Translational research is needed to make this method clinically available.

Indian J. Microbiol., **56**(3), 277–286

Escherichia coli in milk

LEDs throw light on decontamination

Milk is a nutritious food for human beings, but it also serves as a good medium for the growth of microorganisms. The chance for contamination of milk is more during milking, handling and selling and leads to the spoilage of the product. Providing safe milk and milk products to quality conscious consumers is, therefore, a challenge for the dairy industry.

Thermal pasteurization has an adverse effect on taste, smell, etc. as well as on the nutritional value of milk. Repeated boiling leads to energy consumption. But avoiding it results in unsafe milk for consumers...

Among micro-organisms, *Escherichia coli* is found to be the most frequent in contaminated milk. This species is an indicator of fecal pollution due to insanitary conditions. It can cause several health problems such as bloody diarrhea, abdominal pain and fever. A. Srimagal, from NIT, Odisha, T. Ramesh from the School of Food and Agriculture, University of Maine, USA and J. K. Sahu from the Center for Rural Development and Technology, New Delhi, studied the effect of LEDs for inactivating *E. coli* in milk.

The scientists assessed the effect of blue LED light of 405 to 460 nm on the inactivation of *E. coli* ATCC25922 in a food matrix like milk. They found significant differences between the microbial inactivation at different wavelengths and temperatures. The best results are at 406 nm at 13.8°C for 38 min. Milk treated this way shows maximum degradation of microbes and doubled shelf life under refrigerated storage without affecting the innate qualities of milk.

As LEDs consume less energy and are highly durable, the LED treatments may be a better opportunity for the dairy industry to produce hygienic products without losing benefits within a minimum treatment time and expense. Perhaps one day such milk decontaminators may even be a common kitchen gadget.

LWT-Food Sci. Technol., **71**, 378–385

Herbicides in a fungal world

Penoxsulam degrading fungi

In addition to fertilizers and pesticides, agricultural practices heavily rely on the use of herbicides. Of late, it has been realised that certain herbicides can persist in soil for longer durations which can affect the growth of other plants and microbes. One such herbicide – Penoxsulam – has recently caught the attention of scientists. Penoxsulam is a post emergence sulphonamide registered for weed control in India. There is evidence that it is beginning to accumulate in the soil. To promote its biodegradation, Shondia from the Department of Chemistry, Directorate of Weed research, Jabalpur, decided to isolate fungi capable of degrading Penoxsulam.

To isolate Penoxsulam degrading fungi, Sondhia and her team collected soil from farmlands where Penoxsulam was in routine use. The isolated fungi were characterized on the basis of colony morphology and partial gene sequencing. two isolates *Aspergillus niger* and *Aspergillus flavus* were then probed further to understand the mechanism employed for Penoxsulam degradation. Soil samples incubated with Penoxsulam and fungi were withdrawn periodically and analysed through mass spectrometry to identify the herbicide degradation products. The study revealed that even though both the species employ a similar method for cleavage of the Sulfonamide bridge for herbicide degradation, *A. flavus* is more efficient compared to *A. niger*.

The insights from this study suggest that either *A. flavus* and *A. niger* or enriched mixed fungal consortium could be used to promote Penoxsulam degradation in soil. Since fungi accounts for 75% of microbial biomass, researchers are confident that this would be a new low cost method to control herbicide contamination and soil detoxification.

Applied Soil Ecology, **105**, 196–206

Shape Matters

Structure–function of BPA analogues

Bisphenol A (BPA) is the first chemically synthesized variant of estrogen lacking a classical steroid nucleus. Due to availability of more potent variants of the hormone, BPA, instead of being commercialized as a hormone, was channeled into the making of plastics.

This resulted in a massive exposure of humans to BPA which led to its accumulation in the body. Due to its structural similarity to estrogen, BPA acts as an endocrine disruptor. Its trademark benzene rings and hydroxyl group backbone can sit well within the pocket of certain membrane and nuclear receptors thereby affecting metabolism and hormone function. Studies show that exposure to even minute quantities of BPA has adverse affects on human health because it mimics the function of the hormone which is required only in nano quantities.

Following multiple studies that outline the hazardous effects of BPA accumulation on human health, the chemical has been replaced by its structural analogues. Masood Ahmad from the Aligarh Muslim University, and his student recently reviewed available literature on BPA and its analogues to assess the cost–benefit ratio.

All the BPA analogues also contain the same benzene-hydroxyl backbone and are found to possess endocrine disrupting potential. Some of them can stay in the body for longer durations and can also act as carcinogen.

BPA analogues find use as epoxy resins that line most food cans and are also a component of plastics used to make baby bottles which is a cause for concern. The authors thus conclude that the use of BPA analogues needs to be put under scientific scrutiny. 'Instead of introducing new endocrine disruptors into the environment we need to find safer alternatives' says the lead author of the paper.

Chemosphere, **158**, 131–142

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