Current Science Reports

Freshwater Acidification
Snails at risk

The common banded pond snail, *Bellamya bengalensis*, is found in ponds, lakes, rivers and canals. By contributing to the nutrient cycle in freshwater ecosystems, the snail plays an important role. And it serves as food source for other animals in the ecosystem. However, the species is now considered vulnerable by the International Union for Conservation of Nature, mostly due to habitat loss.

The loss of habitat is linked to acidification caused by wastewater discharge and runoff. Studies suggest that this water acidification is due to carboxylic acids, low molecular weight organic acids.

The most frequently encountered carboxylic acids in freshwater are acetic and benzoic acids. How does exposure to acetic and benzoic acid affect *B. bengalensis*?

To investigate, researchers from the University of Burdwan assessed the behaviour of *B. bengalensis* snails exposed to different concentrations of acetic and benzoic acid for four days and monitored their activity levels. They found that the higher the acid concentration, the more withdrawn and inactive the snails became. Crawling and tentacle movement decreased the most – even after a short exposure. Tentacle retraction and mucus secretion showed lower reactions to the acidic environment.

'This shows that snails can sense acidic water and try to avoid it by becoming less active,' says Soumendranath Chatterjee, University of Burdwan.

The team also examined how the two acids affected the snail operculum, a hard, plate-like structure made of calcium carbonate that protects the snail from predators and desiccation. They exposed separate groups of the snails to the same acid concentrations for 28 days. Then they collected the opercula of the snails and examined them using scanning electron microscopy to assess any structural changes caused by the acid exposure.

The acid had eaten into the operculum, making it weaker and less protective. The damage was worse with benzoic than with acetic acid because benzoic acid sticks to the snail's tissues more easily. The severity of the damage depended on the amount of acid to which the snail was exposed and for how long.

The common banded pond snail, *B. bengalensis*, is consumed as food even by people and is part of ethnomedicine. To conserve the species, we need to protect freshwater bodies from pollution.

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Edible Coatings for Mango
Improving shelf life

Many factors, both before and after the harvest, trigger rapid deterioration in the fruit and reduce its shelf life. The mangoes shrivel up, soften and lose vitamins and antioxidants.

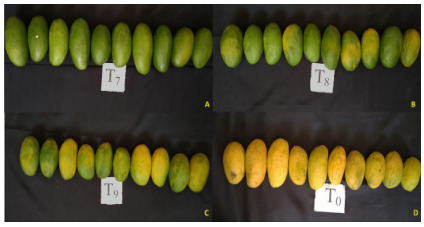

Image Courtesy: Nirmal Kumar Meena

Hydrocolloid-based coatings can retain moisture and reduce spoilage in fruits. They are also edible. Could such edible coatings help preserve the nutritional quality of mangoes during storage?

Researchers from the Agriculture University, Kota created a protective layer by dipping freshly harvested mangoes in two different coating mixtures, one after the other, forming two layers of coating emulsions.

The first layer, rich in gum arabic, provided a barrier against moisture loss and browning. The second layer, with carboxymethyl cellulose, offered additional antioxidant protection.

To assess how well the coating prevents moisture loss, the team coated one group of freshly harvested mangoes with different combinations of the bilayer, and used uncoated mangoes as control.

All the mangoes were weighed and stored at room temperature for 12 days after which they were weighed again. Compared to those that were not coated, coated mangoes had less weight loss, suggesting that the coating had effectively retained moisture.

Before and after storage, the researchers also tested the mangoes for firmness. Coated mangoes remained firmer for longer.

The researchers measured the total soluble solid, an indicator of sugar concentration using a refractometer. Coated mangoes showed a steady increase in soluble solid, suggesting better preservation of sugars and, therefore, sweetness.

The team then measured vitamin C levels. Coated mangoes exhibited slower depletion of vitamin C, indicating the coating's success in protecting this vital nutrient.

Next, they measured the level of phenolic compounds, natural antioxidants, in mangoes. Coated mangoes maintained higher levels of phenols than uncoated ones, signifying better retention of antioxidants. A free radical scavenging assay showed that the coated mangoes had higher antioxidant activity than those that were uncoated.

Dipping the mangoes in an emulsion of gum arabic and carboxymethyl cellulose, one after the other, might help reduce the wastage of mangoes in the peak season. Farmers and fruit traders can translate these findings to preserve nutritional value and to enhance market reach.

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Borderline Mucinous Tumours
Treatment and cancer results

Tumours that produces mucin, the main component of mucus, are usually benign and are not as aggressive as invasive carcinomas. But, at times, they can become borderline, ready to become cancerous. Mucinous tumours found in the intestine are more so than endocervical ones.

Though they are clinically distinct from other epithelial ovarian tumours, there is a considerable overlap in behaviour and clinical presentation in patients with borderline mucinous ovarian tumours. This makes it difficult to diagnose and manage the condition.

What are the clinical, demographic, and pathological features of borderline mucinous tumours?

Researchers from the Tata Memorial Hospital, Mumbai collaborated with a researcher from Scotland, to find out. They analysed the data of 75 patients diagnosed with borderline mucinous tumours at a tertiary cancer centre between January 2017 and December 2019. The median age of the patients was 42 years.

This retrospective cohort analysis examined the outcomes and characteristics of a group of individuals who share a common exposure or experience.

The researchers gathered demographic data, clinical findings, treatment details, follow-up data and survival outcomes from electronic medical records.

The most common clinical symptom was abdominal pain, followed by menstrual irregularities and abdominal distension. Of the 75 patients, 11 experienced recurrences. Most recurrences were seen in patients with stage I disease.

Using the Kaplan-Meier method to compute the probabilities of occurrence of events, the researchers estimated disease-free survival and overall survival.

The entire group had a more than 79% chance of 5-year disease-free survival. The 5-year overall survival for the group was more than 90%. For stage I disease, the 5-year overall survival was 92% and, for advanced stage disease, the 5-year overall survival was 60%.

To identify factors associated with disease-free and overall survival, the researchers used univariate and multivariate analyses based on the Cox proportional hazard model. Only the stage of the disease had a significant association with disease-free and overall survival. The results also indicated that fertility-preserving surgeries had no adverse impact on disease-free and overall survival.

'Patients with borderline mucinous tumours of the ovary have excellent long-term survival rates. So fertility-sparing surgeries can be considered for younger patients especially for stage I disease,' says Pabashi Poddar, Tata Memorial Hospital, Mumbai.

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Adverse Childhood Experiences

Mental health red flags

Stressful events that occur before age 18 can have lifelong negative impacts on a person's health and well-being. Adverse childhood experiences may lead to mental health conditions such as anxiety, substance use disorders, depression, and suicidal behaviour as well as to chronic physical health conditions such as cancer and cardiovascular disease later in life. Low- and middle-income nations, like India, have paid little scientific attention to this field of study.

Recently, researchers from the University of Delhi, the Atal Bihari Vajpayee Institute of Medical Sciences and the Dr Ram Manohar Lohia Hospital, in Delhi collaborated with colleagues from the Public Health Foundation of India, Gurugram to collect relevant data.

A total of 1843 young adults, aged 18 to 25 years, from Amity University, Noida and the University of Delhi were enrolled for the study. The participants were first screened for adverse childhood experiences using the questionnaire developed by the World Health Organisation – 2020. The questionnaire covers 13 domains of adverse childhood experiences, including emotional neglect assessed in a limited capacity, peer violence or being bullied, witnessing community violence and collective violence.

The participants were categorised based on the number of exposures to adverse events. Nearly one-fifth of the cohort was found to have been exposed to high levels of adverse childhood experiences, while over fifty per cent of the participants had experienced moderate levels of adversity.

Each class was assessed for depression, anxiety, stress and well-being using established psychometric measures in the form of questionnaires.

The researchers found that the higher the number of adverse events experienced, the higher the likelihood of experiencing depression, anxiety, stress and poor well-being.

Raising awareness, among parents, educators and clinicians, about the impact of adverse childhood experiences could help prevent mental health issues in young adults.

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Emotion and Mental Health

In higher education

The education system puts students under pressure. The competitive environment it creates results in stress and anxiety. Emotional intelligence may help students cope. What is the impact of emotional intelligence on a student's mental well-being in the growing Indian higher education sector?

Shikha Rana, Graphic Era Hill University, Dehradun collaborated with researchers from the IMS Unison University, Dehradun to determine linkages between emotional intelligence and mental well-being. The researchers administered a questionnaire to 250 students from different universities in Uttarakhand. The 30 questions covered the expression, regulation and use of emotions.

To elicit data on mental well-being, the researchers adopted the Warwick-Edinburgh Mental Well-being Scale which includes positive thoughts, self-control, etc. They evaluated the reliability of the questionnaire and found it satisfactory. To test their hypothesis, they analysed the data statistically. The results indicate that factors such as the COVID-19 pandemic, cutthroat competition, isolation, stress and lack of mindfulness, pose significant challenges for students. The findings also suggest that students who are in touch with their emotions can effectively regulate them and experience better mental well-being.

'Emotional intelligence has a positive impact on the mental well-being of students in Indian higher education institutions,' says Shikha Rana.

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Mutations in Alzheimer's Disease

Identification for early diagnosis

The 2020 annual report by the Alzheimer's Association indicates that Alzheimer's disease occurrence increases with age. The condition involves a decline in cerebral functioning, including memory loss, which can advance irreversibly and impact motor activities, ultimately ending in death. There is evidence to suggest that the development of Alzheimer's disease is influenced by chromosomal abnormalities that affect gene expression levels.

Researchers from Tamil Nadu and Punjab recently investigated chromosomal abnormalities as well as the connection between biochemical parameters and mutations in the mitochondrial calcium uniporter gene in Alzheimer's disease. They recruited 68 Alzheimer's disease participants from Coimbatore, Erode, and Chennai in Tamil Nadu, and Palakkad and Thrissur in Kerala. Sixty healthy volunteers aged between 20 and 90 years served as control.

The patients were further divided into an early onset group, aged less than 65 years, and a late onset group, aged more than 65 years.

The researchers assessed the cognitive functioning of the participants using the Mini Mental State Exam to assess factors such as orientation, attention, memory and language. The researchers found that females were more affected than males.

They measured the levels of various biochemical parameters. There were no significant differences between Alzheimer's patients and the controls – except for the triglyceride level, which was significantly higher in Alzheimer's patients.

When the researchers investigated chromosomal alterations, they found that, compared to the early onset group, a higher percentage of participants in the late onset group had abnormal chromosome numbers.

They then focused on the mitochondrial calcium uniporter coding exon. Any change in the gene leads to disrupted calcium homeostasis and mitochondrial dysfunction. This can cause neuronal impairment, aberrant cell signalling and death, contributing to the pathology of Alzheimer's disease.

The researchers extracted genomic DNA from blood samples to analyse the mitochondrial calcium uniporter coding exon. After isolating, purifying and amplifying the gene, they screened the gene for mutations. There were eight different mutations in Alzheimer's disease patients.

This understanding of chromosomal abnormalities and mutations in the mitochondrial gene in Alzheimer's disease paves the way for future diagnostic and therapeutic advancements.

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Graphene Biosensor

For forensic science

Microscopic pieces of bloodstains can serve as evidence in forensic investigations. But, for accuracy, we need better tools.

And that is what researchers from the Marwadi University, Rajkot, the Karpagam Academy of Higher Education, Coimbatore and the Najran University, Saudi Arabia collaborated to develop.

Graphene is a two-dimensional allotrope of carbon. The material is made up of a single sheet of carbon atoms organised in a hexagonal lattice. The researchers constructed graphene with three separate rectangular geometries, each having the exact length and width measurements of 7800 nanometres and 500 nanometres. They structured the rectangles into star-shaped patterns to enhance the surface area exposed to target compounds.

Then the entire star and square arrangement was precisely centred onto a larger square platform to ensure the sensor's stability, to accurately and reliably detect the target biomolecules. The researchers integrated this hierarchical structure onto a glass substrate, to serve as the foundation for the entire sensor system, ensuring that it remains securely in place during operation.

They then bathed it in terahertz light, the electromagnetic spectrum between microwaves and infrared. They watched the colour shift and dance like a needle on a dial and optimised it to detect haemoglobin, the protein in blood. The sensor could accurately detect haemoglobin based on the refractive index.

The researchers tested the biosensor's performance. It could detect even the tiniest amounts of haemoglobin.

The biosensor promises a revolution in forensic science when bloodstains are too faint for the naked eye. This graphene-based technique can be extended to medical diagnoses, food safety checks, and even environmental monitoring.

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E-learning Classrooms

Manas Chakshu monitors

In the ever-evolving landscape of digital tools, integrating information and communications technologies into the classroom environment is a challenge. Educators have to grapple with the complexities of monitoring large classrooms in real-time. Though learning analytics is popular for monitoring, the inherent design flaws of interactive tools pose a considerable hurdle in blended learning environments where e-learning and regular classrooms complement and supplement each other.

Samit Bhattacharya and his students at IIT, Guwahati first identified deficiencies in the existing system. They designed real-time ICT-based interactive learning analytics specifically for large blended classrooms.

Here, the core concept of the visual learning analytics is introduced at two interactive levels: First, an overview and then the overview with details. This helped optimise screen-area use on available displays.

To tackle the intricate task of computing classroom status, the system incorporated weighted states and Euclidean distance, effectively highlighting critical regions within the classroom.

The team assigned weights to individual student states to classify their situation and to identify when teacher intervention was required. The need for such interventions relies upon the relative distance of students or a cluster of students measured by Euclidean distance.

The system now helps the teachers to see into the needs of students, into their minds. So the team called the system they designed Manas Chakshu.

The researchers pitted the theoretical performance of Manas Chakshu

against the existing state-of-the-art system, and the results were staggering – 89.12% superiority in theoretical performance.

To test it in practical, real-life situations, the team implemented Manas Chakshu as an Android application and conducted an empirical study involving 39 teachers. The results showed a reduction in average classroom monitoring time by about one-fourth compared to the erstwhile system.

The perceived usability, as measured through teacher satisfaction, efficiency and learnability, soared to high ratings and scored more than four on a five-point scale.

'Manas Chakshu is not just a solution. It is a transformative force in the teaching community,' claims Bhattacharya.

Its acceptance, as reflected in the high system usability scale scores, underscores its contribution to educators. Educators looking for a more efficient, responsive, and user-friendly approach to classroom monitoring in blended learning situations can now start using it.

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Nurture Learning Culture

Enhance organisational performance

Within an organisation, managing knowledge involves the acquiring, creating and sharing of knowledge. Knowledge management may, perhaps, be improved by inculcating a learning culture within the organisation. Could organisational intelligence foster a learning culture? How would it impact organisational performance?

To find out, Jamini Ranjan Meher and Gokulananda Patel, Birla Institute of Management Technology, Greater Noida collaborated with colleagues from Sambalpur University, GITAM University and XIM University. They administered a questionnaire to HR managers, software developers and team leaders from information technology firms in Hyderabad, Bengaluru and Bhubaneswar. The questionnaires covered knowledge management, organisational learning culture, organisational intelligence and organisational performance.

From March 2021 to February 2022, the team received around 360 complete responses with an almost even male to female ratio. To analyse correlations between the variables and to confirm the reliability of the conceptual constructs, they used the Cronbach Alpha test.

They evaluated the internal consistency of the variables using Henselers' rho and ensured that the variables are distinct, using discriminant validity tests. To understand the association of organisational learning culture with improving knowledge management and organisational intelligence and the impact on organisational performance, the team used structural equation modelling.

Even though knowledge management did not seem to directly impact performance, they found that it influences performance indirectly by enhancing the organisation's intelligence to use knowledge effectively.

'We have shown the importance of fostering a positive learning culture, conducting regular staff training events, and ensuring effective knowledge management procedures,' says Rohita Kumar Mishra, Sambalpur University.

'For successful knowledge management, the support of senior management is crucial. It can significantly influence the organisational intelligence necessary for organisational success,' adds Lalatendu Kesari Jena, XIM University.

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Reports by **A. Anuradha, A. Karthic, Sileesh Mulasseri, Ravindra Jadav, Sheikh Aneaus** and **Tahera Arjumand**

scienceandmediaworkshops@gmail.com

NUCLEO^{FAST} viral DNA isolation kit

An indigenous viral DNA isolation kit, viz. NUCLEO^{FAST} viral DNA isolation kit has been developed by ICAR-National Research Centre on Pig, Guwahati, Assam, India, which can isolate ready-to-use template viral DNA for routine PCR-based diagnosis of animal viral diseases without any PCR inhibitory effects. This kit is able to isolate 1–2 µg of DNA from 1–2 g of clinical tissue samples with a yield of 200–400 ng/µl, with $OD_{260/280}$ in the range 1.8–2.0. The developed kit has the following distinguishing features when compared to the existing ones: (a) simplicity – the buffer can be easily prepared without any technical difficulties; (b) cost-effectiveness – the estimated cost per sample is INR 10–15; (c) short handling time – the total time required for DNA extraction is less than 5 min; (d) safety concerns – the developed kit does not have any hazardous chemicals, including phenol–chloroform, and (e) storage capacity – the kit can be stored at room temperature for more than one year. An Indian IP has been filed with application no. NUCLEOFAST1057478477/207/AS-ATMA-1276/ICAR-P.

Rajib Deb*, Gyanendra Singh Sengar, Seema Rani Pegu, Swaraj Rajkhowa and **Vivek Kumar Gupta*,** ICAR-National Research Centre on Pig, Guwahati 781 131, India.
*e-mail: Rajib.Deb@icar.gov.in; gupta.drvivek@gmail.com