

## Science Last Fortnight

Between the last issue of *Current Science* on 10 March to this issue on 25 March, much has happened in the world of science. We bring you some snippets from selected scientific literature.

### The LURE of female gametophyte in *A. thaliana*

A pollen falls on a pistil. And a tube grows from the pollen. What attracts the tube towards the ovules? This child-like question is now getting answers.

In the last three years, evidence for the presence of chemo attractants in the female gametophyte has been uncovered. In fact, we know now that these are peptides rich in cysteine. Scientists have fondly named them LUREs.

But how does it turn on pollen tube growth? It is not that every pollen will sprout tubes. Only those from the same species seem to be attracted to the lure of the female gametophyte. Two papers in a recent issue of *Nature* delineate the connection between the LUREs of *A. thaliana* and the pollen – by screening the receptors on the pollen grains. A path has been broken for similar studies on other plants.

In some plants such as mangoes, the pollens from the same tree do not grow tubes. But pollen from another mango tree sprouts tubes. The mystery of molecular mechanisms for this inhibition of the growth of pollen tubes may also be solved soon.

*Nature*, **531**, 241–244, 10 March

*Nature*, **531**, 245–248, 10 March

### Problem of PET bottles

Polyethylene terephthalate, PET, is one of the most common plastics found in the country. PET bottles are sometimes treated like precious pets in summer – especially after a deficient monsoon. What happens to all the PET bottles that are being constantly produced?

Recently, experiments done near Pune revealed that PET bottles can be reused to reduce water evaporation from irrigation tanks. But the amount of PET bottles being produced is much more than can be put to use in this manner, in irrigation tanks.

How does one surmount the mounting problem of PET bottles in the environment?

A paper in the recent issue of *Science* seems to suggest a new avenue. Japanese scientists, screening the area around a plastic recycling facility, discovered a bacterium, *Ideonella sakaiensis*, that can degrade PET. The understanding of how the bacteria manages to attach itself to the smooth material and break up the polymer into environmentally safer monomers of ethylene glycol and terephthalic acid will help us devise bio-industrial recycling strategies to tackle the problem.

*Science*, **351** (6278), 1196–1199, 11 March

### Bioprocessing of lignocellulose

Plant biomass in the form of lignocellulose subsists for a long time, slowly degraded by fungi and ultimately integrated into the soil. Study of such fungi has not yielded industrially useful species that can be put to use for biofuel production from lignocellulosic materials.

To speed up the process, US scientists looked into the guts of herbivores. And discovered anaerobic fungi that can degrade the material more efficiently. These fungi can cut through the lignin and extract energy from the cellulose – of course, under anaerobic conditions. The paper in the recent issue of *Science* delineates some candidate enzymes for the bioprocessing of lignocellulose.

Industrial dump and animal dump. Scientists find interesting things in unlikely places, don't you think?

*Science*, **351** (6278), 1192–1195, 11 March

### Seasonality in cognitive functions

As in migratory birds and animals whose behaviour changes with seasons, our cognitive functions, too, go through seasonal cycles, claim Belgian scientists, in a paper in a recent issue of *PNAS*. It appears that sustained attention becomes better in June and decrease towards winter. But tasks that use working memory improve towards winter.

The finding has implications in education and research and the experiments are worth reproducing.

*PNAS*, **113**(11), 3066–3071, 15 March

### Biological clock reset

Bird migration is seasonal: an important internally produced biological process that is cued by the light–darkness rhythms. Several clock genes interact intricately with the environment and nervous system to produce and seasonal oscillations in cells and tissues such as the hypothalamus and several endocrine glands.

Researchers from the Department of Zoology, University of Delhi, investigated the role of the pineal gland in such rhythms using song birds like migratory red-headed buntings. The researchers removed the pineal gland of the birds. And, along with appropriate controls, entrained them to short days (8 h light). This was followed up by 10 long days (13 h light).

'Migratory restlessness', called Zugunruhe, or orienting towards flight destination at night and practicing flights are used as behavioural indicators of an urge to migrate. Activity/rest patterns and mRNA expression of seven clock genes indicated that the absence of pineal gland did not affect the development of Zugunruhe, but showed a decay of the circadian rhythm during the restlessness.

Reduced gene oscillations in the hypothalamus and variable gene oscillations in peripheral brain tissues and liver were also observed. But, the retina did not appear to be affected.

Birds are known to use any two of the three clocks – hypothalamus, pineal gland and retina. Each clock interacts with at least one other to generate the light–dark cycles entrained for 24 hours. However, the retinal clock seems to have no role in the circannual rhythms. Why? Is it easier to entrain the pineal gland for such long haul seasonal tasks?

*Physiology & Behavior*, **56**, 156–163, 15 March

### Turmeric for stomach ulcers?

Pectins are a group of water-soluble colloidal carbohydrates found in some ripe fruits with an ability to jell. Using specific pH and temperature conditions, pectins can be modified by breaking down long, branched chains of polysaccharides into shorter, unbranched lengths of soluble

fiber molecules that dissolve easily in water.

Researchers from the Central Food Technology Research Institute, Mysuru, have isolated some native and modified pectins from turmeric and evaluated them for ulcer preventive properties – under both *in vitro* and *in vivo* conditions. The modified pectins showed significant superior performance on ulcer scores, protection of mucous membrane, inhibition adherence and growth of *H. pylori*.

The pectins also differed in their structural and molecular properties. The modified pectins were rich in galacturonic acid and galactose. Their NMR and infrared spectroscopy results indicated the presence of galactans which bind to inflammatory markers, thereby reducing inflammation-induced ulcers. Also, because of their low molecular weight, these modified pectins show increased bioavailability.

The humble kitchen herb, turmeric, does it again, claiming yet another neutraceutical property!

*Carbohydrate Polymers*, **138**, 143–155, 15 March

### ***Drosophila* model for neurodegeneration**

Human Apolipoprotein E (hApoE) is majorly synthesized by astrocytes in the brain. There are three common isoforms of hApoE:  $\epsilon_2$ ,  $\epsilon_3$  and  $\epsilon_4$ . Individuals with  $\epsilon_3$  and  $\epsilon_4$  alleles of hApoE are at higher risk for late-onset Alzheimer's disease. Since there are no animal models for the effects due to the difference in alleles, it has been difficult to study the contribution of this factor in the development of the disease.

Researchers in Mysuru University and IISc Bengaluru, overexpressed human ApoE alleles  $\epsilon_3$  and  $\epsilon_4$  in transgenic *Drosophila* lines, specifically in the neurons of the eye and mushroom body, to understand the extent of neurodegeneration mediated by human ApoE alleles.

Over-expression of  $\epsilon_3$  and  $\epsilon_4$  alleles in the eyes caused significant degeneration of photoreceptor cells. Moreover, over-expression in the mushroom body caused significant decrease in the number of neurons. In both cases, neurodegeneration was significantly higher in *drosophila* carrying  $\epsilon_4$  in comparison with those carrying  $\epsilon_3$ .

The mushroom body in *Drosophila* is involved in olfactory memory. Both 10-day and 40-day old transgenic ApoE3 and ApoE4 flies showed decreased retention in olfactory memory. Again, the memory deficit in ApoE4 was significantly higher than in ApoE3 flies.

Transgenic flies also showed a significant reduction in longevity compared to control flies. Irrespective of acute or chronic exposure to paraquat (PQ), both hApoE transgenic lines showed an increase in reactive oxygen species. On chronic PQ treatment, a neuronal damage in the MB was caused by PQ-mediated oxidative stress.

More interestingly, PQ treated flies showed decrease in memory score on a memory test on chronic exposure whereas acute exposure led to an increase in memory performance – indicating a neuroprotective role of hApoE. The memory enhancement was greater in hApoE3 than in hApoE4 expressing flies.

This *Drosophila* model can assist the study of molecular and cellular events accompanying hApoE4 mediated neurodegeneration.

*Behav. Brain Res.*, **301**, 10–18, 15 March

### **Anion chemosensors Production simplified**

Until recently, chemosensors designed for anion detection involved multistep processes, commonly involving polar –NH protons of thiourea, amide or imidazolium moieties for target recognition. The purification of such molecules is tedious and the synthesis yields are low and the product shows delayed recognition response.

A study, involving three institutions in India, promises to overcome these hurdles. Researchers devised two acetate specific receptors using Pyridoxal 5 phosphate (PLP), the active form of Vitamin B6, in a single step. And the products were highly specific to acetates. By making PLP interact with 2 aminophenol and aniline, scientists created a Schiff's base where the polar –OH and –NH groups could induce immediate changes in the mixture by reacting the acetate ion. Both types of receptors displayed colorimetric sensitivity for acetate. The detection limit for acetate ions was in micromolars – 7.2  $\mu\text{M}$  for receptor 1 and 22.9  $\mu\text{M}$  for receptor 2.

Acetate ions are of vital significance due to their role in metabolic processes: enzyme activities, protein synthesis, hormone transport. Researchers are confident that, following their lead, PLP will be increasingly used to develop more chemosensors for bioactive anions.

*Spectrochimica Acta Part A – Mol. Biomol.*

*Spectroscopy*, **157**, 110–115, 15 March

### **Lens regeneration after cataract operation**

Cataract is a leading cause of blindness. Usually the treatment consists of surgical removal of the lens that has become opaque. Techniques for implantation of artificial ocular lens are also refined enough to give sight back to people.

But a minor deviation from the procedure can help the regeneration of the lens, claims a recent paper by Chinese and American scientists. The new procedure leverages on the understanding of the endogenous lens progenitor stem cells and the gene expression in lens.

The lens progenitor cells are primarily in the front part of the eye. So the cut is made not in the centre, but more towards periphery. By removing the lens through a small hole, leaving behind the lens capsule, endogenous lens progenitor stem cells are retained in the eye. They tested the technique first in rabbits and found that vision is restored in about five months after the surgery.

They tried it next on young macaques. Again, within a few months, the endogenous stem cells proliferated and made functional lens. The next attempt was on 12 paediatric cases of cataract. As controls, there were 25 children who underwent the presently accepted procedures and therapy. It took a little more for children than rabbits and macaques. But eight months after the surgery, the new technique was found to have advantages over the traditional procedures.

*Nature*, **531**, 323–328, 17 March

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