

Science Last Fortnight

Flavonoids Fight Ebola

In silico drug discovery

Ebola is a rare and deadly viral disease. It was first reported in Congo in 1976. Recently, it suddenly became an epidemic. No drug or vaccine for the disease is available as yet and experimental drugs don't have FDA approval.

Utkarsh Raj and Varadwaj from IIT, Allahabad, tested flavonoids against Ebola. Flavonoids are known to have antiviral activity. Moreover, their compliance with FDA eliminates the need for clinical trials.

4500 flavonoids were tested, using virtual screening against all four viral receptor proteins. Scientists identified Gossypetin and Taxifolin as potential drug-like molecules. These flavonoids bind with all the four surface proteins of the virus. Thus, they make it difficult for the pathogen to survive and gain drug resistance.

The two flavonoids identified also show better results than the existing experimental drug, BCX4430. So, perhaps, this multi-target strategy can be combined with existing therapy to fight the Ebola outbreak in future.

Interdiscip. Sci. Comput. Life Sci 8(2): 132–141

Resistance in *Helicobacter pylori*

Judicious use of antibiotics advised

A life free of infectious disease is rare. Though scientists have come up with a wide variety of antibiotics to overcome the problem, the development of antibiotic resistant strains is debilitating our capacity to treat infections. For example, take *Helicobacter pylori*. Almost 80% of the population in India is infected with *H. pylori*. What's more, these rates have not changed since 1991. The bacterium is the main cause of stomach ulcer, duodenal ulcer, and over time, it can even lead to cancer!

H. pylori infection is usually treated with a combination of antibiotics. But resistance to multidrug therapy has increased in many countries and has become a major deterrent in eradicating *H. pylori* infection. Reports indicate that the prevalence of resistance varies from

region to region and that it is unrestricted use of antibiotics which causes antibiotic resistance in *H. pylori* strains.

Valentina Gehlot, Amity University, Noida, and her team from five different organizations in Uttar Pradesh, West Bengal and New Delhi assessed antimicrobial resistant *H. pylori* strains isolated from Indian patients. 70% of the *H. pylori* strains showed resistance to at least one of the antibiotics used for treatment. *H. pylori* isolates showed less resistance to amoxicillin and clarithromycin. So now we know which antibiotics are more useful for *H. pylori* management in India.

Detecting, preventing and controlling antibiotic resistance require coordinated efforts. Each country and region must provide local data to guide treatment, slow down the development of resistant bacteria and prevent the spread of antibiotic resistant infections.

J. Glob. Antimicrob. Resist. 5: 51–56

Sweet Immunity

Immune response is a host's immediate reaction to destroy an invasive foreign entity. It is regulated by signals generated when the surface receptors of immune cells interact with specific molecules on the surface of the pathogens.

Tapas Maiti and team, IIT Kharagpur, identified the functional unit of a well characterized heteroglycan – a molecule containing different sugars – on the immune cells which bind to the receptors of pathogens. The team found that a fraction of 10–30 kDa of heteroglycans is adequate for receptor recognition and binding. The immune response increased with the size of the fraction.

This molecular recognition was attributed to Dectin 1 and Toll-like receptors 2 on the surface of macrophages. The recognition activated cell signalling pathways, which increased free radicals and phagocytosis in macrophages.

The paper establishes that immune response depends on heteroglycan size and structure. This method of inducing molecular signalling may prompt many therapeutic applications in the future.

J. Cell. Biochem. 117: 1580–1593

Vitamin A for Gastroenteritis?

Challenging Salmonella

Gastroenteritis is a global burden and one of the leading causes of morbidity and mortality in both developed and developing countries. One of the main causative organisms is *Salmonella enterica*, a food-borne pathogen. The symptoms include acute intestinal inflammation in the terminal ileum and colon in humans.

A team led by Sinha from the National Institute of Enteric Disease, Kolkata, now reports that vitamin A can be used to treat gastritis and to prevent the chances of acute infection. They took three groups of pathogen-free mice for the experiment. For the first two groups, oral inoculation of *Salmonella* mixed with phosphate buffer saline was given. The third group was given only PBS as a negative control.

After inoculation, intravenous injection of all-trans-retinoic acid and dimethyl sulphoxide (DMSO) was given to the first group and only DMSO was injected into the second group. Retinoic acid is a biologically active compound of Vitamin A. Interestingly, retinoic acid treated rats recovered faster than non-treated groups.

Researchers say that retinoic acid treatment not only reduces pro-inflammatory cytokine response but also increases the resistance to salmonella by increasing the production of FoxP3 expressing T-regulatory cells. This also helps reduce bacterial load in other systemic organs.

As everybody knows, vitamin A is good for eyes and its deficiency causes night blindness. Carrots, greens, dairy products, fish, liver and meat are rich sources of vitamin A recommended for any deficiency. Now it appears that these vitamin A rich foods are not only good for your eyesight but also help you remain free from pathogens that cause gastroenteritis!

According to scientists, retinoic acid has the therapeutic ability to reduce the severity of *Salmonella enterica* and is an alternative pharmaceutical strategy for the management of gastroenteritis.

Immunobiol. 221(7): 839–844

Chulha Leads To Osteoporosis!

'Sanjha chulha' brings back memories of our grandmother sitting in courtyard serving hot, delicious 'rotis'. Unfortunately, biomass based 'chulhas' have been implicated as root cause of respiratory and heart diseases in rural women. Now, M. R. Ray and his associates from the Chittaranjan National Cancer Institute, Kolkata and the Ravenshaw University, Cuttack, say that the age-old traditional method of cooking can have adverse effects on bones too.

Cooking with a biomass based 'chulha' leads to production of fine particulate matter. This triggers the expression of a protein, RANKL, in specialized white blood cells. This protein is associated with the activation and differentiation of bone cells. The protein along with its decoy soluble receptor, Osteoprotegerin, has an osteoprotective role. Any change in the ratio of this protein and osteoprotegerin is associated with bone desorption, leading to osteoporosis. Smoke from biomass produces a three-fold increase in this protein, thereby disturbing the ratio. Researchers observed an increase in inflammation inducing cells also. These cells leak into bone lesions and aggravate inflammation.

It is known that estrogen stimulates bone formation. But scientists confirm that fluctuation of the estrogen levels is not sufficient to explain the changes in RANKL/OPG ratio.

Thus, in addition to age and nutritional deficiency, inhalation of particulate matter from burning biomass may lead to deficiency in bone density and osteoporosis. Cleaner fuels like LPG or biogas may act as a preventive against bone disorders. Burning of leaves in some seasons and smoke from forest fires also may trigger the overproduction of RANKL.

J. Appl. Toxicol. **36**: 969–976

What's in Ann's Blood?

NextGen Sequencing of Malaria Vector

Anopheles stephensi is a common vector of malaria, especially in urban areas in India. The insect's blood contains metabolically active cells called hemocytes. These cells not only supply nutrients, but are also involved in the microbial-pathogen interaction and immunity of mosquitoes. Therefore, when an adult

female mosquito feeds on blood, the hemocytes have to become active and proliferate. Since hemocytes do not proliferate *in vitro*, studies on the proliferation and distribution of these cells is limited. But Indian scientists are working around the problem using tools of molecular genetics, to throw light on the functions of these cells in mosquitoes.

Dixit and his team at the National Institute of Malaria Research, Delhi, have recently made advances in our understanding of the complex genetic makeup and molecular facets of hemocytes. They used next-generation sequencing to identify several unique transcripts which encode proteins in hemocytes and they found eleven important immune family proteins such as a group of Leucine-rich repeat proteins, holotricin, odorant binding proteins and nimrod family proteins.

Interestingly, more than 50% of the transcripts encode hypothetical proteins. This opens up further research avenues in their role in the activation of anti-plasmodial responses in malarial vectors.

Since hemocytes interact with the mosquitoes' gut during the transmission of malarial infection, there is a possibility that hemocytes are active players in enhancing anti-plasmodial immunity, similar to specialized immune blood cells in humans.

Gene **585**(2): 177–190

Barcoding Indian lobsters

Identification and evolutionary issues

Lobsters are the most profitable seafood. But their numbers are dwindling due to overexploitation on the Indian coast. There are many species of lobsters including 14 littoral and 6 deep sea species. Accurate identification of these species is needed for their efficient conservation.

Scientists from NBFGR and CMFRI collaborated to identify the molecular signatures for 11 commercially important lobster species from Indian coasts. They collected lobster samples from sites reported as their habitat, across the Indian coast. Numerous nuclear and mitochondrial markers were analysed, among which high levels of interspecific divergence was identified for the 12SrRNA. The molecular markers help

resolve the evolutionary pressures that led to the divergence of lobster species.

Scientists found that lobsters from the family Palinuridae cover larger evolutionary distances than lobsters of the Scyllaridae family. This is also supported by fossil records.

Another marker, Cytochrome oxidase I, has been identified as a genetic barcode for classifying and identifying lobsters. Using this barcode, scientists detected the presence of *Thenus indicus*, on the east coast. This lobster species was previously assumed to be rare in that area.

The study provides information on the genetic evolution of Indian lobsters and a genetic barcode for the accurate identification of lobsters even in their larval stages. In the near future, we can use this barcode to identify our lobster before it appears in a plate for the delight our palette.

It will also open new avenues in the research of larval transport and dispensation. The tools used in the study for analysing the evolution and biogeography of these valuable creatures are applicable for other species.

Mitochondrial DNA A. DNA Mappseq. Anal. **27**(4): 2700–9

Rinderpest Widening its Host?

From ruminants to dogs!

In veterinary clinics, we often find ruminants such as goats, cows and buffaloes suffering from commonplace ailments such as fever, mouth sores, diarrhoea and pneumonia. However, there are also cases which are not so benign. A deadly viral disease: *Peste des petits ruminants* (plague of small ruminants), commonly known as Rinderpest, leads to a high mortality rate in cattle.

The Rinderpest virus belongs to Paramyxoviridae which has a tendency to change host. Has Rinderpest extended its host range in India? Perhaps, yes, claim Ratta and his group from the Indian Veterinary Research Institute, Bareilly, and the College of Veterinary Science and Animal Husbandry, DUVASU.

They were screening three pet dogs suspected for *Canine distemper virus* using microarray. Surprisingly, they found them to be positive for Rinderpest also. They cross-checked the results with a

polymerase chain reaction test. Sequence analysis of the genomic content showed a close relationship to Rinderpest strains reported from India.

There were reports of an Asiatic Lion from an Indian zoo that became positive to Rinderpest due to intake of infected meat. So it is possible that dogs fed with rinderpest-infected goat or sheep meat may become positive to rinderpest. Further investigation of serological data is needed to prove that dogs do get infected by the Rinderpest virus. However, the findings should alert us: is the Rinderpest virus expanding its host range from ruminants to dogs? If that is the case, preventive measures must be undertaken to arrest the spread of the virus to domestic pets.

Curr. Microbiol. **73**(1): 99–103

Wheat Intensification

High returns from less input

Wheat is an important crop in India. Prevailing agricultural practices depend on heavy input of seeds, fertilizer and water. And yet, the wheat yield is declining by more than one per cent every year. Dhar and team from IARI, New Delhi, suggest a new method, known as the System of Wheat Intensification, for overcoming the problem.

In this method, land preparations start at least 15 days before sowing. Compost is treated with beneficial microbes such as *Trichoderma*.

Only 25 kg of quality seed need to be used per hectare instead of 100 kg per hectare. Seeds are soaked for 6–8 hours in a mixture of compost, cow urine and jaggery in warm water. The seeds are sprouted by wrapping in cloth and keeping in the shade for about 10 hours. Sprouted seeds are sown in the field with a spacing of 20 × 20 cm.

After a week, urea is applied followed by vermicompost and phospho-bacteria. If there is no rain, the field is irrigated 15, 30 and 60 days after sowing. Fourth and fifth irrigations are given at flowering and at grain-filling stages.

Scientists have shown that adoption of the wheat intensification system reduces use of seeds, water, fertilizer, land, labour, and capital while providing higher yield as compared to the standard method of wheat cultivation. Extension

workers and educated farmers may follow soon.

Arch. Agron. Soil Sci. **62**(7): 994–1006

Rice Husk To Combat Pollution

Wonders from agricultural waste!

Industrial and agricultural activities inject large quantities of pollutants like heavy metals, pesticides and herbicides into aquatic ecosystems, posing a threat to public health and aquatic life. Scientists are now looking for ways and means to remove pollutants from aquatic ecosystems. Abigail and Chidambaram, VIT University, Vellore, have now developed bio-nanosorbents from rice husk to remove a commonly used herbicide, 2,4-dichlorophenoxyacetic acid, from aqueous solutions.

The scientists evaluated the efficiency of nano-rice husk in removing the herbicide under different environmental conditions. Maximum removal of herbicide is reported in slightly acidic conditions. 1.5 g of nano rice husk can remove 77 mg of the herbicide from a solution of 100 mg per litre in one hour at 30 degrees centigrade. The presence of functional groups such as amino, carbonyl, hydroxyl and silica on the surface of the biosorbent influence the kinetics of adsorption.

Rice husk is available in plenty, as India is one of the largest producers of rice. At present, rice husk is used only for brick making and as fertilizer, insulating material and fuel. Scientist say, that apart from these uses, rice husk can now be used in the production of an effective biosorbent for removing a toxic herbicides from water bodies.

The use of bio-nanosorbents in water treatment is cost-effective and eco-friendly compared to other methods. The day is not far when nanobiosorbents, made from rice husk, will enter the market for removing pollutants.

Ecological Engineering **92**: 97–105

Biogas from Paddy Straw

The price of LPG may rise due to its limited reserves on earth. But don't worry! We have other sources of cooking gas such as biogas. Anaerobic microorganisms act on animal dung to produce methane gas, an energy source. But the availability of dung is limited. So scientists have been trying to use

agricultural waste, such as paddy straw, in biogas tanks, to increase the production of biogas.

Rice is a staple food of India. It produces more straw than grain. But high lignin and silica content in straw makes it unsuitable for biogas generation. In the last fortnight, Karamjeet Kaur and Urmila Gupta Phutela, from the Punjab Agricultural University, Ludhiana, provided a solution. They report a technique to make paddy straw more suitable as raw material to produce biogas.

Before it is added to the biogas tank, the paddy straw is soaked in a 4% solution of sodium hydroxide for one day. It is then irradiated by microwave radiations for half an hour. This reduces the lignin and silica content in the straw by 65 and 88.7% respectively. The straw is now ready for use in biogas generation. Biogas production can be doubled, using this pre-treated rice straw.

This technique can also be applied for other such agricultural wastes and can also be made suitable for biogas generation. If the technique is adopted widely, we can become less dependent on fossil fuels and also make good use of agricultural wastes.

Renew. Energy **92**: 178–184

Carbon Dots

Sensitive detectors of pollution

Nanoparticles have been put to myriad uses ranging from medicine to agriculture to industry. They have emerged as a panacea for all ills including water pollution.

Trace metal pollution of water is a rising problem in India that needs to be tackled on a war footing. Arsenic contamination poses several health risks, while glutathione, an essential endogenous antioxidant, is harmful in excess.

Now, a team led by Gupta, IIT Mandi, has developed a green and economical method for the synthesis of fluorescent carbon nanoparticles to detect aqueous pollutants. Carbon dots are synthesized by microwave assisted pyrolysis of citric acid and sodium thiosulphate. The dots are ultra sensitive and highly selective. Experiments confirm their usefulness as probes for the fluorescent detection of arsenic in potable water and glutathione in biological fluids.

Yellow precipitation and extensive fluorescence quenching of the dots confirm the presence of arsenic and glutathione. This transformation can be detected with the naked eye and has immense potential to identify contaminated water. The nanoparticles can also be used to photo image bacterial nucleoid segregation.

Imagine! To be able to easily test the water you drink!

Biosens. Bioelectron. **81**: 465–472, 2016

Roots To Rout Out Dyes

Scientists make besharam proud

Our daily lives are coloured by a huge variety of dyes, from the clothes on our backs to the food on our plates.

Little do we realize the threats these colour-imparting chemicals pose to our health and the environment. Cleaning up the contaminated environment is a crucial and challenging task. With the advent of biotechnological tools, the task is made easier.

A team of scientists from the DBT-ICT Centre and the Amity Centre for Biotechnology, Mumbai, decolourized 25 textile azo dyes using cultured hairy roots of *Ipomoea carnea*, commonly known as *Besharam*. A model dye, AR 114, was chosen as it is almost completely decolourized. The degradation products were identified using spectroscopic techniques.

The researchers conducted cytotoxicity tests on human skin cell line to make sure of the non-toxicity of the degraded products. Thus, the team demonstrated how the cultured roots of a common weed can detoxify a potent carcinogen.

These plants, found around shallow ponds along railway tracks and marshy commons may, perhaps, become a common component of effluent treatment 'plants', to brighten up our textile cities.

J. Hazard. Mater. **311**: 158–167, 2016

Remote Sensing: Evapotranspiration

Potential evapotranspiration is a measure of the ability of the atmosphere to remove water from the surface of the earth. This factor influences the earth's climate. Estimation of evapotranspiration is, therefore, very important when

designing models for hydrological or atmospheric processes.

Evapotranspiration generally shows a positive correlation with the incoming solar radiation throughout the day. And though remote sensing can provide us a proxy measure of evapotranspiration, scientists have been unsure of the satellite derived data.

P. K. Srivastava from the Banaras Hindu University has collaborated with researchers from leading universities in the world to test the accuracy of the satellite derived evapotranspiration data by comparing it with *in-situ* data. They used the data from the Spinning Enhanced Visible and Infra-Red Imager (SEVIRI) sensor in the European Space Agency's satellite, which provides short-term weather forecasts for Europe, Africa and the Atlantic and Indian Ocean. *In-situ* measured data was collected from ground stations in the Mediterranean and temperate climate zones. These scientists have checked the accuracy of the satellite derived data, comparing evapotranspiration data from SEVIRI with *in-situ* ground station measurements. Strong correlation between the two data sets is observed in summer and autumn. The study confirms that land use and fractional vegetation cover are important factors in controlling evapotranspiration.

Better spatial resolution of the satellite data and proper field validation are the key factors in determining the accuracy of weather prediction. Scientists say that satellite data with minor corrections can reveal the rate of evapotranspiration in water-limiting environments. This technique can also be confidently used in water resource management.

Int. J. Appl. Earth Obs. Geoinf. **49**: 175–187

Forests, Fields or Flats?

Forecast for Western Ghats

UNESCO has declared the Western Ghats a world heritage site for being a biodiversity hotspot. Every week, we read about the discovery of new species in the Ghats. And yet, the controversies about the Gadgil and Kasturirangan Reports refuse to die down. Enter remote sensing to provide more data.

Manish Kale from the Centre for the Development of Advanced Computing, Pune, collaborated with scientists in ISRO and other institutions recently, to assess crucial questions related to forests and human activity in the Ghats. Using the 1985, 1995 and 2005 data from LANDSAT, the Indian Remote Sensing Satellites and available socioeconomic datasets, they extracted trends in the different categories of land use. They also developed statistical models to predict changes in forest cover.

As expected, forest areas declined and residential and industrial areas expanded in this period. Surprisingly, the rate of forest degradation has decreased during 1995–2005 compared to the rate between 1985 and 1995.

The scientists conducted field surveys and collected field data. The predicted forest cover matched well with the field sample data of 2005. They used these predicted values and data to arrive at predictions for 2025.

The study is an early attempt to predict rates of change in land use categories at the taluka/tehsil level. The overall forest cover is projected to shrink. Cultivated areas in the northern part of Ghats and plantation areas in the southern parts will increasingly give way to residential and industrial construction. The distribution of land use at higher elevations, however, will remain constant.

The paper, however, does not compare the 2015 projections with satellite data. The scientists express the need to develop 2015 datasets for all the variables involved, along with economic and policy factors.

Local data and predictions can help to calibrate decision-making. But will it clear the muddy waters around the Western Ghats?

Environ. Monit. Assess. **188**: 387

Reports by Saravanan Paramasivan, Mahadeva Swamy, Rajashree Ramaswamy, P. Thiruchenthil Nathan, Manali Datta, Mona Kejariwal, Anthony Johnson, Ratna Prabha, Mary Teresa Miranda, Rikha Warriar, Bobby Mathew, Chitti Bharatkumar, R Ramasubramanian, Prateek Shilpkar and Anish Mokashi

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