Science Last Fortnight

Acid Test for Treatment

Emperor of Maladies

Cancer is one among the top ten causes of morbidity and mortality in the world. Conventional chemotherapy for cancer has adverse side effects. Scientists have been evaluating natural compounds for drugs which effectively control cancer without any side effects. One such compound is boswellic acid, obtained from the Indian olibanum tree, *Boswellia serrata*.

Boswellia has been used in traditional medicine for various ailments. The gum resin of this plant (Shallaki) contains boswellic acid. Boswellic acid is known for its anti-inflammatory action and has been used in arthritis.

Nand Kishore Roy and his research team from the IIT Guwahati, in collaboration with the Cancer Research Institute of Singapore, did clinical trials on boswellic acid to screen for its effect on symptoms developed due to cancer therapy. They administered boswellic acid to young people diagnosed with intracranial tumour. There was no side effect during the 9 month period of treatment. Five children showed improvement in their general health status. They found that the treatment is useful in reducing the oedema associated with brain tumours.

They report that a cream containing boswellic acid is useful to reduce the radiation induced adverse effect on skin in breast cancer patients. Boswellic acid application significantly reduced the oedema in the skin caused by radiation.

The main constraint in using boswellic acid for treatment is its poor bioavailability: it gets degraded very quickly. They suggest two alternative approaches to solve the problem: (1) delivering the drug through nanoparticles, adjuvants or liposomes and (2) developing structural analogues of boswellic acid to enhance bioavailability.

Cancer Letters, **377**(1), 74–86

Abrus – A Hope for Breast Cancer

With changing lifestyles, women are becoming increasingly vulnerable to breast cancer. It is the most diagnosed malignancy in India. It is also the cause of the largest estimated cancer deaths worldwide. Scientists are now investigating biological molecules to change the cell processes that cause malignancy.

Now, a team of scientists from NIT, Rourkela and IIT, Kharagpur, India, in collaboration with the Virginia Commonwealth University, have demonstrated that agglutinins – proteins that bind to carbohydrates – from the seeds of *rati*, *Abrus precatorius*, a medicinal plant, is efficient against breast cancer.

The scientists found that it inhibits cancer cell multiplication by generating cell death proteins. It simultaneously triggers the generation of reactive oxygen species. The protein, thus, destroys the cancer cells through a two-pronged approach.

The lectin also inhibits the formation of blood capillaries. This stops the cancer cells from proliferating into tumorous growth. This, in turn, further inhibits the ability of the cells to generate new capillary blood vessels.

Scientists say that abrus agglutinins can selectively target human breast cancer cells. These results would enable scientists to adopt a multidimensional approach for battling breast cancer.

Int. J. Cancer, **139**(2), 457–466

Dengue Virus microRNAs

New therapeutic arsenal

The dengue virus causes widespread haemorrhagic fever, morbidity and mortality globally. As many as 400 million people are infected yearly. But there is no specific treatment for dengue. The virus has a compact genome and this poses a challenge to the scientific community in trying to find ways to control the disease.

Kakumani and his team from New Delhi and Faridabad started exploring the role of host miRNAs in dengue replication and pathogenesis. The researchers succeeded in identifying a factor, Glucose Regulated Protein, which is involved in the processing of the small RNAs. Silencing of this protein in human cell lines results in accumulation of dengue viral RNA. Thus the protein restricts dengue replication in human cell lines. The results also reveal that there is a small RNA, called Hsa-mir-126-5p, which directs dengue replication in human cell lines. This discovery suggests that microRNAs might be a potential target against dengue viruses.

This research is evidence enough to support the idea that the RNA interference machinery of the host acts as an antiviral defence mechanism in human cell lines. Since host-derived miRNAs have antiviral activity against many viral infections, miRNA-based therapies may soon be a part of the treatment for a variety of diseases.

Gene, **586**(1), 7–11

Dermal Drug Delivery

Deep rooted solution

Popping pills is a common way to consume medicines. The ingested drug is absorbed into the bloodstream which transports it to the site of infection. But this strategy is ineffective for deep rooted skin infections. Due to low penetrability, it is extremely difficult to deliver drugs to a site within the skin. Scientists are now trying to solve this problem using nanoparticles that can seep into the skin. In the last fortnight, Prasad, from the University of Delhi, in collaboration with researchers in the University of Berlin, reported creation of one such drug delivery model.

Prasad and his team made use of amphiphilic branched shells: spherical nanoparticle shells having both hydrophobic and hydrophilic chains. Such shells have been coupled with a branched polyglycerol core in the past to solubilize water insoluble drugs. Branching serves to trap greater amount of drug.

The researchers synthesized two extensively branched polymer cores by linking polyglycerol with different organic acids. They created three such drug delivery systems which were tested for drug entrapment, skin penetration and toxicity.

The core multi-shell systems are 11 times more efficient in penetrating skin compared to a base cream formulation and exhibit negligible toxicity at a low concentration. Scientists are confident

that efficient drug entrapment and minimal toxicity will make their model commercially viable.

doi: 10.1016/j.polymer.2016.04.074

Ion Passage Restricted

pH gating of toxic pores

Bacteria have an assortment of tricks for attacking the human body. One particularly interesting strategy is the release of toxins that self-assemble to form pores. These integrate with the plasma membrane of the target cell and disturb the osmotic balance leading to cell death. A group of scientists from the Indian Institute of Science, Bengaluru, headed by Maiti, has devised a strategy to block these pores by introducing protonated gates.

Maiti's team tested dendrimers a class of hyperbranched polymers, as pore blockers. They used molecular dynamic simulations to study the efficiency of polyamido-amine dendrimers as pore blockers for Cytolysin A – a toxin released by *E. coli*.

Scientists observe that protonation could cause extensive branching between the dendrimer and the negatively charged pore walls which retard its approach into the pore lumen. The positively charged protonated dendrimers also disturb the potassium ion gradient. While both non-protonated and protonated dendrimers can block the passage of water to a similar extent, protonated dendrimers are 3 times more effective than non-protonated dendrimers in blocking ion transport and can inhibit more than 90% of ions from being transported through the pore. This strategy can be used to devise new therapeutics for bacterial infections.

Nanoscale, **8**, 13045–13058

Shrimp Skeleton to Treat Wounds!

Most wound dressings are designed to hasten the process of healing. But cosmetic requirements demand scar-free healing. Thus, an ideal wound dressing should be antibacterial, skin friendly, capable of absorbing moisture and exudates. And it should be easily removable without reopening the wound.

Bhuvanesh Gupta and his team, from IIT Delhi and Jamia Hamdard, have synthesized a 'wound dresser', a combination of chitosan, polyethylene glycol and polyvinyl pyrrolidone gel, smeared on cotton fabric. There is enough evidence in the literature about the use of chitosan in treating inflammation and obesity. Polyethylene glycol, a water soluble polymer, has good absorption properties and polyvinyl pyrrolidone is a major component of butadiene. The composite has a porous structure enabling easy air passage and could absorb water.

The 'wound dresser' was tested for drug release potential. The drug, tetracycline, was released within 48 hours and maintained an antibacterial action over an extended period. It was effective against *Staphylococcus aureus*, an infectious bacteria. Wound healing properties were effective for 21 days with minimal scarring. Thus, the discovery may enable effective scar free wound healing and aid cosmetic surgeries.

Int. J. Pharmaceutics, **508**(1–2), 92–101

Waste Cooking Oil as Biodiesel!

Scientists from the Indian Institute of Technology, Kanpur and the Korea Advanced Institute of Science and Technology, are now suggesting use of waste cooking oil as a fuel. They conducted experiments for a comprehensive investigation of the spray and combustion characteristics of waste oil.

Technically, waste oil exhibits a larger injection delay and higher injection rate peak than diesel, possibly because of its higher fuel viscosity and density. A decrease in flame intensity and visible flame was observed.

Reduction in harmful exhaust emission is evident for waste oil. Carbon monoxide, hydrocarbon and smoke emissions declined. However, nitrous oxide emission was higher, compared to diesel. So, perhaps in the near future, we may start using leftover of kitchen oil for driving our car.

Fuel, **176**, 20–31

Pollution-free Leather Industries

Next generation greener dyes

Leather industries discharge effluents containing large amounts of synthetic dyes. In recent years, 30% of the leather industries were closed due to charges of environmental pollution.

To become more sustainable, textile industries started using plant and microbial based eco-friendly dyes to reduce pollution. Microbial based dyes are easy to handle, more easily biodegradable. They are also more efficient and inexpensive. Moreover, large-scale production of these dyes is not difficult.

In the last fortnight, Priya and her team from the Central Leather Research Institute, Chennai, reported developing an eco-friendly protein dye using recombinant technology. The team cloned the genes responsible for the green fluorescent protein from a jellyfish.

The protein-based fluorescent pigment of the jellyfish has biochemical characters similar to microbial dye. Three adjacent amino acids are responsible for the green fluorescent colour. It is also possible to alter the colour by mutation. The fluorescent protein is very stable to heat, extreme pH and chemical denaturants.

Two variants of the green fluorescent protein obtained from the recombinant technology showed more than 85% dyeing efficiency. Optimum level of dyeing is observed in 4 hours with 5 μM protein concentration. The intensity of dyeing, colour difference values and characteristics of leather coated with the fluorescent proteins show that they can be used as an environment-friendly dye.

Green fluorescent proteins will go a long way in making future leather industries cleaner and greener!

J. Cleaner Production, **126**, 698–706

Corrigendum

In the last issue, we had reported in this column, about the possibility that PPRV, a virus that infects small ruminants may be extending its host range to dogs. A regrettable error was made in calling the disease rinderpest. Rinderpest, a disease that infected cattle has been eliminated from the world. PPRV is a distant relative, but they are not the same.

Reports by **Sarah Iqbal, Mary Teresa Miranda, Ratna Prabha, Rekha R. Warrier, Manali Datta, Mona Kejariwal, R. Ramasubramanian, P. Thiruchenthil Nathan, Saravanan Parameswaran** and **H. M. Mahadevaswamy**.

scienceandmediaworkshops@gmail.com