

Science Last Fortnight

Arjuna Tree Bark Extract Relief for heart failure patients?

Presently, one in 1000 people suffers heart failure. Its prevalence is growing at 10% every year. Subir Maulik from AIIMS, New Delhi, has now tested a well known Ayurvedic remedy using the methods of modern medicine to reduce congestive heart failure.

Terminalia arjuna, is well known for its ability to enhance muscle contraction, anti-oxidative, anti-ischemic, antihypertensive and anti-hypertrophic properties. This plant is widely used in folk medicine for the treatment of heart diseases in humans. But there has been no concerted effort to scientifically validate its use.

Maulik's team utilized aqueous extracts from the dried stem bark of Arjuna with water. After clearance from the ethical committee, the extracts were tested on 100 heart failure patients. Experimental setup of double-blind and randomized methods under clinical trials were executed with a placebo as control. They also considered the patient's history of the left ventricular region, gender, age, physical fitness and so on. Different tests were conducted to monitor the tolerance of patients to the extract. The treatment had twice a day regime and continued for twelve weeks. The scientists found that the quality of life of the patients improved slightly. Antioxidant activity increased as evidenced by the increase in enzymes like RBC-superoxide dismutase, catalase, glutathione, plasma cytokines and other oxidative stress markers.

There was some symptomatic relief related to heart attack indicators. These outcomes acted as a proxy to the expected performance in the ventricular region. However, in the long term, this was not significant. There was not enough evidence to support the long survival of patients undergoing the treatment. Thus, the study challenges the well-entrenched claim about the efficacy of *Terminalia arjuna* to prevent congestive heart failure. However, survival benefits and functional capacity of the heart and survival period need further well-planned and detailed monitoring.

No doubt the Arjuna tree has an inherent medicinal and therapeutic benefit. This makes it worthy of investigation under specific subgroups of patients. Perhaps, positive outcomes from anti-oxidative reserves could be a better target for future research.

Phytomedicine, **23**, 1211–1219

Weeds to Weed out Bacteria

A wonder drug of its time, Penicillin, was accidentally discovered by Alexander Fleming in 1928 from a mould that killed bacteria. It soon became popular as it cured deadly infections. But in a few decades, it became ineffective as bacteria became drug resistant. Finding new antibiotics has become a continuous challenge for scientists.

Researchers in the Cochin University of Science and Technology have now isolated new antimicrobials from six species of seaweeds from the coasts of Kerala, as crude water-soluble extracts. They found that these antimicrobials are phycosugars (phycos: seaweed or algae). Phycosugars are different from common sugars in being sulphated. Phycosugars kill a wide variety of bacteria and have antioxidant properties. Scientists found that they were as effective as Tetracycline and Chloramphenicol, but less toxic and more cost effective.

For over eighty years, scientists across the globe have been struggling to find new antimicrobials. With seaweeds to our rescue, it could now be reality.

Carbohydrate Polymers, **151**, 584–592

Better Plastics

We have been using plastics for more than 100 years now. They seem to be irreplaceable because of long shelf life and high durability. Sadly, plastics pollute the environment because most plastics are non-biodegradable and cannot be managed by recycling.

A ban on plastics could be a short term solution but bioplastics will perhaps be a longer term solution. However, bioplastics are costly, have lower strength and higher water absorption.

Researchers at IIT Kanpur have improved bioplastics by changing a method of cross linking them. Cross

linking is the same method that hardens rubber; the more bonds a plastic has, the more its strength and durability.

The new method uses easy-to-get, eco-friendly and water soluble citric acid as the cross-linker for agarose. The research team has filed a patent to claim exclusive rights for using and selling the method because it is new and useful.

Carbohydrate Polymers, **151**, 60–67

Uranium Remedies in Jaduguda

People in uranium mining areas like Jaduguda, Jharkhand are exposed to radiations from radioactive uranium. This causes genetic mutations and diseases. Removing minor amounts of uranium from soil is not economically feasible with the available physico-chemical methods.

Uranium accumulation has been recorded in terrestrial and aquatic plants. It is usually fixed in the roots of plants grown in older mining areas. Although it is naturally present in plants in small quantities, uranium has no known functional role in plant nutrition. The absorption of uranium by plants is dependent upon the degree of contamination in the soil and water, pH, temperature, soil ions and organic matter content.

Scientists at the Periyar University, Salem, Tamil Nadu and the Calcutta University in collaboration with scientists in other countries, explored aquatic as well as terrestrial plant species systematically using fluorometry. They found significant variation in absorption and accumulation of uranium between different plant species and also between different organs of the same species.

The maximum accumulation was in roots followed by leaves, stem, flowers and fruits. They found the concentration to be greater in terrestrial plants like *Integrifolia* than in aquatic species such as *Riccia fluitans* and *Lemna minor*. Terrestrial plants have much longer root systems with fibrous adventitious roots covered with root hair. This creates more surface area and leads to higher accumulation of trace elements in roots.

This study opens up the possibility of using such terrestrial plants to clean up uranium from the soil. However, the

plant biomass would now contain excessive uranium, caution the scientists. Methods for safe disposal of the uranium so accumulated by plants need to be explored further.

Sci. Total Environ., **568**, 350–368

Controlling Chromium

PANI: a ray of hope for Odisha

Rub a comb on your dry hair: it can now pick up bits and pieces of paper. Using this simple principle of electrostatic attraction, scientists from the Harisingh Gour University, have prepared a nanopolymer which can separate lethal hexavalent chromium from drinking water.

Chromium primarily exists as trivalent chromium which is not dangerous and does not contaminate water. On the other hand, hexavalent chromium is highly toxic. Drinking water containing hexavalent chromium above the permissible limit of 0.05 ppm, lead to skin irritation, lung cancer, stomach ulcers, and kidney, liver and gastrointestinal tract damage. About 85% of deaths were caused by chromite-related diseases.

We often find silica gel in shoes and electronics boxes. Here the silica gel acts as a drying agent that adsorbs moisture. Likewise, scientists prepared a nanopolymer composite of polyaniline (PANI) and graphene on the surface of magnetic nanoparticles. They demonstrated that the combined effect of electrostatic interaction and electro-reduction of this polymer could adsorb hexavalent chromium effectively from water. The new composite could also convert most of the hexavalent chromium to trivalent chromium. Through this method, they removed 86% of chromium from contaminated water, in just 20 minutes.

The method is easy. The polymer could be produced in bulk and stored in a powder form. After removal of the contaminant, the polymer powder could be easily removed from the water. The user-friendly and cost-effective nature of this technique makes it special as compared to sophisticated water treatment processes.

In chromite mining areas like Sukinda in Odisha, 60% of the drinking water contains hexavalent chromium. Effluents can now be treated with this method to reduce the levels of chromium to per-

missible levels before discharging it into water bodies. This could prevent ground-water contamination to some extent.

Recently, BARC has developed a toolkit for onsite determination of hexavalent chromium in drinking water and groundwater. These two findings could, perhaps, go hand in hand to solve major contamination problems in chromite mining areas.

J. Appl. Polym. Sci., **133**(39), 44002

Polyol from Tobacco Stems

New source for polyurethane

Polyol is a raw material to make polyurethane, an inevitable plastic in this age. It is used in the production of flexible and rigid foams, coatings, sealants, elastomers and adhesives. The polyurethane industry is presently dependent on the petroleum industry which provides two major feedstocks – polyols and isocyanates. The polyurethane industry is unstable because of depleting petroleum resources and increasing costs of petroleum processing. This is forcing the industry to explore the possibility of production of polyurethane from renewable sources.

Now, M. P. Chirag and others from the Sardar Patel University, Gujarat, have new source of polyol: tobacco stems, a waste material that is usually burned. They liquefied tobacco stalk using crude polyhydric alcohol, an organic solvent. Then they used castor oil in the presence of lithium hydroxide to get polyol. It was further tailored to the required –OH value for improved mechanical and chemical properties by adding natural oil or synthetic diols.

They then synthesized polyurethane foam from these bioderived polyols. The characteristics and physical properties matched the marketed foams. The thermal conductivity, thermal stability and morphology were also similar to marketed foams.

The study marks the beginning of high quality rigid polyurethane foams derived from renewable, comparatively less expensive materials.

J. Appl. Polym. Sci., **133**(38), 43974

Gaseous Fuel Efficiency

Reducing vortices

IIT scientists in a study funded by ISRO are experimenting with the laminar burning velocity of methanol with air.

Laminar burning velocity is related to the different layers of liquids. How they glide over each other. This velocity is an intrinsic property of any combustible mixture. If they glide smoothly, combustion is better, but, under high pressure, liquids do not glide in a linear fashion. Some eddy currents are formed which lead to imperfect combustion of fuels. These unburnt gases have their own velocity. This difference between the velocity of burnt and unburnt gases gives birth to eddy currents. Scientists are facing the problem of controlling these eddy currents.

This experiment provides a solution to this problem. If combustible liquids are burnt under specific ratios of pressure and with varying external temperature, there are less unburnt gases. This technology is also effective in the case of liquid propelled rockets. Because of the high pressure of liquids the same problem occurs in burning. Laminar burning velocity is determined using mass balance between the channel inlet and flame stabilization location for the planar flames appearing at certain conditions of mixture flow rate and equivalence ratio.

The scientists optimized the ratio between the fluid pressure and the nozzle to reduce eddy currents. They used quartz material channels because they have high heat resistance. And it is easy to create narrower inlets with quartz. The diverging portion of the channel was externally heated using a sintered metal burner to generate a steady linearly varying temperature gradient in discrete mixture flows. The initial result of this experiment has given hope for future clean burning.

The burning of fossil fuels is a prominent issue all over the world. Now scientists are working on technologies to address this issue, to reduce pollution.

Fuel, **182**, 57–63

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