R.N. 70269/98
ISSN : 0972-169X

Postal Registration No.: DL-SW-1/4082/15-17
Date of posting: 26-27 of advance month
Date of publication: 24 of advance month

Vigyan Prasar

DREAM 2047

July 2017 | Vol. 19 | No. 10 | Rs. 5.00

Editorial: What an Excellent Set of Editorials! 35

Intelligence of the Other Kind 34

Treating Prostate Cancer with Nutraceuticals 31

'Machli': The Queen of Ranthambore 28

Tennis elbow — Causes, diagnosis and treatments 26

Recent developments in science and technology 23

Report on National Science Film Festival 20

... think scientifically, act scientifically... think scientifically, act scientifically... think scientifically, act...

EDITORIAL

What an Excellent Set of Editorials!

Dr. R. Gopichandran

I have the opportunity of citing the reference "TIME 85 years of great writing" edited by Christopher Porter, once again. This was published nearly 10 years ago by TIME Inc., New York. The 85 years of editorial eminence presented by the book brings undiluted joy in reading and learning about communication. 10 editorials are covered under Frontiers of Science and Medicine. The historical perspective and the nuances of excellence on the frontiers of the subject areas make for invaluable learning. Interestingly the other titles include "The National Experience", "The Global Arena", "All Business", "The Arts Scene" and the "Social Fabric" in particular. A comprehensive reading of these editorials inspires me to think that it may not after all be possible to look at science technology and innovation as stand-alone elements. On the other hand they have to be viewed in the context of the topics stated. Any communicator worth his/her efforts must make sure they read and learn from this publication. I am prompted to ask TIME Inc. if it will be useful to help us with more recent insights; 2008 onwards. It could probably make for an interesting comparative analysis.

Going ahead; I am sure many of us face a strange problem while handling our smart phones. It is about the tendency of the phone to propose words depending on the first few letters of the word we wish to present. Embedded knowledge projects itself almost as a drastic interference on our thought process and often compels us to correct and re-construct the word we wanted to. This is a subtle manifestation of a problem of embedded knowledge systems that may or may not respond to the timeliness and the cultural context of the words and therefore our thoughts. I wish to ask if this is also an indicator of the predicament we face when we wish to communicate even about science technology and innovation. It is more likely that receivers of information also process it only within the context of their own embedded knowledge systems. In this context the communicator and receivers of information may actually end up miscommunicating with each other. Embedded knowledge systems should therefore be robust and versatile enough to assist the communicator with corrections only if needed or asked for and not impose alternatives. Science communication is more importantly aligned with resilience and the preparedness to accommodate others points of view. Am I finally right or wrong in asking for a direct link between the values of science and human values that have to be practiced by communicators?

Since science stands for truth, I believe communicators should also have the wisdom to imbibe and practice only truth and therefore foster the agenda of science and not their own personal agendas.

Email: r.gopichandran@vigyanprasar.gov.in ■

Editor : R Gopichandran
Associate editor : Rintu Nath
Production : Manish Mohan Gore and Pradeep Kumar
Expert member : Biman Basu
Address for correspondence : Vigyan Prasar, C-24, Qutab Institutional Area, New Delhi-110 016
Tel : 011-26967532; Fax : 0120-2404437
e-mail : info@vigyanprasar.gov.in
website : http://www.vigyanprasar.gov.in

Published and Printed by Manish Mohan Gore on behalf of Vigyan Prasar, C-24, Qutab Institutional Area, New Delhi - 110 016 and Printed at Aravali Printers & Publishers Pvt. Ltd., W-30, Okhla Industrial Area, Phase-II, New Delhi-110 020 Phone: 011-26388830-32.

Intelligence of the Other Kind

Dipanjan Ghosh

Humans have five basic senses. But scientists have discovered that plants have at least 20 different senses used to monitor complex conditions in their environment. Plants can feel an obstacle through their roots within the soil or can hear waving sounds. Plants even show behaviours similar to sleeping and playing.

Introduction

Plants are the weaker creation of nature. Indeed, from all dimensions of life, this is a fact. Be it their immobility, or inability to break silence, or insufficiency to develop self-defence, among all types of living organisms, plants (Figure 1) are far behind their animal counterparts. However, according to the recent research, a new branch of botany, called plant neurobiology, has found that plants are intelligent and sentient. To most of us, the aforesaid statement may sound at best, unsupportive or at worst, crazy. But plant neurobiologist Stefano Mancuso of the International Laboratory of Plant Neurobiology in Florence, Italy argues that not only are plants intelligent and sentient, but that we should consider their rights, especially in the midst of the Sixth Mass Extinction.

We have long known that other than humans, chimpanzees, orang-utans, dolphins and elephants are thinking, feeling and personality-driven beings. Researches in recent decades have also revealed that many other animals are in the list; for example, octopuses can use tools, whales can sing, bees can count, penguins can apply mathematics, crows demonstrate complex reasoning, beavers can show engineering ability, paper wasps can recognise faces and fish can differentiate types of music. All these examples share one thing in common that all higher animals have brains. But how can plants solve problems, act intelligently or respond to stimuli without a brain?

The legendary naturalist Charles Darwin, who studied plants meticulously for most of his life, was one of the first scientists to break from the general belief and to recognise that plants respond more and more to sensation. Darwin also observed that the radical (the root tip) 'acts like the brain of one of the lower animals'. In Mancuso's

Figure 1: Plants drive many of the biophysical forces that make the Earth habitable for humans and all animals (Photo: Abhinava Mukherjee).

The author is a well known science writer, science communicator and nature lover. He is also one of the Editors of the journal '*Indian Science Cruiser*' published from Kolkata. E-mail: dpanjanghosh@gmail.com

words, We found the reflection of Darwin's notion: "Today's view of intelligence as the product of the brain in the same way that urine is (a product) of the kidneys – is a huge oversimplification. A brain without a body produces the same amount of intelligence of the nut that it resembles".

Panacea of plants

Everyday plants face many of the same problems as animals, though they differ significantly in their approach. Plants have to find nutrition and energy, reproduce and fend off predators. Intelligence is the ability to solve problems and plants are amazingly good in solving their problems. The lowest part of the plant may be the most sophisticated part of its body. Scientists have observed that roots do not flounder randomly but search for the best position to take in water, avoid competition and garner minerals. To solve their energy needs, plants called heliophytes, which can tolerate strong sunlight, turn to the sun or more appropriately move their branches towards light. Plants called sciophytes are able to grow through shady areas to locate light and many even turn their leaves during the day to capture the best light.

Some plants proceed in a different way in receiving nutrition and energy by preying on animals, including everything from insects to mice or even birds. In order

Figure 2: Countless tentacles topped with sparkling dots of sticky mucilage are usually employed to attract and ensnare insects in Sundew (Drosera burmannii) (Photo: Anirban Patra)

Figure 3: In Venus flytrap, the trap only shuts when the trigger hair is stimulated twice (Photo: Sarab Seth).

to do this, these plants have evolved alluring snares and rapid reactions to catch, hold and devour animal prey (Figure 2). There are at least 600 species of these insectivorous plants. The Venus flytrap (*Dionaea muscipula*) is the highest evolved among the insectivorous plants. The mechanism by which the trap snaps (Figure 3) shut involves a complex interaction between elasticity, turgor and growth. The trap only shuts when the trigger hair is stimulated twice. This is to avoid triggering the mechanism from dust and other elements brought by the wind.

By nature, plants do not attack opponents, but can defend self if the opponent attacks. However, plants are not capable of actively protecting themselves from animals. But they have evolved an incredible variety of toxic compounds to ward off predators. When attacked by an insect, many plants release a specific chemical compound that interferes with the insect's digestion, reproduction or otherwise kills the insect (Figure 4). For instance, tomatoes are frequently attacked by a number of enemies – insects and microbial pathogens alike. But they have a very effective and sophisticated defence system that has evolved over millions of years. When a tomato plant is attacked and wounded by plant-eating caterpillar, a small peptide (protein) called systemin is released at the site of the wound. At a target cell, the systemin interacts with a receptor, the equivalent of a radio antenna. The systemin signal is then amplified along a so called 'signal transduction pathway'. Ultimately, genes employed for defence are activated. These genes encode proteins that block digestive enzymes in the insects' guts. This reduces the growth of the attacking caterpillars, which begin to starve or move on to other plants. Such observations show that, not unlike animals, plants too, are prone to take revenge just like their capability to build up self-defence, however insignificant may it be!

The bursera tree (*Bursera schlechtendalii*) of North America drives away animals in a peculiar way. When any herbivore chews its leaves, a sticky pungent liquid is sprayed onto the face of the animal. As a result the marauding animal becomes perplexed and escapes. This type of action is known as 'squirt gun' mechanism. Actually the spray material is terpene. It is made in the trunk and branches and then transferred

Figure 4: This voracious Oleander Hawk moth (Daphnis nerii) caterpillar is not aware of the signal transduction mechanism of its host plant (Photo: Jitendra M Marathe).

to the leaves through resin ducts which are present within the leaves like a network of pressurized canals. This unique spray can shoot a target up to about 15 centimetre distance with a continuity of 3-4 seconds. In this sense plants are both tricky and thrifty.

A hushed communicator

Plants are wonderful communicators and can communicate in a wide variety of ways. The most well-known medium is chemical signalling. If a single leaf is attacked by an insect, then within a few seconds the

wounded leaf will send a chemical signal to the unharmed parts and the entire plant will get enough time to prepare for defence. Apart from that, plants also communicate via electrical signals and even vibrations. Many plants even warn others of their species when danger is near. Acacia trees produce tannin to defend themselves when they are grazed upon by animals. The airborne scent of the tannin is picked up by other acacia trees, which then start to produce tannin themselves as a protection from the nearby animals.

Recent researches have revealed that plants like the Yellow jewelweed (*Impatiens pallida*) recognise their close kin, reacting differently to plants from the same parent from those from a different parent. Among close relatives, the plants do not increase resource allocation to roots or leaves. Rather, they alter their morphology by increasing stem elongation and branching. This appears to be an example of the plants cooperating with kin by attempting to acquire needed resources without shading nearby relatives.

Here one may raise a question why some plants smell so good and others awful. The sweet fragrance of a jasmine or rose, or something less fascinating as the stench of rotting meat produced by *Rafflesia* or *Amorphophallus* flowers, is a message for pollinators. Actually, plants share a lot of information with neighbouring plants or with other organisms such as insects or other animals. Plants also harness animals in order to reproduce. Many plants use complex trickery or provide snacks and attractive colours to lure pollinators, communicating either through direct deception or rewards. New research finds that some plants even distinguish between different pollinators and only develop pollen for the best.

Having no sugar to tempt an insect to spread their pollens, orchids lure them with the scents of more rewarding flowers or mimic the appearance of potential mates. Flower of the orchid *Dendrobium sinense*, which lives on the Chinese island of Hainan, fools its hornet (*Vespa bicolor*) pollinator by issuing a volatile organic compound or bee pheromone that honeybees use to send an alarm. The discovery explains why the hornets, which capture honeybees to serve as food for their larvae, have been observed to literally leap on the not so gifted flowers, as the flowers offer no nectar. The compound that the orchids produce is a rarity even in the insect world and has never before been described in any plant.

Something brainy

Long ago, the legendary Indian biophysicist Sir J. C. Bose had shown that plants are endowed with feeling, in their own way. At present we know that plants can judge good and evil and that they retain the sense to discriminate what they like and what they don't. Each choice a plant makes is based on a calculation. Again, plants can sense a smell, can feel an obstacle through their roots within the soil or can hear waving sounds. Plants even show behaviours similar to sleeping and playing. Humans have five basic senses. But scientists have discovered that plants have at least 20 different senses used to monitor complex conditions in their environment. According to Mancuso, not only plants have senses that roughly correspond to our five, but they also have additional ones that can do such things as measure humidity or detect gravity and to sense electromagnetic fields.

Figure 5: Plants are built of a huge number of basic modules in the form of roots and leaves that interact as nodes of a network.

Bose also expounded on the 'nervous mechanism' of plants, i.e., the ability of plants to recognise and react to the surrounding environment. Though it has not yet been proved that the plants have any kind of nervous system, it is true that their physiological activities respond to diverse stimuli just as any other living organisms. This is why some scientists are keen to prove that the plants may have brains that prompt them to respond. Mancuso has found rising evidence that the key to plant intelligence is in the radicle or root apex. Mancuso and his co-workers recorded the same signals given off from this part of the plant as those from neurons in the animal brain. One root apex may not be able to do much. But instead of having just one root, most plants have millions of individual roots (Figure 5), each with a single radicle. And it turns out that Darwin was almost right all along.

So, instead of a single powerful brain plants have a million tiny computing structures that work together in a complex network. It may be better to think of a single plant as a colony, rather than an individual. Therefore, the destruction of one leaf or one root means the plant can still carry on. The strength of this evolutionary choice is that it allows a plant to survive even after losing 90 per cent or more of its biomass. In this respect, Mancuso has stated, "Plants are built of a huge number of basic modules that interact as nodes of a network. Having a single brain would make plants much easier to kill. Without single organ or centralised functions, plants may tolerate predation without losing functionality. This is why plants have no brain: not because they are not intelligent, but because they would be vulnerable".

Plants have rights

Since the age of Aristotle, we are well acquainted with the fact that plants are but living organisms. Based on the works of Darwin to Bose and the findings thereafter, the recent trends in molecular biology are keen to prove that plants retain their own feeling. They feel any excitement or transmit any pain response just like other living beings and even share altruism, a sense of fellow-feeling and unselfish behaviour that they extend to help other plants to survive and fight against odds. Then, why should plants have no rights? The Swiss government have passed the first ever Plant Bill of Rights

Contuned on page 27

Treating Prostate Cancer with Nutraceuticals



Girish Sharma, Charu Gupta and Dhan Prakash

In developing countries including India, prostate cancer is the fourth most prevalent cancer among elderly men. In India, the incidence of prostate cancer is most common in Delhi, Thiruvananthapuram, Kolkata and Mumbai. Several studies point to the influence of diet and lifestyle on the risk of developing prostate cancer.

Introduction

Second to cardiovascular diseases, cancer is becoming one of the leading causes of death worldwide. In 2012, global estimates of new cancer cases were 14.1 million while 8.2 million deaths occurred due to cancer. Lung and breast cancers are the most frequently occurring cancers in the world causing huge mortality in men and women respectively. However, in more developed countries prostate cancer in men and lung cancer in women are the leading causes of cancer death. Prostate cancer is the second most frequently diagnosed cancer in men, accounting for 15% of all the cancer cases. It is the most frequently diagnosed cancer in men. This variation in incidence between developed and developing countries could be attributed to use of different methods of prostate-specific antigen (PSA) testing for diagnosis. The test can detect even the latent, slow growing, and asymptomatic cancers thereby inflating the observed cancer incidence in developed countries. Therefore, in developing countries where PSA testing is not being used as widely, the incidence of prostate cancer is apparently low. Prostate cancer is the fifth leading cause of death across the world. In 2012, there were 307,000 deaths (6.6% of total deaths in men) worldwide due to prostate cancer.

Prostate cancer in India

In developing countries including India, prostate cancer is the fourth most prevalent cancer among elderly men. In India, the incidence of prostate cancer is most common in Delhi, Thiruvananthapuram, Kolkata and Mumbai. The burden of cancer is expected to grow all over the world and especially in the economically weaker countries due to increased migration of rural population to urban areas, rapid changes in lifestyle behaviours, faulty dietary practices, and other socio-economic reasons that are all directly associated with increased cancer risk. The major risk factors are age, race/ethnicity, genetic factors and dietary or lifestyle changes. Other factors include smoking, poor diet, lack of physical activity and reproductive changes. The risk of developing prostate cancer is directly proportional to age. More than 80% of all cancers are diagnosed in men over 65 years of age. It has been found that prostate cancers developing at a younger age behaved more aggressively. It is noteworthy to mention that for younger men (below 50 years of age), a low-grade and stage tumour that is detected early has a better prognosis than older men with the same grade and stage of tumour.

The other risk factor of acquiring prostate cancer is race or ethnicity. Its frequency of occurrence is higher in black men as compared to Caucasians and Asians. The reasons for this increased susceptibility in black men are not yet understood completely, although it has been suggested that this is due to inherent genetic factors. Mutations in BRCA1 and BRCA2 genes

Girish Sharma is with Amity Centre for Cancer Epidemiology and Cancer Research, Amity Institute of Biotechnology, Amity University, NOIDA, Uttar Pradesh. Email: sharmagi03@gmail.com
Charu Gupta and Dhan Prakash are with Amity Institute of Herbal Research and Studies, Amity University, NOIDA, Uttar Pradesh. E-mail: dpanjanghosh@gmail.com

are associated with risk of both breast and prostate cancer.The positive family history also leads to higher risk of cancer. Of all men affected with prostate cancer, about 10-15% men have a positive family history. Moreover, the risk of developing prostate cancer is significantly higher for men less than 65 years of age than those older than 65 years of age, having a positive family history of prostate cancer. It is also greater for men who have more than one first-degree relative with prostate cancer. However, in case of hereditary prostate cancer, the cancer is diagnosed at an early age (6-7 years earlier) than in non-hereditary cancer.

Dietary and lifestyle-related risk factors

The rise in the incidence of prostate cancer in the Asia Pacific region has been attributed to the influence of Western lifestyle habits and strong economic growth that has lead to higher average family incomes. The diet has shifted from traditional high-fibre and carbohydrate diet based on vegetable foods to a diet rich in processed or red meat and total fat content. This change was accompanied by the change to sedentary lifestyle and lack of physical activity. Together, these factors can contribute to increased risk of developing cancer. Several studies point to the influence of diet and lifestyle on the risk of developing prostate cancer. Positive association of animal fat (total and saturated), alcohol and high-calorie foods with prostate cancer have been shown by a substantial number of studies. Other dietary components that have shown positive association include red meat. As the mechanism of pathology of prostate cancer is not yet understood, several hypotheses have been put forth to justify the link between dietary components and prostate cancer risk. For example, meat, especially roasted meat, could be contributing to the increased risk by any one of the following three reasons:

Meat is roasted at high temperatures at which certain carcinogens (heterocyclic aromatic amines and polycyclic aromatic hydrocarbons) form in it.

Red meat is a rich source of zinc, an essential element for the synthesis of testosterone. As the levels of zinc elevate, levels of testosterone also increase, in turn increasing the risk of prostate cancer.

Diets rich in meat are generally deficient in anti-carcinogenic components found in plant foods.

Animal fats may raise the sex hormone levels thereby increasing the risk of adult cancers at sites sensitive to serum hormone levels, such as breast and prostate. Similarly, sedentary lifestyle and lack of physical activity as well as high Body Mass Index (BMI) have been correlated to the risk of prostate cancer. According to the World Cancer Research Fund (WCRF) and American Institute of Cancer Research (AICR), if exposures of poor diet, physical inactivity and obesity were eliminated, 16 % of the world's prostate cancers could be prevented, even when other risk factors remain unchanged.Smoking has also been linked to risk and prognosis of prostate cancer. It has a strong association with prostate cancer associated mortality

Symptoms and diagnosis

Usually, no proper symptoms are produced during the early stages of prostate cancer. However, sometimes mild symptoms similar to those of benign prostatic hyperplasia (abnormal increase in number of cells) are seen. These include frequent urination (especially at night), painful urination and difficulty in starting and maintaining a steady flow of urine, sense of not being able to empty the bladder, and blood in urine or semen. Rarely, symptoms such as pain in hips, pelvis, back and other bony areas occur when the prostate cancer has metastasised to the surrounding bones. This is known as metastatic prostate cancer. Benign and malignant tumours in the prostate can be diagnosed by different invasive and non-invasive techniques. Non-invasive diagnostic methods include PSA testing, MRI, CT-Scan and transrectal ultrasound (TRUS). While invasive techniques include digital rectal examination (DRE) and a needle biopsy.

Treatment

Treatment options for prostate cancer include radical prostatectomy, radiation therapy, and low-dose rate brachytherapy, hormone therapy (androgen deprivation therapy), combined androgen blockade and chemotherapy (Docetaxel, Cabazitaxel, Enzalutamide, and Abiraterone). The treatment chosen by the physician would depend on the stage of the disease. Surveillance, prostatectomy and radiation therapy are suitable for Stage I to Stage III cancers, while for Stage IV disease and high-risk Stage III cancers, androgen ablation is the preferred treatment.

Limitations of conventional treatment

Even though these agents have been approved by the FDA as the primary treatment, they are associated with toxicities and can lead to problems such as oedema, neutropenia, sensory neuropathy, hyperkalemia, transaminase increases, hot flashes and cardiovascular toxicity including hypertension, atrial fibrillation and cardiac events. Moreover, these methods are expensive with a possibility of multi-drug resistance and time consuming. To alleviate the limitations of the above-mentioned conventional treatment methods, the need of the hour is to use natural phytopharmaceuticals that can minimise the side effects of currently available drugs. The other advantages of using phytopharmaceuticals would be cost effectiveness, avoidance of drug resistance, and safe and fast recovery. In this direction, protective dietary interventions are a newer concept that is gaining popularity thereby focussing on preventative rather than therapeutic effect.

Nutraceutical Interventions

The various phytochemicals present in food and beverages play a key role in the efficacy of nutraceuticals for the prevention and treatment of various diseases. The term nutraceuticals is a combination of the words 'nutrition' and 'pharmaceuticals'. The protective dietary factors or the food components that are negatively associated, i.e., do not contribute to the risk of prostate cancer, include cabbage, cereals, vegetables, soybean, and fish. Foods that have been seen to confer protection from prostate cancer include cereals, nuts, oilseeds (including soybean), fish and vegetables like tomatoes and legumes. Fish seems to protect from cancers at many sites, including the prostate, because it is rich in ω-3 fatty acids. Tomatoes are rich in the antioxidant carotenoid lycopene; that is why they have a protective effect against cancer. Other antioxidants like vitamin E and selenium may also reduce the risk. Certain soybean components (isoflavonoids and lignans) also have antioxidant activity. They have also been shown to increase the production

of sex hormone binding globulin (SHBG) in the liver, consequently keeping the serum levels of testosterone under control and reducing hormonal activity. Studies have also shown that vitamin D protects against prostate cancer while calcium increases its risk.

Evaluation of phytochemical sources such as apples, onions, garlic, cranberries, and tomatoes has shown that these foods all have anticancer capabilities. A study on the effect of quercetin, found in various foods, on prostate cancer cells showed that it inhibited the expression of the androgen receptor protein involved in the development and progression of prostate cancer. Garlic supports the immune system and its sulphur compounds possess anti-prostate cancer properties. Cranberry is also a potential anticancer agent having several beneficial phytochemicals including flavonol glycosides, anthocyanins, pro-anthocyanidins, and polyphenols. These naturally occurring phytochemicals work synergistically to stop the progression of prostate cancer cells.

Lycopene occurs in many plant foods including watermelon, tomatoes, papaya, and apricots. It is the substance that gives these fruit and vegetables their characteristic red colour. Studies have demonstrated its cancer chemopreventive properties specifically against prostate cancer, acting as an antioxidant and inhibiting cell proliferation. Epidemiological evidence suggests that increased consumption of tomatoes or its major carotenoid lycopene is associated with a decreased risk for prostate cancer. Resveratrol is found in various dietary sources, including red grapes, red wine, peanuts, and mulberries. It inhibits the development or progression of prostate cancer, induction of apoptosis and management of the cell cycle. Capsaicin, found in red and chilli peppers is known for its anti-inflammatory and analgesic effects. Studies have shown that it has anti-proliferative and apoptotic effects on prostate cancer cells. Curcumin, a major yellow pigment of turmeric is used to treat a variety of inflammatory conditions and chronic diseases. Many of its traditional properties, including its anti-carcinogenic activity, have been validated in various cellular and animal models have been widely studied for their anti-inflammatory and anti-carcinogenic effects.

Table 1: Phytochemicals of nutraceutical importance, their sources and health benefits

Phytochemicals	Source plant	Health benefits
Carotenoids	Carrots, leafy greens and red, orange and yellow vegetables, pumpkin	Anti-carcinogenic, enhances release of immunogenic cytokines IL-1 and TNF-alpha, provide cornea protection against UV light, stimulate DNA repair enzymes
Epigallocatechin gallate	Tea	Antioxidant, CNS stimulant and Diuretic
Curcumin	Turmeric	Anti-hypertensive, anti-inflammatory, antioxidant and cancer preventive
Lycopene	Apricots, papaya, pink guava, tomato, watermelon	Lowers risk of atherosclerosis and prostate cancer
Quercetin	Red onions, buckwheat, red grapes, green tea, apple skin	Strong antioxidant, reduces LDL oxidation, vasodilator and blood thinner
Resveratrol	Blueberry, peanuts, red grapes, red wine	Antioxidant, prevents aging, cancer, diabetes and heart diseases
Silibinin	Milk thistle (*Silybum marianum*)	Protects from UVB-induced carcinogenesis and hepatoprotective
Sulforaphane, Glucosinolates	Broccoli sprouts, cabbage, cauliflower, collards, cruciferous vegetables, kale, radish, turnip	Antioxidant, prevent DNA damage, reduce risk of breast and prostate cancers
Withanolides	Ashwagangha (*Withania somnifera*)	Anticancer and immuno-modulator

Likewise, inositol hexaphosphate (also known as phytic acid) is a natural dietary ingredient found in most cereals, legumes, nuts, oil seeds and soybean. Its consumption has been shown to have promising results in several animal tumour studies as well as epidemiological reports related to mammary, colon and prostate cancers. Studies have shown that inositol hexaphosphate inhibits growth and induces differentiation of human prostate cancer PC-3 cells. Silibinin found in milk thistle (*Silybum marianum*) inhibits established prostate tumour growth, progression, invasion, and metastasis and suppresses tumour angiogenesis in various mice models.

Asian countries, especially Japan, have diets rich in the components that protect against cancer, such as soybeans, lentils and fish. Soybeans are consumed as tofu, tempeh, miso and soymilk. Consumption of soy products has been reported to be inversely associated with prostate cancer mortality. Some examples of selective phytochemicals of nutraceutical importance, their sources and health benefits in preventive and therapeutic effect against cancer are given in Table 1.

Conclusion

It is now clear that prostate cancer incidence is increasing with time and recent studies have shown that lifestyle factors may have a lot to contribute to this increase in incidence. Moreover, the increasing trend of employing PSA testing for prostate cancer diagnosis is also leading to a rise in its incidence rates due to over diagnosis. There is an urgent need for more accurate diagnostic tests to precisely calculate the burden of prostate cancer in the world. The available treatment options, though effective, do not improve the quality of life of the patient. They cause toxicity in one form or the other and thus suggesting an urgent need for newer and less toxic therapy options. To fulfil these objectives, alternative therapies provide both prevention and treatment of prostate cancer using nutraceuticals, special diets, yoga, Ayurvedic medicines, etc., that are being extensively explored. Synergistic inhibitory action of phytochemicals of nutraceutical importance with anticancer drugs has shown positive correlation. They show great promise in providing safe treatment. These need to be publicised more zealously so that more people can benefit.

'Machli': The Queen of Ranthambore

Shakunt Pandey

Machli the tigress was the stuff that legends are made of. Though she's gone from this mortal world her everlasting glory will not easily fade away. She was burly, majestic, and fearless. She was popular among tourists from all parts of the world.

'Machli 'or T-16, the tigress needs no introduction for she was one of the world's most famous wild tigers. She was first seen in October 1997 and this was the beginning of her everlasting popularity. She has many firsts to her credit, such as being one of the oldest lived wild tigers; being the most photographed wild tiger; to have a postage stamp issued in her name; to having been awarded the Travel Operators for Tigers (TOFT) "lifetime achievement award" in 2009 for her contribution to tiger-tourism economy and thereby leading to conservation of the tiger clan; to name a few. She had a massive fan following and had her own Facebook and Wikipedia page.

Machli's popularity among the tourists had no precedent because it was estimated that she contributed a whopping $ 10 million or more per annum to the economy of Ranthambore National Park, Rajasthan, during the past ten years. Machli was the star of not only Ranthambore and Rajasthan but of the entire country and the world itself and very rightly had two trackers especially assigned to her.

She was burly, majestic, and fearless. Her popularity among tourists from all parts of the world was due to the simple fact that she was camera friendly. She loved to be photographed. She had been a protagonist of innumerable books and documentaries. A 50-minute film on her titled 'Tiger Queen 'is as popular as ever. She has given birth to almost half of the tiger population thriving in Ranthambore and two of her daughters have been sent to Sariska. She was rightly called the Queen of Ranthambore for she was the master of all she surveyed.

Machli -The Queen of Ranthambore National Park. (Credit:www.Ghoomophiro.com)

Machli died at 9.43 am on the 18 August 2016, at the ripe old age of 20 years. Tigers in the wild are known to live for about 12 to 14 years. So Machli can be said to be the longest-lived tiger in the world.

Machli exhibited her aggressiveness from the word go. She was born in a litter of three cubs, all females. Machli being the dominating one soon started catching everyone's attention. She was named Machli (Hindi for fish) due to the fact that she had a mark on her right cheek resembling the

The author is a Kolkata based Journalist and Science Communicator. shakuntpan33@gmail.com

Machli's epic battle with the monstrous Crocodile. (Credit: www.ranthamborenationalpark.com)

outline of a fish. On attaining adulthood Machli chased her mother, named 'Machli 1', out of her territory.

Machli was a good mother having raised many cubs successfully. In her lifetime she gav e birth to 11 cubs in four litters and raised nine cubs to adulthood. She had her first litter in April 2000 and the last in the monsoons of 2006.Hell hath no fury like an angry Machli who protected her cubs from predators and other tigers with all might. It is a well-known fact that male tigers will not hesitate a second to kill cubs. It was often seen that Machli's temper had the male tigers running for shelter.

Machli feared none. She lost two of her canines in a well-documented fight with a monstrous 14-footer crocodile in 2008. Renowned tiger expert and author Valmik Thapar was a witness to this rare jungle occurrence. Although there is no love lost between these two top predators they generally give each other a wide berth. Thapar described this epic battle as follows: "It swirled it around, twisting it and biting it at the back of the neck." Machli proved that she wasn't the Queen of Ranthambore by fluke but deserved it.

At old age Machli lost most of her teeth. Territorial fights also reduced her vision. She could have easily become man-eater and gain notoriety like another tiger of Ranthambore named T-24 or Ustad. It has to be borne in mind here that Ustad was quite young when he had become a notorious man-eater. But Machli was different. She was not content with baits or flesh offered by the forest department of Rajasthan. She was a master hunter. She devised a new hunting strategy by foregoing bigger preys like Sambar deer and opting for smaller preys like the spotted deer. When her killer bites failed to have any effect she chose to kill by using her body weight to her advantage by breaking the backbone of her prey. She was observed very cunningly carrying her prey across streams to have the scent of the hunt eliminated in order to have a peaceful meal.

The end of the legendary tigress - Machli. (Credit: Hemraj Meena)

She was also opportunistic and was always on a look-out for an easy meal like snatching the kill of leopards, who too share these lands with tigers.

History repeated itself when Machli was driven off her territory by one of her daughters T-17 from her last litter. Machli had broken the heart of her fans when she had suddenly vanished in 2014. She was feared dead but to everyone's delight and relief she was found in the non-tourist areas of Ranthambore National Park.

The banished queen had not taken a morsel for five consecutive days and awaited her death in Ama Ghati, which is a fringe area of the Ranthambore National park. A team of forest department officials which included a vet monitored her situation and hoped against hope. She was such a big star that she was not away from the limelight even in her dying moments. Her end was recorded to be preserved for eternity. The Chief Minister of Rajasthan tweeted a condolence message on Machli's passing away, such was her importance.

There were plans to preserve the skin of this legendary tigress, but that was not to be. She was cremated according to Hindu customs at Ama Ghati in presence of hundreds of her admirers. She was accorded a guard of honour by the jawans of the Tiger Protection Force and forest guards, which is unprecedented. Machli the tigress was the stuff that legends are made of. Though she's gone from this mortal world her everlasting glory will not easily fade away.

Intelligence of the Other Kind (continued from page 32)

in 2008. It concludes that plants have moral and legal rights to protection, and Swiss citizens have to treat them appropriately.

But what does it mean for the common man? We prefer to remain indifferent whenever we are asked to ponder over the growing crisis that poses a threat for the plants. But the question is: Should we not have a concern for those mute beings that have kept themselves alive, combating against all natural and manmade hazards from the very first day of plant-animal association? There is another issue. Now that we know plants have feelings and also intelligence akin to animals, can we consider vegetarianism better to avoid needless killing of animals? Is it not cruelty if we agree that plants are only a counterpart of the animal kingdom?

End notes

To conclude, even if we set aside all the debates whether plants show intelligence or sentience or if they should have any rights for survival just like human beings, we cannot overlook the simplest truth that we cannot exist if plants cease to exist.

Further reading

1. S Mancuso and A Viola, *Brilliant Green: The Surprising History and Science of Plant Intelligence*, Island Press, USA, pp 1-192, 2015.
2. F Baluska, S Mancuso, D Volkmann and P W Barlow, The 'root-brain' hypothesis of Charles and Francis Darwin: Revival after more than 125 years, *Plant Signalling and Behaviour*, Vol 4, No 12, pp 1121-1127, 2009.
3. J.C. Bose, *Abyakta* (in Bengali), Shaibya Prakashan Bibhag, Kolkata, pp 1-142, 1988.

Tennis elbow — Causes, diagnosis and treatments

Dr. Yatish Agarwal

Tennis elbow is often caused due to damage to a specific forearm muscle. It is a painful condition of the elbow. Athletes are not the only people who get tennis elbow.Studies have shown that those who work with a computer mouse for long hours, or are auto workers, cooks, painters, plumbers, and carpenters are particularly prone to developing tennis elbow.

Tennis elbow is often caused due to damage to a specific forearm muscle. It is a painful condition of the elbow. Athletes are not the only people who get tennis elbow. Studies have shown that those who work with a computer mouse for long hours, or are auto workers, cooks, painters, plumbers, and carpenters are particularly prone to developing tennis elbow.

Tennis elbow is a painful condition of the elbow. An overuse and muscle strain injury, the condition is precipitated due to repeated contraction of the forearm muscles used for straightening and elevating the hand and wrist. Not surprisingly, playing tennis or other racquet sports often plays the villain.

Essentially, it is an inflammation of the tendons that join the forearm muscles on the outside of the elbow. The forearm muscles and tendons suffer damage from overuse — repeating the same motions.The stress to the tissue results in a series of tiny tears in the tendons that attach the forearm muscles to the bony prominence at the outside of the elbow.

As the name suggests, playing tennis — especially repeated use of the backhand stroke with poor technique — is one possible cause of tennis elbow. However, athletes aren't the only people who develop tennis elbow. Several other common arm motions, activities and sports also can put you at risk. Repetitive computer mouse use, cutting up cooking ingredients, painting, driving screws and using plumbing tools can cause tennis elbow.

The pain of tennis elbow occurs primarily on the outside of the elbow, but it can also spread to the forearm and wrist. The malady has several treatment options. In most cases, thisinvolves a team approach. Rest, over-the-counter pain relievers and physical therapy under the guidance of a physiatrist (who uses physical agents: exercise and massage and other modalities for therapy) and an orthopaedic surgeon often help ease the symptoms. If conservative treatments don't help or if symptoms are disabling, surgery might benecessary.

The elbow joint anatomy

The elbow joint is a joint made up of three bones: the upper arm bonehumerusand the two bones in the forearm, radius and

The author is physician and teacher at New Delhi's Safdarjung Hospital. He has authored 47 popular health-books.
E-mail: dryatish@yahoo.com

ulna. There are bony bumps at the bottom of the humerus called epicondyles. The bony bump on the outside (lateral side) of the elbow is called the lateral epicondyle.

Muscles, ligaments, and tendons hold the elbow joint together.

Lateral epicondylitis, or tennis elbow, involves the muscles and tendons of the forearm. The forearm muscles extend the wrist and fingers. The forearm tendons — often called extensors — attach the muscles to bone. They attach on the lateral epicondyle. The tendon usually involved in tennis elbow is called the extensor carpi radialis brevis.

Causes

Overuse and damage of extensor muscle

Tennis elbow is often caused due to damage to a specific forearm muscle. The extensor carpi radialis brevis muscle helps stabilise the wrist when the elbow is straight. This occurs during a tennis groundstroke, for example. When the muscle is weakened from overuse, microscopic tears form in the tendon where it attaches to the lateral epicondyle. This leads to inflammation and pain.

The muscle may also be at increased risk for damage because of its position. As the elbow bends and straightens, the muscle rubs against bony bumps. This can cause gradual wear and tear of the muscle over time.

Activities

Athletes are not the only people who get tennis elbow. Many people with tennis elbow participate in work or recreational activities that require repetitive and vigorous use of the forearm muscle.

Studies have shown that those who work with a computer mouse for long hours, or are auto workers, cooks, painters, plumbers, and carpenters are particularly prone to developing tennis elbow. It is thought that the repetition and weight lifting required in these occupations leads to injury.

Age

Most people who get tennis elbow are between the ages of 30 and 50, although anyone can get tennis elbow if they have the risk factors. In racquet sports like tennis, improper stroke technique and improper equipment may be risk factors.

Unknown cause

Lateral epicondylitis can occur without any recognised repetitive injury. The cause of this subtle occurrence is often unknown.

Symptoms

The symptoms of tennis elbow develop gradually. In most cases, the pain is mild to begin with and slowly worsens over weeks and months. There is usually no specific injury associated with the start of symptoms.

Common signs and symptoms of tennis elbow include:

Pain or burning on the outer part of the elbow

The pain associated with tennis elbow may radiate from the outside of the elbow into the forearm and wrist.

Weak grip strength

Pain and weakness may make it difficult to shake hands or grip an object, turn a doorknob, or hold a coffee cup.

The symptoms are often worsened with forearm activity, such as holding a racquet, turning a wrench, or shaking hands. The dominant arm, usually the right, is most often affected; however both arms can be affected.

Seeing a doctor

You could talk to thefamily doctor, a physiatrist or an orthopaedic surgeon if self-care steps such as rest, ice and use of over-the-counter pain relievers don't ease your elbow pain and tenderness.

Diagnosis

During the physical exam, the doctor may apply pressure to the affected area or ask you to move the elbow, wrist and fingers in various ways.In many cases, your medical history and the physical exam provide enough information for the doctor to make a diagnosis of tennis elbow. However, if the doctor suspects that something else may be causing your symptoms, s/he may suggest elbow X-rays or other tests, including:

Elbow X-rays

The elbow X-rays will provide clear images of the bones, joint and soft tissues. They may be taken to rule out arthritis of the elbow.

Magnetic resonance imaging (MRI) scan

If the doctor thinks your symptoms are related to a neck problem or arthritis of the elbow, s/he may ask for an MRI scan. MRIs scans show details of soft tissues, and will help the doctor diagnose a possible herniated disk, cervical spondylosis or arthritis of theelbow.

Electromyography (EMG)

The doctor may order an EMG to rule out nerve compression. Many nerves travel around the elbow, and the symptoms of nerve compression are similar to those of tennis elbow.

Treatments

Tennis elbow often gets better on its own. Still, if over-the-counter pain medications and other self-care measures do not ease the symptoms, you might require more elaborate care, including physical therapy. Approximately 80 per cent to 95 per cent of patients have success with nonsurgical treatment.Severe cases of tennis elbow may require surgery.

Non-surgical Treatment

Rest

The first step toward recovery is to give the arm proper rest. This means that

you will have to stop participation in sports or heavy work activities for several weeks.

Non-steroidal anti-inflammatory medicines

Drugs like aspirin or ibuprofen reduce pain and swelling. You might consider taking them under your doctor's guidance.

Equipment check

If you participate in a racquet sport, your doctor may encourage you to have your equipment checked for proper fit. Stiffer racquets and looser-strung racquets often can reduce the stress on the forearm, which means that the forearm muscles do not have to work as hard. If you use an oversized racquet, changing to a smaller head may help prevent symptoms from recurring.

Physical therapy

A physical therapist can teach you exercises to gradually stretch and strengthen your muscles, especially the muscles of your

forearm. Wrist stretching exercise with elbow extended is particularly helpful.

Your therapist may also perform ultrasound, ice massage, or muscle-stimulating techniques to improve muscle healing.

Brace

Using a brace centred over the back of your forearm may also help relieve symptoms of tennis elbow. This can reduce symptoms by resting the muscles and tendons.

Steroid injections

Steroids, such as cortisone, are very effective anti-inflammatory medicines. Your doctor may decide to inject your damaged muscle with a steroid to relieve your symptoms.

Surgical Treatment

If your symptoms do not ease despitesix to twelve months of nonsurgical treatments, your doctor may recommend surgery.

The right surgical approach for you will depend on a range of factors. These include the scope of your injury, your general health, and your personal needs. Talk with your orthopaedic surgeon about the options. Discuss the likely results with the orthopaedic surgeon, and any risks associated with each procedure.

Open surgery

The most common approach to tennis elbow repair is open surgery. This involves making an incision over the elbow.It may require an overnight stay at the hospital.

Arthroscopic surgery

Tennis elbow can also be repaired using miniature instruments and small incisions. This is a same-day or outpatient procedure.

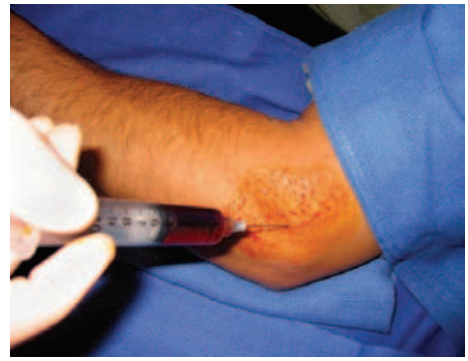
Surgical risks

As with any surgery, there are risks with tennis elbow surgery. The most common things to consider include infection, nerve and blood vessel damage, possible prolonged rehabilitation, loss of strength, loss of flexibility or need for further surgery.

Rehabilitation

Following surgery, your arm may be immobilised temporarily with a splint. About one week later, the sutures and splint are removed.

After the splint is removed, exercises are started to stretch the elbow and restore flexibility. Light, gradual strengthening exercises are started about 2 months after surgery.



Your doctor will tell you when you can return to athletic activity. This is usually 4 to 6 months after surgery. Tennis elbow surgery is considered successful in 80 per cent to 90 per cent of patients. However, it is not uncommon to see a loss of strength.

Newer treatments

Of late, doctors have been using shots of platelet-rich plasma (PRP) to treat tennis elbow. It can possibly work as an effective remedy and speedthe healing of injuries to the extensor carpi radialis brevis tendon.

PRP is a preparation developed from a patient's own blood. It contains a high concentration of proteins called growth factors that are very important in the healing of injuries.

Current research on PRP and lateral epicondylitis has yielded promising results. A few treatment centres across the globe are incorporating PRP injections into the nonsurgical treatment regimen for lateral epicondylitis. However, this method is still under investigation and more research is necessary to fully prove PRP's effectiveness.

Recent Developments in Science and Technology

Biman Basu

When a positron meets its antiparticle, the electron, they annihilate each other, giving off a burst of energy in the form of gamma rays. It is estimated that a gram of antimatter annihilating a gram of matter would release about twice the amount of energy as the nuclear bomb dropped on Hiroshima, Japan.

Rare supernovae may solve 40-year-old antimatter mystery

Since the early 1970s, astronomers had noticed something quite puzzling in our Milky Way galaxy. From the inner parts of the galaxy they detected a special kind of gamma-rays that are given off when positrons are annihilated. Positrons are a kind of antimatter with a mass equal to that of an electron but with opposite charge. When a positron meets its antiparticle, the electron, they annihilate each other, giving off a burst of energy in the form of gamma rays. It is estimated that a gram of antimatter annihilating a gram of matter would release about twice the amount of energy as the nuclear bomb dropped on Hiroshima, Japan. The most astounding thing about the discovery of the 1970s was that the amount of gamma rays being emitted from all around the galaxy could be accounted for only by assuming that as many as 10^{43} positrons per second were being annihilated every second. The astronomers had no evidence at that time about the source of such massive amounts of antimatter in the Milky Way.

There is nothing unusual about finding positrons in the Milky Way galaxy. The positrons could have been emitted from radioactive material synthesised by stars. However, for decades, researchers have not been able to pinpoint a type of star that could generate such vast amounts of antimatter. This led to suggestions that many positrons could originate from exotic sources, such as the supermassive black hole thought to exist at the centre of the Galaxy, or from dark matter particles annihilating one another. But now they seem to have a definite answer.

A team of international astrophysicists led by The Australian National University (ANU) has shown how most of the antimatter in the Milky Way forms.

A new study led by Roland Crocker of the Australian National University in Canberra, suggests that "the cause was a series of weak supernova explosions over millions of years, each created by the convergence and merger of two white dwarfs which are ultra-compact remnants of stars no larger than two suns". The bulk of antimatter that pervades the Milky Way may come from clashing remnants of dead stars, the new study finds (*Nature Astronomy*, 22 May 2017 | doi:10.1038/s41550-017-0135).

Unlike most supernovas, which are the last stage of massive stars and can briefly outshine all of the other stars in their galaxies, a SN 1991bg-type supernova does not generate much visible light and is fairly

The author is a former editor of the popular science monthly *Science Reporter*, published by CSIR, He is a winner of the 1994 'NCSTC National Award for Science Popularisation'. He is the author of more than 45 popular science books. Email: bimanbasu@gmail.com

rare. Specifically, these faint supernovas are thought to occur when two low-mass white dwarfs – one rich in carbon and oxygen, and the other rich in helium –slam together. Previous research had suggested that these dim supernovas result from the merging of two super-dense white dwarf stars, and they generate a huge number of the radioactive isotope titanium-44, which is capable of releasing positrons. White dwarfs are super-dense, Earth-size cores of dead stars that are left behind when stars have exhausted their fuel and lose their outer layers. Most stars, including our Sun, will become white dwarfs one day. The new work suggests that those supernovas could be sufficient to create all of the unexplained positrons, thus solving the galaxy-wide mystery of the source of antimatter.

Nanovaccines tested for cancer immunotherapy

Nanotechnology is not a new concept. It has attained notable momentum in recent years. Nanoparticles have become increasingly important for their applications in the fields of biology and medicine. There are significant applications of nanoscience in biology and biotechnology, especially in cancer therapy by targeting the body's immune system. The initiative that a nanostructure could be assembled, constructed and introduced into the human body to carry out cellular repairs at the molecular level is promising.

The utilisation of nanotechnology in medicine, known as nanomedicine, deals with the use of accurately engineered nanomaterials to build up novel therapeutic and diagnostic tools. Nanovaccines are vaccines that consist of nanoparticles and are rising as a new class of vaccines that directly target the site in the body where a disease or infection originated, as opposed to traditional drugs which affect all parts of the body. Now, for the first time, a team of researchers from the University of Texas Southwestern (UTSW) Medical Center in Dallas, USA, have shown that using a nanovaccine to deliver cancer immunotherapy can slow tumour growth and prolong survival in mouse models of several types of cancer (*Nature Nanotechnology*, 24 April 2017| DOI: 10.1038/nnano.2017.52). Nanovaccine, the authors say, offers a simple, safe and robust

Laser beam can be seen scattered by nanoparticles in a solution of the UTSW-developed nanovaccine. (Credit: UT Southwestern)

strategy in boosting anti-tumour immunity for cancer immunotherapy.

The nanovaccine is made up of tumour antigens – tumour proteins that can be recognised by the body's immune system – inside a synthetic polymer nanoparticle. Nanoparticle vaccines deliver minuscule particulates that stimulate the immune system to mount an immune response. According to the researchers, the goal is to help people's own bodies fight cancer. A significant advantage of using nanovaccine is that the nanoparticles take the antigen directly to the lymph nodes to help generate primed immune cells called T cells to fight cancer. Conventional vaccines do not do this – they require the immune cells to collect the antigens in a "depot system" first and then transport them to the lymph nodes to prime the T cells.

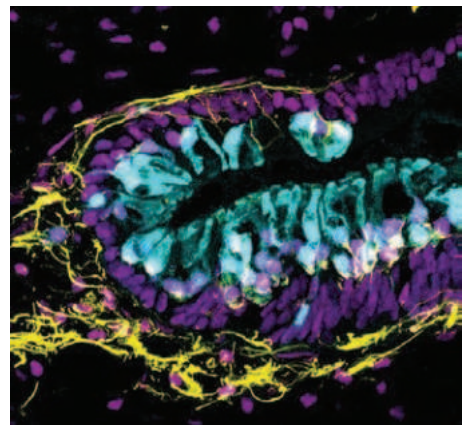
Co-senior author Jinming Gao, a UTSW Professor of Pharmacology and Otolaryngology, says, "What is unique about our design is the simplicity of the single-polymer composition that can precisely deliver tumour antigens to immune cells while stimulating innate immunity. These actions result in safe and robust production of tumour-specific T cells that kill cancer cells".

The team tested the nanovaccine on a variety of mouse models of cancer, including colorectal cancer, melanoma, and HPV-associated head, neck, and cervix, cancers. They noted that in nearly all cases, the treatment led to slower tumour growth and prolonged survival. The authors conclude that "in small animals, a good number of nanovaccines have shown the ability to induce anti-tumour immunity and can be combined with many other therapeutic modalities for synergistic cancer therapy. It is expected that in the next few years, more types of nanovaccines can be manufactured on large scales and at good manufacturing practice (GMP) grade and GMP-produced nanovaccines can be tested in humans for safety and therapeutic efficacy".

Growing hair cells of inner ear to treat deafness

Our life would lose a lot of charm if we lose the sense of hearing. Hearing is the ability to perceive sound, which we do by detecting vibrations in air caused by sound waves that impinge on our eardrums. Hearing loss or deafness occurs when sound signals cannot reach the brain due to various reasons. There are two main types of hearing loss, depending on where the problem lies. The one called 'sensorineural hearing loss' is caused by damage to the sensitive hair cells inside the inner ear or damage to the auditory nerve. Sensorineural hearing loss occurs naturally with age or as a result of injury or loud noise. Sensorineural hearing loss can also be the result of diseases such as mumps, meningitis, multiple sclerosis, or the use of certain drugs, in particular aspirin, quinine or the antibiotics streptomycin and gentamicin. The other type, known as 'conductive hearing loss', happens when sounds are unable to pass from our outer ear to the inner ear, often because of a blockage such as earwax or glue ear.

The ear hairs involved in hearing are actually tiny, sensory hair cells in our cochlea or inner ear. There are about 15,000 of them in each ear, and they are crucial to our ears for detecting sound waves. They also help us maintain our balance. But the tiny hair cells



Human inner ear organoid grown from stem cell showing sensory hair cells (cyan) and sensory neurons (yellow). (Credit: Image courtesy of Karl Koehler)

are very fragile and can be easily damaged from loud noises, and it really does not take a long exposure. The bad thing is that once damaged, cochlear hair cells do not regenerate. So right now, damage to them is permanent, and people with sensorineural hearing loss cannot regain their hearing, although some people find hearing aids very helpful.

The good news is, now there is hope for better treatment for sensorineural hearing loss. Researchers from the Indiana University (IU) School of Medicine, USA, have successfully developed a technique for growing inner ear tissues, including sensory hair cells, from human stem cells. According to the researchers, lab-grown human inner ear tissues offer unprecedented opportunities to develop and test new therapies for various inner ear disorders including hearing loss. The researchers used CRISPR gene editing technology to engineer stem cells that produced fluorescently-labelled inner ear sensory cells. Further studies revealed that the population of sensory cells they had created have the same functional characters as cells that detect gravity and motion in the human inner ear (*Nature Biotechnology*, 1 May 2017 | DOI: 10.1038/nbt.3840).

According to Karl R. Koehler, who led the research, "We also found neurons, like those that transmit signals from the ear to the brain, forming connections with sensory cells. This is an exciting feature of these organoids because both cell types are critical for proper hearing and balance".

Global warming may turn Antarctica green

Antarctica is the fifth largest continent and is the driest, coldest and windiest place on Earth. It is also known as the 'Great White Continent', made up of 90 per cent of the world's ice and has 98 per cent of its surface covered by ice. Very little vegetation grows in the freezing temperatures of Antarctica. But scientists fear that warming temperatures due to climate change may be turning Antarctica 'green' with rapid growth of plant life on the Earth's southernmost continent. In a recent study, researchers from the University of Exeter in the United Kingdom have discovered rapidly growing banks of mosses on the ice continent's northern peninsula, providing striking evidence of climate change in the coldest and most remote parts of the planet. According to the researchers, in the past 50 years the quantity and rate of plant growth has shot up, suggesting further warming could lead to rapid ecosystem changes (*Current Biology*, 18 May 2017 | DOI: 10.1016/j.cub.2017.04.034).

The researchers looked to the Antarctic Peninsula (the northernmost part of Antarctica) because it is one of the most rapidly warming regions on Earth; annual temperatures there have increased by up to 0.56°C per decade since the 1950s. The consequence, the study found, was a four- to five-fold increase in the amount of moss growth in the most recent part of the record. The researchers have found that growth rates and microbial productivity have risen rapidly since the 1960s – in a manner that is unprecedented in the last 150 years – consistent with climate change. Soil samples from a 700-km area along the northern part of the Antarctic Peninsula showed dramatic changes in growth patterns.

Thick banks of moss growing on the Antarctic Peninsula (Credit: Matt Amesbury)

Normally, less than 1 percent of present-day Antarctica features plant life. But in parts of the Peninsula, Antarctic mosses grow on frozen ground that partly thaws in the summer – when only about the first few centimetres of soil ever thaws. According to the researchers, the surface mosses build up a thin layer in the summer and then freeze over in winter. As layer builds on top of layer, older mosses subside below the frozen ground, where they are remarkably well preserved due to the low temperatures.

Says Matthew Amesbury, a researcher with the University of Exeter in the United Kingdom who led the new study, "People think of Antarctica quite rightly as a very icy place, but our work shows that parts of it are green, and are likely to be getting greener. Even these relatively remote ecosystems, that people might think are relatively untouched by human kind, are showing the effects of human induced climate change."

According to some experts, if greenhouse gas emissions continue unchecked, Antarctica will head even further back in geologic time…perhaps the peninsula will even become forested again someday, like it was during the greenhouse climates of the Cretaceous and Eocene, when the continent was ice-free.

National Science Film Festival & Competition 2017

The 7th National Science Film Festival & Competition (NSFF) 2017 was organised jointly by Vigyan Prasar and National Council of Science Museums from 14 to 18 February 2017 at Birla Industrial & Technological Museum, Kolkata. NSFF 2017 was inaugurated by Shri Kesari Nath Tripathi, Hon'ble Governor of West Bengal, Prof. Partho Ghose, renowned science communicator, and Shri Gautam Ghose, veteran film maker. The British Deputy High Commissioner, Mr Bruce Bucknell and *Consulate General of France* Mr Damien *Syed* attended the NSFF 2017 as special invitees.

Lighting of Lamp - Inaugural of NSFF 2017 at Kolkata

In his inaugural remarks Shri Kesari Nath Tripathi said, "This festival lays emphasis on films on science, technology, environment and health. Films, as an audio visual medium, are very effective in communicating to citizens the socio-scientific issues of importance. For this purpose the National Science Film Festival is considered a crucial activity in provoking and recognising creative science films by film makers in different parts of the country."

Shri Goutam Ghose in his comments said, "This initiative has been highly appreciated. Cinema actually is the invention of scientists and technologists. It is a techno art. Since the beginning of cinema, the change in technology has steadily and persistently changed the perception of cinema... after the first screening by the Lumiere Brothers, they had said, 'We are scientists, our job is over, and now the artist will come to create its own language, its grammar.'"

Prof. Partho Ghosh said, "Films are attractive and popular because they tell stories, in an interesting way. Science films must also, primarily, tell stories that common people would find interesting and understandable. Unfortunately, more of the scientists are not good communicators; they are not good story tellers. And those who like to make science films have to tease out interesting stories from practising and successful scientists. There has to be a strong synergy between the filmmaker and the scientist as it happened between Kim Thorpe and Christopher Nolan for the making of *Interstellar*."

Shri A S Manekar, DG, NCSM in his opening remarks said, "We initially think that film is a medium of art. We initially wonder about the exact relation between film and science. But I think that film itself came up because of science. The science in the film, the persistence of vision, the camera, the technology; there is so much of science and technology in the film, so I think it is an appropriate place to have science and art together and that's what we are trying to do."

Dr. R Gopichandran, Director, Vigyan Prasar, said, "While a lot of talk is being made about the benefit of films and process of film making, something that needs to be emphasised upon is the credibility of the communicator and the appropriateness of the message."

Earlier, in his welcome address, Shri S K Emdadul Islam, Director, BITM said, "Through science films we can create a society and citizenry whose thinking process is rational and logical and their decision

Festival Book of NSFF 2017 was released by the dignitaries

Hon'ble Governor of West Bengal Sri Keshari Nath Tripathi during his inaugural speech

making is evidence driven and information driven". Shri Nimish Kapoor, Convener of 7th national science film festival, delivered the vote of thanks.

The objective of NSFF is "to promote students and teachers towards science filmmaking and to inculcate scientific temper through science films." Films on science, technology, environment and health were invited in five categories: (A) films made by government and non-government organisations; (B) films made by professional film makers; (C) films made by college students; (D) films made by school students; and (E) films made by foreign institutions and host organisations. Films of category A, B, C and D were invited for screening and competition and non-competitive category was only for screening. There was another category (E) – on spot science film making through mobile phone. Besides screening of science films; science film workshops, panel discussions and other interactive sessions to inspire budding film makers, students and teachers were organised during NSFF 2017.

VP received 167 films from India and abroad for NSFF 2017. Of the total number received, 53 were shortlisted for Indian competitive science films, 10 for Indian non-competitive science films, and 7 for non-competitive foreign science films. The shortlisted films were screened during

Veteran Film Maker Sri Goutam Ghose during inaugural of NSFF 2017

the festival. 125 invited film makers, 50 workshop participants and approx. 2,000 local students and citizens participated in NSFF 2017 in five days.

NSFF was partnered with the United Nations Information Centre, India & Bhutan; Research Council UK, India; Russian Centre of Science & Culture, New Delhi and Gorki Sadan, Kolkata; French Embassy in India; *InstitutFrancais,* New Delhi; International Quorum of Motion Picture Producers, Australia; I-Lead Media Institute, Kolkata; Bichitra Pathshala, Kolkata; Doordarshan Bangla; and Rajya Sabha Television.

Science film makers were awarded the Beaver Awards, Technical Excellence Awards and Jury Awards in various categories (Govt./ Professional/College & School students) by

Well known Film Maker Sri Madhur Bhandarkar during Award Ceremony of NSFF 2017

Shri Madhur Bhandarkar, Film Maker during award ceremony on 18 February 2017. Shri Bhandarkar said, "Making of a short film on different scientific, environmental or health issues is very difficult. The audience has to be convinced about the issue in a short span of time. It is really commendable of people, who make a film of 10-15 minutes duration."

An interactive session with the Jury members were organised during the NSFF 2017. All Jury members interacted with film makers which included Prof. Partha S Ghose (Chairman of Jury and renowned Science Communicator); Ms Reena Mohan (Documentary film maker and editor); Mr. Arun Chada (Documentary film maker); Mr. Anwar Jamal (Documentary film maker); Prof. Amaresh Chakrabarti (Head, Direction and Writing department of SRFTI, Kolkata); Prof. Shambhu Nath Singh (Head, School of Media Studies, IGNOU); Prof. Syamal Chakrabarti (Professor of Chemistry, Calcutta University); Ms Smriti Nevatia (Film researcher &scriptwriter) and Ms Ranu Ghosh (Film maker & cinematographer). Prof. Iftekar Ahmed, Director, AJK MCRC, New Delhi and Dr. Pradeep Srivastav, Scientoonist & Science Communicator were invited as Observers of the event.

Two panel discussions were held at NSFF 2017 (i) Making science interesting through multi-media, and (ii) Communicating science through films: 5Ws and 1H. Master classes and workshops on various themes related to science film making were organised during the NSFF 2017. These included sessions on (i) How to make science communication interesting through films by Prof. Iftekhar Ahmed, Director, AJK MCRC, New Delhi; (ii) Science communication & Scientoons by Dr. Pradeep Srivastava, Renowned Scientoonist; (iii) Learning with moving images - A workshop on teaching learning design using science films by Ms Subha Das Mollick, Media teacher and Dr. Subir Nag, Principal, SRCE., Kolkata; (iv) Art of science communication by Dr. T. V. Venkateswaran, Scientist F, Vigyan Prasar; (v) River journeys & film making by Dr. Venkatesh Dutta, Coordinator - DST Centre for Policy Research BBA University, Lucknow; (vi) Imaging Ramanujan by Shri Nandan Kudhyadi, Sr. science film maker, Pune; and (vii) Experiential sharing of *Bharat ke Chhap* by Ms Smriti Nevatia, film and theatre critic.

Words of advice by Jury Chair

Prof. Partho S Ghosh, Chairman of the Jury said in his valedictory address, "... being a part of the Jury was not an easy task…with their immense knowledge and experience in film making, Jury Members were quickly able to identify the story line, evaluate its scientific merit and judge its cinematic value."

Prof. Ghosh had a few words of advice for the filmmakers. First and foremost, the use of music should be restrained; secondly, the voice-over narration should be more imaginatively written; and thirdly, there should not be information overload."

List of winners of NSFF 2017 will be published in the next issue of Dream 2047. You lay also log-on to www,vigyanprasar.gov. in to see the list.

(Report: Nimish Kapoor, Scientist E, Vigyan Prasar)