Cinnamon helps address metabolic disorders

A range of health benefits reported in a Delhi-based study

BHAVYA KHULLAR

GETTY IMAGES/ISTOCKPHOTO

A spice commonly used in Indian kitchens may have health benefits, a new study has indicated. The results have been published in the June 2017 issue of the journal, *Lipids in Health and Disease*.

A clinical trial conducted in New Delhi has found that the consumption of cinnamon (*dalchini*) powder helps address obesity and symptoms of metabolic disorder. The study, done at the Fortis Diabetes Obesity and Cholesterol Foundation, involved 116 men and women having conditions such as abdominal obesity, impaired glucose tolerance, high triglycerides and hypertension.

What it does

After consuming three grams of cinnamon powder per day for 16 weeks, the average weight reduced was from 89 to 85 kg in the cinnamon group, while it was from 82 from 81 kg in the control group which was not given cinnamon. Along with dietary intervention, they were all prescribed brisk walking for 45 minutes every day. Patients were monitored two times a week. Researchers said consuming cinnamon along with dietary changes and physical exercise decreased fasting blood glucose, glycosylated haemoglobin, waist circumference, and body mass index. It also improved waist-hip ratio, blood pressure, serum total cholesterol, low-density lipoprotein cholesterol, serum triglycerides, and beneficial high-density lipoprotein cholesterol.

> **Cinnamon is a spice commonly used in Indian cooking and hence can be incorporated in the daily diet – this will balance out metabolism better**
>
> DR. SEEMA PURI, Institute of Home Economics

"Cinnamon is a spice which is commonly used in Indian cooking and hence can be easily incorporated in our daily dietaries, which will balance out metabolism better," says Dr. Seema Puri, associate professor at the Institute of Home Economics, who contributed to the study.

Earlier studies

A few previous studies have shown that cinnamon improves insulin sensitivity, reduces blood glucose levels and glycosylated haemoglobin, cholesterol, and blood antioxidant levels. But these were done with a few patients.

Doctors suggest that the possible mode of action of cinnamon may involve inhibiting activity of enzymes involved in carbohydrate metabolism, stimulating cellular glucose uptake, and enhancing insulin sensitivity. "The study is scientifically well planned, but I have some reservations as the study groups were not matching at baseline. It is a major issue in double-blind-placebo-controlled studies and it raises doubts over successful implementation of plan," says Dr. Rajesh Khadgawat, from the All India Institute of Medical Science (AIIMS), New Delhi, who is not connected with the study.

Dr. Anoop Mishra, one of the authors of the study, agrees that "there are baseline differences in the average weight between the two groups" but says "we have adjusted the analysis for that and found significant differences in outcomes that are valid". – India Science Wire

HINDU, JUNE 25, 2017

HINDU JULY 9-2017

Tea plantations decrease bat diversity

Forests now fragmented by tea or coffee plantations were their home

AATHIRA PERINCHERY

A recent study shows that tea plantations in the Western Ghats harbour less-diverse bat communities – that perform fewer ecological functions – than those found in coffee estates and forests. Protecting existing forest fragments and river stretches in such intensively-cultivated landscapes could be crucial for bats, which are important insect controllers, pollinators and seed-dispersers.

Different bat species can perform these varied ecological functions due to the physical features they have evolved, which help them specialise in hunting different prey across habitats. Bats with short, broad wings, for instance, are better suited to plucking off large insects on the wing, in densely-vegetated patches like the forests of the Ghats.

But forests in this mountain range have changed drastically. In Tamil Nadu's Valparai, for instance, tea and coffee plantations have fragmented natural forests. To examine how bats respond to such extreme changes in land use, scientists from the Nature Conservation Foundation, National Centre for Biological Sciences and the University of Leeds (UK) quantified bat communities in Valparai, based on their ecological functions. Across different habitats, they examined bat diet, echolocation, body size and wing morphology (which determines their mode of hunting and what habitats they are adapted to).

Homeless: Bent winged bat ▪ RAHUL KHANOLKHAR

The scientists found that tea plantations fared badly: only few insectivorous bats that could adapt to highly modified habitats thrived here. However, rivers running through plantations helped offset this slightly. Coffee plantations did better because of native tree presence which is required for coffee growth; but protected areas and forest fragments were the most 'functionally' rich, home to bats with diverse morphologies corresponding to their several functional roles in the ecosystem.

The team's results show that bats with shorter and broader wings, like the lesser woolly horseshoe bat, are most vulnerable and require urgent conservation action in Valparai. "These bats are insect eaters; they keep ecosystems healthy and functioning by keeping the insects they eat in check," says lead author Claire Wordley.

Bats and other fauna could benefit if tea plantation owners leave a buffer of native trees on both sides of every river, write the authors. Protecting existing forest fragments and extending them wherever possible could also help.

"While tea plantations will never be as rich for wildlife as coffee plantations, it can be more biodiversity-friendly if small changes in land use practices are implemented," says Divya Mudappa of NCF.

HINDU JULY, 9-2017

Cocoa: A tonic for cognition and memory retention

This third-in-line beverage tops the other two, coffee and tea, in health benefits, yet it has not become as popular

D. BALASUBRAMANIAN

SPEAKING OF SCIENCE

Coffee and tea came to be popular in India essentially due to colonial history. They are both imports into our country, and we now grow them in large plantations. Today, Darjeeling Tea and Coorg Coffee are world famous and coveted. Yet, an equally popular drink, cocoa, has not become that popular. All we do is, pretty much to eat it in the solid, processed form as chocolate bars, but not as a "Cuppa."

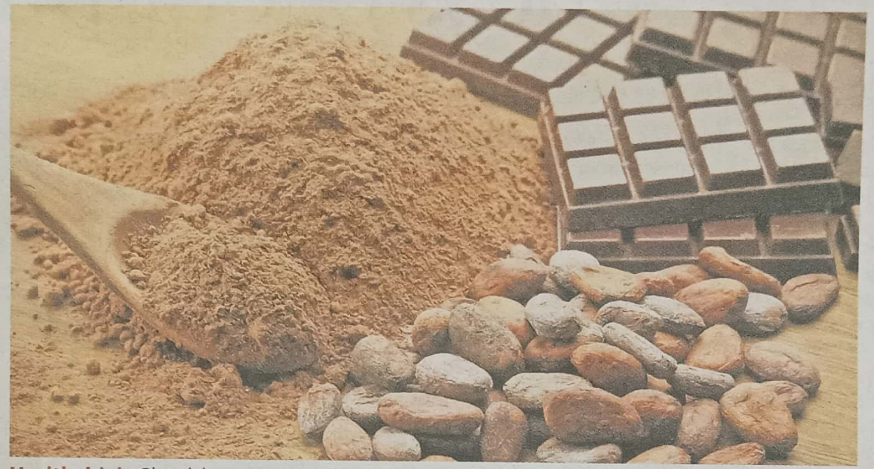
Colonial history has a role in the popularisation of cocoa too, but elsewhere. Cocoa was first discovered and coveted by the Mayan civilisation of Central America. The Mayans gave the plant (and its seeds) the name cocoa (or cacao), meaning 'The Food of the Gods'. Cocoa seeds were used in family and community functions, and even used as currency. The Aztec Indians there made a drink with cocoa powder, chilli, musk and honey, calling it *Chocolatl* or "beaten drink"; hence the name chocolate.

When the Spanish colonised much of the Americas, they popularised and monopolised cocoa, making its production a well guarded secret as they brought it to Europe. Cocoa became the drink of the super rich. A lot of romance and class was associated with it. Love songs, courting the beloved, were written and sung (and are still done) in Europe and America. (For example, you can enjoy watching Doris Day singing "A Chocolate Sundae on a Saturday Night" on Youtube). But as the Industrial Revolution made machines popular, the grinding of cocoa seeds in large amounts and making them available to "all and sundry" made cocoa or hot chocolate lose their fancy.

Only 3 million tons

Today, while 10 million tons of coffee and 5 million tons of tea are produced yearly across the world, cocoa has a production of about 3 million tons. Yet, this third-in-line beverage tops the other two in health benefits. Indeed, much to the consternation of many in South India, we need to point out that coffee is a "drug," albeit a mild one, because of the caffeine it contains. Because of this, many people have taken to drinking "decaf" coffee (which is neither here nor there!). Tea, on the other hand, is now recognised to be a health drink, with its content of molecules of the so called flavonoid family acting as antioxidants and cell-protecting molecules (True, it too has caffeine and theobromine, but much less than coffee). But it is cocoa that tops the list as the healthiest drink. Yet it has not become as popular as tea and coffee – a quirk of history based on who our colonials were!

Over the years, it has become increasing clear that cocoa and chocolates not just good to taste, but are good for cognition as well. Of particular interest is a paper published by Valentina Socci and colleagues, titled " Enhancing human cognition with cocoa flavonoids," which has appeared in the journal *Frontiers in Nutrition,* 16 May 2017 (free access). The authors point out that the family of flavonoids (catechins, quercetin, anthocyanidins) present in cocoa not only act as antioxidants and cell protectants just as tea does, but they protect human cognition, counteract cognitive decline and memory loss as well. In other words, they act directly on the nervous system of the body and the brain. The Socci paper above quotes several earlier works, both relating to the basic biology of the flavonoids in improving health and cognition, but also about a dozen trials involving human volunteers, many of whom show improved working memory, in addition to improvement in blood pressure and insulin resistance.



Health drink: Should one quit coffee and tea and go for this dark brown powder? ▪ GETTY IMAGES/ISTOCKPHOTO

Cocoa and cognition

An Italian group led by Dr. G. Desideri has conducted randomised controlled human trials, and found benefits in cognitive function, blood pressure and the metabolic profiles of elderly subjects with mild memory impairment. They call these studies the Cocoa, Cognition and Aging (CoCoA) study.

What are the molecular underpinnings involved in the mechanisms contributing to learning and memory? An earlier paper by Dr. J.P.E. Spencer, in the journal *Proc. Nutr. Soc.,* 2008, on the control of long-term potentiation and memory lists a series of proteins and enzymes, and how these plant flavonoids reach the brain, crossing the blood-brain barrier, and effect their action. While the exact modes of action are yet to be clarified, it appears that they may protect neurons against damage, reduce inflammation, promote and even generate new connections between nerve cells.

An editorial in the *American Journal of Clinical Nutrition* in 2015 agrees with much of the conclusions drawn on the positive effects of cocoa on memory retention and gain, and points out that unsweetened and unprocessed dark cocoa powder would be the best, while that processed with alkali (which is paler, and more common in candy-bars) is less effective. It is estimated that 100 grams of the usual dark chocolate contains about 100 mg of flavonoids, while 100 mg of unsweetened and unprocessed cocoa powder may have as much as 250 mg.

Should one then quit coffee in the morning and go for dark cocoa powder? A friend (whose name skips me for the moment) has suggested that I drink a cup of cocoa every day, along with the morning coffee and the afternoon tea, and perhaps include a glass of red wine in the evenings, so as to maximise benefit – sound advice!

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M VZ-VZ

Biofortification: Micronutrient-built-in grains

» SPEAKING OF SCIENCE

Mahatma Gandhi was always advocating us to eat hand pound rice and hand ground wheat rather than eating polished rice. Yet we continue using machine-polished cereals because they can be stored longer. But machine-polishing removes the bran (surrounding the seed) containing the pericarp and the 'aleurone layer' which have small amounts of essential nutrients such as some vitamins, iron, zinc and other inorganic components. So, Gandhiji was right! Machine-polished grains are thus poorer in such "micronutrients."

This leads to what is today termed as "hidden hunger." You may a eat stomach full of food everyday and yet miss out on these micro-nutrients essential for the growth and health of the body. UN agencies estimate that hidden hunger affects one in every three children across the world, leading to deficiency in physical growth and development of the brain. Children missing out on vitamin A suffer from vision problems. Missing out on iron leads to blood disorders while deficiency in zinc retards growth, causes diarrhoea, hair loss, lack of appetite and other health issues.

A programme in India, started way back in the 1970s by Dr Ramalingaswami of ICMR, administering large amounts (megadose) of vitamin A every six months to children, has been found serving in helping them come out of "night blindness." This is because a derivative of vitamin A is essential in the retina of the eye in harvesting light and converting it into electrical signals which aid the process of vision.

An effective way of supplying micronutrients is to fortify the wheat itself. PHOTO: REUTERS

Dr Maharaj Kishan Bhan, earlier at the All India Institute of Medical Sciences and was the Secretary of the Department of Biotechnology of the Government of India in New Delhi has come out with a salt mixture containing some of the micronutrients including zinc and iron, to be given to children suffering from diarrhoea and dehydration. The results are strikingly positive; with micronutrient supplementation, particularly zinc, in young children with acute diarrhoea was found to be very useful indeed.

Why is zinc so important to the body? This is because over 300 enzymes in our body use zinc as an essential component in their action. Zinc is essential in supporting our immune system, in synthesising (and degrading) DNA, in wound healing and several other activities. And the amount of zinc we need is not very much. In a human body of, say, 70 kg, there is but 2 to 3 grams of zinc. But if the level falls down to below normal, growth is retarded, diarrhoea sets in, eye and skin lesions appear, and appetite is lost. Thus, addition of zinc in the daily diet becomes essential.

While downing tablets containing vitamins and some of these minerals is fine, this is no solution to billions of children, largely in the developing world. But what if, rather than supplementing these micro-nutrients separately, they become part and parcel of the rice, wheat and other cereals we eat daily? Are there rice or wheat plants which are inherently rich in some of these micronutrients? Can they be grown, cross-bred or hybridised with other conventional rice or wheat plants? This has been the dream of agricultural scientists across the country, and the group led by Dr Vemuri Ravindra Babu of the Institute of Rice Research (of the Indian council of Agricultural Research or ICAR) at Hyderabad has succeeded in doing so, after a pursuit that has lasted for over 12 years. A particular variety, termed DRR Dhan 45 (also ter… IET 23832) is a zinc- rich … plant developed by this group. It contains as much as 22.18 parts per million of zinc (the highest so far in released rice varieties) It is also moderately resistant to pests that kill rice plant by causing the leaf blast disease.

Arriving at DRR Dhan 45, the high zinc rice was not an easy task. Starting in 2004, it has involved screening several thousands of rice varieties from various parts of India, checking the zinc content in each, choosing as many as 168 of them which looked promising, analyzing the iron and zinc content in them, rigorously screening them and cross-breeding and combining the high yield plant with the high zinc one, and finally getting the variety IET 23832 or DRR Dhan 45. It has truly been a long haul and this effort of "biofortification" (meaning that the fortification or enrichment is inher…ent, rather than externally …added, as in the Bhan method) succeeded. It is also important to note that the zinc and other mineral content are not lost upon polishing. The rice can thus be kept for long and used, and it tastes just as good as the conventional variety.

Also note that this is not a GM (genetically modified) crop, so it bypasses any unnecessary controversy. An added benefit is that DRR Dhan 45 has a low glycemic index (51 against 75 in conventional rice), so that it is good for diabetic patients. Dr Babu tells me that it also takes a little longer to digest and thus you feel sated! Their current coordination effort is to develop similar zinc and other nutrient rich varieties of wheat, maize and millets under the ICAR Biofortification. Let us wish them the very best in their endeavors!

D. Balasubramanian
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HINDU, Feb 13, 2017

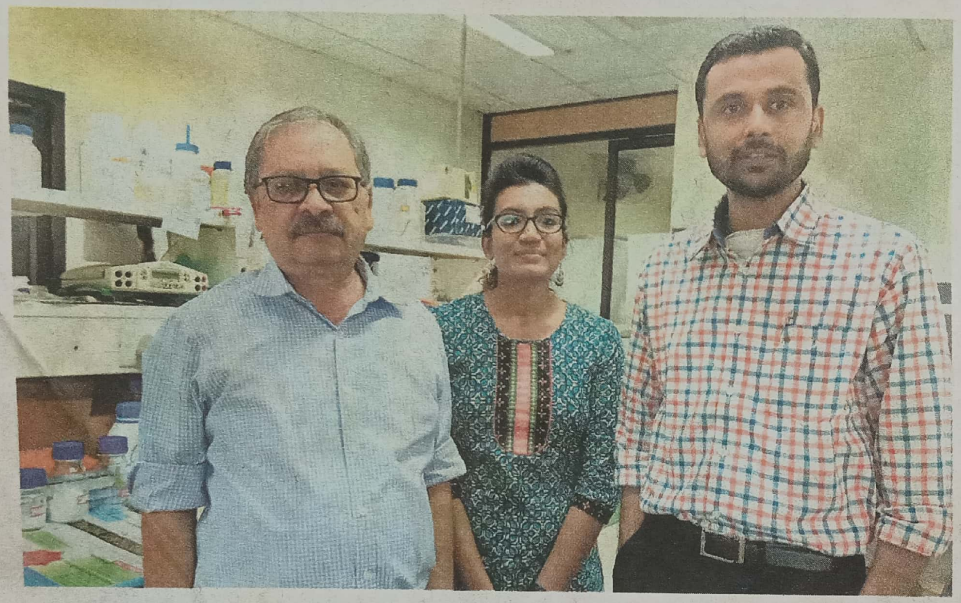
IIT Madras: role of mushroom spores in atmospheric bioaerosols studied

Terrestrially occurring mushrooms are a source of biological aerosols that occupy the atmosphere.

R. PRASAD

Researchers from the Indian Institute of Technology (IIT) Madras have for the first time, over the Indian region, attempted to demonstrate the potential role of mushroom spores in atmospheric bioaerosols. While others have studied the diversity and distribution of mushroom and the presence of mushroom spores in the atmospheric aerosol separately, the IIT team has proved the role of terrestrially occurring mushrooms as a source of biological aerosol particles in the atmosphere. The results were published recently in the journal *PLOS ONE*.

The study was undertaken on IIT Madras campus, which is spread over 678 acres and has very rich vegetation. It is considered an 'ecological island' representative of tropical dry evergreen biome.



Mushrooms release spores into the air when the relative humidity and temperature are favourable, says Prof. R. S. Verma (left). He is shown with Hema Priyamvada and Prof. Gunthe (right).
PHOTO: SPECIAL ARRANGEMENT

DNA analysis

Biodiversity of fungal species in the study site was studied using DNA analysis. To identify the type and diversity of atmospheric fungal spores, DNA analysis of particulate matter was carried out subsequently. The DNA analysis of 165 mushrooms revealed that there are 113 different species of mushrooms belonging to 54 genera and 23 families.

"Source characterisation of airborne fungal spores has been done for the first time in India — we studied the mushrooms and spores released by the mushrooms and present in air," says Prof. Sachin S. Gunthe from the Department of Civil Engineering, IIT Madras, and the corresponding author of the paper.

"Mushrooms grow during monsoon and when the temperature and relative humidity are favourable, spores are released into the air," says Prof. R.S. Verma from the Department of Biotechnology, IIT Madras, and one of the authors of the paper.

"There was 17% match between mushroom species found on land and spores in the air," says Hema Priyamvada, a doctoral student from the Department of Civil Engineering, IIT Madras, and the first author of the paper. Spores collected from the mushroom and from the air were studied to understand how the spores look morphologically — size, shape and surface features.

SEM images

"Morphological characterisation of fungal spores will be useful for identification of spores in the atmosphere. Since fungal spores account for huge fraction of bioaerosols, the SEM images will be helpful in quick and efficient identification," says Priyamvada.

The researchers have also quantitatively estimated the contribution of mushroom spores to atmospheric aerosol by modelling the dispersion of spores from the mushroom. "We found that of the certain number of spores (540 spores per sq. cm) released per second from a mushroom, 6% reached a distance of 100 metres for one second of release. In ambient conditions, the release can happen for a longer time — up to an hour — so the contribution of spores to the atmospheric aerosols will be huge," she says. "Once released from mushrooms, spores can remain suspended in air for a long time and travel great distances."

"We tried to show mushrooms growing in similar kind of ecosystem as IIT Madras are releasing spores into air. It means, to an extent, you can extrapolate these findings to other tropical dry evergreen biomes in India," says Prof. Gunthe.

Besides causing allergy in humans, spores can also damage plants and animal health. It can also have an impact on regional climate. By acting as ice nuclei, the fungal spores can accelerate vapour condensing around spores and forming water droplets. "Presence of specific types of bioaerosol can even advance the precipitation processes especially in convective clouds," says Prof. Gunthe.

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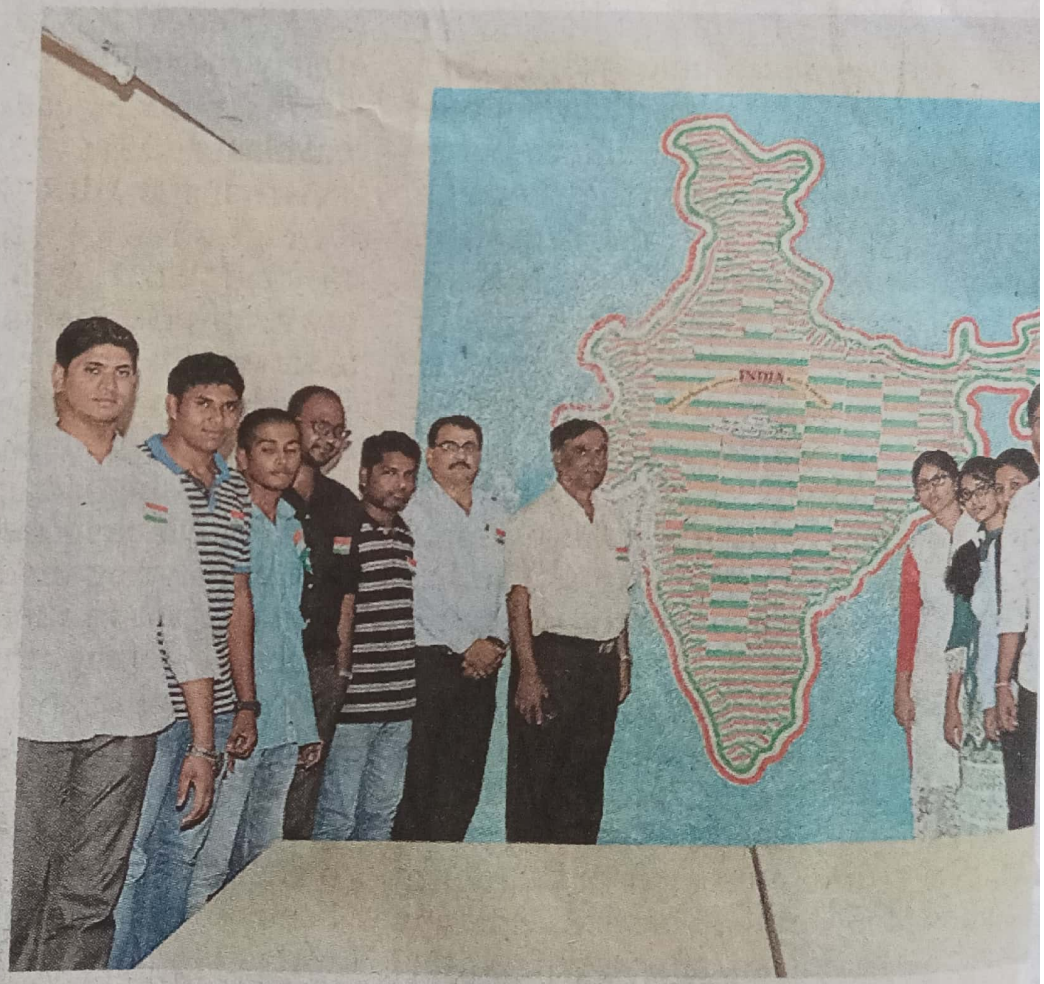
Involving the support staff

Vishwa Vishwani Group of Institutes has been making unique efforts to involve their support staff with the activities of students and faculty to motivate each other in drafting the contours of life. One such effort was to encourage a driver of the institute, Iqbal, who painted the Indian map.

Healthy relationship

This is an example of the teacher-student-employee relationship maintained at the college, said a senior faculty. The driver was encouraged to paint the map as part of Prime Minister Narendra Modi's call for 'Tiranga Yatra', a week-long programme to motivate people regarding nationalism and patriotism.

The horizons are not limited to management only, but expand to all spheres of life, including instilling responsibility towards our Mother Land, the faculty said.



INCLUSIVE DEVELOPMENT: | Students of the Vishwa Vishwani Grou by the painting of the Indian map.

HINDU JULY, 9-2017

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M VZ-VZ

HINDU · JULY 4, 25, 2016

Nano particles pack a mega medicinal punch in green tea

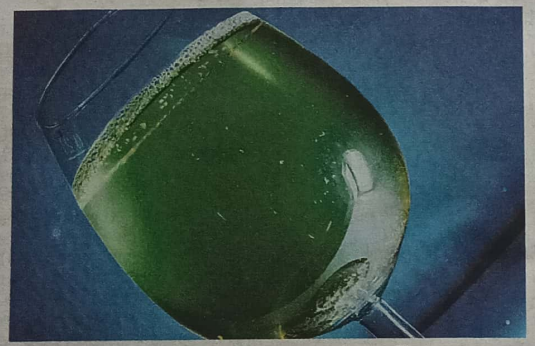
R. PRASAD

It is well known that green tea has many superior medical benefits — antibacterial activity, offers protection against many types of cancer, has anti-diabetic, and anti-inflammatory properties, to name a few. But all these benefits have been based on studying the infusion that is got when the tea bags are dipped into hot water for about 3-4 minutes to allow the active components seep into the water.

But a study published in January 2016 in the journal Scientific Reports has gone beyond studying the infusion and found the answers to what renders the green tea its medicinal properties. The researchers looked at the tiny particles suspended in the tea infusion to understand if these particles played a positive or negative role in the well established bioactivity of green tea.

"After seeping a bag of green tea we can always find fine particles suspended in the tea infusion. These fine particles are of three different sizes — macro, micro and nano. This raised my curiosity to probe the role of those particles in the green tea effect," says Judy Gopal one of the lead investigators of the paper in an email to this Correspondent. Dr. Gopal is a Chennai-born and educated researcher now working as an Assistant Professor in the Department of Bioresource and Food Science, Konkuk University, Seoul, South Korea.

Dr. Gopal and Dr. Manikandan Muthu, the lead investigators of the team, studied the suspended particles by assessing its antibacterial activity against oral microflora. The reason for picking oral microflora to test the effectiveness of the suspended particles is because the oral microflora are the first to come in contact with green tea in the mouth. Also, green tea is known to prevent dental caries.



The bioactivity of green tea is a synergistic effect.

The antibacterial activity seen in green tea comes from catechins, phenolics, flavonoids, with catechins playing a predominant role compared with the other two. "This is the reason why green tea has more antibacterial activity than black tea. Both teas have phenolics and flavonoids but catechins are unique to green tea. This additionally suggests that catechins play a more dominating role compared to phenolics and flavonoids," says Dr. Gopal.

Dr. Gopal and her team studied the effect of all three sizes of suspended particles for their antibacterial properties. The researchers found that the higher the epigallocatechin gallate or EGCG (the major bioactive ingredient in green tea) content the better the antibacterial effect against the oral microflora.

Compared with the macro and micro suspended particles, the nano particles had "significant antibacterial activity against S. mutans and the human dental bacterial samples". The macro particles in the infusion did not have any distinct antibacterial property or EGCG conserved in them. When the researchers removed the macro particles from the infusion, there was no change in the bioactivity of the extract.

Likewise, the micro particles too did not appear to contribute much towards antimicrobial activity. Though the bioactive components and EGCG contents were relatively higher than the macro particles, the removal of micro suspended particles from the infusion did affect the antimicrobial properties significantly. However, the nano-sized particles were found to be "packed with the bioactive components, namely flavonoids, total phenols, catechins, EGCG and exemplified enhanced antioxidation and antimicrobial activity compared to its counterparts," they write. "These results clearly indicate that the bioactivity of green tea was not just a green tea extract-based phenomenon but a synergistic phenomenon of the EGCG in the extract together with the EGCG packed near nano to nano sized green tea particles."

Explaining why the nano-sized particles have greater antimicrobial activity, Dr. Gopal says the higher surface area apparently provides greater surface attachment sites for the EGCG-catechin moieties. "This is not exactly directly evidenced so far, but the fact that these nano-sized particles encase more EGCG has be

sis," she says.

Though the nano particles are way less than macro particles in terms of weight, they are undoubtedly more in terms of numbers. She does not feel that there will be any major improvement in terms of antibacterial properties by increasing the amount of nano particles in green tea.

"When we started working on this project we thought the nano particles in the extract will deter the activity of the extract and, hence, we will make a recommendation to the tea bag manufacturers to pack the tea leaves in bags with finer meshes to avoid the release of these particles into the extract. But, the results we got were diametrically opposite. The nano particles have a huge role to play and ought to be retained," she

HINDU, 22, AUG, 2017

Drones on a mission to restore Myanmar's mangrove cover

Six of them can 'plant up to one lakh trees per day' and cut costs by nearly half

REUTERS
BANGKOK

Fast-dwindling mangroves in Myanmar's low-lying Ayeyarwady Delta, ravaged by decades of deforestation and conversion of land for agriculture and aquaculture, could find an unlikely saviour – drones.

Mangroves protect coastlines in the face of storms and rising sea levels, absorb carbon from the atmosphere, and boost fish stocks, experts say.

Yet Myanmar has lost more than 1 million hectares of mangroves since 1980, said Arne Fjortoft, founder and secretary-general of Worldview International Foundation (WIF), which has worked with two local universities to restore mangroves in the nation since 2012.

Dwindling green cover

In the delta region, known as the country's rice bowl, only 16% of original mangrove cover remains, Mr. Fjortoft told the Thomson Reuters Foundation.

There is an "urgent need" to restore mangroves to stem saltwater invasion of farmland and shoreline erosion due to sea level rise, as well as to protect lives and property from storms and floods in coastal areas, he added.

An annual climate risk index by Germanwatch, a green research group, ranked Myanmar – which suffered decades of military rule – second among the 10 countries worst-affected by extreme weather from 1996 to 2015.

WIF has so far planted some 3 million mangrove trees, but the task is laborious and time-consuming.

Drones, on the other hand, could plant trees 10 times faster and cut costs by half, according to U.K.-based start-up BioCarbon Engineering (BCE), whose CEO is an ex-NASA engineer who worked on the search for life on Mars.

Fight plan: Drones can be used to send seed pods to the best locations for germination. ▪ AFP

Once the process is fully automated, a single pilot operating six drones can plant up to 1,00,000 trees per day, BCE says.

In late July, the inaugural BridgeBuilder Challenge, which awards $1 million in prize money for ideas with global impact, selected as one of its winners a proposal by BCE and WIF to test the use of BCE's drones to plant a million mangroves in Myanmar.

The plan covers 250 hectares and involves training and employing locals to collect and prepare seeds, as well as to maintain, monitor and protect the fragile ecosystems.

It still requires approval from Myanmar's authorities, but Bremley Lyngdoh, a WIF board member who is applying for further grants, is hopeful work could start later this year.

"We don't want another big storm to come and destroy a lot of lives and livelihoods like in 2008," said Mr. Lyngdoh, referring to Cyclone Nargis which devastated the Ayeyarwady Delta region, killing nearly 1,40,000 people.

Drones are particularly useful in complicated or dangerous terrain that is hard for people to access, said Irina Fedorenko, a co-founder of BCE.

They can help cover large areas of land very fast, and could contribute to meeting the international community's commitment to restore 350 million hectares of degraded forests and agricultural land by 2030, she said.

Experts say thriving mangrove ecosystems can store two to four times more carbon than most other tropical forests, helping reduce planet-warming gases in the atmosphere, while slowing coastal erosion and shielding communities against tsunamis and storm surges.

Yet they are being destroyed at rates three to five times higher than global deforestation, a 2014 U.N. report warned.

How it works

BCE's technology, which works in two phases, aims to change that.

First, drones flying 100 metres above the ground take highly detailed, 3D images of the land while sensors record information such as soil type, soil quality and moisture. The data is then used to create a planting pattern, pinpointing the best spots and species to plant in each location.

Then a drone uploaded with the mapping information flies 2 metres above the ground, shooting biodegradable seed pods designed to enhance germination success. A drone carrying 300 seed pods can cover 1 hectare in 18 minutes, according to BCE.

Mr. Fedorenko said BCE had tested around 3,000 species of plants in different conditions, including in Britain and in Australia, and was confident of finding the right combination for Myanmar.

HINDU, AG 27, 2017

A new score in waste management

A novel yeast strain was used to ferment the glucose and make ethanol

ASWATHI PACHA

Scientists from CSIR's National Institute for Interdisciplinary Science and Technology (CSIR-NIIST), Thiruvananthapuram have been able to turn waste into wealth. They have produced ethanol from discarded cotton-stalks by using a combination of chemical and biological techniques. India has about 9.4 million hectares under cotton cultivation and every hectare generates 2 million tonnes of cotton stalk wastes. The results were published in *Bioresource Technology*.

The stalks were first treated with an acid, alkali and different enzymes to breakdown the complex organic polymers of the stalk. "The agro-residues are tough in nature and we need chemical pre-treatment to break down the complex structure of the stalk," explains Meera Christopher, research scholar at NIIST and first author of the paper.

The acid helps to remove hemicellulose, a polymer of the cell wall and the alkali extracts lignin, a binding matrix in the cell wall, made of complex phenolics. These treatments expose cellulose, the major component made of glucose to the action of enzymes.

Rich source: Cotton stalks are first treated to breakdown the complex organic polymers present in it. ▪ K. ANANTHAN

The cellulose was further treated using enzymes to convert it into glucose.

Fermentation

To convert the glucose into ethanol, fermentation using a novel yeast strain was carried out. "We isolated the yeast-*Saccharomyces cerevisiae*-RRP-03N, from a rotting wild fruit we found in the Silent Valley National Park in Palakkad, Kerala. In spite of several inhibitors of microbial growth produced during chemical treatment, the yeast performed better than distiller's yeast strains in fermenting the cotton stalk hydrolysate," says Dr. Rajeev K Sukumaran, Head of the Biofuels and Biorefineries Section, at NIIST and the corresponding author of the paper.

The yeast showed a glucose conversion efficiency of 76% and the entire glucose was utilised by the yeast in just 24 hours and converted into alcohol. This performance was superior to any other organism reported for fermentation of cotton stalk. The final alcohol obtained can be made to fuel grade bioethanol (>99% purity), after distillation and dehydration using molecular sieves, which is an existing technology practised in the distilleries.

Bioethanol

Bioethanol has a number of advantages over conventional fuels as it comes from a renewable resource. It is mandatory to blend 10% ethanol with petrol. Bioethanol presently in use is obtained by fermentation of sugar cane molasses which is a byproduct of sugar production, and has food value. Most of this first generation ethanol finds its way into consumer applications, primarily as liquor. Converting the agro-residues to ethanol reduces the food vs fuel competition," explains Meera.

Further studies should be carried out for commercial viability and large-scale production.

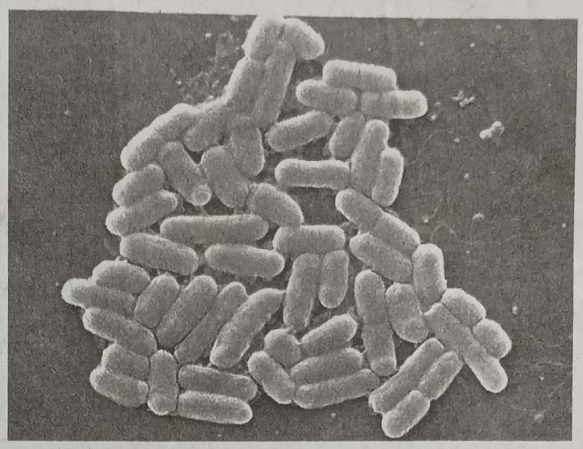
Novel compounds destroy biofilm-forming bacteria

The species studied included chronic pathogens

ASWATHI PACHA

Two new molecules capable of destroying biofilm forming bacteria have been developed by scientists at the Bengaluru-based Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR). The molecules performed better than conventional antibiotics in killing the bacteria during the dormant phase. Biofilms are communities of microorganisms that attach to each other and to surfaces and are able to act as barriers to antibiotics. When used in combination with existing antibiotics, the molecules reduced the microbial burden in the case of burns and surgical wounds.

The effect of these macromolecules on chronic biofilm causing pathogens like *E. coli, Acinetobacter, Klebsiella* were studied and the results were recently published in *PLOS ONE*.



Prime target: Escherichia coli was one of the bacteria to be tested. ▪ AP

Antibacterial activity

The researchers studied the effect of the compound on dormant state *E. coli*. "We tested on *E. coli* that reside in biofilms in a dormant condition. The new macromolecules killed the bacteria by targeting their cellular membrane, the protective layer present in both active as well as dormant state," explains Dr. Divakara SSM Uppu at JNCASR and the first author of the article. Antibiotics become effective when the bacteria are in an active state.

While 100 g/mL of antibiotics (ampicillin and kanamycin) was required to partially kill the bacteria, a concentration of just 10 g/mL of the macromolecule was able to completely kill *E. coli*. "With the rise of antibiotic-resistant superbugs, it is essential to develop new compounds that can work against them. Our new compound was able to disrupt the cell membrane and kill the bacteria even at very low concentration of 5 g/mL," says Dr. Jayanta Haldar, scientist at JNCASR and corresponding author of the paper.

Though the molecule alone was not able to disrupt biofilm, a combination of the molecule with erythromycin in equal concentration caused complete eradication of the tough-to-kill *E. coli* and *Acinetobacter* biofilm. Erythromycin by itself was also not able to disturb the biofilm. This showed that the combined strategy worked efficiently compared with individual antibiotics.

Double advantage

A combination of existing antibiotics (erythromycin) and the macromolecules also showed efficacy in treating burn and surgical wound infections caused by multi-drug resistant pathogens – *Acinetobacter* and *Klebsiella* – in animal models.

Conventional antibiotics were ineffective in the treatment of these infections in mice. However, the combination of macromolecules and the antibiotics could almost completely eradicate the burn and surgical wound infections and facilitate faster regeneration of the epithelial cells and hair follicles in mice models.

Collectively, these findings show the potential implications of the combination approach for topical treatment of infections. However, detailed animal studies are required further to fully understand the prospects of the molecule.

A milestone in treating cancer

HINDU SEP 3, 2017

DENISE GRADY

GETTY IMAGES/ ISTOCK

The United States's Food and Drug Administration (FDA) on Wednesday approved the first-ever treatment that genetically alters a patient's own cells to fight cancer, a milestone that is expected to transform treatment in the coming years.

The new therapy turns a patient's cells into a "living drug" and trains them to recognise and attack the disease. It is part of the rapidly growing field of immunotherapy that bolsters the immune system through drugs and other therapies and has, in some cases, led to long remissions and possibly even cures.

The therapy, marketed as Kymriah and made by Novartis, was approved for children and young adults for an aggressive type of leukemia – B-cell acute lymphoblastic leukemia – that has resisted standard treatment or relapsed. The FDA called the disease "devastating and deadly" and said the new treatment fills an "unmet need". Novartis and other companies have been racing to develop gene therapies for other types of cancers, and experts expect more approvals in the near future. Dr. Scott Gottlieb, the FDA commissioner, said that more than 550 types of experimental gene therapy were being studied.

Drawbacks and cost

There are drawbacks to the approach. Because Kymriah can have life-threatening side effects, including dangerous drops in blood pressure, the FDA is requiring that hospitals and doctors be specially trained and certified to administer it, and that they stock a certain drug needed to quell severe reactions.

Kymriah, which will be given to patients just once and must be made individually for each patient, will cost $475,000 (approximately ₹2.8 crore). Novartis said that if a patient does not respond within the first month after treatment, there will be no charge. The company also said it would provide financial help to families who were uninsured or underinsured. Discussing the high price during a telephone news conference, a Novartis official noted that bone-marrow transplants, which can cure some cases of leukemia, cost even more, from $540,000 to $800,000.

About 600 children and young adults a year in the U.S. would be candidates for the new treatment.

The approval was based largely on a trial in 63 severely ill children and young adults who had a high rhemission rate of 83% within three months. The treatment was originally developed by researchers at the University of Pennsylvania and licensed to Novartis. It was identified in previous reports as CAR-T cell therapy, CTL019 or tisagenlecleucel.

The first child to receive the therapy was Emily Whitehead, who was six and near death from leukemia in 2012 when she was treated, at the Children's Hospital of Philadelphia. Now 12, she has been free of leukemia for more than five years.

Customising Kymriah

To customise Kymriah for individual patients, white blood cells called T cells will be removed from a patient's bloodstream at an approved medical centre, frozen, shipped to Novartis in Morris Plains, New Jersey, for genetic engineering and multiplying, frozen again and shipped back to the medical centre to be dripped into the patient. That processing is expected to take 22 days. Novartis said the treatment would be available at an initial network of 20 approved medical centres to be certified within a month, a number that would be expanded to 32 by the end of the year. Five centres will be ready to start extracting T cells from patients within three to five days, the company said.

Certification is being required because the revved-up T cells can touch off an intense reaction, sometimes called a cytokine storm, that can cause high fever, low blood pressure, lung congestion, neurological problems and other life-threatening complications. Medical staff members need training to manage these reactions, and hospitals are being told that before giving Kymriah to patients, they must be sure that they have the drug needed to treat the problems, tocilizumab, also called Actemra. NYT

HINDU, JULY 30, 2017

IGIB researchers rein in cancer cells

Controlling the level of telomerase can probably prevent cancer metastasis

R. PRASAD

Researchers at Delhi's CSIR-Institute of Genomics and Integrative Biology (CSIR-IGIB) have found the mechanism by which controlling the levels of telomerase can help in reining in the growth of cancer cells and probably prevent cancer metastasis. The results were published in the *Journal of Biological Chemistry*.

Unlike normal cells, most cancer cells have high levels of telomerase and this leads to more than normal length of the telomere. Telomeres protect chromosome ends somewhat like the plastic clips at the end of shoelaces that prevent fraying of the ends. While cells die when the telomere becomes shorter beyond a certain limit, in the case of cancer cells the length of the telomere is maintained thereby ensuring extended life span of the cells.

In normal cells the telomerase is kept under tight control. But in about 85% of all cancers the telomerase levels are more than normal leading to malignant transformation and aggressive metastasis in many cases. "It is not clearly understood how telomerase is kept under tight control in normal cells and how the telomerase levels gets increased in cancerous cells," says Dr. Shantanu Chowdhury from the Genomics and Molecular Medicine Unit at IGIB and the corresponding author of the paper.

It is already known that when the amount of a particular protein that suppresses the spread of cancer (metastasis) called nonmetastatic 2 (NME2) is high the tendency of the cancer to spread is low. But what came as a surprise is the role of this protein in controlling the telomerase levels as well. "How NME2 controls metastasis is not clearly understood. But surprisingly we found that NME2 controls the levels of telomerase," Dr. Chowdhury says.

Proteomics approach: Ankita Singh (seated) and Dr Shantanu Chowdhury worked with Dhurjothi Saha (right) to discover the mechanism controlling the production of telomerase. SPECIAL ARRANGEMENT

The mechanism

The researchers found that NME2 binds to a DNA structure (G-quadrauplex) found in the telomerase promoter. Once bound, the NME2 facilitates a well known suppressor of gene expression (REST complex) to bind to the telomerase promoter and control the production of telomerase.

"Experiments show that if you don't have NME2 then the REST suppressor cannot bind to the telomerase promoter and control the production of telomerase," says Dhurjhoti Saha from IGIB and one of the first authors of the paper.

"We used proteomics approach to study the protein-protein interactions. We could identify protein members of the REST complex that interact with NME2. The IGIB team then confirmed the role of the REST complex and its function," says Dr. Ramesh Ummanni, from the Centre for Chemical Biology at the CSIR-Indian Institute of Chemical Technology (CSIR-IICT), Hyderabad and a co-author of the paper.

Drug target

"We established that the DNA structure (G-quadrauplex) could be a possible drug target once we understood the mechanism of NME2 binding to the promoter followed by the REST suppressor complex," Dr. Chowdhury says. The involvement of a DNA structural architecture allowed the team to use small molecules that recognised the specific structure.

Since the amount of NME2 is low in many metastatic cancerous cells, the researchers used small molecules that were able to function like NME2 by recognising and binding to the DNA structure. "We screened 20 molecules and 11 were able to bring down the telomerase level in fibrosarcoma cancer cells," Dr. Chowdhury says.

Based on the initial lead from the small molecules, the researchers are planning to synthesise new molecules to optimise for drug-like characteristics for therapeutic use. The molecules will then be tested on animals.

HINDU, 29, AUG, 2017

Microbiome reacts to stress

ASIAN NEWS INTERNATIONAL

The bacterial communities that live inside everyone are quite similar and stable during happy times, but when stress enters the equation, those communities can react differently in every person, finds a recent study published in *Nature Microbiology*.

Researchers from Oregon State University in Corvallis, U.S. suggested that this has key implications for a more personalised approach to antibiotic therapy, management of chronic diseases and other aspects of medical care.

Lead author Jesse Zaneveld of the University of Washington, Bothell, collaborated with Vega Thurber and her student, Ryan McMinds, to survey the literature on microbial changes caused by perturbation.

"When healthy our microbiomes look alike, but when stressed each one of us has our own microbial snowflake," she said. This is a very important facet to consider for managing approaches to personalized medicine. Stressors like antibiotics or diabetes can cause different people's microbiomes to react in very different ways.

Humans and animals are filled with symbiotic communities of microorganisms that often fill key roles in normal physiological function and also influence susceptibility to disease. Predicting how these communities of organisms respond to perturbations – anything that alters the systems' functioning – is one essential challenge in microbiology.

Studies of microbiome dynamics have typically looked for patterns that shift microbiomes from a healthy stable state to one in which the microbial communities are out of their natural balance, interrupting basic biological functions.

HINDU, AUG 2, 2017

Rising temperatures drive up farmer suicides in India: U.S. study

Researchers say that a warmer climate reduces crop yields, aggravates distress

R. PRASAD
CHENNAI

Climate change may have led to over 59,000 farmer suicides over the last 30 years in India, argues a research report from the University of California, Berkeley in US.

Even a 1°C increase in temperature above 20° C in a single day during the crop growing season results in about 70 suicides on average.

The increase in temperature during the cropping season reduces crop yields, resulting in increased suicides, according to a study published in the journal *Proceedings of the National Academy of Sciences*.

The study was carried out using data for all States and Union Territories.

It has several limitations, though, including the fact that it has not looked at other factors that could have contributed to suicides.

Endorsing the temperature-crop yield link, agricultural scientist Prof. M.S. Swaminathan said, "The effect of increased temperature on crop yield is real. In the late 1980s we found that when the temperature increases by 1 - 1.5° C the duration of the crop reduces by one month. Since the duration reduces, the yield drops by 300-400 kg."

Tamma A. Carleton from the University of California, Berkeley and the author of the paper, tested the link between climate change, crop yields and suicide by comparing the number of suicides across India between 1967 and 2013 with crop yield and climate data. Data on suicides were collected from the National Crime Records Bureau.

No harvest: In this photo dated May 11, 2016, a farmer inspects his sugarcane crop destroyed due to drought in the Marathwada region of Maharashtra. ▪ AP

An additional burden

She found crop losses due to heat damage cause additional burden on farming households and this at times leads to suicides.

Dr. Carleton found suicides reported when a single day's temperature increased by 1°C only during the crop growing season. Similar increase in temperature during other seasons did not result in a rise in suicides.

Crop yield data from 13 States from 1956 to 2000 were compared with climate change data. Dr. Carleton found annual yield falling when the temperature was above 20°C during the crop-growing season.

An increase in rainfall by 1 cm during the growing season leads to a decrease of about 0.8 deaths per 100,000, thus lowering the suicide rate by 7% on average, she writes.

The effect of climate variation reveals that past growing season temperature strongly influences suicide rates in the following years up to about five years.

For instance, when there is abundant rainfall during one growing season, the suicide rates dip for the next two or three years. Drought apparently does not seem to have any effect on suicide rates, the researcher found.

The study says South India, which is generally hotter, has higher farmer suicide rates.

Comparing the yields to growing season temperature for 13 States, the author found that States where the yields are more affected by high temperatures are also the States which report higher suicide rates. Maharashtra, Karnataka, Tamil Nadu, and Andhra Pradesh not only show severe suicide responses to temperature but crop yield is also more negatively affected by higher temperature.

The study did not find any adaptive behaviour to prevent suicides in response to climate change.

Weak studies in India

"We must undertake anticipatory research using genetic checkmating for potential changes in climate such as changes in precipitation, and temperature. I don't think we have done such research as seriously as we should have," says Prof. Swaminathan. "Sub-Saharan Africa and South Asia are the most vulnerable regions and we would be the most affected."

India's average temperature is expected to increase by 3°C by 2050.

HINDU, AUG 3, 2017

Global warming cuts protein in key crops

Phenomenon leaves vulnerable populations at risk of growth stunting and early death, says study

AGENCE FRANCE-PRESSE
MIAMI

Rising carbon dioxide levels from global warming will drastically reduce the amount of protein in staple crops like rice and wheat, leaving vulnerable populations at risk of growth stunting and early death, experts warned on Wednesday.

Researchers say they still don't understand how or why carbon dioxide emissions sap protein and other nutrients from plants, but the mystery is one that could have devastating consequences across the globe.

An additional 150 million people globally may be at risk of protein deficiency by 2050 because of rising levels of carbon dioxide in the atmosphere said the report in the journal *Environmental Research Letters*.

The study, led by Harvard University researchers, is the first to quantify the impacts of global warming on the protein levels of crops.

Field experiments

It relies on data from open field experiments in which plants were exposed to high concentrations of CO2. Global dietary information from the United Nations was used to calculate the impact on people who live dangerously close to the edge when it comes to getting enough protein. Without it, growth is stunted, diseases are more common and early mortality is far more likely.

Carbon dioxide is a byproduct of fossil-fuel burning that helps trap heat around the Earth. Without stark action, these emissions are expected to climb in the decades to come, resulting in rising seas, hotter temperatures and more extreme weather events.

A leading hypothesis was that CO2 might increase the amount of starch in plants, thereby decreasing protein and other nutrients.

But lead author and senior research scientist Samuel Myers said experiments did not back up the theory.

Africa, Asia hardest hit

Protein was not the only nutrient to take a major hit. Other research has shown that rising CO2 will cut key minerals like iron and zinc in staple crops, leading to further nutritional deficiencies worldwide.

Researchers calculated that by 2050, higher CO2 concentrations will sap the protein contents of barley by 14.6%, rice by 7.6%, wheat by 7.8%, and potatoes by 6.4%.

"If CO2 levels continue t rise as projected, the popu lations of 18 countries ma lose more than 5% of the dietary protein by 2050 du to a decline in the nutrition value of rice, wheat, ar other staple crops," said th report.

The hardest hit areas a expected to be Sub-Sahar Africa, where millio already don't get enou protein in their diets, ar South Asia where rice ar wheat are common staples

India alone may lose 5.3 of protein from a standa diet, putting a predicted 5 million people at new risk protein deficiency.

HINDU JULY 4, 2016

A plant that makes cameo appearance when rain subsides

K. S. SUDHI

Plant taxonomists have found a new species of mycoheterotrophic plant in the Idukki forests of Kerala. The plant species makes a cameo appearance after the heavy spell of monsoon showers.

The species has been named as *Thismia sahyadrica* and is the first report from the mainland of India, according to scientists.

A mycoheterotrophic plant is the one that depends on mycorrhizal fungus, with which it establishes a symbiotic relationship, for carbon and nutrient supply. The plants resort to parasitism as they lack chlorophyll and cannot produce food on its own through photosynthesis.

It was during a floristic exploration in the Idukki district of Kerala, which falls under the Anamalai phyto-geographical region of Western Ghats, that the scientists stumbled upon the species. "It was found surviving in the humus-rich soil of medium elevation evergreen forests," said P. Sujanapal, a plant taxonomist of the Kerala Forest Research Institute (KFRI), Peechi, Thrissur.

The exploration team, which consisted of A.J. Robi of the Department of Botany, Bishop Abraham Memorial College, Pathanamthitta, and K.J. Dantas and M. Sumod of the KFRI, counted 35 flowering individual plants within one sq.km area of the forest. The researchers say that phylogenic studies related to the evolutionary and phyto-geographical affinities of the species with its cousins in other parts of the world needs to be carried out as its major distribution is found in the East Asian region of Asia and other continents.

Thismia sahyadrica found in Idukki district. PHOTO: SPECIAL ARRANGEMENT

Though the new species has similarities to the *Thismia rodwayi* of Australia and New Zealand in general habit and flowers, it stands out with its long stem, obconical shape and colour of the perianth tube. According to the researchers, the newly described species is a non-photosynthetic ephemeral, which emerges briefly to flower and fruit after a period of heavy showers during the monsoon, especially in the months of June and July.

"Observations on the microhabitat and distribution pattern indicated that the new taxon is restricted to undisturbed and morphologically highly unique, humus-rich soil substratum under the dense shade of evergreen forests with associations of macro and micro biota".

Little is known about its habitat, distribution, reproductive biology and lifecycle. A detailed ecological evaluation is essential for understanding the structure and associations of the plants with its complex ecosystem, says Dr. Sujanapal.

The plant has qualified to be included in the Critically Endangered category of the IUCN Red List Categories and Criteria of endangered flora and fauna, they say.

The earliest plants that colonised land

SHUBASHREE DESIKAN

A study of rooted fossil soils in China's Yunnan region, published in *Proceedings of National Academy of Sciences* on August 8, has established the time of colonisation of land regions by the earliest plants to be 20 million years earlier than was believed.

The greening of the land is a very important transition in the history of earth. Up until about 450 million years ago, there was no plant life on land. Hence there were no soils and the land consisted of mainly rocky masses. The first plants crept out of water and populated regions close to the water. It was later, around 390 million years ago that trees took root and digested the rocks to make soils, in the middle Devonian period — a geologic period stretching from about 420 million years ago to 359 million years ago.

This study, carried out by researchers from the universities of Bristol and Peking, reveals a rooted paleosol, or fossil soil, which sets the date of colonisation of land by the plants. This paleosol contains the fossilised roots of the plant *Drepanophycus*, a surprisingly deep-rooting system.

In a press release from the universities, Jinzhuang Xue, the first author of the paper, from Peking University, is quoted as saying,

The soil, nearly 410-million-years old, showed extensive rhizome traces of *Drepanophycus*, an early vascular plant.
PHOTO: JINZHUANG XUE.

"We have been doing fieldwork in the Devonian rocks of Yunnan for some time, and we kept finding large-scale structures up to 1 metre deep in the red rocks. They looked like a plant called *Drepanophycus*, already known from rocks of the same age in Europe and North America."

Though the roots of the plant were short, it sent out long rhizomes, or underground stems, that went in deep and broke up the rocky masses to make the first soils. Looking at the soil thickness and comparing it with modern floodplain soils, the study estimates that it may have taken from 50 to 200 years for one soil bed to form.

HINDU, AUG 15, 2016

IIT Madras develops optical system to detect and monitor algal bloom

R. PRASAD

An integrated optical system capable of detecting and monitoring algal (or phytoplankton) blooms both spatially and temporally in coastal and open ocean waters has been developed by a team of researchers at the Indian Institute of Technology (IIT), Madras. Very soon, the Hyderabad-based Indian National Centre for Ocean Information Services (INCOIS) will begin using the optical system for detecting and monitoring algal blooms in ocean waters surrounding India. INCOIS is currently in the process of making the system operational.

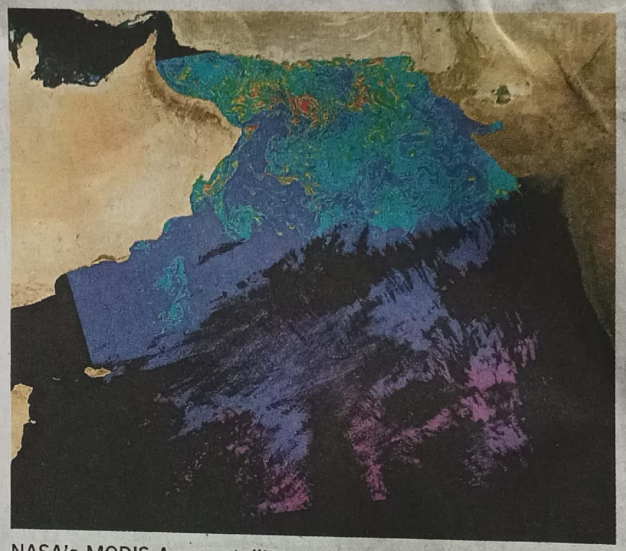
Phytoplankton are the base of the aquatic food web, providing food and shelter for different organisms including fish. Along with other parameters, phytoplankton biomass (algal blooms) tends to behave as potential zones of fish aggregation. So identifying such algal blooms in real time using satellite data will greatly benefit the fishing community to zero in on fertile fishing locations.

The optical system provides an array of optical parameters and spatial information regarding algal bloom density (chlorophyll) and their causative algal species that are commonly seen in coastal and oceanic waters around India, particularly in the Arabian Sea. Results of the study were published recently in the *Journal of Geophysical Research: Oceans*.

"A few field-based techniques are available for studying algal blooms. But those techniques are limited in time and space besides being labour intensive, time-consuming and expensive, and hence they cannot be used for monitoring large water bodies. ISRO's Oceansat-2 satellite launched in 2009 can cover larger areas and provide global ocean colour observations," says Prof. Palanisamy Shanmugam, the senior author of the paper from the Department of Ocean Engineering, IIT Madras.

The optical-detection system developed by Prof. Shanmugam and his team uses the ocean colour satellite data, in situ measurements and underwater light field data collected from the field to provide algal species-specific information required for their monitoring and assessment.

Unlike the blooms that are found on the surface of water bodies, observing and monitoring subsurface blooms is particularly challenging. Conventional techniques fail when it comes to monitoring subsurface algal blooms. Though the optical-detection system was tested only to detect blooms from near surface waters, Prof. Shanmugam is confident that the optical system is capable of detecting and classifying blooms present under water. "We have not tested to what depth the optical system can be used. We are planning to carry out this study soon," he says. "We have tested and validated the results of this optical system with in situ measurements of the three algal blooms collected from the ocean waters. The average accuracy of our optical system which was developed in 2015 is over 85 per cent," he says. The uncertainty in accurately identifying the blooms was primarily due to lack of distinctive water colour, and absence of unique spectral features (in the backscattering coefficients caused by cases of less photosynthetic organisms), fluorescence and chlorophyll signatures associated with the bloom species.



NASA's MODIS-Aqua satellite captured on 18 February 2010 processed using a global algorithm developed by Prof. Shanmugam. Red, green and blue colour gradients depict very high algal bloom density, intermediate bloom density and very low bloom density.

The water colour is determined by particulate matter and dissolved substances in water, while fluorescence is to do with the light energy that gets absorbed by algae and re-emitted as fluorescence at a longer wavelength than the absorbed light.

Chlorophyll is used as a proxy for measuring the phytoplankton biomass. The increase in biomass of phytoplankton due to their increased growth or physical aggregation leads to algal blooms. Typically one dominant or a few phytoplankton species are involved in bloom formation.

Chlorophyll is used as a proxy for measuring the phytoplankton biomass.

Some algal blooms including "red tides" and "blue-green blooms" are a serious concern because they can pose significant threats to water quality and risks to human and animal health.

All the major algal blooms are predominantly found to be associated with the cooler water masses off the western coast in the northern Arabian Sea. These blooms then spread into the central Arabian Sea along with a whirling motion of waters and currents. The blooms reach its peak spatial distribution between November and February and minimum in June to September. Strong upwelling along the Arabian Sea coast triggers initiation and growth of algal blooms, while enhanced cooling, vertical mixing, favourable winds, and atmospheric deposition of the mineral aerosols from surrounding deserts further aid its growth. The Bay of Bengal is relatively free of algal blooms except off the Ganges-Brahmaputra Estuarine Frontal system and estuarine and coastal regions where nutrients are abundant supply.

HINDU, JULY-9-2017.

IISc works to make a common antibiotic more effective against TB

R. PRASAD

Bacteria develop resistance against a drug only when they are exposed to it or when the drug is misused. But now, a team of researchers from India has found whether and how drug resistance can develop against a candidate drug called Augmentin even before the drug is approved for treating patients with drug-resistant TB. Augmentin is currently undergoing clinical trials in patients with drug-resistant TB; it is already being used for common bacterial infections.

Besides deciphering the mechanism by which TB bacteria can develop resistance against Augmentin, the researchers have found ways of overcoming this potential resistance mechanism, thereby making Augmentin a potentially powerful drug to treat both multidrug-resistant TB (MDR-TB) and extensively drug-resistant TB (XDR-TB).

The beta-lactam class of antibiotics such as penicillin, ampicillin and amoxicillin is one of the most widely used class of antibacterial drugs. Despite its ability to kill several types of bacteria, the beta-lactam antibiotics have never been used against TB bacteria. This is because TB bacteria are naturally resistant to this class. TB bacteria inherently produce an enzyme called beta-lactamase which breaks down beta-lactam class of antibiotics (through hydrolysis) and makes the drug ineffective against TB disease.

Making of Augmentin

One of the strategies of getting around using the beta-lactam class of antibiotics is developing an inhibitor against beta-lactamase enzyme. Clavulanic acid is one such inhibitor, which blocks the beta-lactamase enzyme. Augmentin, which is a combination of a beta-lactam antibiotic (amoxicillin) and beta-lactamase inhibitor (clavulanic acid), can thus be an effective drug against TB bacteria.

"Till now no one knew the exact mechanism of how the combination of beta-lactam and beta-lactamase inhibitor was killing TB bacteria and how resistance against the combination can emerge in future," says Dr. Amit Singh from the Centre for Infectious Disease Research at the Indian Institute of Science (IISc), Bengaluru, and the corresponding author of the paper published in the journal *eLife*. "Our study was able to provide insights into how resistance against Augmentin can emerge."

The team used integrated experimental technology and computer tools to understand the mechanism by which resistance against Augmentin can set in.

On a mission: Prashant Shukla (Left), Amit Singh and Saurabh Mishra used integrated experimental technology and computer tools to understand the mechanism by which resistance sets in. ▪ SPECIAL ARRANGEMENT

Deciphering the mechanism

The first thing that the researchers asked was how the TB bacterium senses the presence of the drug combination in and around it. "We found the bacterium when exposed to this drug combination changes its metabolism and respiration, which led to the production of sub-lethal amount of reactive oxygen species (ROS). The ROS acts as a danger signal for the bacteria to mount a defence mechanism against Augmentin," Dr. Singh explains.

The defence mechanism is through a protein called WhiB4, which is normally present in bacteria and is responsible for regulating the production of beta-lactamase enzyme. When the WhiB4 protein senses the ROS signal, it produces large amounts of beta-lactamase enzyme in the TB bacteria. "This could be one method by which the bacteria can become resistant to Augmentin," Dr. Singh says.

Besides producing beta-lactamase enzyme, the WhiB4 protein also controls the production of an antioxidant molecule called mycothiol. The main role of mycothiol is to reduce the excessive increase in ROS so that ROS level is kept in balance; excessive ROS can kill bacteria by damaging proteins, DNA, and cell wall lipids.

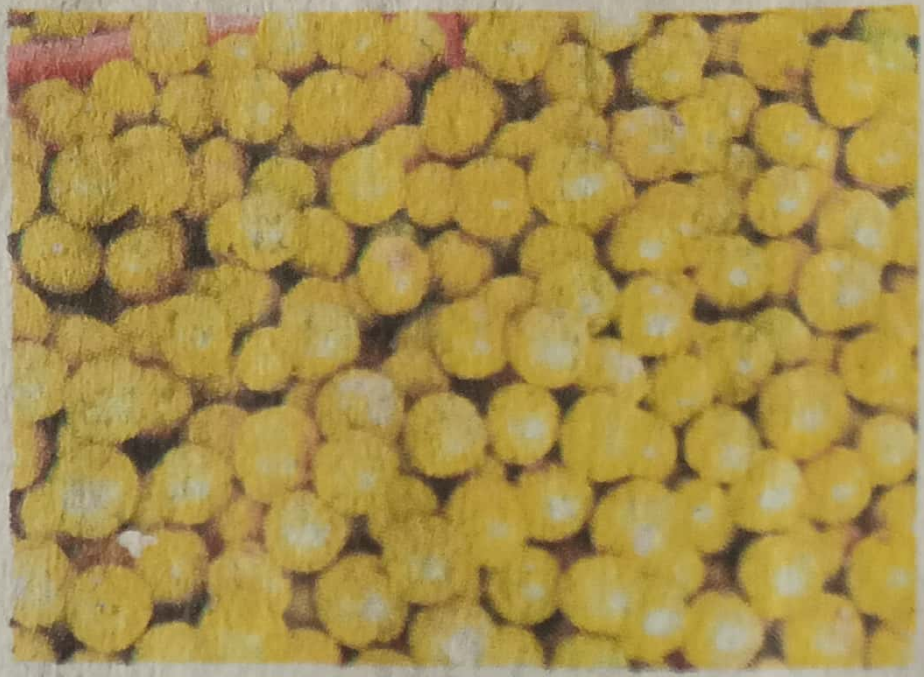
"The WhiB4 protein can detect the ROS signal produced by antibiotics and direct the production of both beta-lactamase and mycothiol, which work together and contribute to bacterium's ability to resist augmentin," says Saurabh Mishra from the Centre for Infectious Disease Research at IISc and the first author of the paper.

Making Augmentin powerful

The researchers demonstrated that it is possible to kill MDR-TB and XDR-TB by simply changing the levels of the regulator, WhiB4, and/or increasing the ROS levels inside the bacteria. "When we knocked out mycothiol production, the level of ROS increased inside the bacteria and ultimately resulted in efficient killing of drug-resistant TB bacteria," he says.

There are certain antibiotics (such as clofazimine) that work by increasing the ROS levels inside bacteria. The researchers are currently testing if using such antibiotics along with Augmentin can efficiently kill drug-resistant TB bacteria. Augmentin and clofazimine antibiotics can together elevate the production of ROS. The excessive ROS inside the bacteria can then kill all forms of drug-resistant TB bacteria.

HINDU, July 18, 2017



Eco-friendly plastic made with lemon extracts

LONDON

Scientists have developed an eco-friendly kind of plastic using lemon extracts called limonene and carbon dioxide that may replace potentially harmful materials widely used in everyday items like phone cases and bottles. Limonene can replace bisphenol-A that is used to make plastics, the researchers said. PTI

Malaria drug shields foetus from Zika

HINDU, JULY 18, 2017

Effects of using hydroxychloroquine over a long term remains to be assessed, say researchers

R. PRASAD
CHENNAI

Commonly used malaria drug hydroxychloroquine can effectively block the Zika virus from crossing the placenta and getting into the foetus and damaging its brain, say researchers from Washington University School of Medicine in St. Louis, U.S.

The drug already has approval for use in pregnant women.

The placenta acts as a barrier to protect the developing foetus from disease-causing organisms.

It prevents pathogens from reaching the foetus through a form of a garbage recycling system that removes some components of cells, termed autophagy.

While infections often ramp up this recycling system to get rid of any pathogens, the effects of autophagy on Zika infection and its impact on transmission of the virus past the placenta were earlier not known.

"We found that the Zika virus actually manipulates the garbage recycling system to its own advantage. The Zika infection ramps up autophagy. So when we use a drug that inhibits or suppresses this ramping up, we can block the virus from infecting the foetus," says Indira U. Mysorekar from the Department of Obstetrics and Gynaecology, Washington University School of Medicine and the corresponding author of the study published in *The Journal of Experimental Medicine*.

Placental cells

To understand how the Zika virus crosses the placenta and infects the foetus, Prof. Mysorekar and her team infected human placental cells.

They found the Zika virus activating the genes related to autophagy thereby heightening the destructive recycling system activity.

But treating the cells with drugs that inhibit autophagy resulted in significant decrease in Zika virus replication about two days after infection. On the other hand, when drugs that promote the cell recycling process were administered, the virus multiplied and caused increased viral infection.

Aedes aegypti mosquitoes transmit the Zika virus. ▪ AP

Prof. Mysorekar got similar results when her team repeated the experiments in mice.

They infected two groups of pregnant mice – one which had reduced autophagy and mice that had normal autophagy.

In the former group, the virus in the placenta was 10 times lower and placental damage was decreased compared with the normal mice.

Also, the presence of Zika virus in the foetus was 15 times lower in mice with reduced autophagy. However, the virus load in the blood was the same in both groups of mice.

Viral loads

"The viral loads in maternal blood were not affected by loss of autophagy which is good because we don't want whole body effects of loss of autophagy as that could lead to side effects. Adults with Zika virus can clear the infection without too much trouble; it's the transmission to the foetus that is devastating," Prof. Mysorekar said in an email.

Since the malaria drug hydroxychloroquine inhibits the cell recycling response, the researchers repeated the experiments using mice with a normal autophagy response.

Pregnant mice infected with Zika virus were treated with the drug or a dummy for five consecutive days. Compared with the controls, there was significantly less virus in the placenta of mice that received the drug.

The damage to placent was also less in mice tha were treated with the dru and foetus showed reduce Zika infection.

The drug has been ap proved for use in pregnan women but only for a shor duration of time.

But with Zika virus infec tion even during the third tr mester causing foetal dam age, the treatment has to b for a long time in the case o Zika virus.

Lab to clinic

"We do not know what th risk may be of long-tern treatment with the drug [Hy droxychloroquine]. Thes tests have to be done an that will be the next step a the findings leave the lab an head to the clinic," said Pro Mysorekar.

"Carrying out a trial o pregnant women is alway challenging. But given tha the drug is already approve and Zika infections hav such terrible consequences there may be more chance of going forward," she said.

HINDU, JULY, 28, 2017

'Secret garden' opens after a century

The delicate wetlands near Lake Tahoe in Sierra Nevada are home to rare species

ASSOCIATED PRESS
TRUCKEE

Pink and yellow wildflowers burst from a lush bed of grass hidden from public view for more than a century. Towering trees and snow-capped mountains encircle the wild meadow, beckoning visitors to a largely untouched piece of California's Sierra Nevada.

Conservation groups bought the land in Lower Carpenter Valley north of Lake Tahoe and are opening it for tours. It contains rare carnivorous plants and threatened birds and serves as a migration corridor for other species.

Bird songs and the gurgle of a serpentine creek provide the soundtrack in the meadow a few kilometres from noisy Interstate 80. The ground suddenly turns spongy underfoot as visitors step onto a deep bog that has formed along parts of the valley floor.

"It literally is a secret garden," said Kathy Englar, the Truckee Donner Land Trust's development director.

Pristine spot: The North Fork of Prosser Creek flows through the Lower Carpenter Valley near Truckee, California. ▪ AP

The Lake Tahoe region regularly draws tens of thousands of people to ski, hike and camp, but the piece of land along a creek near Truckee has been kept behind locked gates along a winding dirt road.

The trust and the Nature Conservancy, with other partners, bought more than 5 sq.km. from the longtime owners for $10.3 million. The partnership bought 600 acres in mid-July, but that area is so sensitive it will initially be open only for guided visits. It includes about two-thirds of the vast meadow. It acquired about half the property last year, 637 acres known as Crabtree Canyon, that is now open to hiking and mountain biking.

Sensitive habitat

The partners have a contract to buy a final 80-acre parcel.

The sensitive 600-acre site includes "these incredibly verdant habitat areas with fens, they call them, these seeps and springs," said Elliott Wright, senior associate director of philanthropy for the Nature Conservancy.

The delicate wetlands are home to rare native sundew, small carnivorous plants that attract insects to sticky residue on their leaves.

The North Fork of Prosser Creek is fed by snow and lined by willows and once was home to native Lahontan cutthroat trout, a threatened species that could be reintroduced if no natural population has remains. The willows provide habitat for 40 of the 270 known nesting pairs of willow flycatchers, a small insect-eating bird once was common in the Sierra Nevada, Mr. Wright said.

The valley was initially settled by dairyman William Carpenter and his wife, Julia. It was purchased in the mid-20th century by a group of fishermen, including newspaper publisher James McClatchy, who used it as a private retreat.