

SNAPSHOTS



Little stem bird
Scientists have discovered a fossil of a tiny bird-like creature whose skull was preserved in 99-million-year-old amber. This tiny stem bird - a bird close to the point where avians split from the dinosaur ancestors - has tiny teeth. The creature is the tiniest Mesozoic dinosaur to be discovered so far. Such discoveries have an impact on how paleontologists reconstruct the past.



Iron rain on exoplanet
A distant giant exoplanet described in a *Nature* report, recently, probably has iron raining on it. During its daytime, temperatures reach about 2,400 degrees Celsius, which can evaporate metals like iron. Strong winds carry this vapour to the night side where it cools and condenses as iron rain. Named WASP-76b, the exoplanet is some 640 light years away.

TIFR study reveals role of glucose in regulating liver functions, ageing

Study shows both over-activation and under-activation of longevity factor SIRT1 can lead to diseases

SHUBASHREE DESIKAN

An enzyme that goes by the name SIRT1 is known to be associated with regulation of metabolic activities and also ageing and hence has become a target of therapeutics. A study by researchers from Tata Institute of Fundamental Research, Mumbai (TIFR) shows that glucose controls the function of SIRT1 directly. A shortage or absence of this control can lead to a diabetic-like state, while excess feeding and sustained low levels of SIRT1 can lead to obesity and enhanced ageing. The study was published in the *Proceedings of the National Academy of Sciences*.



Life activities: The study paves the way to regulating this modification, which may help tackle lifestyle disorders and ageing related diseases. • GETTY IMAGES

Health and feeding regimen
There are many diseases related to high calorie content in the body, such as metabolic disorders as shown in animal studies. Studies have shown that metabolic diseases are associated with wrong feeding regimen, even in humans. Every organism has evolved so as to feed and then alternately fast, so it becomes important to understand this cycle. This cycle, known as the feed-fast cycle is a basic pattern and the metabolism related to this is largely taken care of by the liver.

In an earlier work, published in *Cell Reports*, researchers in the lab of Ullas Kolthur-Seetharam from the Department of Biological Sciences at

TIFR, found the mechanism that triggers the liver to go from one stage to another in the feed-fast cycle.

Role of glucose
Now, working on a different angle, the group has discovered that glucose controls the functions of a protein SIRT1 which in turn maintains everyday feed-fast cycles and is also associated with longevity. "In normal healthy individuals, SIRT1 protein levels are known to increase during fasting and decrease during feed, which is essential to maintain a

balance between glucose and fat metabolism," says Prof Kolthur-Seetharam.

"Despite decades of work on the beneficial roles of SIRT1, metabolic factors that decrease its functions both during normal feed-fast cycles and in nutrient excess states (like obesity) was unknown," explains Tandrika Chattopadhyay, who is the first author of the *PNAS* paper in an email to *The Hindu*.

"While there is active research to identify drugs that can activate SIRT1 which would be beneficial in coun-

tering ageing and metabolic diseases, the cost of uncontrolled overactivation of SIRT1 has not been investigated especially since it decreases in a healthy individual in a fed state," says Dr. Chattopadhyay.

Glucose puts a check on the activity of SIRT1 in the fed state. In the absence of this check, SIRT1 activity increases and results in hyperglycaemia in a fasted state, mimicking diabetic state. "Constant feeding or high calorie intake that leads to sustained reduction in the levels of SIRT1 (by glucose) is associated with ageing and obesity," she says.

"Our study shows that both over-activation and under-activation of this longevity factor could lead to diseases," she adds.

Future steps

This study paves the way to regulating this modification, which might be beneficial in tackling lifestyle disorders and ageing related diseases.

The group next seeks to investigate if glucose-dependent control can dictate gene expression during feed-fast cycles. "Also, we would like to investigate if small chemical molecules or drugs can selectively activate SIRT1 which could be used in the clinic to either increase or decrease the levels of SIRT1, as per the needs of the individual," says Prof. Kolthur-Seetharam.



• G. RAMAKRISHNA

The time is right for OneHealth science

Emergence of pathogens calls out for cross-country collaborations

ABI T. VANAK
MRIDULA MARY PAUL

As India goes into emergency mode to tackle the potentially catastrophic impacts of the novel coronavirus (COVID-19), the 'Kerala model' is being widely cited as an example to emulate. In 2018, Kerala reacted quickly and efficiently to tackle the Nipah virus outbreak and successfully managed to confine it to 23 cases. This success has been credited to the strong public health infrastructure and the political will to quickly seek help from a multidisciplinary team of national and international experts. The Kerala Nipah virus outbreak was thought to have come from fruit bats, a group of animals that may also be implicated in other more deadly outbreaks, possibly including the novel coronavirus.

These diseases, which "spillover" from animals to humans are referred to as zoonotic diseases, and represent more than 60% of emerging infectious diseases worldwide. The destruction of the natural environment, globalised trade and travel and industrialised food production systems have created numerous pathways for new pathogens to jump between animals and humans. Understanding this critical intersection between human health, domestic and wild animal health and the environment requires a new integrated framework - a paradigm called 'OneHealth'.

Kyasanur Forest Disease

Although OneHealth, as a conceptual entity, emerged relatively recently, a stellar example of OneHealth being operationalised in the field was seen in India in the late 1950s. It helped discover the source of Kyasanur Forest Disease (KFD), a highly dangerous haemorrhagic fever more threatening than COVID-19. It was locally called 'monkey fever' because of the links between monkey deaths and human infections in Shimoga District of Karnataka where it emerged in 1957. It took pioneering interdisciplinary work to bring together diverse entities like the Rockefeller Foundation and the Virus Research Centre (later the National Institute of Virology), Pune, the World Health Organization (WHO) and the Bombay Natural History Society.

The Rockefeller Foundation provided the financial and technical support, including laboratory facilities, while P.K. Rajagopalan and a team of dedicated researchers from the Virus Research Centre combed the forests of the Western Ghats for potential carriers and autopsied monkeys in their investigations into the cause of the disease. The legendary bird man of India, Salim Ali, supported by WHO funds, tagged migratory birds to rule out the possibility that they were carrying pathogens responsible for the disease in their cross-continental flights.

As successful as the epidemiological investigation into KFD was, it largely remained an isolated example. This model of cross-sectoral collaboration did not set the tone for further research along similar lines or fructify into readying our public health system to address zoonotic diseases. To our great loss, everyone slipped back into their silos. Many decades later, India is yet to operationalise a true OneHealth policy.

Range of permissions

Further, the regulatory framework for doing OneHealth research in India with international collaboration typically requires approvals from multiple authorities, including ICMR, the Ministries of External Affairs and Finance, Directorate General of the Armed Forces, National Biodiversity Authority, Committee for the Purpose of Control & Supervision of Experiments on Animals and State health authorities, among others. Additional permissions are required from state forest authorities and biodiversity boards for accessing biological resources within natural landscapes. While the necessity for research permits is not being questioned, the range of permissions needed and the long waiting periods (ranging from three months to more than a year), raises the issue of whether we are unwittingly hampering our ability to rapidly respond to emerging threats from infectious diseases.

Given our pioneering historical contribution to combat zoonotic diseases, and robust institutional framework for biomedical research, India has the opportunity to take the lead in combating the massive public health crisis posed by emerging infectious diseases. An opportunity now exists for India to leap-frog over the systemic and institutional barriers that prevent an integrated OneHealth framework from being operationalised.

The Government of India has recently launched the National Mission on Biodiversity and Human Well-being. The mission aims to explore the neglected links between biodiversity science and human well-being across the sectors of health, economic development, agricultural production and livelihood generation, in combination with efforts to mitigate climate change and related disasters. One of the components of the mission explicitly links biodiversity to human health through the OneHealth framework.

The OneHealth programme aims to encourage team science by having networks of institutions collectively bid for grants to set up integrated OneHealth surveillance systems across India at 25 sentinel surveillance sites in potential emerging infectious disease hotspots. In this manner, government and private institutions, across a range of disciplines, from virology to epidemiology, genomics to ecology, and social and behavioural sciences to veterinary and animal sciences can collaborate to understand how zoonotic diseases can emerge, the threats they can pose, and the mechanisms by which the emergence or spread can be controlled.

The frequency with which new pathogens are emerging or old ones are re-emerging across the world are alarm calls for greater transparency, cross-country collaborations, and enhanced national infrastructure and capacity for integrated OneHealth science. The cause of mitigating large-scale human suffering justifies making such a hitherto unprecedent effort.

(*Abi Vanak is a Clinical and Public Health Fellow, DBT/Wellcome Trust India Alliance Program, and Mridula Mary Paul is a Senior Policy Analyst with ATREE*)

Superhydrophobic coating to save metallic surfaces

Created with polyurethane and silicon dioxide nanoparticles, the coating can be easily spin-coated on steel

ASWATHI PACHA

Fascinated by the beauty of water rolling off a lotus leaf, a team of chemical engineers has now created a similar superhydrophobic coating that can be used to save steel from rusting.

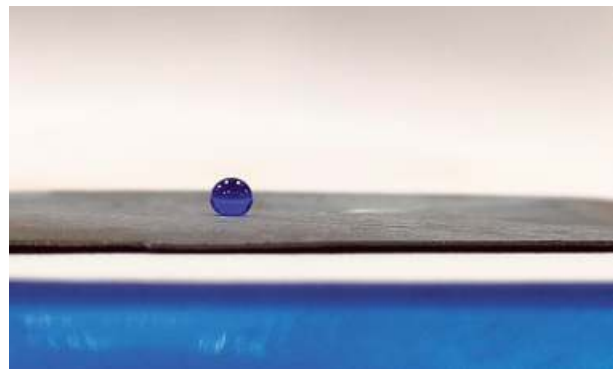
The team from the Indian Institute of Technology (Indian School of Mines), Dhanbad, and Ohio State University used polyurethane and silicon dioxide nanoparticles to create the coating which can be easily spin-coated on steel.

"Not just steel, the coating can be done on other metallic surfaces, such as aluminum, copper, brass. We have also successfully developed superhydrophobic coatings for glass, cloth, paper and wood," explains Aditya Kumar from IIT (ISM) Dhanbad and one of the corresponding authors of the work published in the journal *Philosophical Transactions of the Royal Society A*.

Treated surface

Before applying the coating, the team created a roughness on the steel using a chemical etching process to improve the adhesion strength. Without this, the coating tends to easily peel off due to smoothness of steel.

The team also tried different methods for the applica-



Repels water: In the case of a coated sample, water droplets roll away leaving the surface free of dust. • SPECIAL ARRANGEMENT

tion of the coat on steel and found that spin coating was advantageous and cost-effective compared to immersion coating and spray coating. Spin coating dried quickly and the thickness of the coat could be controlled easily.

The surface of the coating was found to have superhydrophobic property. The coating was also chemically stable in both acidic (pH 5) and alkaline (pH 8) conditions for more than six weeks. It also exhibited thermal stability up to 230 degree C.

The mechanical stability of the coating was tested with water jet, floating, bending, sand abrasion tests and was found to be highly stable.

Self-cleaning coating

Another useful property exhibited by the coating was of

self-cleaning. When water droplets were made to fall on an uncoated surface they stuck to it and made a messy surface.

However, in the case of a coated sample, water droplets roll away while collecting dust from the surface.

Easy to make

"The chemicals used to make the coating are easily available in our country and they are environmental friendly too. When mass-produced on commercial scale, the cost of coating will further reduce," adds Mukesh Kumar Meena, first author of the paper who completed his M.Tech from IIT (ISM) Dhanbad.

Now the team is working on developing an antimicrobial superhydrophobic coating for biomedical applications.

Trial shows success in treating drug-resistant TB

The small trial using three oral drugs in 109 patients showed a treatment success rate of 90%

R. PRASAD

A small trial (Nix-TB) undertaken at three sites in South Africa to test the safety and efficacy of three oral drugs - bedaquiline, pretomanid and linezolid - in 109 patients (57 males and 56 females were HIV positive) with extensively drug-resistant TB (XDR-TB) and multidrug-resistant TB (MDR-TB) showed encouraging results - treatment success rate was 90%. The favourable results held true regardless of the HIV status of the patients.

The treatment using the three oral drugs lasted for 26 weeks and was followed-up for six months after the end of the treatment. Patients received the treatment daily for 26 weeks. The trial of 109 patients included 71 who had XDR-TB and 38 with MDR-TB.

Success rate

The 90% treatment success in the case of hard-to-treat patients is at par with the success rate seen while treating drug-sensitive TB. Of the 109 patients treated, 11 had unfavourable outcomes while 98 had favourable outcomes. Of the 11 patients who had unfavourable outcomes, there were seven deaths and two had a relapse dur-



Combating resistance: The 90% treatment success in the case of hard-to-treat patients is at par with the success rate seen while treating drug-sensitive TB. • GETTY IMAGES

ing the six-month follow-up period. Of the 98 patients who were successfully treated using the three drugs, 63 patients had XDR-TB and 35 had MDR-TB. The treatment success rate was 89% (63 of 71) for XDR-TB and 92% (35 of 38). The MDR-TB patients included in the trial were either not responsive to standard treatment or had discontinued treatment due to side effects.

Adverse effects

"This study shows that XDR tuberculosis and complicated MDR tuberculosis can be treated with a regimen consisting of three oral agents for 26 weeks," the authors write. The results of the study were published in *The New England Journal of Medicine*.

Of the three drugs used in the trial, a "high-percentage" of patients experienced adverse effects related to linezolid drug. Of the 109 patients treated, 88 patients (81%) had peripheral neuropathy (weakness, numbing and pain usually of hands and feet due to nerve damage), though the symptoms were mild to moderate in the majority of cases.

Two patients developed optic neuritis, where the optic nerve becomes inflamed, which was resolved when linezolid drug was withdrawn. Also, 40 had anaemia, while eight patients had adverse event of the liver and the regime had to be interrupted (but they eventually resumed and completed the 26-week treatment).

Heat stress may impact over 1.2 billion people annually by 2100: study

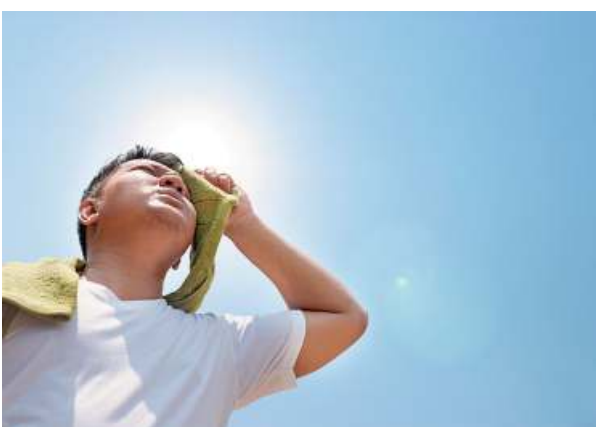
This is more than 12 times the number who would have been affected without industrial era global warming

PRESS TRUST OF INDIA

Stress from extreme heat and humidity will annually impact areas which are home to about 1.2 billion people worldwide by 2100, assuming current greenhouse gas emissions, according to a study.

This is more than four times the number of people affected today, and more than 12 times the number who would have been affected without industrial era global warming, said researchers from Rutgers University-New Brunswick in the US.

Rising global temperatures are increasing exposure to heat stress, which harms human health, agriculture, the economy and the environment, according



Heat stress: High temperatures may damage the brain and other vital organs. • GETTY IMAGES

to the research published in the journal *Environmental Research Letters*.

Most climate studies on projected heat stress have focused on heat extremes but not considered the role

of humidity, another key driver, the researchers said.

"When we look at the risks of a warmer planet, we need to pay particular attention to combined extremes of heat and humidity, which

In New York City, for example, the hottest, most humid day in a typical year already occurs about 11 times more frequently than it would have in the 19th century.

DAWEI LI
University of Massachusetts

are especially dangerous to human health," said senior author Robert E Kopp, from Rutgers University-New Brunswick.

"Every bit of global warming makes hot, humid days more frequent and intense. In New York City, for example, the hottest, most humid day in a typical year already occurs about 11 times more frequently than it would have in the 19th century,"

said lead author Dawei Li, a former post-doctoral associate at Rutgers, and now at the University of Massachusetts.

Heat stress is caused by the body's inability to cool down properly through sweating. Body temperature can rise rapidly, and high temperatures may damage the brain and other vital organs.

Heat stress ranges from milder conditions like heat rash and heat cramps to heat exhaustion, the most common type.

The study looked at how combined extremes of heat and humidity increase on a warming Earth, using 40 climate simulations to get statistics on rare events.

It focused on a measure of heat stress that accounts for

temperature, humidity and other environmental factors, including wind speed, sun angle and solar and infrared radiation.

Annual exposure to extreme heat and humidity in excess of safety guidelines is projected to affect areas currently home to about 500 million people if the planet warms by 1.5 degrees Celsius, and nearly 800 million at 2 degrees Celsius, the researchers said.

The planet has already warmed by about 1.2 degrees above late 19th century levels, the said.

An estimated 1.2 billion people would be affected with 3 degrees Celsius of warming, as expected by the end of this century under current global policies, according to the study.