

Current Science Reports

Increase in Tropical Cyclones Over the Arabian sea

Recently, cyclone Tauktae tore into the coasts of Maharashtra and Gujarat at 220 kilometres per hour, claiming many lives and damaging property worth 1.5 lakh crores. The tropical cyclone activity over the Arabian Sea, it appears, is changing.

Researchers from IITM, Pune, Pune University and NIT Rourkela decided to statistically verify this using 1982 to 2019 cyclone data from the Joint Typhoon Warning Centre. Regression analysis confirmed the up-trend of cyclonic storms over the Arabian Sea.

To understand the reasons, the team analysed various oceanic and atmospheric parameters. There was a significant increasing trend in sea-surface temperature. Higher sea-surface temperature increases the latent heat flux and pumps more moisture into the atmosphere leading to the formation of deep convection. These factors favour tropical cyclone formation and intensification.

The researchers examined the genesis potential parameter. Close to the equator, increase in mid-level humidity at a height is considered the reason for cyclogenesis. The increasing cyclone activity over the Arabian Sea is due to the increasing relative humidity and moist static energy averaged over an atmospheric column from 950 to 150 hectopascals, say the researchers.

The thermodynamic conditions in the Arabian Sea are getting favourable for generating more cyclonic storms. In comparison to the Bay of Bengal, these factors are increasing over the Arabian Sea.

Forewarned now, shouldn't people on the west coast be forearmed?

DOI: 10.1007/s00382-021-05880-z

Sargassum Marine Algae Scope as antihypertensive

Kajal Chakraborty from the Central Marine Fisheries Research Institute (CMFRI), Kochi has been exploring the pharmacological activities of *Sargassum wightii*, brown seaweed.



Image: Kajal Chakraborty

In an *in vitro* study in 2020, his team found a bioactive compound with antihypertensive properties in the seaweed. They identified it as polygalacto-fucopyranose.

Kajal and colleagues teamed up with researchers from the Dravidian University, Andhra Pradesh and the Mangalore University, Karnataka to investigate the antihypertensive property *in vivo*.

They scuba dived to collect brown seaweed samples from the Mandapam area of the Gulf of Mannar. In the lab, using chromatography, they isolated polygalacto-fucopyranose.

Then, they induced hypertension in rats by injecting them with cadmium chloride for 14 days.

After conducting a preliminary toxicity study, they treated the hypertensive rats with different doses of purified polygalacto-fucopyranose.

They also treated a group of rats with telmisartan, a standard antihypertensive. After 28 days, they found that rats treated with polygalacto-fucopyranose had a higher survival rate.

Analysis of serum hypertension biomarkers in blood samples showed that cardiovascular risk indices decreased in rats treated with the bioactive component – administering 50 milligrams per kilogram of bodyweight had a result comparable to treatment with telmisartan.

The team examined the liver, heart, kidney, brain and lung tissue of the rats.

'Alterations in vital organ tissues due to hypertension were absent in polygalacto-fucopyranose-treated rats,' says Kajal Chakraborty.

Studies using immunolocalization and quantification showed that oxidative damage was significantly reduced in the treated rats.

The compound from brown seaweed can perhaps be used as a food constituent to regulate hypertension. However, studies on human beings are necessary to evaluate the antihypertensive properties of the seaweed. The nutraceutical industry can then develop it as a commercial product.

DOI: 10.1016/j.ijbiomac.2021.04.140

Withania for COVID-19 An *in-silico* study

The RNA of SARS-CoV-2 codes for a protease, which processes polyproteins that are translated from viral RNA. Because it plays such a critical role in viral replication, the protease is an attractive target to develop antiviral drugs. Some glycosides, now recognized as antiviral agents for COVID-19, act by inhibiting this protease.

Withanolides, natural steroids, isolated from *Withania*, have close structural similarity to glycosides. Perhaps some withanolides may also inhibit the protease.

Muktesh Chandra from the University of Allahabad collaborated with Chirag Patel from the Gujarat University and a researcher South Africa to conduct a study.

From literature survey, they identified about 70 withanolides isolated from five *Withania* species including *Ashwagandha*. To reduce the list of molecules to be tested, they applied Lipinski's Rule of 5 which predicts that when there are more than five hydrogen bond donors, absorption or permeation becomes poor.

They conducted molecular docking and molecular dynamics simulation studies to screen the compounds for binding affinity with the active sites of SARS-CoV-2's main protease.

Nine molecules showed a significant docking score. Molecular dynamics and simulation identified the most stable compound, *Withacoagulin H*.

Before sinking more money into clinical trials with *Ashwagandha* for treating COVID-19, would it not be

wiser to fast forward the follow up with *in vitro* and *in vivo* studies using Withacoagulin H?

DOI: 10.1002/jcc.26717

Exposing Latent HIV

By targeting glycolysis

HIV infects monocytes and CD4 T cells of the immune system. The RNA genome is reverse transcribed into DNA and integrated into the genomic DNA of the infected cells. The current antiretroviral treatments are ineffective against the transcriptionally silent provirus in the latently infected cells.

The proviral DNA can generate RNA and start producing virions. So, people with HIV have to take medication for life to reduce the chances of developing AIDS.

Studies have found that cells in the latent state with HIV provirus have a robust capacity to mitigate oxidative stress and overproduce NADPH – an antioxidant formed via the pentose phosphate pathway.

This pathway is an alternate counterpart of glycolysis that breaks down glucose to release energy. But, what happens to glycolysis during viral latency? And can we shift the pathway to bring the provirus out of latency?

Recently, a group of researchers across the world, including Amit Singh, Mohamedhusen Munshi and Virender Kumar Pal from IISc, Bengaluru came together to find the answer.

The researchers examined HIV-infected lymphoid and myeloid cell cultures and observed that glycolytic enzymes were downregulated during latent infection. The transcription profiling also showed downregulation of the glycolysis pathway.

Using mass spectrometry, the team double checked – the metabolites of the glycolysis pathway were also reduced in the latently infected cells. Instead, there was an increase in the metabolites of the pentose phosphate pathway.

Next, the researchers checked if inhibition of NADPH-mediated antioxidant effects can bring the virus out of latency. They administered drugs to target the latently infected cells by inhibiting the major cellular antioxidant systems, thioredoxin reductase and glutathione.

They found that oxidative shock reactivated the latent HIV. And, the glycolysis-downregulated environment killed the infected cells.

The strategy can be a breakthrough for a complete cure for HIV.

DOI: 10.1101/2020.12.30.424810

Indigenous Fish Powder

A livelihood source?

Pool barb and Mola carplet are two small indigenous fishes of Assam which are nutrient-loaded and also a livelihood source. But they are difficult to store.

Mansi Tiwari and team from the Assam Agriculture University recently reported preparing an edible nutrient-rich fish flour that can be stored and transported easily.

After washing the cleaned fish at chilling temperature, they blanched, minced and dried them before storing in an airtight container. Heads and bones were retained to reduce the loss of calcium and phosphorus.

'Retaining bones and head reduced processing loss,' says Mansi Tiwari.

The researchers analysed mineral contents through absorption spectrophotometry, to explore the nutritional composition of fresh and flour samples of fish. The fish flour had high protein, fat, carbohydrate and energy content. Minerals such as calcium, phosphorus, iron, potassium, magnesium were also high. The flour of Pool barb, especially, had higher calcium and phosphorus.

High bulk density and foam capacity of the flour indicated suitability for baking and other food preparations.

The flour had high water absorption capacity and can be used as a high protein and mineral source. However, it had low fat absorption capacity which is required for a better mouth feel.

The team tested the oxidative stability of the flour after refrigeration for 30 days.

'The moisture limit did not rise beyond the safe limit of 10%,' says Pranjyoti Sharma, Assam Agricultural University.

'The fatty acid and peroxide values were within safe limits for even up to 90 days. But later, rancidity increased,' adds Abdul Mallik Ahmed, Assam Agricultural University.

Besides providing better nutrition, such processes for value addition to indigenous fishes can help boost local livelihood.

DOI: 10.1111/jfpp.15704

Anaemia in Adolescent Girls

Iron enrich fish powder

The northeast region of India reports high prevalence of anaemia. Interestingly, people there love eating fish. Can fortifying dry fish with an iron source increase haemoglobin levels?

A team of researchers from the ICAR–Central Institute of Fisheries Technology, Kochi fortified fish powder using sodium iron ethylene diamine tetraacetic acid, as an iron source to enrich the dry fish powder.

'Sodium iron EDTA is a promising iron compound for food fortification because of its high iron bioavailability,' explains Asha Kurukkan Kunnath, ICAR–Central Institute of Fisheries Technology.

'It is also less susceptible to oxidative damage and does not cause side effects,' adds Suseela Mathew, her colleague.

The fish powder was prepared with onion powder, corn flour and milk powder to enhance flavour. After fortification, the iron content in fish powder increased two and a half times. The team made packets of the fortified fish powder such that each packet fulfilled the 25 milligrams of iron per day requirement.

A batch of 190 girls from a village in Meghalaya was randomly selected. Of these, 123 were anaemic based on blood reports. A daily consumption record showed that all the girls mostly consumed cereals.

The team gave the child development office packets of plain and iron enriched fish powder. The primary health care workers, unaware of the coding, prepared soup and gave it to the anaemic girls, randomly assigned to two groups – one group received the fortified fish powder and the other, plain fish powder. The iron rich soup fed group showed increased haemoglobin level after 60 days.

'Enriched fish powder can be used as condiment or as soup,' says Asha Kurukkan Kunnath, ICAR–Central Institute of Fisheries Technology.

Food industries producing enriched fish powder can now help prevent anaemia in fish loving populations.

DOI: 10.1007/s12011-021-02820-0

Preventable Stillbirths

Inviting intervention

Stillbirths are largely preventable. Yet, according to the WHO, one stillbirth occurs every 16 seconds. Stillbirths not only have a psychological impact but also spell economic consequences for the families. And it is in low and middle income countries like India and Pakistan that an average 84% of stillbirths occur.

Researchers from the Jawaharlal Nehru Medical College, Belagavi, in collaboration with universities in the United States and Pakistan, recently assessed how many stillbirths are preventable.

The researchers collected data from three maternity hospitals in Davangere, India and one public hospital in Karachi, Pakistan. They recorded the demographic and medical information of 872 women who experienced stillbirth before and immediately after delivery. They examined placental tissues for any damage and checked for bacterial, viral and fungal infections in the placental tissues, umbilical cord and cord blood samples.

They found that stillbirths are unavoidable if babies have structural and functional anomalies like neural tube defects which block brain and nerve cord development.

Moreover, lack of proper nutrition and oxygen supply cause lower than expected weight of babies for their gestational age.

'Babies with anomalies cannot survive if they weigh under a kilogram at or before 20 weeks gestational age,' says Shivaprasad S. Goudar, Jawaharlal Nehru Medical College.

Other stillbirth factors, such as maternal hypertension, rupture of membranes, bleeding and fetal infections are controllable.

'Proper nutrition, quality care by skilled staff, vaccination and availability of functional cesarean and neonatal intensive care units can prevent most still births,' says Yogeshkumar, Jawaharlal Nehru Medical College.

With these interventions, 58% of stillbirths are preventable if babies weigh more than 1 kilogram at 20 weeks or more gestation age. This number increases to 74% if the gestation age is 28 weeks or more.

'Regular prenatal checkups and baby delivery surveillance like monitoring fetal heart rate can further reduce stillbirths,' adds Shivaprasad S. Goudar.

DOI: 10.1111/1471-0528.16820

Smokeless Tobacco

Causing placental damage

Besides being smoked, tobacco is also chewed. Nicotine in tobacco juice is absorbed by the lining of the mouth. Female tea workers in the North East, find tobacco chewing more comfortable than smoking because it keeps hands free for work. How does the habit affect them during pregnancy?

Arun Kumar Jain, ICMR–National Institute of Pathology, New Delhi collaborated with a team of researchers from Jamia Hamdard and the Assam Medical College to study structural changes in the placental tissue of females who regularly chew tobacco.

From the Assam Medical College, Dibrugarh the researchers collected data of tea garden workers and their placental samples. None of the women had any pre-existing illnesses. Thirty chewed tobacco throughout pregnancy and 21 were nonusers.

Nearly two-thirds of women who chewed tobacco delivered babies weighing less than 2.5 kilograms. Among nonusers, only one third of the babies had low weight.

Microscopic examinations of placenta showed that those who chewed tobacco had placental villi that were longer, thinner and less vascularized. The terminal villi in placenta are the junction for the exchange between the developing embryo and the mother.

'Any modification of their structure could affect placental functions and fetal growth,' says Arun Kumar Jain.

'This could lead to decreased exchange of gases, nutrients, and waste between maternal and fetal circulatory systems,' says Sheikh Raisuddin, Jamia Hamdard, New Delhi.

During pregnancy, in tobacco consuming women who delivered low

weight babies, the researchers observed an over expression of a protein complex that is usually a response to reduced oxygen.

'This dimeric protein complex is over expressed in the placenta in early gestation,' says Shashi Nandar Kumar, ICMR–National Institute of Pathology.

In women who chewed tobacco, the placental cells showed changes in the nuclei. The mitochondria were swollen and had abnormal architecture. The endoplasmic reticulum had a rough appearance.

'In other words, the metabolic functions of cells involved in nutrient circulation between embryo and mother were affected,' says Usha Agrawal, ICMR–National Institute of Pathology.

The campaign to reduce tobacco use so far had a focus on smoking. Public health authorities need to consider the risk related to chewing tobacco especially during pregnancy.

DOI: 10.1002/bdr2.1941

Detecting Cow Milk Adulteration

Using lateral flow immunoassay

Cow milk is often adulterated with buffalo milk. Rajan Sharma and team at the ICAR–National Dairy Research Institute (NDRI), Karnal have now come up with a method to detect such mixing. In collaboration with researchers from the Netherlands, they developed a rapid and sensitive immunoassay device.

They raised antibodies against proteins of buffalo milk by injecting the proteins into rabbits. Then, they extracted serum, purified the antibodies and did an agglutination test to confirm the specificity of the antiserum towards buffalo milk. The antibodies were then conjugated with carbon nanoparticles.

'Carbon nanoparticles are hydrophobic and immobilize the antibodies by physical adsorption,' says Rajan Sharma.

The researchers loaded different amounts of antibodies on carbon nanoparticles to find the amounts needed for optimum sensitivity.

Then they prepared an optimized lateral flow assay strip using antibody conjugated carbon nanoparticles on a nitrocellulose membrane.

'Out of various nitrocellulose membranes available, the FF120HP membrane provides the brightest testline,' says Archana Verma, ICAR–NDRI.

To check the strip, the team used a boiled milk sample diluted ten times. The results were satisfactory.

'The antigenic proteins are recognized by the antibody in the strip,' beams Rajan Sharma.

The assay strip can be used by food processing industries to quickly detect adulterated milk.

DOI: 10.1016/j.foodchem.2021.129311

Auto Rickshaw Driving Cycle

Present and future emissions

Emission from a vehicle is estimated by its driving cycle – the speed pattern with time. As local traffic and road conditions also impact driving cycle, the emissions calculated are more real than lab-based figures.

But some vehicles like auto rickshaws usually lack fixed stops and routes. So calculating the driving cycle may give widely varying results. To calculate emissions accurately, a real-world driving cycle is a must for such modes of transport.

Researchers from D.Y. Patil College of Engineering, Pune, CSIR–Central Road Research Institute, New Delhi and Sardar Vallabhbhai National Institute of Technology, Surat joined hands to do just that. They took the case of Surat to construct a real-world driving cycle.

Three routes in developed and developing regions of the city, representing the dominant traffic pattern, were selected. The researchers fixed an on-board measurement system with GPS to record speed-time data during the test trips.

Test trips while cruising through traffic were divided into microtrips, each starting and ending at zero

speed. By combining such microtrips and their frequency using a computer program, the team constructed the driving cycle.

Combining the driving cycles of different regions gave a representative driving cycle for Surat. The team then simulated the driving cycle using a chassis dynamometer and measured harmful gas emissions.

'Emissions from the real-world driving cycle were more than those from the regulatory Indian Standard driving cycle,' says Tushar Rajendra Bagul, D.Y. Patil College of Engineering.

From real world data, the team projected future emissions till 2030, taking into account the government's policy to shift to electric rickshaws at 5% per year. They considered scenarios with and without the shift. Without any shift, emissions from 2017 will increase by 50% by 2021 and by 77% by 2030.

Emissions will increase, even with the shift, but at a lesser rate: half per cent per year. Shifting to electric mode at the rates planned may not bring down emissions.

'To bring emissions down, we need to keep scrapping old vehicles and employing emerging advanced technologies,' says Ravindra Kumar, CSIR–Central Road Research Institute.

DOI: 10.1007/s11356-021-14805-6

Image Forgery Detection

For flagging fake news

Recent technology advancements to modify digital images led to the surfacing of fake images in media and even in scientific journals. Though this decreases the credibility of digital images, they influence emotions, opinions and actions if not immediately identified.

It is difficult to visually distinguish original from forged images. But an automatic forgery detection approach

was recently proposed by V. Vinolin from the Noorul Islam Centre for Higher Education, Kanyakumari and M. Sucharitha from the Malla Reddy College of Engineering and Technology, Telangana.

They used a deep convolutional neural network which extracts thousands of facial landmarks from images and builds a 3D face map. Each image has distinctive landmarks.

To improve this network, the researchers integrated a Taylor-adaptive rag–bull rider algorithm which uses light coefficient matrices to illuminate extracted face images.

If the image is forged, the illuminated light transmissibility changes. These changes may not be detected easily by our eyes.

'But the method we propose is able to detect them,' explains Vinolin.

To test this network, they generated four databases from different websites. The datasets contained original and forged images taken indoors and outdoors.

'Our method is robust and 97% accurate in identifying forged images obtained from different databases,' says Sucharitha.

Such emerging research in digital media forensics can help scientific journals and media outlets detect and prevent the spread of manipulated images.

DOI: 10.1002/int.22558

Reports by: Ravindra Jadav, G. Sharath Chandra, Tahera Arjmand, Aradhana L. Hans, Shwetakshi Mishra, Archana Singh, Sileesh Mullasserri and Khuban Buch

ACKNOWLEDGEMENT: NCPOR, Goa for access to scientific databases.

scienceandmediaworkshops@gmail.com