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07 जून, 2024

संदेश

विज्ञान चेतना के उद्घाटन संस्करण के सफल प्रकाशन पर विज्ञान एवं प्रौद्योगिकी उच्च अध्ययन संस्थान (आईएसएसटी) को हार्दिक शुभकामनाएं। यह प्रकाशन संस्थान की वैज्ञानिक जागरूकता और ज्ञान के प्रसार के प्रति समर्पण को दर्शाता है।

"विज्ञान चेतना" का उद्देश्य समाज में विज्ञान की गहरी समझ और चेतना उत्पन्न करना है। संस्थान के निदेशक प्रो. आशीष कुमार मुखर्जी और संपादकीय मंडल की यह पहल सराहनीय है। यह पत्रिका शोधार्थियों और वैज्ञानिकों के लिए एक महत्वपूर्ण मंच बनेगी, जहां वे अपने शोध निष्कर्षों को सरल भाषा में प्रस्तुत कर सकते हैं और वैज्ञानिक विषयों पर रचनात्मक दृष्टिकोण साझा कर सकते हैं। इससे आईएसएसटी के शोधार्थियों और वैज्ञानिकों को अपनी विविधता और कल्पनाशीलता को आगे बढ़ाने का अवसर मिलेगा।

इस प्रकाशन का एक महत्वपूर्ण पहलू हिंदी और अन्य क्षेत्रीय भाषाओं के उपयोग को बढ़ावा देना है, जिससे वैज्ञानिक ज्ञान उन लोगों के लिए भी सुलभ हो सके जो अंग्रेजी में दक्ष नहीं हैं। यह समावेशिता वैज्ञानिक विकास के साथ अधिक से अधिक लोगों को जोड़ने और वैज्ञानिक रूप से सजग समाज के निर्माण में सहायक होगी।

मैं आईएसएसटी के इस प्रयास की सराहना करता हूं और "विज्ञान चेतना" के माध्यम से वैज्ञानिक ज्ञान को आम जन तक पहुंचाने की इस पहल के सफल होने की कामना करता हूं। आपका कार्य न केवल वैज्ञानिक समुदाय को समृद्ध करेगा बल्कि आम जन को भी वैज्ञानिक ज्ञान और समझ से सशक्त बनाएगा।

एक बार फिर से आप सभी को बधाई, और आपके सभी भावी प्रकाशनों में निरंतर सफलता के लिए शुभकामनाएं।

जय हिंद !


(अभय करंदीकर)



निदेशक का संदेश

विज्ञान एवं प्रौद्योगिकी उच्च अध्ययन संस्थान की ओर से सभी पाठकों को शुभकामनाएं!

विज्ञान चेतना के प्रथम अंक के प्रकाशन की घोषणा करते हुए मुझे अत्यंत गर्व और प्रसन्नता है। अथक प्रयासों, व्यापक विचार-विमर्श तथा सहयोगात्मक प्रयासों के माध्यम से आज हमारा दृष्टिकोण साकार हुआ तथा विज्ञान चेतना को एक मूर्त स्वरूप प्राप्त हुआ। यह प्रयास हमारे वैज्ञानिकों और शोधकर्ताओं के समाज के प्रति समर्पण और प्रतिबद्धता को उजागृत करता है।

जैसा कि इसके नाम से ही स्पष्ट होता है, 'विज्ञान चेतना' का सार विज्ञान की चेतना को परिलक्षित करना है। आईएसएसटी में यह चेतना लोक कल्याण के हर पहलू में दृश्य होती है। हम मानते हैं कि मानवता के समक्ष आने वाली असंख्य चुनौतियों का समाधान करने तथा एक उज्ज्वल एवं अधिक टिकाऊ भविष्य का मार्ग प्रशस्त करने के लिए विज्ञान एवं प्रौद्योगिकी की शक्ति का उपयोग अत्यंत आवश्यक है।

विज्ञान चेतना के पहले संस्करण के प्रकाशन के साथ, हमने अपने इस लक्ष्य की प्राप्ति की दिशा में एक आवश्यक कदम उठाया है। यह हमें न केवल वैज्ञानिक क्षेत्रों की जटिलताओं से परिचित करता है, बल्कि हमारे शोधकर्ताओं के अत्याधुनिक शोधकार्य को प्रदर्शित करता है और साथ ही महत्वाकांक्षी लेखकों को अपना लेखन कौशल व्यक्त करने के लिए एक मंच भी प्रदान करता है। इस पत्रिका का भाषाई माध्यम निश्चित ही पाठकों का ध्यान इसकी ओर आकर्षित करेगा। विज्ञान और साधारण ज्ञान को बढ़ाने हेतु हमारा यह प्रयास भाषाई विविधता के महत्व को समझाते हुए उसमें हिंदी, असमिया और अन्य क्षेत्रीय भाषाओं के महत्व को भी शामिल करता है। हमारी सच्ची राय है कि वैज्ञानिक अवधारणाओं को समझने योग्य और सुगम तरीके से व्यक्त करने पर हमारा कार्य अधिक व्यापक दर्शकों तक पहुंचने में सफल होगा।

हमारे शोधकर्ताओं, लेखकों और समर्थकों के योगदान ने विज्ञान चेतना को जीवंत बनाने में महत्वपूर्ण भूमिका निभाई है। इस उद्देश्य की प्राप्ति में आपके समर्पण और प्रतिबद्धता के लिए मैं आप सभी का हृदय से आभार व्यक्त करता हूँ। इसके साथ ही मैं इसके आने वाले अंकों के सफल प्रकाशन के प्रति आशावान हूँ। विज्ञान चेतना एक प्रकाशन मात्र नहीं है, बल्कि यह दिखाने का प्रयास है कि पुस्तकें किस तरह जनमानस को सशक्त और प्रभावित कर सकती हैं।

"आंतरिक क्षमता को खोजना, जिज्ञासाएं उत्पन्न करना- आइए साथ मिलकर, हम आईएसएसटी में ज्ञान की सीमाओं को पुनः परिभाषित करें।"



Director's Message

Greetings from the Institute of Advanced Study in Science and Technology!

As I address you today, it fills me with immense pride and joy to announce the realization of a vision nurtured through extensive deliberation and collaborative endeavours. After tireless efforts and countless discussions, Vigyan Chetna has finally come to fruition. This effort is a tribute to our eminent scientists and researchers' devotion and commitment to furthering knowledge for the benefit of society.

As summarized in its name, The essence of 'Vigyan Chetna' embodies the notion of Science Consciousness. At IASST, this consciousness is reflected in every aspect of our ethos and serves as our guiding principle. We believe in harnessing the power of science and technology to address the myriad challenges facing humanity and to pave the way for a brighter and more sustainable future.

With the publication of the first edition of Vigyan Chetna, we have taken an essential step toward attaining this goal. Through its pages, we hope to dig into the complexities of scientific realms, showcasing the cutting-edge work of our researchers while also providing a forum for aspiring authors to add to the conversation. Finally, the magazine's language medium has received much attention. Understanding the significance of linguistic diversity in our attempts to promote science and knowledge, including languages like Hindi, Assamese, and other regional languages, is equally vital. Our earnest opinion is that by expressing scientific concepts in an understandable and approachable manner, our work will reach a much larger audience.

In conclusion, the contributions of our researchers, writers, and supporters have been instrumental in bringing Vigyan Chetna to life. I extend my heartfelt thanks to all for your dedication and commitment to this cause. I am filled with a sense of optimism and excitement for the journey that lies ahead. Vigyan Chetna is not just a publication but an endeavour to show how books can empower and influence.

"Unleashing passion, igniting curiosity – Together, we redefine the limits of knowledge at IASST".

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भारत में विषैले सर्पदंश जैसी घातक उपेक्षित उष्णकटिबंधीय बीमारी की समस्या और इसकी रोकथाम

प्रोफेसर आशीष कुमार मुखर्जी

निदेशक, विज्ञान एवं प्रौद्योगिकी उच्च अध्ययन संस्थान
(विज्ञान तथा प्रौद्योगिकी विभाग, भारत सरकार के तहत एक स्वशासी संस्थान)
विज्ञान पथ, पश्चिम बड़ागाँव, गड़चुक, गुवाहाटी- 781035, असम, भारत

1. भूमिका: सर्पदंश विष की महामारी विज्ञान

सर्पदंश एक गंभीर, जीवन-घातक चिकित्सीय आपात स्थिति है। भारी वर्षा और नम जलवायु वाले उष्णकटिबंधीय और उपोष्णकटिबंधीय भारत जैसे देशों में रह रहे ग्रामीण आबादी को अक्सर ऐसी सार्वजनिक स्वास्थ्य परिस्थितियों का सामना करना पड़ता है। विश्व स्वास्थ्य संगठन (डब्ल्यूएचओ) का मानना है कि पूरे विश्व में सालाना लगभग ५.४ करोड़ सर्पदंश होते हैं, जिसमें से लगभग १.८ से २.७ करोड़ विषैले सांपों के काटने से होते हैं। इस सूची में पहला नंबर एशिया का आता है जिसमें सबसे अधिक सर्पदंश (२० लाख प्रति वर्ष) और (१ लाख प्रति वर्ष) मौतों का आंकड़ा दर्ज किया जाता है, इसके बाद अफ्रीका, मध्य और दक्षिण अमेरिका, मध्य पूर्व, यूरोप, अमेरिका और कनाडा का स्थान आता है;

ओशिनिया में सर्पदंश के सबसे कम मामले दर्ज किए गए हैं। एशियाई देशों में, भारतीय उपमहाद्वीप (भारत, बांग्लादेश, नेपाल, भूटान, पाकिस्तान, श्रीलंका) में प्रति वर्ष सर्पदंश की सबसे अधिक संख्या (लगभग २ लाख) और मौतें (लगभग ४५,००० से ५०,०००) दर्ज की गई हैं। हालाँकि, दक्षिणी एशियाई देशों में विषैले सर्पदंश और उसकी वजह से मौतों पर महामारी विज्ञान के आंकड़ों में असंगतता ने मुख्य रूप से किसी विशेष क्षेत्र में विषैले सर्पदंश की पूर्ण संख्या जानने के लिए व्यवस्थित प्रयास और विश्लेषण को रोक दिया है।

भारत में २८५ से अधिक सांपों की प्रजातियाँ पाई जाती हैं, जिनमें ६० से अधिक विषैले साँप शामिल हैं। हालाँकि, उनमें से केवल कुछ के काटने से ही गंभीर चिकित्सीय समस्या हो सकता है। २०१७ में, विश्व स्वास्थ्य संगठन ने सर्पदंश को एक उपेक्षित उष्णकटिबंधीय बीमारी घोषित किया और २०३० तक विषैले सर्पदंश से होने वाली मौतों और विकलांगता को आधा करने के लिए २०२२ में एक वैश्विक पहल शुरू की। इसे सर्पदंश के विरुद्ध शून्य सहनशीलता के रूप में जाना जाता है।

भारत में विषैले सांपों में इंडियन स्पेक्टेल्ड कोबरा या नाग (*नाजा नाजा*), इंडियन कॉमन क्रेट या सामान्य करैत (*बुंगारस सेरूलेस*), इंडियन रसेल वाइपर या दबोईया (*डबोइया रसेली*), और इंडियन सॉ-स्केल्ड वाइपर या अफई (*एचिस कैरिनैटस*) पूरे देश में (उत्तर पूर्वी भारत को छोड़कर) पाए जाते हैं। इन्हें "बिग फोर" विषैले सांपों के रूप में भी जाना जाता है और ये भारत में अधिकांश विषैले सर्पदंश के मामलों के लिए मुख्य रूप से जिम्मेदार हैं। हमारे देश में इन बिग फोर सांपों के विष के खिलाफ ही पॉलीवैलेंट एंटीवेनम (सर्प विषरोधी दवा) का उत्पादन किया जाता है। हालाँकि, घातक विषैले साँपों की कई अन्य प्रजातियाँ, जैसे कि *नाजा कौथिया* (भारतीय मोनोकल्ड कोबरा), *ओफ़िफ़ैगस हत्रा* (किंग कोबरा), और *बुंगुरस फेशियाटस* (बैंडेड क्रेट) भी भारत के विभिन्न हिस्सों में खासकर पूर्वोत्तर भारत में पाया जाता है और सर्पदंश से होने वाली महत्वपूर्ण मौतों के लिए जिम्मेदार हो सकते हैं। अफसोस की बात है कि साँपों की इन प्रजातियों द्वारा किए गए दंश की

घोर उपेक्षा की जाती है। भारत में, इन साँपों के विष के खिलाफ वाणिज्यिक सर्प विषरोधी दवा का उत्पादन नहीं किया जाता है, जो साँपों की इन प्रजातियों द्वारा किए गए सर्पदंश के उपचार के लिए एक महत्वपूर्ण चुनौती है।

1. सर्प विष क्या है?

साँप का विष एक प्रकार का लार है जो साँपों के विकास के दौरान धीरे-धीरे विकसित हुआ। यह अपने (साँप के) शिकार को पंगु या गतिहीन कर देता है, साँप इसका उपयोग आत्मरक्षा में भी करते हैं। विष 'उन्नत साँपों' के बीच विकास के दौरान अपनाया गया एक व्यापक गुण है। विष को एक विशेष ग्रंथि द्वारा संश्लेषित और संग्रहीत किया जाता है जिसे 'विष ग्रंथि' के रूप में जाना जाता है, जो विष नलिकाओं से जुड़ा होता है और साँपों के, खोखले दांतों (जिन्हें 'फेंग' कहा जाता है) के माध्यम से शिकार में प्रवेश कराया जाता है। हालाँकि, कुछ प्रजातियाँ, उदाहरण के लिए, स्पिटिंग कोबरा, बचाव के दौरान अपने हमलावर पर विष छिड़कने के लिए जाना जाता हैं। भारतीय मोनोकल कोबरा भी पीड़ित के चेहरे पर विष छिड़क सकता है। इसलिए इन साँपों से बच के रहना चाहिए।

साँप का विष एंजाइम, प्रोटीन और पेप्टाइड्स का एक जटिल मिश्रण होता है। इसके अलावा, इसमें कार्बोहाइड्रेट, लिपिड, एमाइन और विभिन्न धातु आयन, जैसे सोडियम, कैल्शियम, पोटेशियम, मैग्नीशियम और जिंक कम मात्रा में पाए जाते हैं। विष के विषाक्त घटकों में शिकार के एक विशेष रिसेप्टर के प्रति उच्च आकर्षण और चयनात्मकता होती है और जिसके फलस्वरूप शिकार या काटने वाले पीड़ितों में नैदानिक गतिविधियों की एक विस्तृत श्रृंखला प्रदर्शित होती है। साँप का विष मुख्य रूप से शिकार या पीड़ितों के हृदय और न्यूरोमस्क्युलर सिस्टम (न्यूरोटॉक्सिक काटने) और रक्त जमावट (हेमोटॉक्सिक काटने) को प्रभावित करता है।

2. भारत में सर्पदंश की पैथोफिजियोलॉजी या विषाक्त प्रभाव तथा लक्षण

अधिकांश सर्पदंश पैर पर होते हैं; पीड़ित के शरीर में विषैले पदार्थ (विष) फैल जाते हैं, जिसके गंभीर परिणाम होते हैं। साँपों के विष के फलस्वरूप उत्पन्न लक्षण मुख्य रूप से उनके विष में मौजूद विषैले घटकों के कारण होते हैं। विष की घातकता साँप की प्रजाति, अलग-अलग साँप की उम्र, विष की संरचना में मौसमी बदलाव, शिकार या मानव के शरीर में प्रवेश के मार्ग (अंतःशिरा, इंटराडर्मल, चमड़े के नीचे, आदि) और साँप के काटने के दौरान निकलने वाले विष की मात्रा पर निर्भर करती है। इसलिए सर्पदंश के विष के रोग संबंधी प्रभाव भिन्न होते हैं और इसमें न्यूरोमस्क्युलर पक्षाघात (न्यूरोटॉक्सिसिटी), रक्तस्राव और कोगुलोपैथी (हेमोटॉक्सिसिटी), और काटने वाली जगह के आसपास सूजन, घाव (अल्सरेशन) और ऊतक परिगलन (साइटोटॉक्सिसिटी) जैसे लक्षण शामिल हैं। ये सभी दुष्प्रभाव पूरी तरह से साँप की प्रजाति पर निर्भर करते हैं।

भारतीय कोबरा (नाग) और आम करैत का विष पक्षाघात (न्यूरोपैरालिसिस), श्वसन विफलता की तीव्र शुरुआत और चेतना की हानि को दर्शाता है। इन न्यूरोपैरालिटिक लक्षणों में दृष्टि का धुंधलापन, बोलने में अस्पष्टता, निगलने में कठिनाई, अनिद्रा और जीभ का मोटा होना (स्वाद का पता न चलना) आदि देखे जाते हैं। नाग के काटने के तुरंत बाद, मरीजों को काटने वाली जगह पर जलन और तेज दर्द महसूस होता है, इसके २-३ घंटे के बाद सूजन आ जाती है। करैत के विष में ऊपर बताए

गए कोई लक्षण नहीं दिखते हैं। इसके अलावा, करैत द्वारा काटे गए रोगियों में आंतरिक रक्तस्राव के कारण गंभीर पेट दर्द और ऐंठन के लक्षण देखे जाते हैं। परंतु नाग के विष के मामले में इन ध्यान देने की आवश्यकता है।

दबोईया जैसे भारतीय वाइपरिड सांपों के विष मुख्य रूप से हेमोस्टैटिक असंतुलन, रक्त जमावट और प्लाज्मा फाइब्रिनोजेन के क्षरण होते हैं, जिससे अंततः कोगुलोपैथी (रक्त का नहीं जमना) और असहनीय पीड़ा होती है। प्राथमिक चिकित्सीय लक्षणों में गुर्दे की चोट और रोगी थ्रोम्बोसाइटोपेनिया (प्लेटलेट की गिनती में कमी) जैसे लक्षण परिलक्षित होते हैं, जिससे बार-बार प्लेटलेट आधान और हेमोडायलिसिस की आवश्यकता होती है। इसके अलावा, दक्षिण भारत तथा श्रीलंका में दबोईया के काटने से मरीजों में प्रीसिनेटिक न्यूरोमस्क्युलर ब्लॉकेज के कारण पीटोसिस (पालक का झुकना), बल्बर पक्षाघात, इंटरन्यूक्लियर ऑप्थैल्मोप्लेजिया (एक नेत्र संबंधी गतिविधि विकार) और श्वसन पक्षाघात जैसे अद्वितीय न्यूरोटॉक्सिक लक्षण भी दिखाई देते हैं।

दबोईया के विष की तुलना में, अफई का विष पीड़ित के रक्त जमाव पर अधिक गंभीर प्रभाव डालता है। विष के प्राथमिक लक्षणों में गंभीर सूजन, रक्तस्रावी छाले और काटने की जगह पर गंभीर दर्द शामिल हैं। तीव्र गुर्दे की विफलता, रक्तस्राव और हाइपोटेंशन (अल्प रक्त चाप) के अलावा, हेमोटॉक्सिसिटी और कोगुलोपैथी जैसे गंभीर लक्षण भी बताए गए हैं। अधिकांश नैदानिक निष्कर्षों में काटने के बाद परिसंचरण प्लेटलेट्स में कमी भी बताई गई है जिसे थ्रोम्बोसाइटोपेनिया कहते हैं।

3. भारत में सर्पदंश का उपचार

ऊपर उल्लिखित सांप सबसे घातक हैं और इनके काटने से गंभीर लक्षण पैदा होती हैं। इसलिए विषैले सांपों के काटने बाद तत्काल कार्रवाई और उपचार की आवश्यकता होती है।

सांप के विष के प्रभाव के बाद तत्काल कार्रवाई में मरीज को नजदीकी अस्पताल ले जाना शामिल है। सर्पदंश की अधिकांश घटनाएँ ग्रामीण क्षेत्रों या गाँवों में होती हैं; इसलिए तृतीयक स्वास्थ्य केंद्रों के पैरामेडिकल स्टाफ को प्राथमिक चिकित्सा प्रदान करने के लिए उचित प्रशिक्षण दिया जाना चाहिए ताकि सर्पदंश से पीड़ित कई लोगों की जान बचाने में मदद मिल सके। प्राथमिक उपचार करने से रोगी के शरीर में विष के फैलाने को कम करने में मदद मिल सकती है और निकटतम अस्पताल तक पहुंचने से पहले कम से कम कुछ समय मिल सकता है। विश्व स्वास्थ्य संगठन ने निम्नलिखित प्राथमिक चिकित्सा दिशानिर्देशों का पालन करने की अनुशंसा की है:

- सूजन होने पर नुकसान से बचने के लिए काटे गए स्थान के आसपास से तंग चीज जैसे चूड़ी, अंगूठी इत्यादि हटा दिया जाए।
- चिंता को कम करने के लिए पीड़ित को आश्वस्त करें और शांत करने में मदद करें। इससे विष शरीर में कम फैलेगा।
- व्यक्ति को पूरी तरह से स्थिर करें और उसे निकटतम स्वास्थ्य सुविधा तक पहुंचाएं।

- पारंपरिक प्राथमिक चिकित्सा पद्धतियों या हर्बल दवाओं के प्रयोग से बचें।
- गंभीर दर्द के लिए पैरासिटामोल दिया जा सकता है।
- यदि उल्टी होती है, तो रोगी को ठीक होने के लिए बाईं ओर लिटाएं।
- रोगियों के सांस लेने की प्रक्रिया की बहुत सावधानी से निगरानी की जानी चाहिए और आवश्यकता पड़ने पर कार्डियोपल्मोनरी पुनर्वसन के लिए तैयार रहना चाहिए।

इसके अतिरिक्त, मान लीजिए कि किसी विषैले सांप के काटने से पक्षाघात के लक्षण होती है लेकिन स्थानीय ऊतक क्षति नहीं होती है। उस स्थिति में, दबाव पट्टी लगाने से शरीर में विष का प्रसार धीमा हो सकता है। हालाँकि यदि विष स्थानीयकृत ऊतक क्षति का कारण बनता है, तो दबाव पट्टी का उपयोग करने से बचना बेहतर है। काटने के स्थान पर समीपस्थ टूर्निकेट लगाने की अनुशंसा नहीं की जाती है क्योंकि इससे परिणामों में कोई सुधार हुए बिना रुग्णता बढ़ जाती है।

किसी भी जहरीले सर्पदंश के खिलाफ वैज्ञानिक रूप से स्वीकृत चिकित्सा अस्पताल में काटे गए रोगी को मोनोवैलेंट या पॉलीवैलेंट एंटीवेनम (सर्प विषरोधी दवा) का तात्कालिक अंतःशिरा प्रशासन है। भारत में घोड़ों में उत्पादित एंटीवेनम (इक्विन एंटीवेनम के रूप में जाना जाता है) पेप्सिन द्वारा पचाई गई प्लाज्मा आईजीजी (IgG) का एफ (एबी) 2 (Fab2) अंश होता है। मोनोवैलेंट एंटीवेनम को एक ही सांप की प्रजाति के विष के खिलाफ उत्पादन किया जाता है और यह उस विष को तुरंत बेअसर कर सकता है जिसके प्रतिकूल इसे विकसित किया गया है। हालाँकि आजकल भारत में मोनोवैलेंट एंटीवेनम का निर्माण नहीं किया जाता है। ऐसा इसलिए है क्योंकि भारत में सर्पदंश निदान किट उपलब्ध नहीं हैं, और डॉक्टर काटे गए सांप की प्रजाति का निदान नहीं कर सकते हैं। इसके विपरीत, पॉलीवैलेंट सर्प विषरोधी दवा, "बिग फोर" (इंडियन कोबरा, इंडियन कॉमन क्रेट, इंडियन रसेल वाइपर और इंडियन सॉ-स्केल्ड वाइपर) जैसे विषैले सांपों के विष मिश्रण के खिलाफ तैयार किया जाता है। इसलिए, पॉलीवैलेंट सर्प विषरोधी दवा उनके अधिकांश विषाक्त पदार्थों (लेकिन कम आणविक भार वाले विषाक्त पदार्थों को नहीं) को एक अलग स्तर तक बेअसर कर सकता है। इसके अलावा पॉलीवैलेंट सर्प विषरोधी दवा में भारत में पाई जाने वाली अन्य प्रमुख विषैले सांपों के विष के प्रतिकूल एंटीबॉडी की भी सिफारिश की जाती है ताकि विषैले सांप के काटने के पर बेहतर इलाज किया जा सके।

4. निष्कर्ष: सर्पदंश के समस्या को कम करने के लिए सामाजिक जागरूकता और संयुक्त प्रयास की आवश्यकता है

सर्पदंश की समस्या और संबंधित मौतों को कम करने के लिए, सभी स्वास्थ्य अधिकारियों, चिकित्सकों और सर्प विषरोधी दवा बनाने वाली कंपनियों का एक संयुक्त प्रयास स्थिति से निपटने के लिए अत्यधिक प्रभावी होगा। इसके अलावा विशेष रूप से ग्रामीण क्षेत्रों और दूरदराज के गांवों में सांपों और उनके काटने के बारे में सामाजिक जागरूकता से लोगों को सांपों और सांपों के विष के बारे में शिक्षित करने में मदद मिलेगी और कई मरीजों की जान बचाई जा सकेगी।

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शक्कर एक :मिठी लत

पियाली देवरॉय, आशीष बाला *

औषधि विज्ञान एवं औषध खोज अनुसंधान प्रयोगशाला, जीवन विज्ञान विभाग, विज्ञान एवं प्रौद्योगिकी उच्च अध्ययन संस्थान, विज्ञान पथ, पश्चिम बड़ागाँव, गड़चुक, गुवाहाटी- 781035, असम, भारत

एक समय की बात है, एक ऐसी दुनिया जहां भोजन दुर्लभ था और ऊर्जा स्रोतों को अत्यधिक महत्व दिया गया था, वहां चीनी तेज ऊर्जा के स्रोत के रूप में उभरी। यह पोषण का एक प्रत्यक्ष रूप था जो मानव शरीर के सबसे महत्वपूर्ण हिस्से- मस्तिष्क- को पोषण देने के लिए रक्तप्रवाह और मस्तिष्क के बीच महत्वपूर्ण बाधा को पार कर सकता था। इस अनूठी क्षमता ने चीनी को मानव आहार का एक अनिवार्य हिस्सा बना दिया। चीनी का मीठा स्वाद आनंद से जुड़ा हुआ था, जो अक्सर कठिन और क्षमाशील वातावरण में इंद्रियों के लिए आनंद के रूप में कार्य करता था।

जैसेजैसे सभ्यताएं आगे बढ़ीं और भोजन की कमी कई लोगों के - लिए अतीत की बात बन गई, चीनी ने दुनिया भर के लोगों के दिलों और घरों में अपना रास्ता खोज लिया। जो कभी ऊर्जा का एक दुर्लभ स्रोत हुआ करता था, अब पाककला तथा विभिन्न व्यंजनों का एक - लोकप्रिय अंग बन गया। जो आनंद यह प्रदान करता था, वह अविवादित था, और जल्द ही यह भोजन का एक मुख्य भाग बन गया, न केवल अपने प्राकृतिक रूप में, बल्कि बढ़ती हुई विभिन्न खाद्य और पेय पदार्थों में भी एक अतिरिक्त तत्व के रूप में।

हालांकि, कहानी ने एक गहरा मोड़ तब लिया जब वैज्ञानिकों ने मानव मस्तिष्क पर शक्कर के प्रभाव के रहस्यों को उजागर करना शुरू किया। अनुसंधान ने संकेत दिया कि जिस तरह नशीले पदार्थ मस्तिष्क के इनाम और आनंद केंद्रों को प्रभावित करते हैं, उसी तरह शक्कर भी मस्तिष्क में ओपियोइड और डोपामाइन रिसेप्टर्स की उपलब्धता को कम करने की क्षमता रखता है। इन परिणामों से यह स्पष्ट हो गया कि क्यों बहुत से लोग चीनी के लिए एक अंतहीन लालसा का अनुभव करते हैं, जो कि नशीले पदार्थों की लत के समान है, और जो इच्छा और सेवन के निरंतर चक्र की शुरुआत करता है, जिस से बाहर निकलना मुश्किल हो सकता है। ऐसा इसलिए है क्योंकि चीनी का हमारे शरीर पर महत्वपूर्ण प्रभाव पड़ता है।



चित्र १. आपकी शाम की चाय के दृश्य की एक मीठी झलकी



चित्र २. अपने विचार प्रक्रिया पर नियंत्रण खो चुका एक चीनी पर निर्भर रोगी।

अतिरिक्त शर्करा की औसत अमेरिकी दैनिक खपत क्या है?

आश्चर्यजनक रूप से, एक औसत अमेरिकी वयस्क प्रतिदिन चम्मच अतिरिक्त चीनी का सेवन करता है 30 से 22, जो अमेरिकन हार्ट एसोसिएशन की केवल 6 से 9 चम्मच की सिफारिशों के विपरीत है। यह इष्टतम स्वास्थ्य के लिए अनुशंसित खुराक से कहीं अधिक है। इस अतिरिक्त सेवन से मधुमेह, पाचन समस्या, मोटापा, चिंता, पुरानी सूजन और हृदय रोग जैसी विभिन्न स्वास्थ्य समस्याएं हो सकती हैं।

हालांकि चीनी ऊर्जा की प्रारंभिक वृद्धि प्रदान करती है, परंतु समय बीतने के साथ ही यह रक्त शर्करा के स्तर में उतारचढ़ाव का - कारण बन सकती है, चिड़चिड़ापन, तनाव, अवसाद, आत्म नियंत्रण में कमी और-चिंता रोग जैसे नकारात्मक परिणाम इस मिठे जाल से जुड़े हुए हैं।

परंतु कब एक साधारण लालसा एक लत में बदल जाती है?

पंजीकृत आहार विशेषज्ञ बेथ सेर्वोनी (Beth Czerwony; renowned registered dietitian) , आरडी, एलडी, ने चीनी पर निर्भरता के संकेतों की पहचान करने के महत्व पर जोर दिया, उनके अनुसार, चीनी की लत की प्रमुख विशेषताएं मात्रा, आवृत्ति और भावनाएं हैं। उन्होंने बताया कि चीनी के सेवन को नियंत्रित करने में असमर्थता, मीठे भोजन के बारे में लगातार विचार करना और हानिकारक प्रभावों के बावजूद चीनी का सेवन करना चिंताजनक है।

एक महत्वपूर्ण मुद्दे के रूप में चीनी की लत की स्वीकृति ने आहार की आदतों के पुनर्मूल्यांकन को प्रेरित किया है। चीनी के प्रभाव से बचने के लिए एक व्यापक दृष्टिकोण की आवश्यकता होती है, जिसे रक्त शर्करा के स्तर को स्थिर करने के लिए फलों, सब्जियों, प्रोटीन और उच्च फाइबर खाद्य पदार्थों से भरपूर संतुलित आहार पर ध्यान केंद्रित करके प्राप्त किया जा सकता है। भोजन ना छोड़ने, योजना बनाने और पहले से खाने की तैयारी करने से हम अनावश्यक चीनी से भरे खाद्य पदार्थों के आकर्षण से दूर रह सकते हैं। यह समझना भी महत्वपूर्ण है कि चीनी मध्यम मात्रा में हानिकारक नहीं होती परंतु अधिक मात्रा और आवृत्ति में चीनी लेना अत्यधिक हानिकारक है।



चित्र ३. लालसा से लत तक की यात्रा

* सभी चित्र AI का उपयोग करके बनाए गए हैं। (<https://www.bing.com/>)

प्लाज्मा एक्टिवेटेड जल (Plasma Activated Water) कोविड-१९ के ओमिक्रोन वेरिएंट को निस्संक्रामक करने के लिए एक आर्थिक और प्रभावी हरित विकल्प

रीमा, दीपज्योति बसुमातारी, हेरेम्बा बाइलुंग, कामक्षी शंकरनारायणन *

विज्ञान एवं प्रौद्योगिकी उच्च अध्ययन संस्थान, विज्ञान पथ, पश्चिम बड़ागाँव, गड़चुक, गुवाहाटी- 781035, असम, भारत

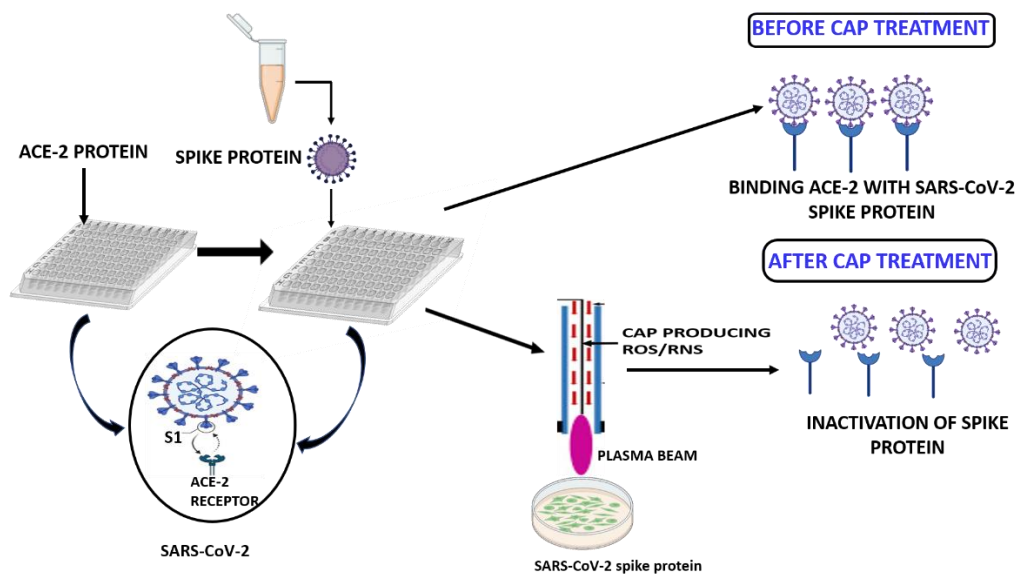
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विज्ञान एवं प्रौद्योगिकी विभाग (डीएसटी) के अंतर्गत एक स्वशासी संस्थान विज्ञान एवं प्रौद्योगिकी उच्च अध्ययन संस्थान (आई.ए.एस.एस.टी.), गुवाहाटी के शोधकर्ताओं ने पाया है कि प्लाज्मा सक्रिय पानी (पी.ए.डब्ल्यू) कोविड-19 के ओमिक्रोन वेरिएंट के स्वच्छीकरण के लिए एक संभावित वैकल्पिक रणनीति के रूप में अपनाया जा सकता है। है। कोविड-19 वायरस के कई वेरिएंट्स हैं जैसे कि बीटा, गामा, ओमिक्रोन, डेल्टा, और इस वायरस और इसके वेरिएंट्स के प्रसार को संभालने के लिए प्रभावी और आर्थिक प्रौद्योगिकियों का अध्ययन करने की एक आत्यंत आवश्यकता है। इससे पहले, आईएसएसटी में कार्यरत डॉ. के. शंकरनारायण द्वारा सार्स-कोवी-2 को रोकने के लिए कीटाणुशोधन की रणनीति के रूप में कोल्ड एटमॉस्फेरिक प्लाज्मा (सी.ए.पी) को दिखाया था, क्योंकि सी.ए.पी कोई हानिकारक रसायन नहीं छोड़ता है। पी.ए.डब्ल्यू जिसमें पानी को निश्चित समय के लिए प्लाज्मा के साथ ट्रीट किया जाता है, पर्यावरण के लिए कितनी असरदार हो सकती है इसे अध्ययन किया गया है। यह पानी कई दिनों तक संचित भी किया जा सकता है।

पिछली खोज को ध्यान में रखते हुए, डॉ. के. शंकरनारायण और उनकी टीम, मिस्स रीमा और श्री दीपज्योति ने सी.ए.पी के सीधे और परोक्ष तरीके से सी.ए.पी द्वारा ओमिक्रोन वेरिएंट कोविड-१९ के प्यूडो वायरस के निष्क्रियकरण को दिखाया है। सी.ए.पी के सीधे प्रभाव के बाद, ओमिक्रोन वेरिएंट सार्स-कोवी-२ के स्पाइक और आरबीडी प्रोटीनों की बाधात्मक प्रभावक्षमता कम हो जाती है, औसतन 1, 3, और 5 मिनट के प्लाज्मा उपचार के बाद लगभग 75%, 55%, और 40% तक पहुंचती है। दूसरी ओर, जब 5 और 10 मिनट के पी.ए.डब्ल्यू से उन्हें ट्रीट गया तो स्पाइक और आरबीडी प्रोटीन लगभग 50% और लगभग 90% का निष्क्रियण हुआ। पी.ए.डब्ल्यू सार्स-कोवी-2 को निस्संक्रामक करता है (स्पाइक प्रोटीन) और आरबीडी डोमेन की गतिविधि को भी बाधित करता है, जिससे यह मानव एसीई-2 रिसेप्टर से जुड़ने की उसकी क्षमता को सीधे सी.ए.पी की तुलना में काफी पैमाने पर विरोधित करता है। पी.ए.डब्ल्यू में मौजूद विलीन होते हैं जिन्हें उनके संक्रमण के लिए मुख्यतः जिम्मेदार माना जाता है, जैसे हाइड्रोजन पेरोक्साइड और नाइट्रेट (NO_3^-) और नाइट्राइट (NO_2^-) जो लंबे समय तक बने रहते हैं और चिकित्सात्मक प्रभावी प्रकार स्पाइक और आरबीडी प्रोटीनों को बाधित करते हैं। इस तरह, ओमिक्रोन वेरिएंट सार्स-कोवी-2 को निष्क्रिय करने के लिए पी.ए.डब्ल्यू एक प्रभावी प्रतिस्थापन हो सकता है। रासायनिक आधारित पारंपरिक स्वच्छीकरण प्रक्रियाओं के मुकाबले इसके इतने सारे लाभों के साथ, सी.ए.पी के भविष्य में बायोमेडिकल क्षेत्र के लिए महत्वपूर्ण है।

यह कार्य प्लाज्मा रसायन और प्लाज्मा प्रासेसिंग (Plasma Chemistry and Plasma Processing) में प्रकाशित किया गया है।

स्रोत: <https://doi.org/10.1007/s11090-024-10449-9>



प्लाज्मा ट्रीट्मन्ट से पहले और बाद में ओमिक्रॉन वेरिएंट सार्स-कोवी-2 स्पाइक प्रोटीन और एसीई-2 प्रोटीन के बीच बाइंडिंग प्रतिक्रिया का ग्राफिकल प्रतिनिधित्व

भविष्य के उन्नत उपकरणों के लिए 2डी नैनोमटेरियल

खोमद्रम बिजयकुमार सिंह^{1,2} और डॉ. अरूप आर. पाल^{1,2,*}

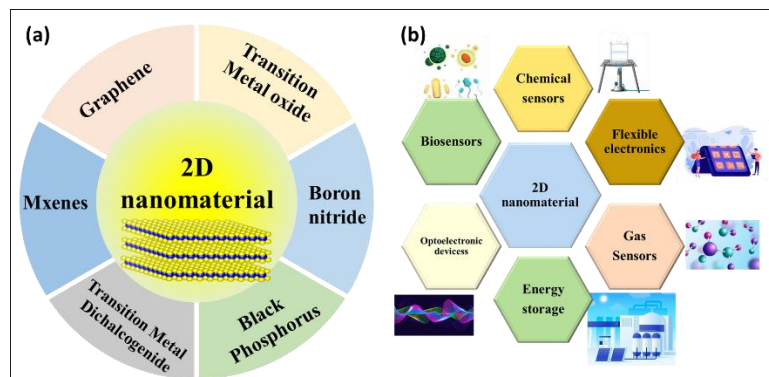
¹ प्लाज्मा नैनोटेक्नोलॉजी प्रयोगशाला, भौतिक विज्ञान प्रभाग, विज्ञान एवं प्रौद्योगिकी उच्च अध्ययन संस्थान, , विज्ञान पथ, पश्चिम बङ्गाँव, गड़चुक, गुवाहाटी - 781035, असम, भारत

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ट्रांजिस्टर आधुनिक सभ्यता की एक अविभाज्य संपत्ति बन गए हैं, जो इलेक्ट्रॉनिक उपकरणों और प्रौद्योगिकियों की एक विस्तृत श्रृंखला के विकास को सक्षम बनाता है। 1947 में जॉन बार्डीन, वाल्टर ब्रेटन और बेल लैब्स के विलियम शॉक्ले ने सबसे पहले ट्रांजिस्टर का आविष्कार किया। पचास साल पहले, जैसा कि गॉर्डन मूर ने भविष्यवाणी की थी, कि एक चिप पर ट्रांजिस्टर (घटकों) की संख्या हर दो साल में दोगुनी हो जाएगी [1]। इसलिए उल्लेखनीय प्रगति से सिलिकॉन (Si) आधारित धातु ऑक्साइड सेमीकंडक्टर क्षेत्र प्रभाव ट्रांजिस्टर (MOSFET) का लघुकरण संभव हो गया है। हालाँकि, एक चिप में ट्रांजिस्टर की संख्या बढ़ाने के लिए सी-आधारित ट्रांजिस्टर को कितने बड़े पैमाने पर कम किया जा सकता है, यह एक चुनौती बन गई है। वर्तमान में, सैमसंग 3 नैनोमीटर (एनएम) गेट ऑल राउंड एफईटी (जीएफ एफईटी) की पेशकश कर रहा है। Apple Corporation ने अपने A17 Pro और M3 श्रृंखला चिप्स में 3 एनएम ट्रांजिस्टर तकनीक का उपयोग किया है।

वर्तमान सिलिकॉन सेमीकंडक्टर तकनीक से प्राप्त न्यूनतम सिस्टम आकार अपनी सीमा तक पहुंच रहे हैं। समस्या सिलिकॉन शीट की मोटाई को आवश्यक मूल्य तक कम करने में उत्पन्न होती है, जिससे इंटरफेस पर चार्ज बिखरने में वृद्धि होती है और चैनलों के भीतर वाहक गतिशीलता कम हो जाती है, इसके कारण डिवाइस का प्रदर्शन कम हो जाता है [2]। इन पर काबू पाने के लिए, शोधकर्ताओं ने पिछले 15 वर्षों से बेहतर वाहक गतिशीलता के साथ 1nm से कम मोटाई के द्वि-आयामी (2D) अर्धचालकों पर ध्यान केंद्रित किया है। 2डी अर्धचालक परमाणु रूप से पतले होते हैं, वे स्व-निष्क्रिय होते हैं, और उनकी आवेश वाहक गतिशीलता सतह के बिखरने से स्वतंत्र होती है। इसलिए, सी नैनोशीट्स [2], [3] के विपरीत, परमाणु मोटाई सीमा पर गतिशीलता बढ़ी है। यह विशिष्ट व्यवहार कई प्रौद्योगिकियों के लिए वास्तविक स्केलिंग को सक्षम बनाता है और अर्धचालक उद्योग के लिए अंततः 2डी सामग्रियों के साथ सिलिकॉन-आधारित ट्रांजिस्टर को बदलने पर विचार करने का एक मजबूत उद्देश्य है।



चित्र 1: (a) कुछ सामान्य 2डी नैनोमटेरियल; (b) 2डी नैनोमटेरियल्स के कई अनुप्रयोग

2डी नैनोमटेरियल परमाणु रूप से पतली परत वाली संरचनाएं हैं जहां परतें इंटरलेयर सहसंयोजक और इंटरलेयर वैन डेर वाल्स बॉन्डिंग द्वारा एक साथ जुड़ी होती हैं। ये अनूठी बॉन्डिंग संरचना उनके असाधारण गुणों और बहुमुखी प्रतिभा में योगदान करती है। उनके पास विशिष्ट सतह रसायन विज्ञान, उच्च सतह से आयतन अनुपात और क्वांटम आकार प्रभाव जैसे अद्वितीय गुण हैं [2] [3]। पहला 2डी नैनोमटेरियल, ग्राफीन 2004 में आंद्रे गीम और कॉन्स्टेंटिन नोवोसेलोव द्वारा खोजा गया था। [4] ग्राफीन एक हेक्सागोनल जाली में पैक कार्बन परमाणुओं की एक मोनोलेयर परत है। ग्राफीन के अलावा, शोधकर्ताओं ने अन्य 2डी नैनोमटेरियल्स, जैसे हेक्सागोनल बोरान नाइट्राइड, ग्रेफाइटिक कार्बन नाइट्राइड, ब्लैक फॉस्फोरस, ट्रांज़िशन मेटल डाइक्लोजेनाइड्स (टीएमडी), एमएक्सीन आदि में बहुत रुचि दिखाई है। [2][3][5]। हालाँकि ग्राफीन का व्यापक रूप से इसके उत्कृष्ट विद्युत, थर्मल और यांत्रिक गुणों के कारण 2डी नैनोमटेरियल्स में अध्ययन किया जाता है, लेकिन इसमें एक अलग बैंड गैप नहीं होता है, जो इसे डिजिटल इलेक्ट्रॉनिक अनुप्रयोगों के लिए अनुपयुक्त बनाता है।

टीएमडी के बीच सबसे अधिक अध्ययन किया गया 2डी नैनोमटेरियल मोलिब्डेनम डाइसल्फ़ाइड (एमओएस₂) है, जहां बैंड गैप परत की मोटाई के साथ बदलता रहता है। मोनोलेयर MoS₂ एक डायरेक्ट बैंड गैप सेमीकंडक्टर है [6], जो इसे ऑप्टोइलेक्ट्रॉनिक उपकरणों के लिए उपयुक्त बनाता है जो प्रकाश उत्पन्न कर सकते हैं, पता लगा सकते हैं, उसके साथ इंटरैक्ट कर सकते हैं या नियंत्रित कर सकते हैं। इसमें सौर सेल, लेजर, एलईडी, फोटोडिटेक्टर और डिस्प्ले शामिल हैं [6]। प्रकाश अवशोषण और उत्सर्जन की क्षमता 2डी नैनोमटेरियल्स की इलेक्ट्रॉनिक बैंड संरचना से काफी प्रभावित होती है। चूंकि सिंगल-लेयर टीएमडी मुख्य रूप से प्रत्यक्ष बैंड गैप अर्धचालक होते हैं, वे उस फोटॉन को अवशोषित कर सकते हैं जिसकी ऊर्जा उसके बैंडगैप से अधिक होती है; इसलिए, वे लचीले और पारदर्शी ऑप्टोइलेक्ट्रॉनिक्स में अनुप्रयोग के लिए बहुत रुचि रखते हैं। टीएमडी की तुलनात्मक रूप से उच्च पृथ्वी बहुतायत और दृश्य सीमा में बैंडगैप के कारण, उन्हें वैकल्पिक प्रकाश-अवशोषित सामग्री के रूप में पतली फिल्म सौर सेल में उपयोग किया जा सकता है। इसके अतिरिक्त, उन्हें घुमावदार और वास्तुशिल्प संरचनाओं को कवर करने के लिए लचीले फोटोवोल्टिक के रूप में लागू किया जा सकता है। उनका उपयोग लचीले इलेक्ट्रॉनिक उपकरणों के लिए किया जा सकता है जो अन्य 2डी सामग्रियों के साथ संयोजन करते हैं, जैसे ग्राफीन का संचालन और बोरॉन नाइट्राइड को इन्सुलेट करना [2]।

2डी नैनोमटेरियल्स यादगार व्यवहार भी दिखाते हैं जिसका अर्थ है कि लागू वोल्टेज और करंट के इतिहास के आधार पर प्रतिरोध को बदला जा सकता है। इस संपत्ति में क्वांटम कंप्यूटिंग और भौतिक तंत्रिका नेटवर्क में मेमोरी डिवाइस के रूप में संभावित अनुप्रयोग हैं [2] [6]। न्यूरोमॉर्फिक कंप्यूटिंग के लिए 2डी आधारित यादगार उपकरणों के अनुप्रयोग पर शोध चल रहा है, जो इलेक्ट्रॉनिक सर्किट का उपयोग करके मानव मस्तिष्क की संरचना और वास्तुकला की नकल करता है।

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শীতল বায়ুমণ্ডলীয় প্লাজমা আৰু চিকিৎসা বিজ্ঞানত ইয়াৰ প্ৰয়োগ

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বিজ্ঞান আৰু প্ৰযুক্তি বিদ্যাৰ দ্ৰুত অগ্ৰগতিৰ ফলত চিকিৎসা বিজ্ঞান আৰু চিকিৎসা বিজ্ঞানৰ বিভিন্ন পদ্ধতিৰ সমসাময়িকভাৱে উন্নীতকৰণ হৈছে। বৰ্তমান সময়ত ৰবটিক্স, কৃত্ৰিম বুদ্ধিমত্তাৰ দৰে নতুন প্ৰযুক্তিয়ে চিকিৎসা আৰু স্বাস্থ্যসেৱাক এক নতুন দিশ প্ৰদান কৰিছে। চিকিৎসা বিজ্ঞানত হোৱা বিভিন্ন আধুনিকীকৰণৰ ভিতৰত শীতল বায়ুমণ্ডলীয় প্লাজমাৰ গুৰুত্ব লেখত লবলগীয়া। এই কথা আলোচনা কৰিবলৈ যোৱা আগতে প্লাজমাৰ বিষয়ে চমুকৈ আলোচনা কৰাটো প্ৰয়োজনীয়।

প্লাজমা হৈছে পদাৰ্থৰ তথাকথিত চতুৰ্থ অবস্থা (কঠিন, তৰল, আৰু গেছীয় অবস্থাৰ পিছত) [1, 2], আৰু ই তেজত পোৱা প্লাজমাৰ পৰা পৃথক। প্লাজমা হৈছে আয়নিত গেছ য'ত মুক্ত ইলেক্ট্ৰন আৰু ধনাত্মক আয়নৰ সংখ্যা প্ৰায়ে সমান। কিন্তু, বৈদ্যুতিকভাৱে প্ৰশম হোৱা স্বত্বেও প্লাজমাই সহজে বিদ্যুত পৰিবহন কৰে। গৱেষণাগাৰত গেছ এটাক নিম্নচাপত ৰাখি তাক বাহ্যিক শক্তি প্ৰদান কৰি প্লাজমা উৎপন্ন কৰা হয়। এনে প্ৰক্ৰিয়াৰ ফলত উচ্চ তাপমাত্ৰাত থকা গেছীয় কণাবোৰৰ মাজত সংঘৰ্ষৰ ফলস্বৰূপে গেছৰ আয়নীকৰণ হয়। সাধাৰণতে এনেদৰেই উৎপন্ন কৰা প্লাজমাৰ তাপমান অতি উচ্চ। আন্তঃনাক্ষত্ৰিক স্থান, প্ৰতিপ্ৰভ (Fluorescent) চাকি, নক্ষত্ৰৰ (আনকি সূৰ্য্যৰ) বাতাবৰন, বজ্ৰপাত আৰু পৰীক্ষামূলক তাপ-নিউক্লীয় বিক্ৰিয়ক (Thermonuclear reactor)ত প্লাজমা অৱস্থা পোৱা যায়। ১৮৭৯ চনত ছাৰ উইলিয়াম ক্ৰুকছে প্লাজমা অবস্থাৰ প্ৰথম গৱেষণা কৰিছিল যদিও ১৯২৮ চনত ৰসায়নবিদ আৰভিং লেংমুৰয়ে পোন প্ৰথমে প্লাজমা শব্দটো আগবঢ়াইছিল।

প্লাজমা পদাৰ্থ বিজ্ঞানৰ ভিতৰত শীতল বায়ুমণ্ডলীয় প্লাজমা এবিধ সুকীয়া প্লাজমা। ইয়াক ইংৰাজীত Cold Atmospheric Plasma আৰু চমুকৈ কেপ্ (CAP) বুলি জনা যায়। 'কেপৰ' বৈশিষ্ট্য হ'ল যে ইয়াক বায়ুমণ্ডলীয় চাপত উৎপন্ন কৰিব পাৰি আৰু এই প্লাজমাৰ উষ্ণতা বায়ুমণ্ডলীয় উষ্ণতাৰ প্ৰায় সমান হয়। গৱেষণাত পোৱা গৈছে যে 'কেপৰ' তাপমান প্ৰায় ২৫-৪৫ ডিগ্ৰী চেলচিয়াচৰ ভিতৰত হয়। সাধাৰণতে উৎপন্ন হোৱা প্লাজমাৰ তুলনাত ইয়াৰ তাপমান বহুগুণে কম হোৱা বাবে এই প্লাজমাক ঠাণ্ডা/ শীতল প্লাজমা বুলি কোৱা হয়। লগতে 'কেপৰ' উৎপন্ন বায়ুমণ্ডলীয় চাপতে হোৱাৰ বাবে এই প্লাজমাক শীতল বায়ুমণ্ডলীয় প্লাজমা নামাকৰণ

কৰা হৈছে। 'কেপৰ' আন এক গুৰুত্বপূৰ্ণ বৈশিষ্ট্য হ'ল যে ইয়াত প্ৰচুৰ পৰিমাণে বিক্ৰিয়াশীল অক্সিজেন আৰু নাইট্ৰজেনৰ যৌগ (reactive oxygen and nitrogen species) পোৱা যায়। এই যৌগ সমূহ ৰসায়নিকভাৱে অতি সক্ৰিয় হয় আৰু মানৱ শৰীৰৰ যিকোনো বিক্ৰিয়াত এই যৌগসমূহে গুৰুত্বপূৰ্ণ ভূমিকা পালন কৰে।

১৯৯৬ চনত মৌনিৰ লাৰোচিয়ে প্ৰকাশ কৰা গৱেষণা পত্ৰই প্লাজমাৰ প্ৰয়োগৰে জৈৱ বিজ্ঞানৰ ক্ষেত্ৰত এক নতুন দিশৰ সূচনা কৰিছিল [3]। তেওঁৰ দ্বাৰা প্ৰকাশিত গৱেষণা পত্ৰত 'কেপ' প্ৰয়োগৰ ফলত বেক্টেৰিয়া কোষৰ বিনাশৰ কথা প্ৰতিবেদন কৰা হৈছিল। ইয়াৰ পিছতেই বিজ্ঞানী সকলে 'কেপৰ' বিভিন্ন প্ৰয়োগৰ ওপৰত গৱেষণা চলাই আহিছে। ১৯৯৬-২০০৬ চনলৈ হোৱা গৱেষণাক প্লাজমা চিকিৎসা বিজ্ঞানৰ আধাৰ হিচাপে বিবেচনা কৰিব পাৰি। আজিৰ দিনৰ চিকিৎসা সেৱাত 'কেপৰ' প্ৰয়োগ ঘাঁ নিৰাময়, দন্ত চিকিৎসা, ছালৰ ৰোগৰ নিৰাময়, বেক্টেৰিয়া জনিত ৰোগৰ নিৰাময় আদিত ব্যৱহৃত হৈছে। বৰ্তমানলৈ হোৱা গৱেষণাত পোৱা গৈছে যে জীৱৰ কোষৰ ওপৰত কেপ প্ৰয়োগৰ ফলস্বৰূপে ই কোষৰ ওপৰত নিৰ্বাচিত প্ৰভাৱ বিস্তাৰ কৰে। 'কেপ' প্ৰয়োগৰ ফলত জীৱ দেহৰ সাধাৰণ কোষ সমূহৰ হানি নকৰাকৈ, বিপদজনক কোষ যেনে কৰ্কট ৰোগৰ কোষ কেপে ধ্বংস কৰিব পাৰে। তাৰ ফলস্বৰূপে কৰ্কট ৰোগৰ দৰে জটিল ৰোগৰো নিৰাময় পোৱা গৈছে।

'কেপৰ' প্ৰয়োগ জৈৱ বিজ্ঞানৰ বাহিৰেও আন আন ক্ষেত্ৰতো দেখা পোৱা যায়। তাৰে ভিতৰত বস্তু বিজ্ঞান (material science), পৰিবেশ বিজ্ঞান, খাদ্য বিজ্ঞান, কৃষি আদিত 'কেপৰ' প্ৰয়োগ সচৰাচৰ দেখা যায়। সাম্প্ৰতিক কালত বিভিন্ন ক্ষেত্ৰত 'কেপৰ' প্ৰয়োগ হৈ আছে আৰু ই বহুতো পুৰণি প্ৰযুক্তিৰ প্ৰতিষ্ঠাপন কৰিবলৈ সক্ষম হৈছে। অদূৰ ভবিষ্যতে 'কেপৰ' প্ৰয়োগৰ ফলত চিকিৎসা বিজ্ঞানৰ লগত বিজ্ঞানৰ আন ক্ষেত্ৰ সমূহতো নতুনত্ব আনিব বুলি আশা কৰা হৈছে।

অসমৰ এক আগশাৰীৰ গৱেষণাৰ প্ৰতিষ্ঠান 'বিজ্ঞান আৰু প্ৰযুক্তিৰ উচ্চ অধ্যয়ন প্ৰতিষ্ঠানৰ (Institute of Advanced Study in Science and Technology)' গৱেষক সকলে নিজৰ আশাশুধীয়া প্ৰচেষ্টাৰে 'কেপ' উৎপন্ন কৰিব পৰা সজুলি নিৰ্মাণ কৰিছে। এই গৱেষণাৰ বাবে ভাৰতীয় চিকিৎসা অনুসন্ধান পৰিষদৰ, ভাৰত চৰকাৰ (Indian Council of Medical Research, Government of India) পৰা অনুদান গৃহীত কৰা হৈছে। ইতিমধ্যে এই 'কেপৰ' প্ৰয়োগৰ গৱেষণা পত্ৰও প্ৰকাশ হৈছে। আগন্তুক দিনত বিভিন্ন ক্ষেত্ৰত 'কেপৰ' প্ৰয়োগৰে গৱেষণাৰ প্ৰচেষ্টা চলাই থকা হৈছে।

কৃতজ্ঞতা স্বীকাৰ:

লেখকসকলে ভাৰতীয় চিকিৎসা অনুসন্ধান পৰিষদক, ভাৰত চৰকাৰ (Indian Council of Medical Research, Government of India) গৱেষণাৰ অনুদান প্ৰদানৰ বাবে কৃতজ্ঞতা জ্ঞাপন কৰিব বিচাৰে।

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Scorpion Stings: Let's Bust the Myths!

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1. Myths on scorpions:

One of the most terrible unintentional tragedies that affect humans is being stung by a scorpion. More than 2 billion people on the planet could be stung by a scorpion; of them, over 1.2 million people get stung, and 3250 people lose their lives annually. The actual statistics, however, are unknown for India; the reported occurrence rate is estimated to be 0.6%. Southern India, including Kerala, Andhra Pradesh, Tamil Nadu, Saurashtra, Karnataka, Konkan area, Pondicherry, Chennai, Bellary, Rayalaseema, and Western Maharashtra, is where the highest death tolls are reported.

Scorpions are the oldest known arthropods on Earth, having existed for about 450 million years. They are found in India and worldwide, except Antarctica and the Pacific islands. They are mainly habitat to tropical forests, grasslands, and caves. However, most cases occur in rural areas because of poor medical facilities, limited availability of antivenom, lack of trained doctors (for envenomation), inadequate transportation, and lower socioeconomic structures. One of the biggest challenges in managing scorpion stings is that the majority of the population choose faith healers over medical aid or antivenom, or they resort to their wrong traditional beliefs. There is a considerable portion of the population where people still tend to believe in magical treatments, chants/mantras to treat the victim. This happens because of a lack of awareness and so much misinformation spread among people that it leads to the formation of wrong knowledge and myths, but in reality, they are not valid. Therefore, it is vital to take a moment and help people to be aware and debunk such misinformation with the help of science and proper scientific explanation. Some of such myths and misinformation are mentioned below with their explanation:

- i. **All scorpions are deadly:** Not all scorpions are dangerous to humans. Approximately 1500 scorpion species exist, of which only a few (~50) are hazardous to humans, while most belong to *Buthus* and *Scorpionidae* families. The medically essential scorpions in India are *Mesobuthus tamulus*, *Palamneus swammer-dami*, and *Heterometreus bengalensis*.
- ii. **All Scorpion stings are fatal:** When a person gets stung by a scorpion, they will not necessarily develop envenomation. Some scorpion stings are dry, which means they do not inject venom. However, it may cause intense pain at the site of the sting. Specific

individuals face a higher risk of experiencing severe symptoms. Young children and older adults are particularly vulnerable to the effects of scorpion stings.

- iii. **Giant Scorpions are more dangerous or the opposite:** Some think small scorpions are more destructive, whereas others believe more giant scorpions are more dangerous. But in reality, it is not the size of the scorpion but the amount of venom injected into the person & species of scorpion during a sting that decides the severity of symptoms. Even small scorpions can pack a potent sting if they inject enough venom (if it is venomous scorpions). At the same time, *Androctonus* and *Parabuthus* are both giant scorpions found in South America and Africa and are both medically important. Another example is giant hairy scorpions; though they have frightening appearances, they are less dangerous than those of Arizona bark scorpions, which are small.
- iv. **Scorpions often attack people:** Scorpions are known to be aggressive, but they primarily use their venom/ sting to catch their prey. They attack humans only when people step on or reach an area where scorpions are hiding and accidentally touch/ grab them. They preferred to live beneath rocks and debris, i.e., where they do not encounter people quickly.
- v. **Scorpions are only found in deserts:** Scorpions can be found in almost every environment on Earth except for the ocean and the polar regions. Despite evolving from aquatic ancestors, they have adapted to thrive in diverse habitats, including forests, humid areas, and other ecosystems. However, two bizarre incidents of scorpion stings have been reported in 2023, where a woman passenger got stung by a scorpion on an Air India flight while flying from Nagpur to Mumbai. Where in another bizarre incident, a scorpion stung a man when he was asleep in a hotel in Las Vegas.
- vi. **Scorpion stings can be cured by local healers/chants/ magical treatment:** The idea that scorpion stings can be cured by local healers, chants, or magical treatments is a misconception. Scorpion venom contains toxins that can cause various symptoms, from mild irritation to severe reactions affecting the nervous system and other organs. Scientifically proven treatments, such as antivenom, are necessary to neutralize the venom and alleviate symptoms effectively. Relying on traditional or magical remedies can delay proper medical care, potentially worsening symptoms and endangering the individual's health. Seeking prompt medical attention from qualified professionals is crucial for the effective management of scorpion stings and for ensuring a positive outcome.

2. Conclusion:

Numerous difficulties and serious illnesses have resulted from such disinformation. Thus, we and others must educate ourselves and one another on the dangers of scorpion stings. By dispelling falsehoods and disseminating factual information, we can enable people to make

wise decisions and swiftly seek appropriate medical attention. Prioritizing education and awareness is essential to preventing harmful practices from misconceptions and guaranteeing that people receive prompt and efficient treatment in case of a scorpion sting.

Acknowledgements: Ms. S. Nath receives JRF from IASST, Guwahati.

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How the quantum world may influence our future

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Classical physics laws lose their footing when confronted with the intricacies of the atomic and subatomic realms. The dissolution of familiar physical constraints that govern our everyday experiences is particularly intriguing. Consequently, the realm of what can be achieved undergoes a profound transformation. For instance, throwing a ball at a wall guarantees a rebound in our macroscopic world. However, at the subatomic scale, there is the possibility of quantum tunnelling, where a minute particle could traverse the wall's barrier. While this phenomenon may strike some as surreal and implausible, it primarily stems from being less known and thus not widely accepted or comprehended.

Quantum physics has revolutionized our perspective on basic physics concepts (such as matter, electric current, chemical bonds, etc.) since the 20th Century. Quantum physics allows us to get inside of the individual physical entities; as a result, in practical terms, we can manipulate everything on the microscopic level. During the past 20 years, researchers have observed a “second quantum revolution,” spurred by understanding how to isolate and entangle quantum objects. Researchers are attempting to model the behaviour of ‘quasi-periodic’ materials, which are too complex to be described on the atomic scale. Quantum physics makes it possible to explain the behaviour and interactions between particles and the forces that drive them. We already use quantum physics in our everyday lives, but the second quantum revolution could make it possible to apply it to industry. The medical field has also made the quantum leap: how drug molecules interact with those in living organisms is being studied through “quantum chemistry”. Many modern medical treatments and imaging techniques are based on quantum physics. MRI would not be possible without quantum physics and a detailed understanding of the behaviour of atomic nuclei in an electromagnetic field.

Eighty years after Dirac formulated the quantum theory of electron spin, modern information technology continues to rely heavily on classical electronics, utilizing electron charge for computation and magnetic materials for durable storage. However, there is a burgeoning interest in harnessing spins within semiconductor nanostructures to advance spintronics and quantum logic technologies, aiming for enhanced information manipulation and storage capabilities. Recently, localized electronic states found in carbon-based systems have emerged as a distinctive solid-state platform. These systems offer a novel opportunity

for in-depth explorations of magnetism and quantum phenomena at the level of single spins, marking significant strides in both fundamental research and practical applications.

Quantum technology stands at the forefront of a transformative frontier in scientific



exploration and engineering innovation. It leverages the principles of quantum mechanics to usher in a new era of computation, communication, sensing, and simulation. At its essence, quantum technology capitalizes on the extraordinary characteristics inherent in quantum systems, including but not limited to the phenomena of superposition and entanglement. These properties afford quantum systems a remarkable capability to execute tasks that surpass the limitations of classical systems, thereby paving the way for unprecedented advancements across various fields of study and technological domains.

Quantum computing uses qubits, which is the quantum equivalent of classical bits. Qubits can exist in a superposition state, enabling simultaneous computation of multiple states. Additionally, quantum entanglement allows qubits to be correlated in ways that classical bits cannot, leading to exponential computational power. This promises transformative applications in cryptography, optimization, drug discovery, and artificial intelligence. Control of the above process and transmission of cryptographic keys is achieved by quantum communication that offers unparalleled security through protocols like Quantum Key Distribution (QKD), which leverages the principles of quantum mechanics to enable secure transmission. Quantum teleportation and secure communication protocols hold the potential to revolutionize data privacy and safeguard sensitive information. Precision in these communication processes is ensured by quantum sensors that facilitate unprecedented levels of precision in measurements. These quantum sensors find applications in navigation,

imaging, and defence, offering enhanced capabilities for detecting subtle signals and phenomena. Out of these applications, quantum imaging is a prosperous field of quantum technology. Unlike classical imaging, which relies on classical physics principles, quantum imaging leverages the unique properties of quantum mechanics, such as superposition, entanglement, and interference, to achieve improved imaging resolution, sensitivity, and security. Quantum imaging holds promise for various applications, including biomedical imaging, remote sensing, quantum-enhanced microscopy, and quantum communication. While many quantum imaging techniques are still in the research and development phase, they have the potential to revolutionize imaging technology and enable new capabilities not achievable with classical imaging methods.

Quantum computers can instantly execute a task that would normally take 47 years

Understanding complex quantum systems often necessitates modelling and using advanced quantum simulation techniques. This cutting-edge technology empowers researchers to replicate and analyse complex molecular structures, material compositions, and biological systems with unparalleled precision and fidelity. By harnessing the capabilities of quantum simulation, scientists gain invaluable insights into the behaviour and interactions of these intricate systems, thereby unlocking new frontiers for scientific exploration and technological advancement. This groundbreaking approach facilitates the elucidation of fundamental scientific principles. It holds the potential to catalyse transformative innovations across diverse fields, ranging from drug discovery and materials science to environmental sustainability and quantum computing.

These techniques and applications make quantum technology a booming domain in current research and technological development. For example, Google's achievement of quantum supremacy with Sycamore demonstrated the ability of a quantum computer to solve a specific problem that would be practically infeasible for supercomputers to solve within a reasonable timeframe. This milestone showcases the immense computational power of quantum computers and suggests their potential for tackling complex scientific problems that are currently beyond the reach of classical computing. Google's advancements in quantum computing could contribute to developing a quantum internet, enabling ultra-secure communication and distributed quantum computing across global networks. A quantum internet would facilitate quantum key distribution, teleportation, and distributed quantum computing applications. While these potential benefits are promising, it's important to note that quantum computing is still in its early stages, and significant technical challenges remain to be addressed.

Despite the vast potential inherent in quantum technology, it encounters formidable challenges that demand careful attention and innovative solutions. The main challenges are scalability, error correction, and the preservation of quantum coherence, all of which pose significant obstacles to the practical implementation of quantum systems. Overcoming these challenges requires the development of robust frameworks and methodologies that can effectively manage and mitigate the inherent complexities of quantum systems. Furthermore, realising quantum technology's full potential depends not only on scientific breakthroughs but also on establishing robust infrastructure and technological readiness. Building the necessary hardware and software infrastructure and fostering a supportive ecosystem of research and development is paramount to harnessing the transformative power of quantum technologies across various industries and applications.

Moreover, as quantum capabilities advance, ethical considerations loom large on the horizon. Questions surrounding data privacy, security, and equitable access to quantum technologies demand careful deliberation and proactive measures to ensure responsible and ethical deployment. Addressing these ethical considerations requires interdisciplinary collaboration and a commitment to upholding ethical principles and societal values in developing and applying quantum technologies. By confronting these challenges head-on and fostering collaboration across disciplines, industries, and stakeholders, we can unlock the full potential of quantum technologies and pave the way for a quantum-enabled, impactful, and ethically sound future.

The future of quantum technology is promising, with ongoing advancements in quantum hardware and cross-disciplinary collaborations driving innovation. Integration with classical computing technologies and exploring societal impacts present exciting research, development, and commercialization opportunities. Quantum technology is key to unlocking unprecedented computational power, communication security, sensing capabilities, and simulation accuracy. As we navigate the challenges and harness the opportunities of quantum technology, collaboration across academia, industry, and government will be crucial in realizing its transformative potential and shaping a quantum-enabled future.

Perspective of Science and Technology in the NE Region

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With the scientific marvels worldwide during the 20th century, science and technology have profoundly influenced the course of human civilization. Scientific achievements provided remarkable insights into the issues and problems of human life. The achievements promise to herald new eras in many fields. In the North Eastern region, we must take advantage to ensure fullest use of these developments for our people's well-being and economic uplift. Science and technology have a major impact on economic growth and social development. Scientific knowledge has become a source of economic might, power and self-reliance. This has led to increased restrictions on knowledge sharing, new norms of intellectual property rights, and global trade and technology control regimes. The ongoing globalization and the intensely competitive environment has a significant impact on the production and service sectors.

The North Eastern Region

The country's North Eastern region comprises seven states, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura, popularly known as seven sisters. The total geographical area of the region is 2,55,063 ha, and it has a population of about four crores. The region is joined with the main land of the country with a chicken neck like land area belonging to the state of West Bengal. On immediate West Side and on top of the chicken like structure there lies the state of Sikkim. The area is surrounded by the great Himalayas in three sides of the region. In the west, Bangladesh shares the common boundary. The Himalayan range stands like a 'Berlin wall' against Southern China in both North and East sides. Across the Patkai hills, there lies Myanmar and Thailand in the east and south sides. In fact, the Eastern and Southern tertiary folds of the Himalayan range surround the region. The Himalayas also intrudes into the heartland of each of the states. Except Assam, Manipur and Tripura, the other states have mostly mountainous terrains. The region is situated in between 89½° to 97½° E longitude and 21° to 30° N latitude. It has the typical sub-tropical climate of moderate temperature and high humidity. The minimum and maximum winter temperature ranges from below 10° - 22°C, whereas during summer 22° - 34°C. During winter, the region experiences almost drought having rainfall less than 200 mm, but in summer 4,000 – 5,000 mm. More than 300 big and small rivers flow through the region and the main carrier of river water in the region is the mighty Brahmaputra in Assam valley and the Barak in Cachar valley. The excessive rainwater leads to severe flood in almost 40% area of Assam. The plain land

of Assam has a common boundary with remaining six states effectively acting as a facilitator cum gateway to all of them.

Topographically the region can be broadly divided into five parts: the Eastern Himalayas, the Brahmaputra valley, Khasi and Jaintia hills, the Surma valley, the Naga, Manipur and Lushai hills. The region represents tertiary old sedimentary and granite rocks, whereas Assam valley contains Pleistocene rocks. The soil of both valleys is alluvial and laterite-old alluvial. Meghalaya, Manipur, Mizoram and Nagaland predominantly contain red loam soils. On the other hand, Arunachal Pradesh and parts of Tripura contain forest and hill soils rich in organic matter. Every major hill range of the region is the direct or indirect expression of some geographical niche.

Evergreen, mountainous sub-tropical and mountain-temperate natural forests characterize the region. Almost 55% area of the region is covered by forest vegetation, 10% is snow-clad wasteland and the remaining 35% area under crop cultivation. There is scope for increasing the cultivation area in the region. The major crop plants of the region are rice, tea, mustard, jute, black-gram, sugarcane, maize, potato and vegetables. However, the productivity is one of the lowest except in the case of tea and jute. On the other hand, the destructive shifting cultivation has still been practiced in the hilly areas.

People of the region are predominantly (80%) of Mongoloid origin and there are more than 350 tribes each one of them having own language or dialect, culture and traditions. The average population density in the region is hardly 250 per km, the highest being 400 per km in Assam and the lowest 50 per km in Arunachal Pradesh. Education in the region is a far cry having the average literacy rate of 30%. The highest literacy rate of above 80% is prevailing in Mizoram and the lowest below 15% in Arunachal Pradesh.

Major problems of the Region

Every year the region suffers from natural calamities like flood riverbank erosion, landslide, earthquake and drought. Due to excessive rainfall during summer, water levels in all rivers of the region rise beyond the danger mark causing severe flood. The strong under current of the rivers cause serious erosion of sandy alluvial riverbank soils of the Brahmaputra and the Barak valleys. The hilly terrain of the region also encounters landslides every year mostly during the rainy season. The region is situated in an active seismic zone; every year it encounters weak to strong tremors. The region is characterized by very complex contemporary tectonic setup due to accumulation of interplate stress below the Meghalaya plateau and its surroundings, post-collisional adjustment along the Himalayan arc and active subduction convergence along the Indo-Burmese arc resulting in high level of seismic activity. Drought during the winter is becoming a regular feature in the region since 1997 having rainfall less than 100 mm.

In the health front, diseases like cancer, malaria, cholera, jaundice and AIDS are predominant in the region. Every year a large number of people suffer from the diseases and a good number of them succumb to.

Human influx from foreign countries like Bangladesh, Nepal and Bhutan is one of the most serious problems of the region. Lack of economic development and employment coupled with influx problem has led to some complex social problems like insurgency in the region.

The region lacks effective quality roads and bridges affecting transportation and communication. Large-scale deforestation has disturbed the ecological balance in the region affecting the climate in a major way. Deforestation has also adversely affected the rich biodiversity of the region.

Limited cropping intensity coupled with low yield, low input application, lack of effective weather forecasting, lack of cold storage facility for agro-horticultural crops, lack of measures to control crop and food spoilage, lack of strong post harvest technology including food processing and packaging, lack of proper marketing facility, lack of animal improvement and management practices have hindered the development of agriculture sector of the region. The region lacks effective strategies for systematic exploitation of plant, animal and microbial diversity.

Pollution has been increasing at an alarming rate in the region. Contamination of soil, water and air by crude petroleum is a major issue. Poly cyclic aromatic hydrocarbon fractions are carcinogenic in nature. Burning of untapped natural gas over the last three decades has caused serious impact on the agro-silk sectors of the region. Similarly, dusts, suspended particles, fumes and waste chemicals released by paper industries, fertilizer plants, cement and sugar factories cause pollution. Furthermore, excessive and injudicious use of pesticides by the tea gardens has been polluting the river ecosystem of the region making them almost barren.

The Science and Technology Policy, 2003

To address these problems, it is necessary to formulate certain policy decisions in line with the science and technology policy of the Government of India. The Central Government enunciated the following S & T Policy, 2003 for the country:

- To ensure that the message of science reaches every citizen of the country for the advancement of scientific temper, emerge as a progressive and enlightened society and to make it possible for all people to participate fully in the development of science and technology and its application for human welfare.
- To ensure food, agricultural, nutritional, environmental, water, health and energy security of the people on a sustainable basis.

- To mount a direct and sustained effort on the alleviation of poverty, enhancing livelihood security, removal of hunger and malnutrition, reduction of drudgery and regional imbalances both rural and urban, and generation of employment by using scientific and technological capabilities along with our traditional knowledge pool. This will call for the generation and screening of all relevant technologies, their widespread dissemination through networking and support for the vast unorganized sectors of our economy.
- To use the full potential of modern science and technology to protect, preserve, evaluate, update, add value to and utilize the extensive knowledge acquired over the long experience.
- To encourage research and innovation in areas of relevance for the economy and society, particularly by promoting close and productive interaction between private and public institutions in science and technology sectors such as soil and water management, human and animal nutrition, fisheries, water, health, education, industry, energy including renewable energy, communication and transportation would be accorded the highest priority.
- In the era of information technology, to ensure speedier access to information both in quality and quantity for the development of science and technology.
- To encourage research and application for forecasting prevention and mitigation of national hazards, particularly flood, earthquake, cyclone, drought, riverbank erosion and landslides.
- Protection and conservation of bio-diversity, traditional knowledge base and their improvement.

Work strategies

Mechanisms have to evolved for continuous and independent policy and planning of science and technology. Scientists, technocrats as well as academic and professional bodies have to be engaged for the purpose. These inputs will help in decision making and formulation of policies in socio-economic sector. The states and the North East Council have to be encouraged and assisted in the use of science and technology for developmental purposes through suitable mechanisms and in establishing linkages with national/international institutions for solving local and regional problems. The science departments, academic institutions including Universities have to be substantially strengthened by giving full autonomy and flexibility and de-burocratization. Reviewing mechanisms at all levels of academics and administrative structures and procedures in science and technology have to be established for meeting the challenge of changing needs. The State Governments and the NEC should take steps to modernize science and engineering infrastructures.

Standard laboratory facilities have to be created for taking up research works on seismology, riverine and water body studies, hill and riverbank soil conservation, flood control, communicable disease control, cancer and AIDS research, refugee studies and planning, agro-forestry, hill cultivation, eco-protection, road bridge construction, plant based medicine production and improvement of economic and minor crop plants. Efforts have also to be made to develop skilled manpower to take up the challenging science and technology tasks of the states and the region. Funds may be created to impart training to qualified personnel. Manpower has to be created in emerging areas like biotechnology, medicine production and synthesis, hydropower, seismology, software and information technology etc. Planning and investments have to be made for harnessing river and other water bodies, bio-diversity and human resources.

Indigenous knowledge based on age-old traditions and experiences, have to be harnessed for the purpose of wealth and employment. Modern approaches to document, protect, evaluate and to learn from rich heritage of traditional knowledge of the natural resources of land, water, bio-diversity, medicine, food processing preservation, packaging and beverage production have to be strengthened and enlarged. Technologies need to be developed to add value to indigenous resources and traditional knowledge systems for providing holistic and optimal solutions suited to socio-cultural-economic issues. A concerted plan to identify research on traditional systems of medicine, local beverage industry, food processing and preservation so as to contribute to fundamental advances in health care, nutrition and quality drink and leading to commercialization of effective products have to be undertaken.

Science and technology have to be streamlined to address the problem of mitigation and management of the impacts of natural hazards like earthquake, flood, river-erosion, landslide, drought and cyclone. A concerted plan to enhance protective capabilities and preparedness for meeting emergencies arising from the natural calamities has to be developed. Measures have to be undertaken to promote research on natural phenomena that lead to disasters and human activities that aggravate them. Practical technological solutions have to be developed for predicated preparedness and mitigation and management of post disaster situations.

There is a growing need to enhance public awareness of the importance of science and technology in everyday life and the directions where science and technology are taking us. People must be able to consider the implications of emerging science and technology options in areas, which impinge directly, their lives including ethical, moral, legal, social and economic aspects. Support for wider dissemination of scientific knowledge through establishment of science museums, botanical gardens, herbarium preparation, planetarium,

natural aquariums and zoos have to be enhanced. Every effort has to be made to attract the young ones to science and technology.

In order to highlight regional science and technology needs and to design policy decisions and working procedures, the North Eastern Council should be the lead organization. The state Governments should also frame their own policies on the basis of their local problems, aspirations and needs. Along with the 'Regional Science and Technology Policy' under the auspices of the NEC, there should also be 'State Science and Technology Policy' for each of the states of the region. An initiative has to be made to establish collaboration among the scientists, teachers, planners, managerial and administrative personnel belonging to Government departments, research and academic institutions and industries of the region as well as of the states. As and when necessary, collaborative research works have to be taken up by involving internal and external experts. The work strategies for the region could be covered under:

- I. Regional weather and climate forecasting
- II. Hazard warning and management
- III. Science education and research
- IV. Biodiversity and resource management
- V. Infrastructure development
- VI. Agro-science & rural technology
- VII. Food processing and
- VIII. Energy and environment.

On the vector status of the biting midge *Culicoides* spp. (Diptera: Ceratopogonidae) prevalent in the North Eastern Region (NER) of India

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India's most bio-diverse region, *i.e.*, North Eastern Region (NER), holds sixteen national parks, fifty-five wildlife sanctuaries, three bird sanctuaries, and two tiger reserves with a thriving population of animals and birds. Besides, this region accounts for 24.3 million livestock, poultry birds of 69.2 million, cattle occupy 54.84% of the total livestock population, the goat population is about 22%, followed by the population of pigs, horses, *mithuns*, mules, donkeys, camels, and yaks (20th Livestock Census, 2019). Despite such a large number of livestock and wild animals and birds, entomological surveillance reports on disease *viz.*, lumpy skin disease (LSD), bluetongue disease (BTD), and the role of adult *Culicoides* (Diptera: Ceratopogonidae) spp. prevalent in the North Eastern States (NESS), *i.e.*, Assam, Arunachal Pradesh, Manipur, Mizoram, Meghalaya, Nagaland, Tripura, and Sikkim (Barkataki et al., 2012; Mukhopadhyay et al., 2016; Sarkar et al., 2023b) is lacking.

This article deals with the adult *Culicoides*, which are the smallest blood-sucking biting midges ranging from 1-3 mm (Mellor et al., 2000), often known as *biting machines* that have been implicated globally in vectoring several important arboviruses, bacteria, protozoa, filarial nematodes, etc. Throughout Southeast Asia, these *biting machines* are known as "makunagi" or "nukaka" (Japan); "agas" (Malaysia and Indonesia), "nyung noi" or little mosquitoes (Laos) (Wirth & Hubert, 1989), and "ruwani" (rural areas of West Bengal), etc. The developmental cycle is similar to any other holometabolous insect, consisting of an egg, four larval instars, a pupa, and an adult (Mellor et al., 2000). Most immatures thrive in moist areas, and these environments' availability is a crucial determinant limiting their seasonal occurrence, distribution pattern, and abundance (Mellor et al., 2000). Geographically, the NER is characterised by prolonged annual precipitation of 1500-2500 mm, a humidity of 70-85% (Dikshit & Dikshit, 2014), and organic-rich soil, which is conducive to breed the vectors with the large availability of host variety. The vectorial study of these essential medico-veterinary flies remains utterly neglected throughout the region. In India, among 84 *Culicoides* species recorded (Sarkar et al., 2023b), only 18 species (Table 1) were identified from this region to date, and their impact in vectoring arboviruses, bacteria, protozoa, and nematodes to humans and animals remains neglected. This article gives a cursory look into the status of the known potential vector species recorded, particularly in the North Eastern Region (NER) and their host range. It documents the transboundary occurrence of various *Culicoides*-borne pathogens.

Table 1. Distribution of *Culicoides* spp. recorded from the North Eastern Region (NER) of India

Subgenus/Species group	Species	Distribution
<i>Avaritia</i> Fox	<i>Culicoides actoni</i> Smith	Assam (Burnihat), Arunachal Pradesh
	<i>Culicoides annandalei</i> Majumdar & Das Gupta	Sikkim (Rhenock)
	<i>Culicoides orientalis</i> Macfie	Sikkim (Nayabazar)
	<i>Culicoides sikkimensis</i> Das Gupta	Sikkim (Nayabazar)
<i>Haemophoructus</i> Macfie	<i>Culicoides rariradialis</i> Das Gupta	Sikkim (Nayabazar)
<i>Hoffmania</i> Fox	<i>Culicoides peregrinus</i> Kieffer	Assam
<i>Meijerehelea</i> Wirth & Hubert	<i>Culicoides arakawae</i> (Arakawa)	Assam (Golaghat, Guwahati)
<i>Pontoculicoides</i> Remm	<i>Culicoides kamrupi</i> Sen & Das Gupta	Assam (Guwahati)
<i>Remmia</i> Glukhova	<i>Culicoides oxystoma</i> Kieffer	Assam (Golaghat)
	<i>Culicoides schultzei</i> (Enderlein)	Assam (Golaghat, Nagaon, Burnihat, Kaithalkuchi, Jorabat, Boko, Sonapur, Silonijan)
	<i>Culicoides anophelis</i> Edwards	Assam (Golaghat)
	<i>Culicoides flaviscutatus</i> Wirth & Hubert	Assam

<i>Trithecoides</i> Wirth & Hubert	<i>Culicoides inornatithorax</i> Das Gupta	Sikkim (Nayabazar)
	<i>Culicoides palpifer</i> Das Gupta & Ghosh	Assam
	<i>Culicoides parararipalpis</i> Das Gupta	Sikkim (Nayabazar)
	<i>Culicoides raripalpis</i> Smith	Assam (Burnihat), Sikkim
<i>shortti</i>	<i>Culicoides shortti</i> Smith & Swaminath	Assam (Guwahati)
	<i>Culicoides swaminathi</i> Majumdar & Das Gupta	Arunachal Pradesh (Pasighat)

Virus

In Bluetongue disease (BTD) epidemiology, among 29 serotypes of bluetongue virus (BTV), 23 serotypes have so far been reported from India (Saminathan et al., 2020). A meta-analytic study by Rupner et al. (2020) indicated BTV seropositivity in several animals, such as cattle, buffaloes, mithuns, camels, sheep, and goats. The prevalence of BTV serotypes in different states of India has already been summarized by Saminathan et al. (2020). Among seven species reported transmitting BTV in India, the following four species, *C. actoni*, *C. orientalis*, *C. peregrinus*, and *C. oxystoma* have been recorded in this north-eastern region (Harrup et al., 2016; Mukhopadhyay et al., 2016; Sarkar et al., 2023b). Previously, BTV serotypes have been detected in *C. orientalis* (serotype-21), *C. oxystoma* (serotypes-1 and 16), *C. schultzei* (serotype-16), *C. peregrinus* (serotype-23) associated with Indian livestock farms of Gujarat and Tamil Nadu, West Bengal and from Indonesia (Sendow et al., 1993; Dadawala et al., 2012; Halder et al., 2013; Ranjan et al., 2017a; Ranjan et al., 2017b). Joarder et al. (2013) documented seroprevalence of BTV within the animals (sheep, goat and cattle) from different districts of Assam (Golaghat, parts of Karbi Anglong, Morigaon, Nalbari, Bongaigaon, Goalpara, Kamrup Metro and Kamrup Rural) located within four agro-climatic zones (Upper Brahmaputra Valley, Central Brahmaputra Valley, Lower Brahmaputra Valley, and hills).

Other viruses like ephemeral fever virus were detected from *C. peregrinus* (Wirth & Hubert, 1989); Chuzan virus (CHUV), D'Aguilar virus (DAGV), Ibaraki virus (IBAV), Akabane virus (AKAV), Aino virus (AINOV), and epizootic hemorrhagic disease virus (EHDV) isolated

by Yanase et al. (2005) and Thabet et al. (2023) from *C. oxystoma* trapped from Southern Japan and Tunisia. Diarra et al. (2014) and Fall et al. (2015) suspected this species as the potential vector of the African horse sickness virus (AHSV) based on its abundance data near horses in the Niayes area, Senegal. *Culicoides arakawae* is the fowlpox virus vector (Wirth & Hubert, 1989).

Lumpy skin disease (LSD), caused by the lumpy skin disease virus (LSDV), is a global concern that affects cattle, buffalo, camel, gaur, and giraffes. Reddy et al. (2023) provided insight into the occurrence of LSD in cattle, and Yak from Sikkim exhibited skin nodular lesions. Bianchini et al. (2023) pointed out that *Culicoides* spp. are transmitted LSV, and Topan (2023) documented LSD from Assam, Arunachal Pradesh, along with other states. ABP News Bureau updated LSD from the villages of Meghalaya of the districts of Ri-Bhoi (Sumer, Umkon-Umden, Mawlyngkhung, Saiden-Nongpoh, Umpyrdong-Umden, and Jyntru-Nongpoh) and South West Khasi Hills district (Rangthong) and 20 cows dead on 31 May (2023). Press Trust of India updated on 27 July (2023) that 900 cattle, especially the 'thutho' indigenous breed to Nagaland, were infected with LSD and declared this state as an 'LSD positive state'. Reddy et al. (2024) first reported LSD infection within Mithun distributed across NERs.

Bacteria

Pathogenic bacteria-specific information within Indian *Culicoides* spp. is still scarce. Sarkar et al. (2023a) made a detailed study on beta haemolytic strains of *Bacillus cereus* from the non-blood utilizing life stages, i.e., eggs, four larval instars, pupae including in laboratory-emerged males and females, as well as in the field-collected males and females (nulliparous, parous, and post-oviposited) of the abundant vector species, *C. peregrinus* trapped from the district of Burdwan (West Bengal). Based on Drobniewski (1993) and Kotiranta et al. (2000), this bacterium is pathogenic, as it also causes septicemia, endophthalmitis, and food poisoning in humans and other mammals. Further studies will be needed to identify pathogenic bacteria within salivary glands, specifically the saliva of these vector species, as it serves as an anterior transmission route for these pathogens.

Protozoa

The protozoans: *Leucocytozoon* sp., *Leishmania (Mundinia) martiniquensis*, *L. (M.) orientalis*, and *Crithidia* species were detected from another vector, *C. oxystoma* in Phatthalung Province and Songkhla Province of Southern Thailand (Sunantaraporn et al., 2022; Songumpai et al., 2022). *Crithidia* sp. and *Leishmania (Mundinia) martiniquensis* were also identified from *C. peregrinus* (Sunantaraporn et al., 2022; Kaewmee et al., 2023). In Japan, *C. arakawae* has been reported as a pest of fowls and turkeys, along with being implicated as the vector of Leucocytozoonosis as *Leucocytozoon caulleryi* is transmitted by this species (Wirth & Hubert, 1989). Besides that, avian haemosporidia was detected in this species (Inumaru et al., 2023).

Nematode

Buckley (1938) recorded infections of *C. actoni*, *C. orientalis*, *C. oxystoma*, and *C. shortii* with *Onchocerca gibsoni*'s larvae, cattle filaria's causative agent, in Malaya.

Host range

Adult *Culicoides* spp. have diverse blood-meal sources, and the vast majority of midge species are mammalophilic and ornithophilic; however, reptiles and amphibians are also in the host spectrum of these midges (Lassen et al., 2012). The information about their blood-feeding source is essential in elucidating the host-vector interactions and *Culicoides*-borne virus eco-epidemiology. Some *Culicoides* spp. rely on insect haemolymph as a protein source (Lassen et al., 2012). Further, there is a record of *C. anophelis* feeding on engorged mosquitoes (Ma et al., 2013). Wirth and Hubert (1989) suggested that *C. peregrinus* is strongly zoophilic and a general feeder. Kamyngkird et al. (2023) identified positive *C. actoni*, *C. arakawae*, and *C. peregrinus* for horse blood. Sunantaraporn et al. (2022) detected the blood meal of *C. arakawae* and found it positive for pigs. Based on the investigation of Kar et al. (2022) and Kamyngkird et al. (2023), *C. oxystoma* fed the blood of cows, buffaloes, sheep, pigs, and humans; *C. anophelis* fed the blood of humans; *C. palpifer* fed the blood of buffalo. Gomontean et al. (2023) documented positive samples of *C. shortii* and *C. flaviscutatus* for buffalo's blood. Wirth & Hubert (1989) observed that *C. anophelis*, *C. raripalpis*, and *C. flaviscutatus* bite on cows and humans. Sarkar et al. (2023b) reviewed the data regarding blood meal analysis by earlier researchers. They noted positive *C. actoni* for cow, buffalo, chicken, horse, and human blood and *C. orientalis* for cow blood. Ogola et al. (2024) analyzed the blood meal of *C. schultzei* and detected positive for cattle blood.

Despite several *Culicoides* spp. identified from NER, data regarding pathogens and disease epidemiology still needs attention. Although their broad host range and pathogen-specific information have been collated from other regions of India and contiguous Southeast Asian countries, further mapping will still be required to generate these data specific to the NER. Vector-borne disease assessments of animals of NER will need a continuous entomological survey of the vectors, RTPCR-based pathogenic load analyses, and identifying diseases in the host animals and birds, which should be taken up immediately. The transboundary incursion of vectors and pathogens makes the situation more complex and unpredictable. Let us not wait for disease outbreaks to spur but recommend to the competent authorities amongst NER institutes that they build a strong network and generate interactive databases of the host-vector-pathogen. This information, once generated, will safeguard our animal resource wealth of NERs.

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Shattering Boundaries: IASST's Empowerment Campaign for Northeast India's Tribal Women

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The Institute of Advanced Study in Science and Technology (IASST), Guwahati, an autonomous Institute of DST, has integrated programs that highlight the significance of women's empowerment in the Northeast region because women are the driving force of change and are necessary for a nation to prosper and sustain itself. With its objective to empower tribal women and promote sustainable livelihoods, IASST has become a beacon of success in Northeast India's varied cultural landscape. The institute has integrated its efforts with the Government of India's 'Atmanirbhar Bharat' and 'Vocal for Local' initiatives while also revolutionizing traditional customs through creative activities under the "ST/SC Community Development Program at IASST," which is supported by DST's SEED division.

Reviving Tradition: *Xindol*'s Journey from Traditional Household Delicacy to Supermarket Shelves

At Bakarapara village, near Guwahati, a Self-Help Group (SHG) named *Upasona* ethnic food society was formed, bringing together 21 rural tribal women to promote their traditional delicacy, *Xindol*—a fermented fish product deeply embedded in their cultural heritage (Fig. 1). IASST was pivotal in elevating *Xindol* from a household delight to a marketable product by conducting nutritional analyses, facilitating FSSAI certification, and safeguarding traditional knowledge through geographical indication (GI) filing.

IASST has set up a Biofloc system for fish farming to guarantee a steady supply of fish for fermentation. The members have received specialized training in handling *Xindol* safely. Additionally, IASST has fostered the society for market connection under the Bionest facility. In addition to over 300 direct and indirect beneficiaries, this program has tremendously aided 21 women in creating sustainable subsistence.

Diversification for Prosperity: *Eri* Silk and Edible Pupae Production

Recognizing the need to enhance income opportunities, IASST expanded its initiatives to include the production of *Eri* silk and its edible pupae (Fig. 2). This forward-looking approach not only contributes to the economic prosperity of tribal women but also preserves and promotes indigenous practices, fostering a sense of self-sufficiency within the community. Many women in the three adopted villages of IASST, viz. Satargaon, Kallapara, and Bakarapara have incorporated *Eri* rearing into their livelihoods as a significant income source.

Through hands-on training provided by IASST, these women are now equipped with the knowledge and skills required for successful sericulture.

Soybean Cultivation: Transforming Lives and Landscapes

Scientists at IASST have launched an unprecedented project to grow soybeans to transform the agricultural landscape and lives of tribal people in Northeast India. To reduce dependence on imported soybean seeds, IASST's strategic intervention in Barnagaon village, Udalguri district, led to the formation of the Daogalang Soya Society and Gwjwnsri Soy Society, focusing on the cultural and economic importance of fermented soybean (Fig. 3). Comprising more than 20 tribal women from the Bodo community, this society processes soybean seeds into various products, including soy tofu. This initiative has positively impacted more than 200 individuals directly and indirectly. Through its BioNEST incubation facility, IASST is crucial in facilitating market linkages for women engaged in soybean-related businesses. The institute supports the commercialization of products developed by women, ensuring that their efforts translate into tangible economic opportunities.

IASST's Commitment and Goal: Towards a Sustainable Future

The B. R. Ambedkar centre for Community Empowerment (BRACE), a specialized platform created to serve the particular requirements of the weaker portion of society, primarily focusing on women, is central to IASST's commitment to social empowerment (Fig. 4). Equipped with cutting-edge facilities, BRACE is the focal point for programs promoting inclusive empowerment. It provides targeted training, skill development, educational opportunities, and awareness campaigns, particularly for women from under-represented groups. The center aims to enable women to actively advance society by creating a supportive atmosphere through networking and mentorship opportunities.

Beyond empowering tribal women, these programs significantly contribute to Northeast India's larger objective of developing a locally oriented and self-sufficient economy. IASST grows crops and sows the seeds of prosperity and change as success stories keep coming to life, influencing the next generations.



Fig. 1 Glimpses of activities of the *Upasona* Ethnic Food Society.



Fig. 2 *Eri* silk and edible pupae production in the adopted villages.



Fig. 3 Glimpses of activities of the *Gwjwnsri* Soya Society.



Fig. 4 B.R. Ambedkar centre for Community Empowerment (BRACE).

CAR-T Cell Therapy for Cancer: A Revolutionary Advancement in Indian Biomedical R&D

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Cancer is a global health threat and a primary cause of death worldwide. In 2020, it was estimated by the World Health Organization that cancer claimed the lives of 10 million individuals. According to the National Cancer Registry, there were 1.39 million cancer patients in India and around 8 million worldwide, with the global burden expected to increase 5-fold by 2025. Although conventional treatments like surgery, radiation therapy, and chemotherapy are still crucial in cancer care, recent advancements have introduced new treatment options that are significantly altering the landscape of cancer therapy for patients. Immune checkpoint inhibitors, for example, are drugs that are widely used to treat various types of cancer, including melanoma, lymphoma, lung, bladder, and kidney cancer. Immunotherapy is an advanced approach to treating cancer by utilizing the patient's immune system to target and combat cancer cells. In the 2000s, targeted therapies like trastuzumab (Herceptin) and imatinib (Gleevec) emerged, which destroy cancer cells by targeting specific molecular changes found in those cells. CAR-T cell therapy is another promising treatment. India's first indigenously produced NexCART, which uses this technique, made headlines in the news after its successful application.

CAR-T cells are a revolutionary form of treatment for cancer patients. They involve genetic modification of T cells taken from the patient, which makes them more efficient at recognizing and destroying tumor cells. Chimeric antigen receptors (CARs) are produced from these modified T cells and added to their surface, which helps them identify and bind specific antigens on cancer cells' surfaces (Figure 1). This process is called precision medicine, as the therapy is customized for each patient. The Food and Drug Administration has authorized six CAR-T cell treatments for various blood cancer types, including lymphomas, specific leukaemias, and multiple myeloma.

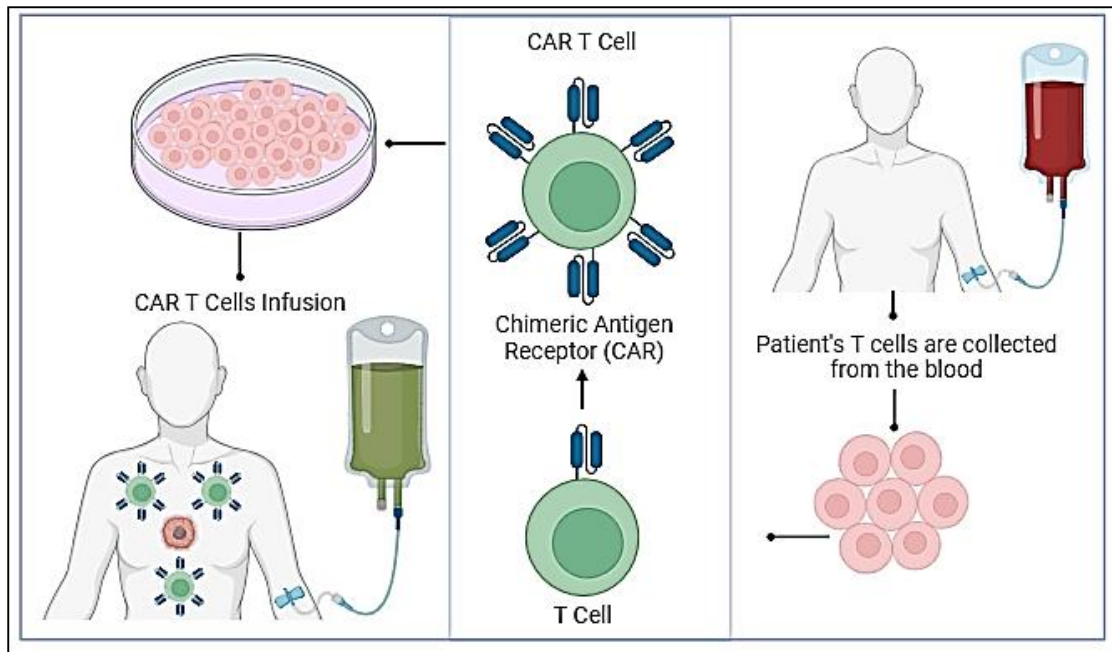


Figure 1: Schematic representation of CAR-T cell therapy technology.

In 2015, Dr. Alka Dwivedi and her team developed NexCAR19, a modified CAR-T cell that showed promise in treating blood cancers. After unsuccessful attempts to design the CAR-T cells, Dr. Dwivedi and her colleagues collaborated with experts in CAR-T cell therapy at the National Institutes of Health (NIH) Clinical Centre in Maryland. They developed an innovative CAR-T cell tailored for the Indian context that led to the approval of NexCAR19 in India in October 2023, marking India's first venture into CAR-T cell treatments. NexCAR19 demonstrated impressive efficacy in treating advanced lymphoma or leukemia, with 67% of patients experiencing a significant reduction in cancer burden and approximately half achieving complete remission following promising outcomes from two clinical trials carried out in India.

On June 4th, 2021, a significant milestone was achieved in the field of cancer therapeutics in India, marking a historic day for Tata Memorial Hospital (TMC) and IIT Bombay. This was due to the success of India's NexCAR19 procedure, which was carried out at the ACTREC Bone Marrow Transplant Unit, TMC, in Mumbai. The CAR-T cells used in this procedure were developed and produced at IIT Bombay. The team from IIT Bombay-TMC received additional support from DBT/BIRAC through the National Biopharma Mission, which allowed them to lead this project and conduct Phase I and Phase II trials of their CAR-T product.

Following that, in October 2023, CDSCO, India's drug regulator, approved NexCAR19 for commercial use. It was developed by ImmunoACT, a company incubated at IIT Bombay. Dr.

(Col) VK Gupta, a gastroenterologist based in Delhi, underwent treatment in India for Rs 42 lakh instead of 4-5 crore abroad. On April 4, President Droupadi Murmu launched the first CAR T-cell therapy developed within India, designed to target and treat cancer. She referred to it as a "breakthrough" that provides "new hope for humankind" in the fight against cancer. The therapy is now available throughout the country.

CAR-T cell therapy faces manufacturing, distribution, logistics, quality control, and affordability challenges, particularly in low-resource settings like India. Challenges include high manufacturing costs, complex supply chain logistics, GMP-compliant facilities, quality control, and traceability measures. Standardized manufacturing, reduced pricing, infrastructure development, and workforce development initiatives can help overcome these challenges. Government support, policy formulation, and strategic collaborations are also necessary to foster a conducive ecosystem for CAR-T therapy in India. The President of India praised CAR-T cell therapy as a major advancement in cancer treatment, highlighting its accessibility and affordability. This milestone represents a beacon of hope for patients worldwide, underscoring the transformative impact of innovative medical interventions.

CAR-T cell therapy holds immense promise for transforming the approach to cancer care in India, improving outcomes for patients nationwide. To position India as a global leader in this field, investing in research, infrastructure, and regulatory frameworks is crucial. By continuing these efforts, India can take advantage of the bright future that CAR-T cell therapy promises.

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Tradition knowledge to fix your 'gut microbes'

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Did you know that trillions of bacteria are present in your gut? These gut bacteria are crucial in keeping our gut healthy and balanced. These microscopic heroes play an essential role in digestion by breaking complex food matter, producing vitamin K, improving the immune system, and controlling mood and sleep cycle.

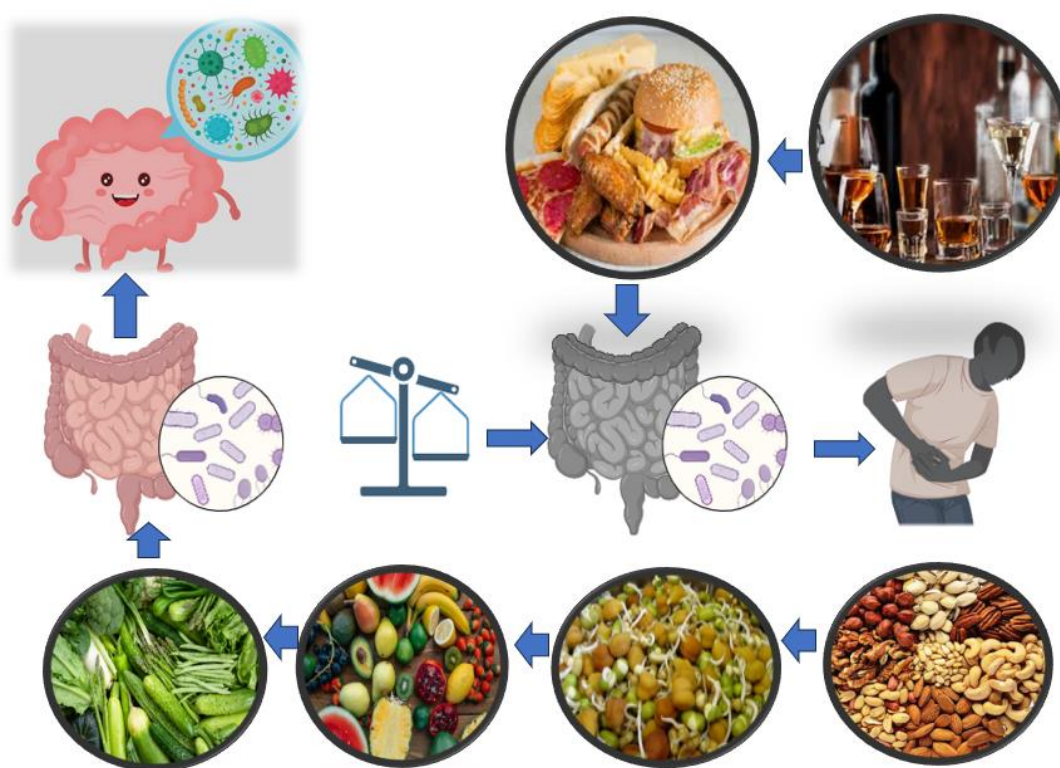


Fig. 1 Gut microbes and foods are associated with human health.

Sometimes, these gut microbes may get out of balance. This may occur for many reasons, like taking antibiotics that kill both good and bad bacteria or eating unhealthy foods that create an imbalanced state. Nowadays, the term “gut bacteria” has drawn much attention because their imbalanced state is linked with different human diseases like fatty liver, diabetes, obesity, inflammation in the gut, depression, neurological disorders, and many more.

But don't worry; scientists have discovered magical bacteria known as probiotics, which are live bacteria that can improve your gut health and maintain harmony when consumed in adequate amounts. Probiotics are superheroes that help us fight diseases and

foreign pathogens so that we live happily and age healthy. So now the question arises: from where do we get probiotics? You can find them in foods like yogurt or curd, fermented food products like *kombucha*, fermented bamboo shoots, *kharoli*, etc, or take them as supplements available in the market with doctors' prescriptions.

Though probiotics are a new concept for improving our health in this modern twenty-first century, do you know? In Bharat, our ancestors practiced probiotic-rich food daily while worshiping or during pooja. They used to prepare prasad, known as *panchamrit*, and we still follow the same. In Hindu ritual, no pooja is complete without offering panchamrit. It comprises of five divine ingredients — milk, curd, honey, ghee (clarified butter), and jaggery — and *Panchamrit* was a symbol of devotion and a secret of health and vitality. Curd is rich in beneficial bacteria like *Lactobacillus sp.* Raw milk is a fundamental element in panchamrit, which supplies nutrients for the growth of probiotic bacteria. Honey is also rich in potential probiotic bacteria and micronutrients. In contrast, ghee contains butyric acid, which is good for gut health, and a small amount of jaggary as an energy source.

How do you maintain good gut health? Include lots of (a) green vegetables and fruits in your diet, which are rich in fiber, (b) a handful of sprouts and nuts, (c) fermented food products like curd or dahi, (d) exercise daily and (e) avoid junk food or packed food packets. “Take care of your gut bacteria. They will take care of you”. By taking care of your gut bacteria, you're supporting your digestive system and nurturing your overall health and well-being. So, listen to your gut, nourish it with care, and it will surely take care of you in return.



Fig. 2 Key ingredients of *Panchamrit*.

Human gut microbiome and metabolic health – past, present and future

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In the bustling city of an adult human body resides about 30 trillion cells, of which less than a third belongs to itself! The rest are tiny microscopic organisms comprised of bacteria, archaea, fungi, protists, and viruses, with bacteria dominating more than 90% of the microbial ecosystem. These inhabitants are called human 'microbiota', and their collective genome is termed as 'microbiome'. Microbial diversity differs across populations, communities and nations, from person to person and even in different body sites of a single human. Yet of all, the gut microbiome is thought to be crucial in our overall health and well-being. In a healthy individual, the majority of the gut bacteria belong to the phyla Bacteroidetes and Firmicutes. The remaining 10% is largely from the phyla Actinobacteria, Proteobacteria, Fusobacteria, and Verrucomicrobia. This is known as eubiosis or 'balanced microbiome'. Here arises a lot of questions. What are the factors that maintain and sustain this balance? Are all factors equally important, or do few have a more significant role to play? What role does it play in our overall health and metabolism? Does change in microbiome have a connection to diseased states, particularly metabolic diseases? Let us explore and address these questions.

Colonisation of gut microbiota begins as early as in the fetus during gestation. The metabolic health and gut microbiome of the mother, mode of delivery and feeding breastmilk or infant formula significantly influence the early microbiota establishment in newborns and kickstart the initial development of the immune system. Factors including diet, medications, infections, environment and even genetics modulate our microbiota. Originally said by Jean Anthelme Brillat-Savarin, a lawyer and gastronome in 1826 and later popularised by nutritionist Victor Lindlahr in the 1920s, the phrase 'we are what we eat' is true. But how does it relate to the gut microbiota? Recent studies have shown how the quality of diet shapes our gut microbiome affecting our gut health, body metabolism, mood, and even immunity in ways unknown before! Scientists are linking perturbed gut health to conditions such as obesity, diabetes, metabolic-associated fatty liver disease, cardiovascular diseases and neurodevelopmental and neurodegenerative disorders. Quality of the food depends on a balanced diet, consisting of edible fiber in the form of leafy vegetables, and colourful fruits packed with proteins, antioxidants, vitamins, minerals, and essential amino acids, commonly termed a 'rainbow diet'. Fiber-rich food contains undigestible carbohydrates like inulin, fructans, and levan, to name a few. Humans cannot fully digest such complex molecules

because of lack of specific enzymes involved in degradation and there comes the role of our friends living in the intestine. These bacteria contain the necessary enzymes needed to break down the resistant carbohydrates and fibers into simpler molecules which can be absorbed. The end product of the fermentation produces short-chain fatty acids (SCFAs) and gases. As part of their metabolism neuropeptide molecules and antimicrobial products are also released. Lactic acid bacteria are known to produce lantibiotics like *nisin* which help in keeping the abundance of pathogens in check, a phenomenon known as 'colonisation resistance'. SCFAs are small organic acids with up to six carbon atoms. Major SCFAs produced are acetate, propionate, and butyrate and neurotransmitters like dopamine, serotonin and glutamate. SCFAs and neurotransmitters have been linked to improved gut health and energy homeostasis, possibly playing a major role in different pathways through gut-organ axes.

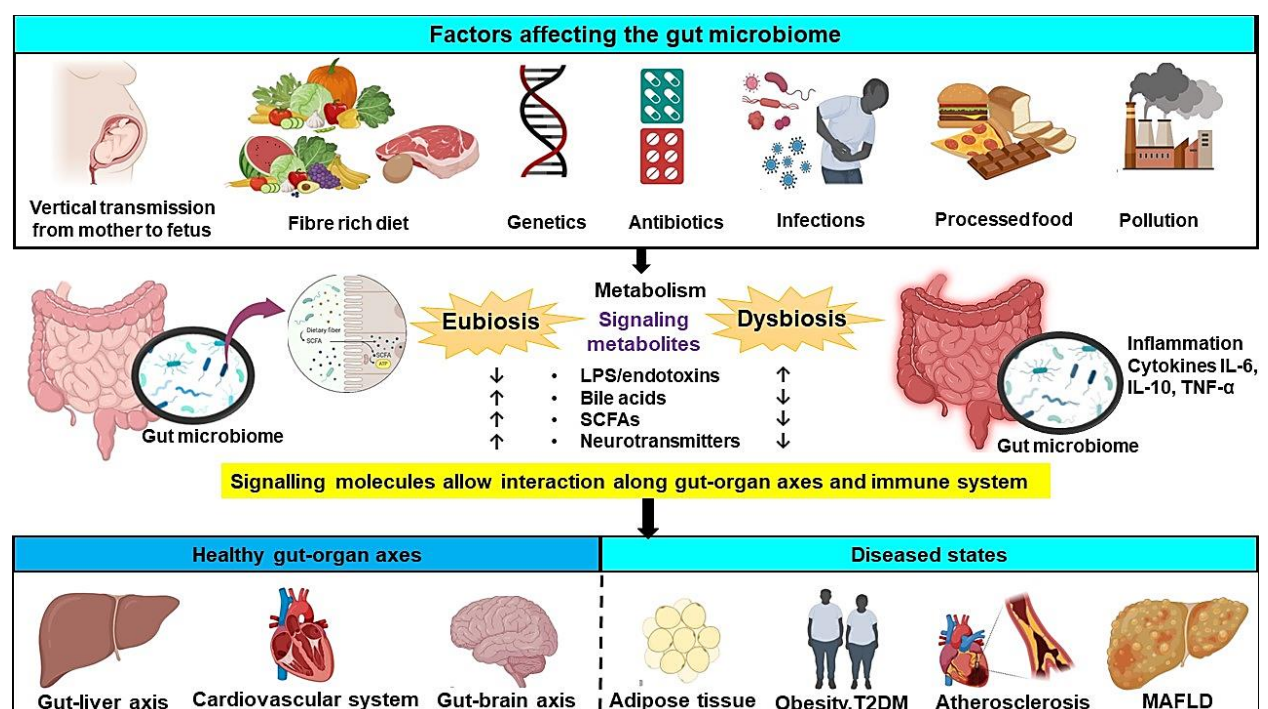


Fig. 1 Gut microbiome in health and diseases.

Besides the fresh food consumed, humans traditionally have also been consuming fermented food and beverages for ages. Although fermentation might have started to preserve food during off-seasons, the health benefits reaped in doing so are coming to the limelight only recently. Major thanks go to Russian microbiologist and Nobel laureate, Ellie Metchnikoff, who brought the spotlight on fermented products by hypothesizing that the longer lifespan of Bulgarian farmers was due to their regular consumption of yoghurt, a fermented milk product. Most recent science does agree with him! Periodically consuming a consortium of probiotics present in fermented beverages and foods is beneficial for health. Fermented foods might also contain pathogens in case of unhygienic handling and storage, which can be minimized by stringent sterile practices and maintaining an aseptic condition.

Unlike earlier days, recent drastic changes in food habits from a fiber-rich balanced diet to refined and processed carbohydrate-based diet rich in fructose and low in fiber have brought havoc in body metabolism across populations. Disruption of this delicate microbial ecosystem leads to gut dysbiosis, the hallmarks of which are gastrointestinal discomforts such as bloating, nausea or diarrhea, inflammation, gut permeability, and development of irritable bowel syndrome (IBS), and/or inflammatory bowel disease (IBD) in severe cases. Further shifts in the intricate balance due to increased abundance in certain microbial community in small intestine can also lead to dyshomeostasis, a condition known as 'small intestinal bacterial overgrowth (SIBO)'. SIBO might lead to over-fermentation and release of toxins present in the cell wall of some pathogenic bacteria. Gram-negative bacteria, like an increased abundance of Proteobacteria, and changes in Bacteroidetes/Firmicutes ratio, have been linked with obesity, insulin resistance and fatty liver disease. Bacteria belonging to Enterobacteriaceae also release toxins. A class of endotoxin produced is lipopolysaccharides (LPS). It often leaks into the system through compromised gut integrity, binds with toll-like receptors (TLR4), igniting a cascade of reactions involving immune cells like Th1 and release of cytokines like IL-6, IL-10 and TNF α , ultimately leading to low-grade inflammation. Another phenomenon involved in increasing obesity during dysbiosis is over-harvesting of food. Due to SIBO, the conversion of complex undigestible food into simpler absorbable molecules increases manifold, leading to an increased rate of nutrient absorption. If alcohol producing bacteria is more, then 'endogenous alcohol production' might increase inflammation and gut permeability.

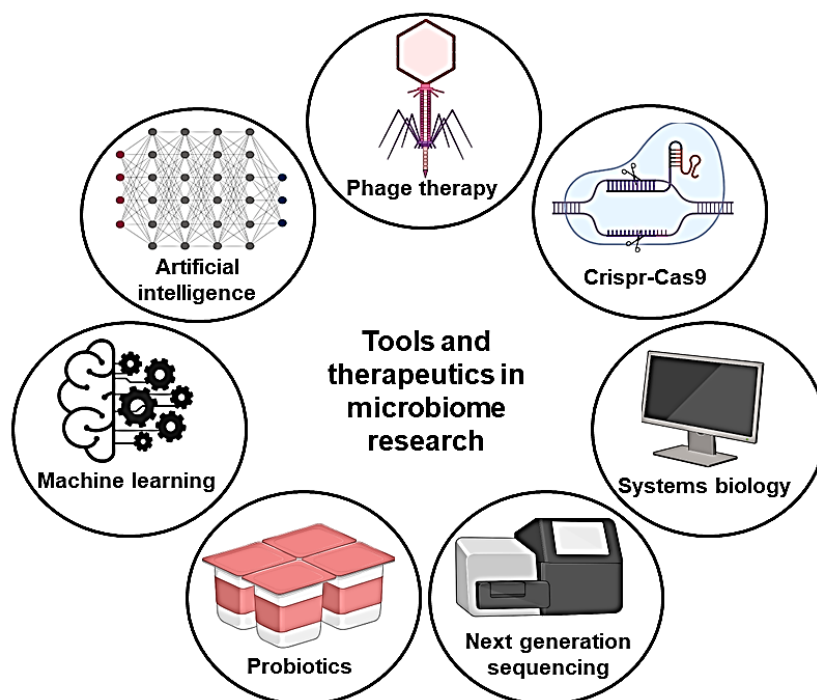


Fig. 2 Recent tools and therapeutics used in gut microbiome research.

However, defining “good” and “bad” bacteria is not straightforward. Even LPS producing bacteria are necessary at a young age to help develop our adaptive immune systems. Nonetheless, overgrowth and diversity loss of the microbes lead to health issues, where a targeted treatment approach is most desired. In that regard, one exciting area of research is bacteriophage-mediated gut modulation. Bacteriophages, or phages for short, are viruses that infect bacteria. Scientists are exploring how phages can be used to selectively target pathogenic bacteria and reverse the dysbiotic state. Another promising approach is microbiome engineering, which involves manipulating the gut microbiome to improve health. This could involve everything from introducing beneficial bacteria (probiotics, live biotherapeutics, fecal microbiota transplantation etc.) to using genetic engineering techniques like CRISPR-Cas9 to modify bacteria in beneficial ways. In this complex scenario, artificial intelligence and machine learning techniques are also emerging as powerful tools to decipher the intricate interactions within the gut microbiome. These technologies can help identify patterns and make predictions, offering new insights into disease mechanisms and potential treatments. Despite these advances, many challenges remain - from clinical studies to data generation – to make the next big jump in human microbiome research. The road is long ahead and the journey to decode the host-microbe interactions must continue!

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Transforming Waste into Clean Water: Harnessing Biomaterials for Sustainable Wastewater Treatment and Organic Pollutant Removal

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Water stands as an indispensable pillar of civilizations. The foundation of vibrant health rests firmly upon the availability of pure water. In recent decades, the global landscape has witnessed remarkable economic growth. As the surge in industrialization, expansion of agriculture, and rapid urbanization continues to spike, a notable increase in water contamination has escalated, ultimately leading to associated environmental problems. Water pollution is an alarming challenge that has continuously evolved over the past decade. Wastewater discharged from industries of different sectors like metal, food, textiles, paper, leather, cosmetics, pharmaceuticals, and other manufacturing sites stands out as a major cause of water pollution. This wastewater contains various hazardous pollutants, including harmful synthetic dyes, which are detrimental to living organisms. Annually, out of the global dye production of approximately 2 million tons, around 15% of it is being discharged as dye wastewater into the environment. The unplanned and haphazard release of these dye-laden industrial effluents into water bodies has given rise to numerous problems as they not only impart artificial color to the water bodies but also possess carcinogenic and mutagenic effects to living beings. These non-degradable and pigmented colorants when exposed to direct contact can cause severe irritation of the eyes and skin, while their consumption may lead to gastrointestinal discomfort like nausea, vomiting, and diarrhea. Prolonged exposure can affect the organs such as the liver, thyroid, and spleen as well as can damage the nervous system leading to headache, dizziness, and muscle cramps. Thus, considering the inherent toxicity of these synthetic dyes, it has become crucial to establish effective dye removal techniques from the wastewater.

Separating dye compounds from water can be a challenging task. Several techniques like adsorption, membrane separation, chemical coagulation, precipitation, flocculation, photodegradation, and ion exchange are available that bring the dye concentration within the World Health Organization (WHO) recommended limits. However, these techniques along with their excellent removal efficiency are also accompanied by several drawbacks like high cost, complicated multistep process, toxic sludge production, and overall slow process.

Among them, adsorption stands out as a highly efficient technique for purifying colored wastewater surpassing the available alternative techniques in numerous aspects due to its straightforward and user-friendly operation making it relatively economical with widespread availability. However, there are challenges related to the type of adsorbent used and their disposal after potential post-contamination by the pollutants. These challenges can be mitigated by using cheap and biodegradable sorbents originating from agricultural by-products. The utilization of this waste biomass addresses waste management problems, and, also seamlessly contributes to environmental sustainability.

Keeping this in view, a comprehensive series of studies was embarked on by a dedicated team of researchers led by Dr. Arundhuti Devi, a distinguished senior scientist of the Institute of Advanced Study in Science and Technology (IASST). Notably, one of their research ventures on the utilization of the waste derived from the preparation of *Kolakhar*, a traditional Assamese alkaline food additive used in many of their dishes. The solution is prepared by collecting the filtrate of water-soaked ashes derived from *Musa Balbisiana* stems, locally known as *Athiya Kol*. In the process, the stems of the banana plant are cut into small pieces and sun-dried for a couple of days, and subsequently burnt to ash in the open air. The resulting ash is then soaked in water and filtered to yield the alkaline solution known as *Kolakhar*. The research team ingeniously used the residual ash, i.e. banana stem ash (BSA), as a bioadsorbent to remove toxic synthetic dyes, viz., methylene blue (MB) and basic fuchsin (BF), showcasing an innovative approach integrating traditional practices with a modern scientific solution. Upon using different characterization techniques like FTIR, XRD, XPS, and EDX, it was evident that the ash contained high carbon content along with different elements like K, Ca, and Si with different oxygen and nitrogen-containing functional groups. These functional groups of the ash interacted with the dye molecules via different interactions like n- π , π - π , cation- π , hydrogen bond formation, electrostatic interactions, and covalent interactions. This insight into the mechanism involving the adherence of the dye molecules to the surface of the bioadsorbent was examined by the team using various kinetic models, isotherm models, and thermodynamics data, in conjunction with experimental factors. The team also studied the potency of the mentioned bioadsorbent by using it to purify synthetic textile effluent formulated by combining various dyes such as malachite green, methyl violet, methyl orange, rhodamine B along with methylene blue, and basic fuchsin and salts like NaCl, NH₄Cl. This testing aimed to validate the efficacy of the removal process under conditions mirroring real-world wastewater scenarios. The result showed perceptible performance of the bioadsorbent with a 57.38% removal percentage, demonstrating it as a highly efficient adsorbent suitable for practical applications in the treatment of textile wastewater. This approach not only mitigates

waste management issues but also aligns with eco-friendly practices, a conscientious solution that promotes both resource efficiency and environmental well-being.

Harnessing waste biomass for reuse not only effectively tackles waste disposal challenges but also exemplifies a commitment to environmental friendliness. This practice not only addresses waste management concerns but also aligns seamlessly with eco-friendly principles, showcasing a thoughtful and sustainable solution that fosters resource efficiency and environmental well-being. With detailed investigations and an analytical approach, Dr. Arundhuti Devi and her research team have achieved significant advancements in unraveling the intricate techniques that have proven to be exceptionally effective in purifying wastewater using the waste agricultural biomass via an economically and environmentally sustainable process.

Pictorial Representation

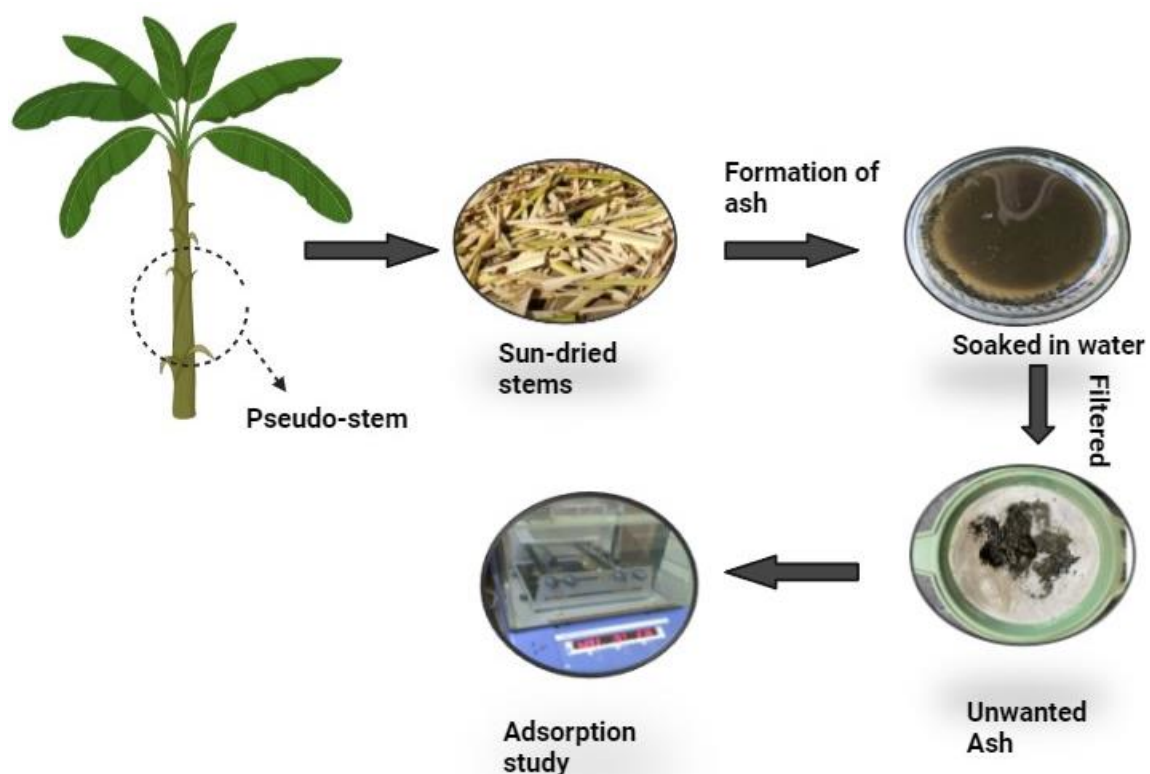


Fig 1-Illustrating the formation process of banana stem ash (BSA) during Kolakhar preparation

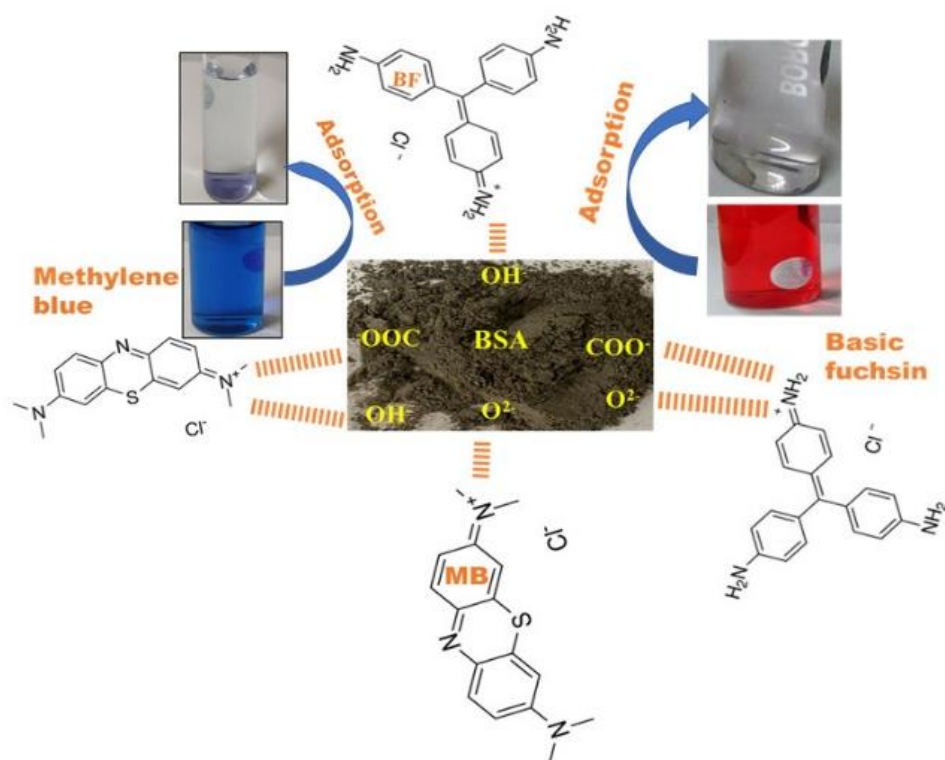


Fig 2- Removal of Methylene Blue (MB) and Basic Fuchsin (BF) with their potential mechanisms

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Crude oil: An Environmental Boon or Curse

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“Will you like to have coffee”, asked one of the seniors in my lab. Four of us went outside the institute in a small stall. “So, how is your paper coming up” asked another senior to which I replied, “Very very lengthy”. Everyone laughed except the newest member of the group. She just sat quietly and listened with a confused look on her face. Days passed and one fine morning she asked me “Baa, why did you say that day that your paper was lengthy?” I smiled and replied, “Because I have so much to report on one havoc of Assam that I don’t know where to stop”. Without a word, she stared at me and I just continued, “Have you seen an oilfield and its effects on the nearby areas? Have you seen crude oil just scattered everywhere?” She nodded no. “I have, and once you see it, it cannot be unseen” I continued. “It was like stepping into a nightmare when I first set foot in the Geleky oilfield of the Sibsagar district in upper Assam. Everywhere I looked, there was oil; staining the grass, polluting nearby ponds. There are tea gardens, agricultural rice fields, and muga cultivations nearby (Fig. 1). The sight prompted us to launch a monitoring survey, driven by the urgent need to assess the contamination levels and their potential impact on the local community. We also wanted to investigate whether plants in the vicinity were absorbing crude oil from the soil, a possibility that could have disastrous implications for those living in the area. We gathered samples of water, soil, plants, and sludge (Fig.1) from a wide radius around the oilfield and do you know what we found?”. Just then we were interrupted and we heard someone calling, “It’s 5.30. Aren’t you late to catch the bus?” She ran and luckily caught the Institute bus.

“Baa I was waiting for you”, I heard someone as soon as I reached the lab the next morning. It was her again. I asked what the matter was, to which she replied, “So, what did you find Baa? Did you find oil in those places? In the soil, water, plants? Do plants take up oil from the soil? Are we eating plants full of oil?” were some of the 100 questions lingering in her mind. To her surprise, my answer was “YES! There was oil present everywhere. The situation near the oilfields was terrible, with soil contamination extending even into people's homes. Water sources and ponds in the vicinity were polluted with oil as well. Analysis revealed alarming concentrations of heavy metals and petroleum hydrocarbons, beyond safe levels. This petroleum contamination has a tremendous effect on the environment causing water, soil, and air pollution, as well as a threat to wildlife. Heavy metals, known carcinogens, pose grave health risks, potentially leading to irreversible disorders after prolonged exposure. Human health effects ranged from cancer to respiratory and cardiovascular diseases, gastrointestinal issues, skin problems, and neurological complications. Petroleum hydrocarbons, on the other hand, are highly toxic and lethal substances, that also threaten both human and animal health. Their effects include haematotoxicity, carcinogenicity, genotoxicity, mutagenicity, immunotoxicity, and neurotoxicity. Metabolites of these hydrocarbons also act as potent endocrine disruptors, adversely impacting human reproductive development. In the samples analyzed, heavy metals like nickel, lead, iron, and arsenic exceeded permissible limits at most sites, while hydrocarbon concentrations were significantly elevated. Out of all, the most alarming concern was the discovery of an aromatic hydrocarbon derivative in one of the groundwater samples, with a concentration of 130.66 mg/L, far exceeding the safe threshold for drinking water of 1 mg/L, posing a threat to aquatic ecosystems and biotic species. Additionally, investigations into plant samples revealed the uptake of metal and hydro

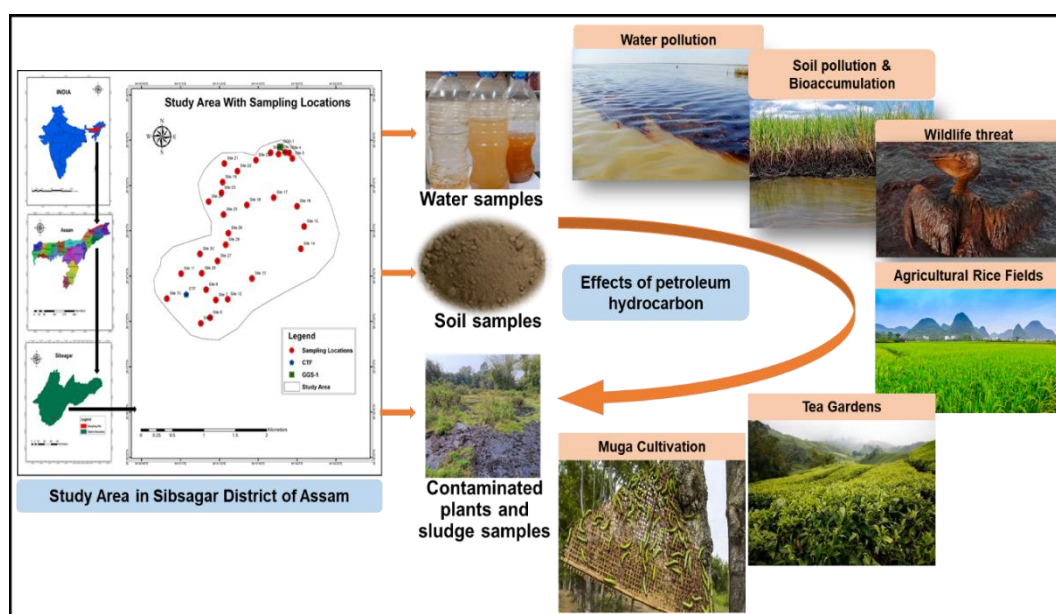


Fig. 1 Schematic representation of the study survey

carbon contaminants by six different plant species, namely, *Chromolaena odorata*, *Parthenium hysterophorus*, *Colocasia esculenta*, *Ageratum conyzoides*, *Leucas aspera*, and *Vernonia cinerea*, highlighting the widespread impact of pollution on local flora. Now can you see why I called it a havoc of Assam?" She gazed at me in stunned disbelief. "So, what is the solution to this havoc?", she asked with distress. "The solution lies in developing measures and strategies to protect the communities in those regions from this environmental threat. Our laboratory is actively researching various remediation techniques to combat such disasters, offering hope for both the environment and society."

"Ah, I see now," she murmured, "I've found my purpose too. I'll also try to find solutions for such petroleum contamination that will be beneficial for our society," she declared with newfound hope resonating in her words and determination lighting up her eyes.

Acknowledgments

The authors extend their sincere gratitude to the Director of the Institute of Advanced Study in Science and Technology (IASST), Guwahati under the Department of Science & Technology (DST), Government of India for the successful completion of the work. The authors would also like to express their appreciation to the Sophisticated Analytical Instrumentation Centre (SAIC), IASST for generously providing access to essential instrumental resources.

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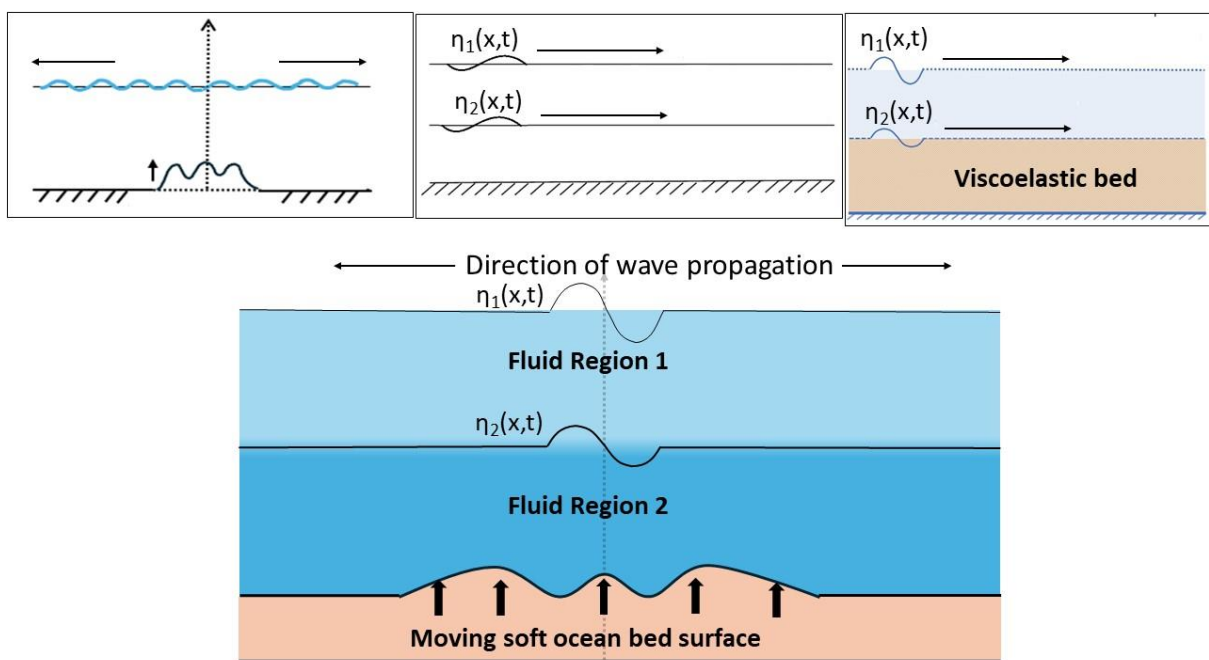
Tsunami waves: Multiple factors for comprehensive modeling

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Tsunamis are one of the most devastating natural disasters, and they can cause significant loss of life and property. These destructive waves are generated by large-scale disturbances, such as earthquakes, landslides, or volcanic eruptions, which displace a large volume of water in the ocean. Understanding the mathematical theory of tsunami wave generation is crucial for developing early warning systems and designing effective mitigation strategies. In particular, understanding and modelling the generation of surface ocean waves due to ocean floor movement is paramount. The devastating impact of tsunami waves on coastal areas has been witnessed throughout history; the recent one relevant to the Indian subcontinent is the 2004 Indian Ocean tsunami (Sumatra earthquake) that caused an estimated US\$ 13 billion in damage, 227,899 human casualties, and displacement of 1.7 million people. Appropriate modelling will enable us to accurately predict the tsunami arrival time, leading to an early warning system and preparation time for evasive measures to minimize potential damage. My research group at IASST is engaged in building mathematical theory incorporating (i) ocean water compressibility, (ii) density stratification and (iii) ocean floor softness that can better simulate the tsunami generation mechanism and subsequent transoceanic propagation (Fig. 1). These are a few important factors that require attention while building a mathematical



model for tsunami propagation. It is well known that the slight compressibility of ocean water triggers hydroacoustic waves, which

Fig. 1: Incorporation of ocean water compressibility, density stratification, and movement of soft ocean floor.

are highly influenced by gravity at low frequencies and lead to the generation of acoustic-gravity waves (AGW). These waves influence the propagation of tsunami waves, and their importance was established by a series of works by the group led by Prof. M. A. Nosov. The success of these works motivated researchers to look back at the theory of compressible ocean, which is well established in the literature through the works over the last 80 years. Detecting and analysing the AGWs plays a pivotal role in estimating the earthquake fault location, intensity, and tsunami wave arrival time. On the other hand, natural density stratification in the ocean, caused by variations in temperature and salinity, further complicates wave propagation. Under these conditions, the ocean becomes a non-homogeneous domain, requiring separate consideration of wave propagation within different layers (concept of a two-layered ocean structure), as first discussed by Stokes in 1857. This aspect remains deficiently understood and could prove to be a crucial connection.

Moreover, understanding how AGWs attenuate and dissipate is another crucial factor affecting their propagation in a softer ocean bed, such as one with properties similar to that of a viscoelastic medium. This knowledge could ultimately enable the measurement of AGW mode strength at any depth and provide insights into the size of potential tsunamis. Hence, it is imperative to closely study and understand these various factors in conjunction with one another to arrive at comprehensive conclusions, highlighting the critical importance of such investigations in tsunami research and early warning systems.

My international collaborative work on the factors of tsunami wave propagation mechanism is focussed on the impact of (i) bathymetry change due to submarine earthquake, (ii) sudden ocean depth change, and (iii) moving atmospheric pressure wavefront on tsunami wave (Fig. 2). Let us dive deep into each of these aspects to understand their significance in transoceanic tsunami propagation.

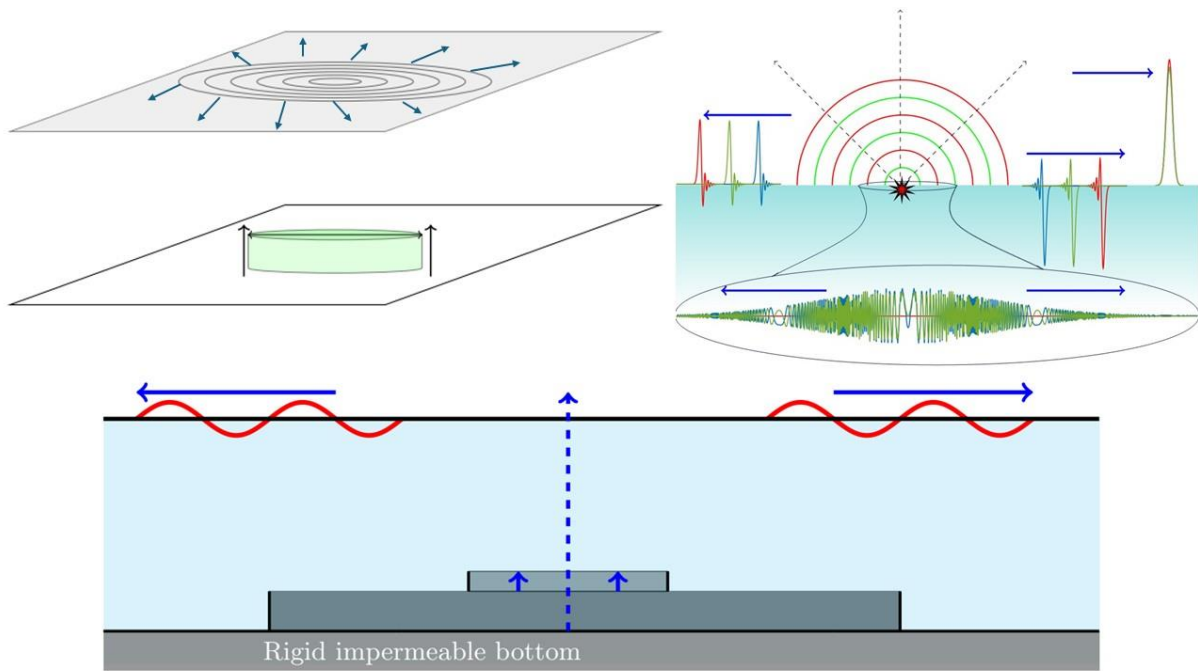


Fig. 2: Incorporation of arbitrary motion of circular ocean floor, moving atmospheric pressure front, and sudden depth change.

A bathymetry change is quite common after a submarine earthquake, and the process varies event-wise. For example, the 2004 Indian Ocean tsunami resulted from a moving fault under the ocean. A vertical uplifting of the seabed was observed in the 2011 Tohoku Oki earthquake, such that the displaced block had different heights at both ends. The rupture of numerous faults caused the 2016 Kaikoura earthquake. The 2018 Sulawesi earthquake resulted from strike-slip faulting, leading to a moving Palu-Koro fault. These bathymetry changes can be approximated with multiple moving circular patches, implying that a moving circular patch holds the key to a benchmark solution and the associated mathematical problem can be considered canonical.

Any changes in ocean floor bathymetry are associated with ocean water column depth variations, often influencing surface wave propagation, including transoceanic tsunami waves. These changes may occur slowly, allowing one to model the wave propagation using a mild-slope equation and its variants, or it could be abrupt, so the assumption of slowly spatially varying water depth stands invalid. The latter case primarily consists of oceanic plateaus equivalent to large flood basalt provinces existing underneath the ocean, creating a significantly thicker crust than the normal ocean crust, which is 6-7 km on average, and trenches with thinner crusts than the average, resulting from tectonic plates' geological movement. The discovery of such plateaus is relatively new (the term was coined by Kroenke in 1974) compared to trenches (initially discovered by Vening Meinesz circa 1930). However, significant progress has been made to locate numerous such topography over the years. A

surface wave generated by a submarine earthquake, underwater volcanic eruption, or landslides occurring near such sudden topography changes undergoes a significant evolution once it propagates across the sudden depth change. Such evolution results in variable impacts along the coastline, depending on how much energy is transported towards it. The devastation caused by a tsunami in coastal areas, financially or in terms of casualty, has been evident over the years. An appropriate mathematical model accounting for a sudden depth change near the submarine earthquake fault is key to accurate tsunami prediction.

As far as tsunami generation from a moving pressure front is concerned, it could be from a volcanic eruption or any other event similar in magnitude of meteorological origin, such as thunderstorms, atmospheric gravity waves, squalls, and frontal passages. The physical mechanism behind these meteorological phenomena is an abrupt change in the sea-surface atmospheric pressure leading to pressure wave propagation in the atmosphere. Nomitsu provided the maiden description of tsunamis triggered by atmospheric phenomena, whereas Defant coined the term. Even though the reported damages caused by meteotsunamis over the years are not as monstrous as a seismic tsunami, reports of million-dollar damage to boats and harbours worldwide are available. In addition, a similar wave height to the 2004 Indian Ocean tsunami was recorded at Freemantle, Western Australia, during a 2002 meteotsunami. The recent eruption of the Hunga Tonga-Hunga Ha'apai volcano (HTHH) in 2022 increased interest in meteotsunamis. The eruption was so violent that it generated a 58 Km high flume with an atmospheric pressure wave propagating at a speed of approximately 306-320 m/s, circling the globe for several days after the explosion.

The only two volcanos in India with historical or recent activity are Barren Island (active volcano) and Narcondam (dormant one) in the Andaman Islands. The risk of tsunami inundation from these is relatively low. However, any violent volcanic eruption, as destructive as the HTHH 2022 eruption, in the vicinity of the Indian coastline, might trigger tsunamigenic waves. A comprehensive atmospheric pressure-driven tsunami generation mechanism model can be utilized as an initial state to an existing computational model. The ongoing collaborative research successfully incorporated the impact of submarine earthquakes, including bathymetry change, sudden ocean depth change, and moving atmospheric pressure wavefront on tsunami waves using linearized water wave theory. The research shows intricate relationships among oceanic and atmospheric parameters on tsunami propagation. The proposed mathematical models are useful in testing different numerical models and simulations for their accuracy and can be provided as the initial conditions. Recent tsunami encounters point towards further efficacy of existing tsunami warning systems and improved mathematical models that can eloquently capture the physics behind tsunami generation mechanism and subsequent propagation.

Acknowledgment: SD acknowledges the Science and Engineering Research Board (SERB), Govt. of India, for SERB International Research Experience (SIRE) Fellowship (Sanction No. SIR/2022/000994) awarded to him, and IASST Guwahati for the in-house project (Sanction no. IASST/R\&D/PSD/IHP-15/2023-24/1214-1221).

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Wind Energy: A brief overview

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"I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that. I wish I had more years left!"

- Thomas Edison

Achieving net-zero emissions is one of the most significant tasks humans have to perform urgently to maintain a sustainable future and save the world before reaching the point of no return. Inevitably, the search for clean and renewable energy sources has begun. Consequently, we have various renewable energy sources such as bio, hydro, photovoltaic, wind, thermal (renewable), geothermal, tidal, etc. Among these, photovoltaic and wind energy are projected to be the leading ones, which will dominate the renewable energy sector in the future [1,2]. Interestingly, both photovoltaic and wind energy are fundamentally derived from the sun. So, looking at the parallel development of photovoltaic and wind energy sources is more desirable and sensible than comparing their micro and macro details. Here, we will primarily focus on wind energy sources.

With technological innovations and financial support, using renewable energy has become more affordable and practical than ever, and relying on renewable energy is estimated to contribute to half of the global energy mix by 2030 [2]. The world is on track for a temperature rise of 2.8 °C above preindustrial levels at the end of this century. Hence, an imminent deployment of renewables in electricity generation, heat production for buildings and industry, and transport is pivotal to maintaining the global temperature rise below 2 °C following the Paris Agreement [1,3]. This requires annual investments of 4-6 trillion US dollars (USD) as suggested by the 27th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP27) [3]. Currently, only the solar photovoltaic (PV) renewable energy technology is 'on track'; for all other renewable energy technologies, the status is 'more efforts needed'. Now coming to wind energy, as of 2022, the worldwide total wind energy generation stands at 902 GW, of which 93% is onshore, and 7% is offshore, with an annual capacity addition of 75 GW, which is expected to reach 350 GW by 2030 provided the annual generation growth rate is 17%, to get 'on track'. An outlook for renewable energy and wind energy is presented in Fig. 1.

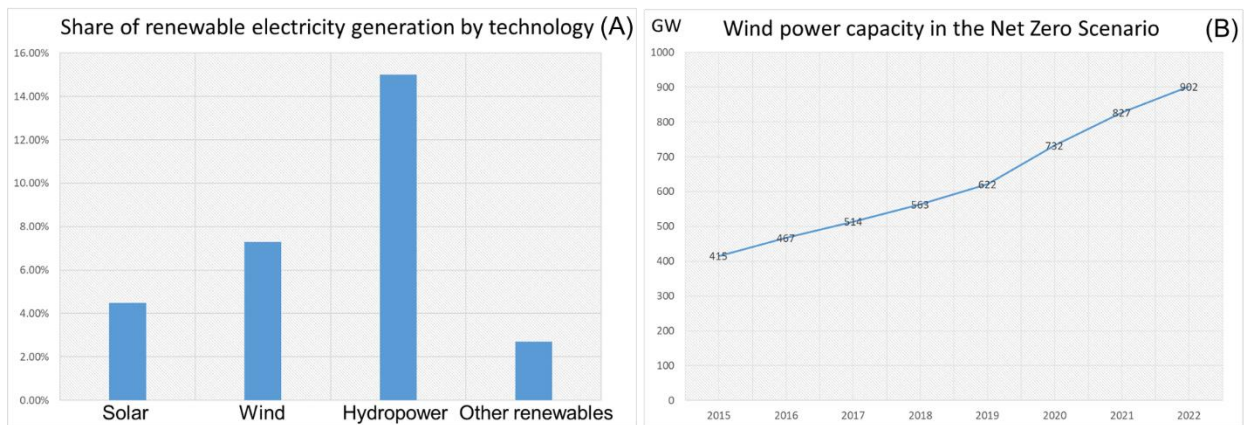


Fig. 1. Outlook for renewable energy. (A) Bar chart showing the share of renewable electricity generation by technology as of 2022. (B) Wind power capacity in the Net Zero Scenario (a normative scenario defining a way for realizing net zero CO₂ emission for the global energy sector by 2050, with advanced economies hitting the target in advance) from 2015 to 2022. Here, all data are collected from Ref. [1].

For this, the worldwide investment of USD 185 billion is reported, the second largest among the renewable energy technologies next to solar PV [4]. In India, an unprecedented advancement is also being observed, securing 4th place in overall renewable energy capacity globally, according to the International Renewable Energy Agency (IRENA). Since 2014, the total renewable energy production has increased 1.75 times from 190 TWh to 332 TWh, and the wind energy generation capacity has increased 2.18 times from 21 GW to 45.88 GW [5]. It is noteworthy to mention that, till now, wind energy has been mainly harvested using giant wind turbines. However, the installation and operation of those gigantic wind turbines face common challenges of institutional investment, trade-offs with agricultural, residential, and industrial lands; technological sophistication of maintaining the connection of large-scale power grids, costly transmission infrastructure, governmental restrictions regarding the specification of the wind turbines, and ecological impacts in terms of damages to the ecologically sensitive areas, harming birds and bats, and changing landscape.

Therefore, to harness the maximum benefits of wind energy, progress in various aspects such as engagement of more countries through inter-governmental collaboration and participation in global organizations, partnership building and project facilitation, policy-making and planning, technological advances and innovation, and socio-economic transition and investment, must be focused on [6]. Moreover, introducing alternative systems to the conventionally used wind turbine-based wind energy harvester, like triboelectric nanogenerator (TENG) and piezoelectric nanogenerator (PENG) based wind energy harvesters, can further expedite the process of achieving the target of net-zero emission, and can make wind energy a more common energy source and at our doorstep [7, 8].

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Long Queue...? Don't Worry, We've Got Your Back

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We've all been annoyed by waiting in line. It happens a lot in busy, modern communities. We experience waiting in various settings, including banks, airports, gas stations, automobile traffic, hospitals, telephone queues, computerized commercial systems, flexible manufacturing systems, production-to-order systems, inventory control, and whatnot. Whether we're stuck in traffic, on hold during a phone call, waiting in line at the store, grabbing a quick bite at a fast-food restaurant, or mailing a package at the post office, waiting is an inevitable part of our daily lives. Customers prefer to avoid waiting, and businesses don't either because it can lose them money. But why does waiting happen so much? The reason is straightforward: There's more demand for service than resources available. This could be due to various factors, like a staff shortage, financial constraints preventing optimal service levels, or physical space limitations. To determine the right amount of service to offer, we need to understand factors like how long customers are willing to wait and how many people will join the line.

The term "queue" originates from the German phrase "Warteschlange" and the French phrase "File de attente," signifying customers' desire for service at a service establishment. A queue represents a waiting line typically formed in front of a service facility due to irregular arrival or departure patterns or when demand for service surpasses availability. Queue formation, a social phenomenon, can be mutually beneficial when managed effectively for those waiting and those getting the service. A mathematical exploration of queues or waiting lines is called "Queueing Theory". Specifically, queueing theory, a subset of stochastic process or stochastic modeling, orchestrates service in an organized manner, capturing various common physical and biological phenomena. It furnishes essential insights to forecast several queueing characteristics, such as the average number of customers in the queue and system and the mean waiting time. Numerous researchers dedicate significant efforts to crafting mathematical models and formulating theories to analyze such systems' irregularities and statistical fluctuations, aiming to propose improved and better-organized facilities for management. A queueing system primarily comprises customers arriving for service at a service channel, waiting in a queue for service if necessary, and leaving the system after being served. Here, the term "customer" is inclusive and not limited to human customers; any entity requiring service is considered a customer.

Agner Krarup Erlang, a Danish mathematician, statistician, and engineer (January 1, 1878 - February 3, 1929), made significant contributions while working at the Copenhagen Telephone Exchange. Widely recognized as the father of queueing theory, Erlang invented traffic engineering and queueing theory, revolutionizing our understanding of service systems. His notable publications include "The Theory of Probabilities and Telephone Conversations" (1909), which demonstrated the applicability of the Poisson distribution to random telephone traffic, laying the foundation for queueing theory. Additionally, "Solution of Some Problems in the Theory of Probabilities of Significance in Automatic Telephone Exchange" (1917) introduced Erlang's classic formulae for call loss and waiting time, which are still used by telephone companies worldwide, including the British Post Office. Erlang also introduced the concept of statistical equilibrium, developed techniques for balancing state equations, and tackled optimization problems in queueing theory for the first time.

The topics investigated within queueing theory can be categorized as follows:

- Analyzing the stochastic behaviour of random variables and processes and evaluating related performance measures.
- Utilizing various solution methods such as exact, transform-based, algorithmic, asymptotic, numerical, and approximations to solve queueing models.
- Understanding the nature of solutions, including time-dependent and limiting behaviours.
- Controlling and designing queues to compare behaviour and performance under different scenarios, including queue disciplines, service rules, and strategies.
- Optimizing specific objective functions involving performance measures, associated cost functions, and other relevant factors.

To sufficiently explain queueing theory, it's essential to understand and discuss its basic characteristics. These include

1. **Input Pattern:** The arrival pattern in a service facility defines how customers enter and interact with the system. It includes whether arrivals are predictable or random, the time between successive arrivals, the total number of arrivals within a given period, and whether customers arrive individually or in groups. Additionally, it considers behaviours such as balking (refusing to join a long queue), reneging (leaving the queue after waiting), and jockeying (switching queues to potentially find faster service). Understanding these dynamics is essential for optimizing service systems and ensuring customer satisfaction.

2. Service pattern: Service pattern refers to how a server provides service to units arriving at a facility, typically represented by a random variable indicating the time needed to complete a service, known as the service rate. Units may be served individually or in groups by one or multiple servers operating in parallel or series. The time to complete a service, termed 'service time,' can be stationary or non-stationary over time and deterministic or stochastic. If stochastic, the distribution of service times must be specified.

3. Queue Discipline: Queue discipline outlines the rules governing how a queue forms and the order in which customers are chosen for service. It can be one of the following:

(a) First-in, first-out (FIFO), also known as first-come, first-served (FCFS).

(b) Last-in, first-out (LIFO), also known as last-come, first-served (LCFS).

(c) Service in random order (SIRO).

(d) Priority Service, where customers are served based on their assigned priorities (PR).

4. System Capacity: System capacity pertains to the maximum number of units that a service channel can accommodate, encompassing both those in the queue and those being served. When the capacity is reached, additional arrivals are permitted once space becomes available due to service completion. Systems can either accommodate an infinite number of customers, allowing any number at a given time, or a finite number only. In the case of finite capacity, it can be likened to force balking when the system size reaches its maximum limit.

5. Number of Service Channels: The number of service channels refers to the count of servers within the system. Depending on the service requirements, systems can feature either a single server or multiple servers organized in series, parallel, or hybrid configurations. With multiple servers, customers may join a single queue or opt for parallel queues corresponding to each channel. Typically, in parallel channels, service mechanisms are assumed to function independently.

6. Stages of service: A queueing system can consist of either a single service stage or multiple stages, known as a multistage queueing system, to fulfill a service. The number and nature of service stages can vary based on the specific model being considered.

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Synergistic Solutions: Harnessing Titanium and Plasma for Eco-Friendly Dye Degradation

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Dyes possess a great deal of industrial applicability, whether in textiles, printing, beverages, etc., due to their ability to selectively bind to specific molecules and structures. However, overuse and improper disposal management of dyes can lead to major environmental problems like water pollution, soil contamination, and human health [1]. The dyes from industrial processes often end up in water bodies, contaminating them. This pollution can harm aquatic life and disrupt ecosystems and agricultural practices. Some dyes contain chemicals that are harmful to human health, and their exposure to contaminated water, food, or air can lead to various health issues, including allergic reactions, skin irritation, and even cancer. Addressing these issues, we require developing eco-friendly treatment methods for dye-containing wastewater, and photocatalysis is one method utilized for degrading dyes.

Photocatalysis is the phenomenon whereby a semiconductor material (e.g. TiO_2 [2]) upon irradiation with light of energy greater than its bandgap energy leads to the production of electron-hole pairs (e^-h^+). These (e^-h^+) pairs result in radicals ($\bullet\text{OH}$, $\text{O}_2^{\bullet-}$ etc.) formation through the oxidation and reduction of water molecules present in the solution. The highly reactive radicals interact with the dye molecule and eventually break down the dye molecules into simpler compounds like water and carbon dioxide. A schematic representation of the photocatalytic mechanism for the degradation of dye solution is shown in Fig. 1. A photocatalyst can be in the form of powder, thin films, nanoparticles (suspended in a solvent), etc., with each having its own merits and demerits. Although powder and nanoparticle forms of the photocatalyst offer faster degradation of the dye present in the wastewater, they have certain limitations. Thin film photocatalysts offer several advantages over their powder and nanoparticle counterparts, such as enhanced surface area, improved stability, ease of handling, reduced agglomeration, longevity, reusability, and better flexibility and scalability [3]. Overall, the

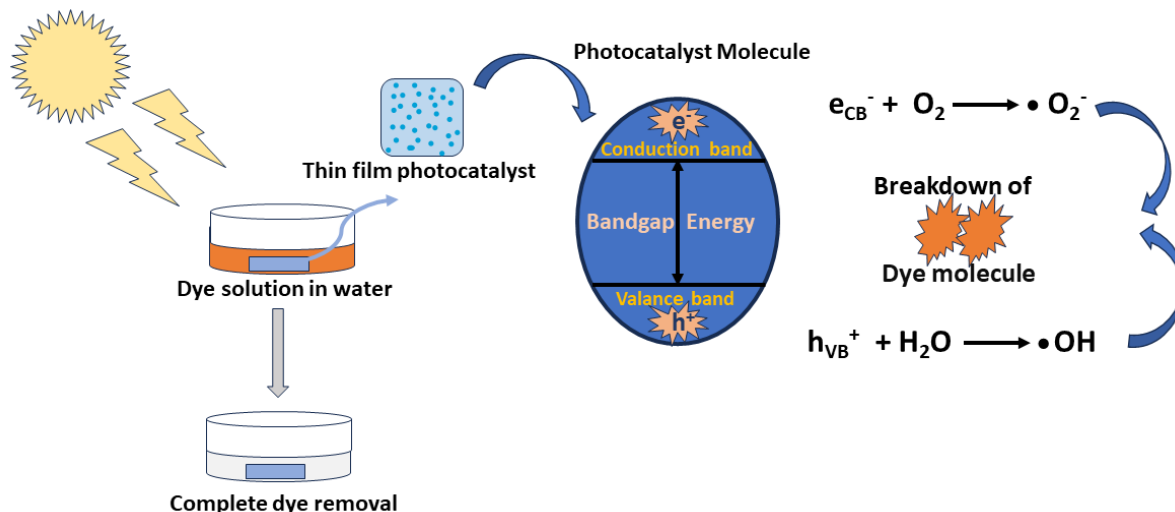


Fig 1. Schematic representation of the photocatalytic mechanism for degradation of dye solution

advantages of thin-film photocatalysts make them a promising choice for efficient and sustainable degradation of dyes present in wastewater.

With every photocatalyst, a region in the natural solar spectrum exists where the photocatalyst is active, i.e., (e^-h^+) pairs are formed. In the case of titanium dioxide (TiO_2), this region lies in the near UV region of the natural solar spectrum. This poses a problem, as only 5% of the natural light from the sun is in the UV region. The solution to this problem can be overcome by modifying the thin films using various methods, which results in the reduction of the bandgap and also leads to enhancement in its surface properties. Various approaches have ensured such enhancement by doping the photocatalyst with various metallic/non-metallic elements, introducing vacancies and defect states in the bandgap (leading to reduced bandgap energy), and surface modification by various treatment methods [4].

Plasma treatment is one method by which we achieve surface modification and reduce bandgap energy [5,6]. In plasma treatment, the plasma generated is used as a medium to introduce such defect states in the bandgap of the thin films, thereby enhancing photocatalytic activity. With the bandgap energy reduced, the formation of (e^-h^+) pairs occurs in the visible light region (45%) of the natural solar irradiation. Furthermore, this approach can be scaled up for industrial applications, making it a viable solution for addressing dye pollution in various sectors.

Overall, the synergistic effect of titanium-based compound films and plasma treatment holds great promise for efficient and sustainable dye degradation, preserving environmental quality and human health.

Acknowledgment:

Authors would like to acknowledge Institute of Advanced Study in Science and Technology (IASST), Guwahati, India for the research grant of in-house project [Project Sanction No: IASST/R&D/PSD/IHP/2023-24/1231-1239 dated 01/05/2023] .

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Zonal Flow: An Astonishing Thrust towards Improved Plasma Confinement in Fusion Reactors

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Nuclear fusion energy is a promising alternative to traditional energy sources, as it provides a safer, sustainable, and copious source of energy. Fusion reactions occur naturally in the sun and stars, where light-weight atoms fuse to form heavier ones, releasing an enormous amount of energy. Scientists have been working on reproducing fusion in the laboratory in a controlled manner for decades, and nowadays, research has advanced to a crucial point where scientists are constructing experimental reactors, *i.e.*, tokamak, stellarator etc., that eventually may demonstrate that fusion reactors can be utilized for commercial purposes to produce electricity. Poor plasma confinement is one of the dead ends in the commercialization of fusion reactors.

Plasma, the fourth state of matter, is an electrically conducting gaseous medium containing roughly equal numbers of positively and negatively charged particles and are produced when the atoms in a gas become ionized. Plasma is distinct from other states of matter (solid, liquid, and gas) because of electric and magnetic forces present between the charged particles in plasma, alongside forces like gravity that affect all forms of matter. Moreover, due to the long-range behaviour of electromagnetic forces, plasma acts collectively, just like a fluid. Surprisingly, almost 99% of our known universe exists in the plasma state, from the sun and other stars to interstellar space.

Being consists of ions and electrons, it is the natural tendency that plasma particles recombine and form neutral gas in the normal temperature of our earth. The term "plasma confinement" describes the process of confining plasma using a variety of forces at the critical conditions required for thermonuclear fusion. These circumstances are found in stars naturally, where plasma is sustained by the force of gravity due to the enormous mass of the stars. In fusion devices like tokamak or stellarator, a strong magnetic field is generally utilized to confine the plasma.

Several waves and instabilities, generally, are present in the plasma, which enhance the anomalous cross-field diffusion in plasma, causing degradation in plasma confinement. One of the advantageous ways to curb low-frequency turbulence is zonal flow. In plasma physics, zonal flows [1] are a fascinating and crucial phenomenon observed in various natural and

laboratory systems, from the Jovian belts (alternating zones of light and dark-colored belts on outer planets, namely, Jupiter, Saturn, Uranus, and Neptune) and Venusian atmosphere to terrestrial atmospheric jet streams and even in the solar dynamo mechanism and solar tacholone region. In the context of fusion plasma, zonal flows refer to azimuthally symmetric band-like shear flows within a constant magnetic surface and localized in their radial extent (see Fig. 1). Inhomogeneity in plasma parameters (i.e., density and temperature gradients) generates instability and turbulence, eventually enhancing plasma transport. Like the protagonist of Shakespearean tragedy, such type of turbulence carries the seed of its own destruction. The low-frequency turbulence transfers the required energy in the formation of zonal flows. Additionally, the zonal flows react to turbulence through shearing and wave trappings. This back reaction further works as a reduction of turbulence. Due to its symmetric nature, zonal flows prohibit radial or cross-field transport. Consequently, the anomalous transport is reduced by increasing the zonal flow fraction in the turbulence. In this way, zonal flows can play a crucial role in the self-organization of plasmas and improved magnetic confinement. Furthermore, due to the presence of zonal flows in planetary atmospheres and solar winds, studying zonal flows in these contexts helps understand atmospheric dynamics, climate patterns, and solar activity.

However, the theoretical study of zonal flow started in the 1970s. The existence of zonal flow in the core region of TFTR tokamak was confirmed using spectral analysis by Levington *et al.* [2] in the late 90s. The coupling between turbulence and zonal flows was experimentally confirmed in the first decade of the 21st century. In the case of the experimental study of ZFs, the main challenges come to ensure sensing long correlation length in the azimuthal direction along with fast radial variation. Therefore, we need highly spatial and temporal resolved measurement systems. Due to high heat flux in fusion devices, material probes cannot be used in the core region of tokamak, making such studies challenging. Furthermore, experimental investigation of zonal flows with external control is challenging in tokamak-like devices due to their complex geometry. That's why the best opportunity for experimental study of zonal flows lies in linear device regimes. The pioneer groups for zonal flow study in linear devices are Holland *et al.* (University of California, USA) [3], Sokolov *et al.* (Columbia University, NY, USA) [4], and Itoh *et al.* (Kyushu University, Japan) [5]. Scientists of the Institute of Advanced Study in Science and Technology (IASST), Guwahati headed by Dr. Subir Biswas, in collaboration with the scientists from the Institute for Plasma Research (IPR), Gandhinagar, are also working to build a linear plasma device suitable for zonal flow study (see Fig. 2)

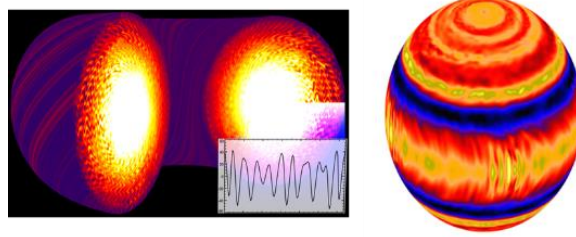


Fig 1. Simulated depiction of zonal flow in tokamak-like plasmas as well as Bands of zonal flow velocity in Jovian turbulence [ref: <http://www.ipp.mpg.de/4171847/zfsftp/>]

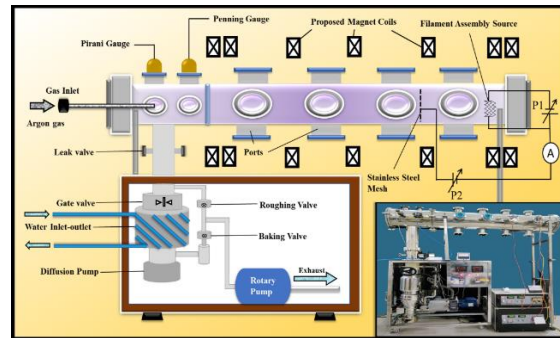


Fig 2. Schematic diagram of linear plasma device at IASST, Guwahati. The snapshot of the device is in the present state in the inset.

The study of zonal flows has a profound impact on astronomical plasmas as well as on fusion research, particularly in the context of magnetic confinement and eventual particle and energy loss in fusion experiments. The study of zonal flows is a rich and complex field, with many exciting discoveries and insights still to be made.

Acknowledgment:

The authors would like to acknowledge Board of Research in Nuclear Sciences (BRNS), Department of Atomic Energy (DAE), Government of India for the research grant (project sanction no. 57/14/01/2021 dated 14/06/2021).

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Detection of accelerated electron group in a fireball assisted double layer produced via DC discharge plasma

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Plasma, often called the "fourth state of matter," is a unique state in which gas particles become ionized, forming a hot, electrically charged mixture of ions and free electrons. In astrophysics, plasma plays a crucial role in the dynamics of stars, galaxies, and interstellar space, influencing phenomena such as solar flares and cosmic ray propagation. Plasma's applications extend to propulsion systems, where ion thrusters utilize the accelerated ions to generate thrust efficiently in space exploration. In fusion research, plasma confinement is central to achieving controlled nuclear fusion reactions, holding the key to sustainable and clean energy production. Moreover, plasma finds application in medicine, specifically in plasma medicine, where ionized gas is used for sterilization, wound healing, and cancer treatment. The versatile nature of plasma makes it a fascinating and invaluable component across various scientific disciplines, contributing to advancements in our understanding of the cosmos, space exploration, energy generation, and healthcare.

One of the important phenomena in plasma is a double layer structure. It refers to a space charge region where two distinct plasmas with different properties meet. These layers are characterized by a sharp change in electric potential, creating a strong electric field. Commonly found in celestial bodies' magnetospheres or in interstellar space, these double layers play a crucial role in energy transfer and particle acceleration processes. Studying plasma double layers enhances our understanding of astrophysical phenomena, including solar flares, auroras, and the dynamics of cosmic plasma environments [1,2].

In laboratory settings, double layers are harnessed for advanced propulsion systems and high-energy experiments. Additionally, their relevance extends to industrial applications, including semiconductor processing and materials synthesis. Understanding and manipulating plasma double layers offer promising avenues for advancements in both fundamental research and technological innovation [3,4].

Plasma Physics research group of IASST recently executed an experiment focusing on the formation of a plasma double layer within a DC discharge plasma. This double layer manifests near the boundary of a fireball, a complex discharge phenomenon that has garnered significant attention over the past two decades due to its diverse applications. A fireball as

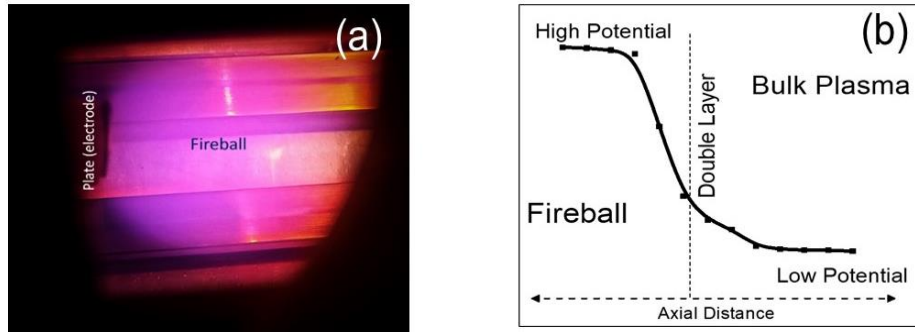


Fig 2: (a) Image of the fireball produced in IASST basic plasma laboratory, and (b) electrical potential structure near double layer region.

seen in Fig. 1 (a) is a discharge phenomenon observed in the vicinity of an electrode biased at a far higher positive potential within a plasma. The fireball zone (*higher potential side*) is separated from the bulk plasma (*lower potential side*) by a double layer as shown in Fig. 1(b). Our experiment revealed the presence of two electron populations: one comprises low-energy trapped electrons situated upstream of the double layer, while the other consists of higher-energy electrons accelerated by the double layer potential. Similar particle populations and acceleration phenomena are commonly observed in auroral plasma and other analogous astrophysical environments. This work has been published in the journal *Physics Letters A*, Vol. 498, No. 129335 [5].

Acknowledgment:

Authors would like to acknowledge Prof. Arup Ratan Pal, Physical Science Division, Institute of Advanced Study in Science and Technology, Guwahati, Assam for the fruitful discussion on the research work.

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The symphony of a particle like wave called Solitons

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A wave is a disturbance that propagates through a medium, transferring energy from one point to another. They are more than just a natural spectacle, rather they are the underlying fabric of our entire universe. Waves exhibit a variety of forms, and their behavior is dictated by parameters such as amplitude, wavelength, frequency, and velocity. While we encounter many different types of waves in our regular lives, a fascinating wave that has been successful in captivating human imagination for a long period of time is a Solitary wave. This wave which has been observed in various fields ranging from fluids and plasmas to solid-state, chemical, biological, and geological systems has a very intriguing property; it can propagate through a medium without any change in its shape and at a constant velocity. This particular class of waves possesses another distinctive characteristic: when colliding with another solitary wave, it can maintain its original shape and velocity. This unique particle-like property leads to them being referred to as solitons, as the suffix "on" in physics is frequently used to denote particles, a common example of it being that of "photon" which can be defined as a tiny particle or packet of light.

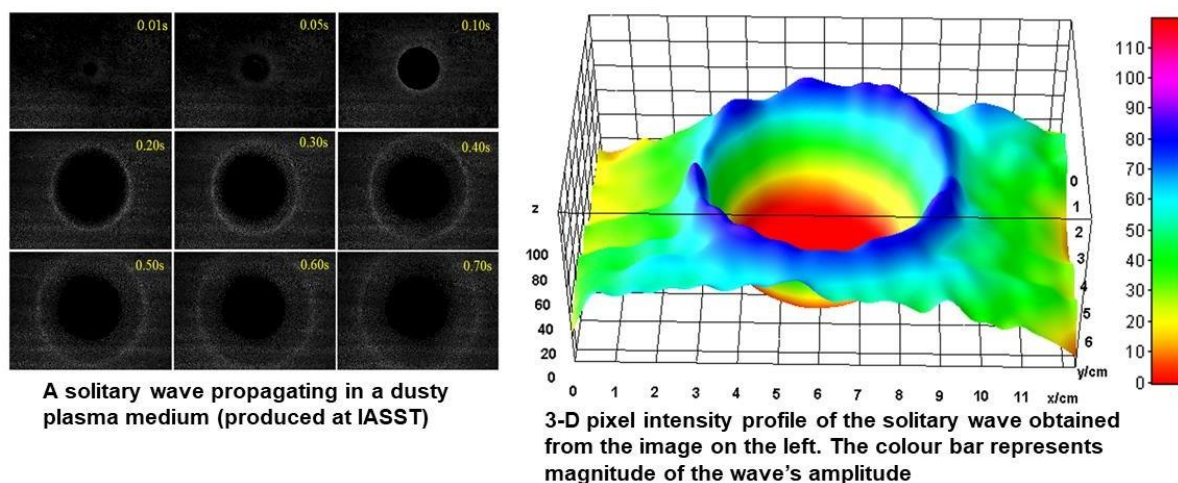
Solitary waves were first observed in water almost 200 years back by a Scottish civil engineer, naval architect, and shipbuilder, John Scott Russell, in 1834. He observed these waves traveling down the Scottish channel while conducting experiments to determine the most efficient design for canal boats. These waves have since been observed in various physical systems, including fluids, optics, plasmas, and more. These long-standing waves are born from the delicate dance between nonlinearity and dispersion and emerge as self-sustaining entities, gracefully moving through space and time. The nonlinearity prevents the wave from spreading out, while dispersion tends to disperse the wave. The combination of these effects allows for forming a stable, localized structure.

The enchanting elegance of the solitary waves is explained using complex mathematical language. In this regard, the nonlinear partial differential equations are mostly used, notably the renowned Korteweg–de Vries and nonlinear Schrödinger equations. These equations provide a window into the intricate mathematical foundations that govern solitons. Solitary waves are, however, not confined to the realm of theoretical physics and mathematics; instead, they weave their magic across diverse fields. In telecommunications, solitons play a

crucial role in optical fiber communication. This is because their ability to maintain their shape over long distances makes them ideal for transmitting information without distortion.

One will find solitons performing in nature's grand theatre when stepping outside the laboratory. From certain atmospheric waves to the rhythmic pulse of ocean waves, these solitary dancers leave their mark on Earth's ever-changing landscapes. Solitons showcase their elegance even in the intricate pathways of biological systems, such as nerve impulses. Plasma physicists have also discovered the presence of solar waves in multicomponent, dusty plasmas, adding a cosmic touch to their repertoire. These waves, undeterred by the complexities of charged dust particles, exhibit a dance that mirrors the cosmic ballet seen in planetary rings and cometary tails.

While we revel in the marvels of solitary waves, challenges persist in fully understanding their dynamics in complex systems. Ongoing research seeks to unravel the mysteries surrounding these waves, forever pushing the boundaries of our knowledge and opening up new avenues for exploration.



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The Ocean of Clean Energy: Nuclear Fusion

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Humanity has looked towards the sky with curiosity for millennia, mesmerized by the blazing sphere that sustains life on Earth. The complete mystery of the Sun's boundless energy remained elusive until 1921, when Arthur Eddington proposed that the source of stellar power lay in the fusion of hydrogen into helium. After this revelation, a team of visionary minds started thinking about building a miniature Sun here on Earth, a nuclear fusion reactor. They recognized the potential for near-limitless clean energy production, depending upon our ability to control it successfully. The concept of replicating the process that fuels the stars is elegantly simple. It just involves the fusion of atomic nuclei. Unlike nuclear fission, which involves splitting of heavy atoms, fusion unites light atoms like hydrogen isotopes deuterium and tritium, yielding far more energy with minimal radioactive waste. This boundless sea of energy holds the promise of an almost limitless power source that is safe, sustainable, and environmentally friendly.

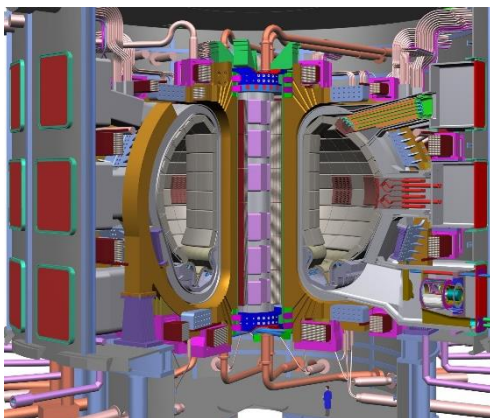
The journey, however, is filled with challenges. Recreating the Sun's environment here on Earth is a challenging task. It involves extreme conditions such as a high temperature of around 150 million degrees Celsius, which is more than the temperature of the Sun itself, and immense pressure to confine the hot, reactive plasma. This problem is now addressed through a donut-shaped magnetic confinement device known as tokamak. The tokamak holds the superheated plasma suspended within the vessel with the help of powerful superconducting magnets, preventing it from coming into contact with the walls.

The efficacy of a fusion reactor is commonly assessed through its fusion energy gain factor Q , which measures how much energy it produces compared to how much energy it takes to operate. A Q value of 1 signifies equilibrium, where the power generated by fusion reactions matches the input heating power. Ideally, a commercially viable fusion reactor should achieve a Q value of at least 5. For over two decades since 1997, the Joint European Torus (JET) in the UK held the record with a Q value of 0.67. In December 2022, the National Ignition Facility (NIF, US) reached $Q = 1.54$, which remains the record as of 2023. Despite these modest achievements, they seed optimism among scientists, offering valuable insights into the challenges that need to be addressed. Pushing the boundaries of fusion research, ITER (meaning 'the way') is the largest globally collaborated fusion reactor under construction in France. ITER is designed to achieve a ten-fold return on power in its plasma ($Q=10$), generating 500 MW of fusion power from 50 MW of input heating power. As a research reactor,

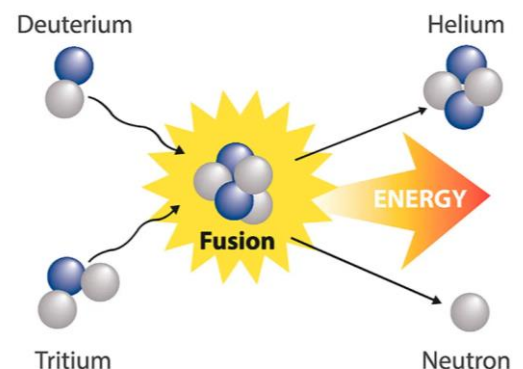
the heat energy produced will not be converted to electricity but will be vented. ITER's primary objective is to close the divide between the current generation of smaller experimental fusion devices and the envisioned future fusion power plants. This initiative enables scientists to examine plasma under conditions analogous to those anticipated in forthcoming power plants and evaluate various technologies, including heating, diagnostics, cryogenics, control mechanisms, and remote maintenance.

The road to commercial fusion power is long. Challenges of controlling instabilities within the plasma, developing efficient methods for fueling and extracting energy, and ensuring the materials can withstand the harsh environment remain. However, with each experiment, scientists are making significant progress.

The Sun might be out of reach, but the fire it ignites can be replicated here on Earth. It will illuminate a brighter future for generations to come through the promise of a world powered by clean, abundant energy, freeing us from the shackles of fossil fuels and their detrimental effects on the environment. It will open doors to energy independence and a future where energy scarcity is a relic of the past.



Crosssectional view of the world's largest tokamak, ITER.



Schematic diagram of the fusion process.

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2D nanomaterials for future advanced devices

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Transistors have become an inseparable asset of modern civilization, enabling the development of a wide range of electronic devices and technologies. In 1947 John Bardeen, Walter Brattain, and William Shockley of Bell Labs first invented the transistor. Fifty years ago, as predicted by Gordon Moore, that the number of transistors (components) on a chip would be doubled every couple of years [1]. Hence the miniaturization of the silicon (Si) based metal oxide semiconductor field effect transistor (MOSFET) has been made possible by notable advancements. However, how extensively Si -based transistors can be scaled down to increase the number of transistors in a chip becomes a challenge. Currently, Samsung is offering a 3 nanometer (nm) gate all round FET (GAA FET). Apple Corporation employed 3 nm transistor technology in its A17 Pro and M3 series chips. The minimum system sizes achievable with current silicon semiconductor technology are reaching their limit. The problem arises in further scaling down the silicon sheet thickness to the required value, which increases the charge scattering at the interfaces and decreases the carrier mobility within the channels, due to this the performance of the device reduces [2]. To overcome these, researchers have focused on two-dimensional (2D) semiconductors of thickness below 1 nm with superior carrier mobility for the past 15 years. 2D semiconductors are atomically thin, they are self-passivated, and their charge carrier mobility is independent of surface scattering. Therefore, mobility is large at the atomic thickness limit, unlike Si nanosheets [2],[3]. This distinct behavior enables real scaling for several technologies and strongly motivates the semiconductor industry to finally consider replacing silicon-based transistors with 2D materials.

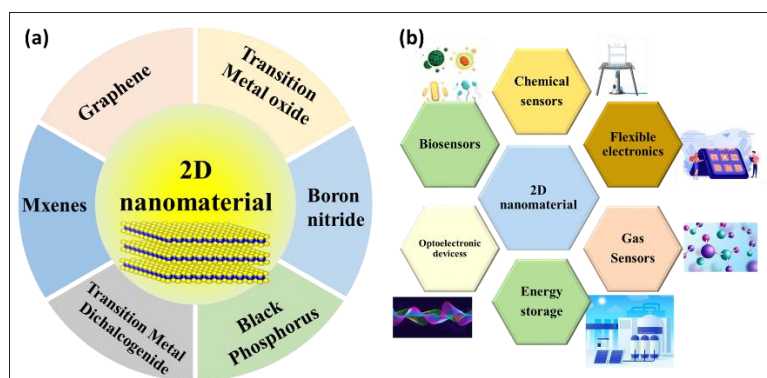


Fig 1: (a) Some common 2D nanomaterials; (b) several applications of 2D nanomaterials

2D nanomaterials are atomically thin layered structures where layers are held together by intralayer covalent and interlayer van der Waals bonding. These unique bonding structure contributes to their exceptional properties and versatility. They have unique properties like distinct surface chemistry, high surface to volume ratio, and quantum size effect [2][3]. The first 2D nanomaterial, graphene was discovered in 2004 by Andre Geim and Konstantin Novoselov [4]. Graphene is a monolayer layer of carbon atoms packed in a hexagonal lattice. Apart from graphene, researchers have shown a great deal of interest in other 2D nanomaterials, such as hexagonal boron nitride, graphitic carbon nitride, black phosphorous, transition metal dichalcogenides (TMDs), Mxene etc [2][3][5]. Although graphene is widely studied in 2D nanomaterials due to its excellent electrical, thermal, and mechanical properties, it does not have a distinct band gap, making it unsuitable for digital electronic applications.

Fig 1 (a) represents some of the commonly studied 2D nanomaterials, and (b) represents the various applications of these 2D nanomaterials. Among them, the most studied 2D nanomaterial among TMDs is molybdenum disulfide (MoS_2), where the band gap varies with the layer thickness. The monolayer MoS_2 is a direct band gap semiconductor [6], which makes it suitable for optoelectronic devices that can generate, detect, interact with, or control light. It includes solar cells, lasers, LEDs, photodetectors, and displays [6]. The ability of light absorption and emission is greatly influenced by the electronic band structure of 2D nanomaterials. As single-layer TMDs are primarily direct band gap semiconductors, they can absorb the photon whose energy is greater than its bandgap; hence, they are of great interest for application in flexible and transparent optoelectronics. Owing to TMDs' comparatively high earth abundance and bandgap in the visible range, they could be utilized in thin film solar cell as an alternative light-absorbing material. Additionally, they can be applied as flexible photovoltaics to cover curved and architectural structures. They can be used for flexible electronic devices combined with other 2D materials, such as conducting graphene and insulating boron nitride [2].

As 2D nanomaterials have a large surface-to-volume ratio, they are very sensitive to changes in their surroundings. Any particle or molecule capable of adsorbing or chemically absorbing to its surface may induce a change in electronic properties like resistance and, thus, current [6]. Thus TMDs can be used for chemical and gas sensing. Owing to the large surface-to-volume ratio, the surface is efficiently functionalized with biomolecules, and these

biomolecules can selectively capture the target molecule, enabling high specific detection of biomolecules.

2D nanomaterials also show memristive behavior, which means that resistance can be changed based on the history of applied voltage and current. This property has potential applications as memory devices in quantum computing and physical neural networks [2][6]. Research has been going on in the application of 2D based memristive devices for neuromorphic computing, which mimics the structure and architecture of the human brain using electronic circuits.

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Illuminating Data: Florence Nightingale's Journey from the 'Lady with the Lamp' to Statistical Pioneer

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Florence Nightingale, renowned as the "Lady with the Lamp," is often celebrated for her groundbreaking work in nursing during the Crimean War. However, her contributions extend far beyond the confines of the hospital ward. Nightingale's lesser-known but equally significant role as a pioneering statistician revolutionized the way we understand and interpret data. Through her innovative use of graphical representation, particularly the creation of the rose diagram, Nightingale transformed complex statistics into accessible and actionable insights, leaving an indelible mark on the field of public health.



Born on May 12, 1820, in Florence, Italy, Nightingale enjoyed a privileged upbringing within a prominent British family. Upon their return to England in 1821, the Nightingale household was situated across two residences: Lea Hurst in Derbyshire served as their summer abode, while Embley in Hampshire was their winter retreat. Raised in affluence, Florence received her education through home schooling under her father's guidance and was groomed for early marriage as per societal expectations. During her teenage years, Nightingale perceived a divine "calling" urging her to aid the impoverished and the ailing. Undeterred by the prevailing norms, she pursued her calling with unwavering determination, eventually receiving formal training in nursing against her family's wishes.

Nightingale's pivotal moment she has arrived with the outbreak of the Crimean War in 1854. Appalled by the appalling conditions faced by wounded soldiers in military hospitals, Nightingale resolved to make a difference. Accompanied by a cadre of nurses, she undertook a mission to enhance sanitation, hygiene, and patient welfare, earning the nickname "the Lady with the Lamp" for her nightly vigil and care among the wounded. However, it was during her time in the Crimea that Nightingale's analytical mind began to intersect with her passion for

healthcare. Faced with staggering mortality rates among soldiers, Nightingale recognized the urgent need for a systematic approach to understanding and addressing the underlying causes[1]. She utilized her expertise in mathematics and statistics to thoroughly analyze the data. She meticulously documented instances of disease and mortality, employing a rigorous approach to her investigation.

Nightingale's keen observational skills and analytical prowess soon revealed a disturbing truth: the majority of soldier deaths were not due to battlefield injuries but rather to preventable diseases like typhoid and cholera, exacerbated by unsanitary conditions in the hospitals. Armed with this insight, Nightingale set out to enact meaningful change, advocating for reforms in hospital sanitation and administration.

Yet, Nightingale faced a formidable challenge in conveying the gravity of the situation to policymakers and the public. Traditional tabular presentations of data proved ineffective in capturing the attention and understanding of her audience. Undeterred, Nightingale turned to a novel approach: graphical representation.

In 1857, Nightingale unveiled her **new-iconic rose diagram** [Figure 1], a groundbreaking visual tool that depicted the monthly mortality rates of soldiers in the Crimea. Consisting of a series of concentric circles divided into segments, each representing a month of the year, the diagram vividly illustrated the stark contrast between deaths due to preventable diseases and those from wounds sustained in battle. The visual impact was immediate and profound, compelling viewers to confront the human cost of inadequate healthcare practices.

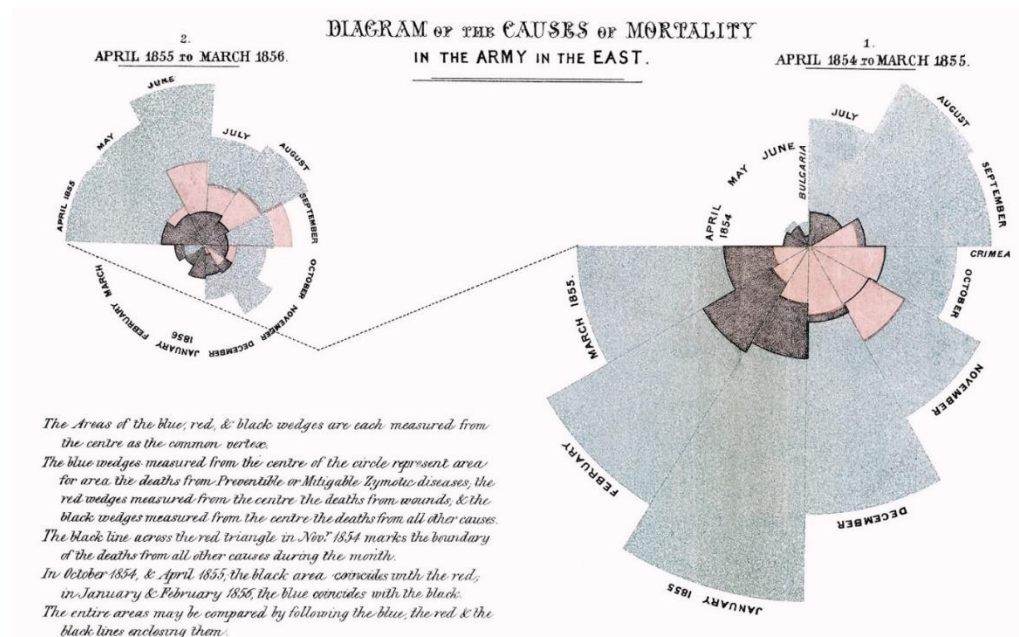


Figure 1: Detail from Nightingale's "Diagram of the Causes of Mortality in the Army of the East".Source: <https://www.sciencelearn.org.nz/images/4288-causes-of-mortality-in-the-army-in-the-east>

The rose diagram was more than just a compelling visual[2]; it was a weapon of statistical persuasion. Unlike traditional tabular presentations, the diagram offered a clear and immediate comparison. It was a catalyst for change. With Nightingale's persuasive evidence, policymakers were spurred into action, implementing widespread reforms to improve hospital conditions and reduce mortality rates. Nightingale's advocacy laid the groundwork for modern public health practices, emphasizing the importance of data-driven decision-making and the power of visual storytelling.

Beyond her contributions to nursing and statistics, Nightingale's legacy endures as a testament to the enduring power of dedication, compassion, and innovation in the face of adversity. Her tireless efforts to improve the lives of others, both on and off the battlefield, serve as an inspiration to generations of healthcare professionals and statisticians alike.

Florence Nightingale's journey from the Lady with the Lamp to statistical pioneer encapsulates the intersection of passion, intellect, and social responsibility. Through her pioneering work in graphical representation, Nightingale not only transformed the way we understand healthcare data but also paved the way for a more equitable and compassionate approach to public health[3]. As we continue to grapple with complex challenges in healthcare and beyond, Nightingale's example serves as a guiding light, illuminating the path toward a healthier, more just society. In an era marked by ongoing healthcare challenges, Nightingale's example continues to serve as a beacon, guiding us toward a healthier and more just society[4].

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Iteroselectivity – The Hidden Chapter

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'Oh! What was that? One of the snakes had seized hold of its tail' probably this could have been the reaction to the surprising 'Benzene' dream that occurred to Friedrich August Kekule, which led to the discovery of the organic structural theory of tetravalency and self-linking of carbon in the year 1858-1859 along with Archibald Scott Couper. This was one of the leading stepping stones that helped organic chemistry emerge from the grasp of 'vital force' to the hands of human intelligence. The structural theory's impact was such that more than twenty well-known reactions were discovered in the second half of the 19th century. The discovery of structural theory and the tempo it followed have given the thrust for chemo, regio, and stereochemical theories for reactions to emerge over time in due course. It marked the beginning of the 'Selective' era in organic chemistry.

Chemoselectivity deals with the reactivity of functional groups, regio with the reactive sites, and stereo with the 3D spatial arrangements of atoms. The trinity of selectivity ruled the organic reaction pathways for centuries, but scientists started to realize something was missing in the selectivity theory. There must have been some other concept, along with the trinity of selectivity, which led to the formation of product molecules. Now consider a hydrocarbon chain with a long string of carbon-carbon bonds. Each carbon atom is a potential reactive site ready to undergo chemical transformation if given the reaction condition. The selectivity that allows chemists to control the number of these sites to transform sequentially is different from the chemo, regio, and stereoselectivity, and these theories will also not fit if we want a particular reaction to occur twice on a polyfunctionalized substrate. This is entirely different from the pre-existing selectivity theories. It was one concept that was not completely aligned with either of the chemo, regio, or stereochemical aspects of a reaction.

*"Let us learn to dream,
gentleman, then perhaps
we shall find the truth"*

- Friedrich August Kekule'

The breakthrough happened when a team of scientists, Roy Lavendomme, Axel Leroy, Michel Luhmer, and Ivan Jabin from the Department of Chemistry, Université Libre de Bruxelles (ULB), Belgium, termed the concept its name 'Iteroselectivity' in the year 2014.

Further, it was conceptualized by Lavendomme and Ivan in 2022. Iteroselectivity can be defined as the selectivity that dictates the number of repeating transformations that can happen or occur on a precursor molecule containing similar identical reactive sites or when the reactive sites can be regenerated. It is completely different from sequential reactions since sequence-based reactions occur by controlled methods of providing inputs to the reactant molecules such as adding protecting groups for a reaction to occur on a site and then deprotecting the group to further proceed according to the reaction needs. The number of times a functional group will attach to a reactant species will be termed an iteration or ' i ' whereas the reaction can be termed an iterative reaction. The Iteroselectivity can only occur in 'one-pot reactions'. Substrates carrying multiple identical groups can react iteratively in a one-pot reaction.

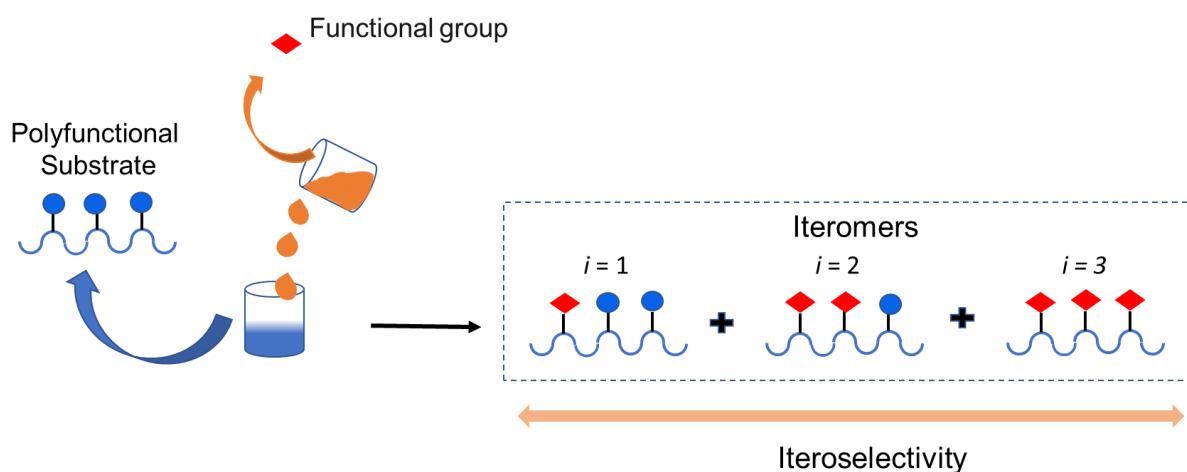


Figure 1. Selectively modifying multiple substrate sites with functional groups gives its iteromers in a typical one-pot reaction.

If one or more products appear primarily in opposition to the predicted outcome while maintaining the same reaction kinetics during each cycle, iteroselectivity will occur. The products can be thus termed as iteromers and not to be confused with or should not be termed as iteroisomers. It emphasizes selectivity between several non-isomeric products formed iteratively in a one-pot reaction. At the same time, the chemo, regio, and stereoselectivity govern the selectivity between isomeric product forms in a single-step reaction. After a given number of iterations in a kinetically controlled reaction, one iterative site or iteration site after an iteration can activate or deactivate the reacting site in the same typical chemical reaction, thus giving rise to iteromers irrespective of the stability of other iteromeric products. The thermodynamic control of an iteroselective reaction will come into the picture in case of a reversible reaction and under equilibrium, the most stable iteromer or iteromers will be formed.

The occurrence of Iteroselectivity may happen due to multiple reasons like electric, steric effect, and supramolecular effects or can occur due to differences in solubilities.

A typical reaction of alkylation of ethylene glycol is an example of an iterative reaction. A strategy to calculate the degree of Iteroselectivity as iteromeric excess 'ite' corresponding to enantiomeric and diastereomeric excesses has also been given in the literature. For positive Iteroselectivity the 'ite' will range from 0 to 100% and for negative Iteroselectivity it will range from $-\infty$ to zero.

The discovery of iteroselectivity has opened up a new scope in organic chemistry where control over molecules will result in the development of more precise and complex reaction pathways more easily. The future lies in using the strategy standing upon the foundation of selectivity theories to craft more intricate molecular architectures.

The Age of Flexible Nanogenerators

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Fig. AI inspired concept art on flexible nanogenerator's use

Nanotechnology is now an inseparable part of our lives. It is the technology at the nano level. 'Nano,' as the word suggests, refers to minuscule levels invisible to our normal vision. One unit of a nanometer is one billionth of a meter. To put it into perspective, if humans were ant-sized, every hair would have a one-nanometer thickness. Using nanomaterials in material science is a boon for multiple applications. These come in every daily aspect. Nanotechnology applications are ubiquitous from medical science, textile industry, energy harvesting, environment-remediation, and agriculture to space technology [1].

The current energy crisis adds up the need for energy scavenging or harvesting as an essential need of the hour. As we thrive on minimalistic things nowadays, conventional energy-generating systems have shrunk to nano levels. These nanoscale generators, which convert light, heat, mechanical fluctuations, etc., to electrical energy, are called nanogenerators. The first work on nanogenerators came up about two decades ago. Professor Zhong Lin Wang of the Georgia Institute of Technology and his group initiated the research on nanogenerators [2,3]. The development of nanogenerators in research groups worldwide spread later with an

increasing number of their types. Triboelectric nanogenerators (TENG) were the first nanogenerators studied extensively, followed by piezoelectric nanogenerators (PENG) and pyroelectric nanogenerators (PyNG). Triboelectric nanogenerators functioned with the use of the triboelectric effect. It is the effect where contact or friction between two surfaces generates electric charge, hence electric energy. Piezoelectric nanogenerators work on the principle of piezoelectric effect. It is the effect where constant stress or strain generates continuous electrical energy. Pyroelectric nanogenerators are based on the pyroelectric effect. This is a temporal effect where temperature difference causes electrical energy output [3].

The nanogenerators are used for multiple reasons. Conventional generators hold numerous advantages. In addition to being compact, flexible, adaptable, and adept at capturing energy from small sources, nanogenerators offer improved efficiency, cost-effectiveness, and eco-friendliness. Their ability to integrate seamlessly, withstand wear and tear, scale to different sizes, and function independently as self-powered units highlight their potential to transform energy harvesting methods [2].

At the beginning of the last decade (c. 2012), pioneering work was done by adapting the flexible nature of such nano-electronics. An impactful work in flexible triboelectric nanogenerator (FTENG) was done by the same group of Georgia Tech [2,4,5]. By introducing flexibility using a rubber cover, their applications increased in manifolds. That included human motion energy harvesting, wind, or even water flow. The invention marked a breakthrough in energy scavenging from ambient energy sources. These sources may be in flexible or deformed configurations. Flexible nanogenerators have developed over the years and have stretchable properties. For flexible nanogenerators, polymers are used. They provide support to the matrix as well as the entire body of the nanogenerators [4,5].

Recent years have shown flexible nanogenerators in a new light. Instead of being used in single energy generation mode, they have also been used in hybrid mode [2,7]. Thus, they are named flexible hybrid nanogenerators (FHNG). In this approach, triboelectric and piezoelectric properties are conjoined in a hybrid way. The advantages of combining these modes are high flexibility, high moisture, dust resistance, high electrical output, and wide applications.

Various materials are used in flexible nanogenerators to impart triboelectric or piezoelectric properties. As mentioned, some materials provide both properties as a single framework. Materials like P(VDF-TrFE) nanofiber, BCZT ($\text{Ba}_{0.85}\text{Ca}_{0.15}\text{Zr}_{0.1}\text{Ti}_{0.9}\text{O}_3$) nanoparticles, $\text{BaTiO}_3/\text{PVDF}$ nanocomposite impart piezoelectric properties to flexible nanogenerators. On the other hand, PDMS (polydimethylsiloxane), MWCNT (multi-wall carbon nanotubes) doped into PDMS, silicone rubber, polyester conductive cloth, defatted

cowhide, etc. induce triboelectric properties to flexible nanogenerators [8]. As scientific literature progresses, researchers discover new materials that show promising properties in supportive, flexible nanogenerator frameworks.

Recently, flexible pyroelectric nanogenerators (FPyNG) have also been realized. Mostly in literature, pyroelectricity is used to harness energy in the mutual application of the piezoelectric effect to explore flexibility effects. It is because flexibility inherently makes studying piezoelectric properties of immense importance. There is a broader scope for photovoltaic materials to be used with other discussed properties. Flexibility improves the benefits of photoconversion in specific configurations [9].

As mentioned here, flexible devices have immense capabilities of harvesting energy from body movements and ambient light to power sensors, wearable electronic devices like smartwatches, fitness trackers, health monitors, and communication modules without requiring external batteries. They can also be used for textile integration due to flexibility, thus forming intelligent fabrics. IoT sensors and nodes can utilize flexible nanogenerators to harness energy from vibrations, temperature gradients, or ambient light, enabling numerous applications in intelligent infrastructure. Biomedical applications like powering up implantable medical devices, such as pacemakers, neuro-stimulators, and drug delivery systems, are also at the forefront [10,11].

Researchers have kept pushing the boundaries of flexible nanogenerators, tinkering with new materials, designs, and ways to make them work better, last longer, and fit into more stuff. These tweaks and improvements have given rise to cool gadgets that the modern world can welcome enthusiastically.

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Spintronics: The power of electron spin

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In the vast area of electronics, advancement frequently depends on shrinking components to microscopic scales; a curious phenomenon is emerging from the quantum realm: the spin of electrons. This might sound not very easy, but it is pretty exciting and has the potential to make our gadgets even better. Instead of just focusing on how much electricity flows, we can also pay attention to how the electrons spin. In an atom, an electron revolves around the atom, and along with the revolving, the electron also spins in a clockwise or anticlockwise direction. Electron spin is permanent and can be described as spin up or down. Spin-up is when an electron spins clockwise on its axis, while spin-down is when it spins counterclockwise. Spin can be considered a tiny magnetic moment associated with the electron.

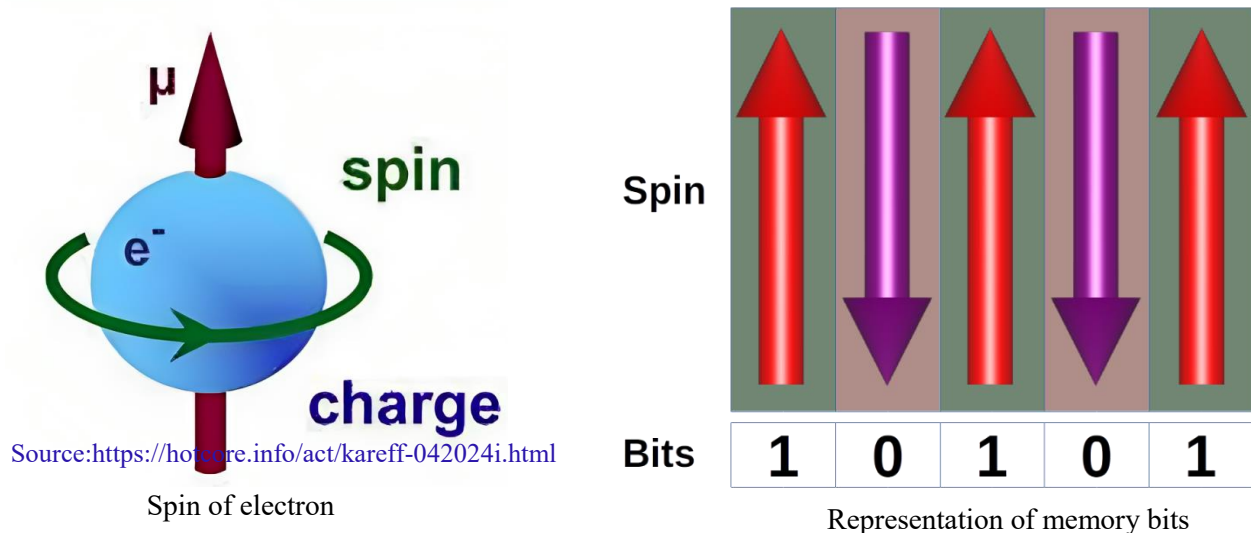
In traditional electronics, the movement of electrons occurs, which is called electronic current; here, we are neglecting the spin of the electrons. The spin power of an electron can be used, which means that instead of the flow of charges, the spin flow can be generated as a signal called spin current or spintronics. As spintronics does not consider the physical movement of electrons or charges, it is fast and can operate with meagre power.

Memory devices store data using binary code, where each bit represents a 0 or a 1. Memory devices comprise millions or billions of tiny electronic component transistors, capacitors, or logic gates. With the help of an electrical charge, data are stored like this: if a charge is present, it is considered a 1; if no charge is present, it is regarded as a 0. The memory controller within the computer or device manages the reading and writing of data to and from these memory cells based on the binary patterns stored within them. However, instead of an electronic charge, we can also use the property of electron spin orientation to encode bits of data, either 'up' or 'down,' which can be manipulated to encode and process data. This shift from charge-based to spin-based electronics opens up many possibilities. One exciting use of spintronics in memory devices lies in non-volatile memory devices, where data retention without a constant power supply uses the spin of electrons to store information, which makes them very stable and energy-efficient. This approach holds immense promise for overcoming the limitations of current memory technologies, which could mean faster computers, energy efficiency, and data storage density. Spintronics promises a new wave of technological innovation, from memory devices and sensors to quantum computing.

However, moving from theory to real-world application presents a strict set of obstacles. A significant obstacle is found in materials engineering, where scientists are trying to find and

create materials that have the necessary electrical and magnetic characteristics to manipulate spin. A major challenge is still regulating electron spin, especially at average temperatures. Quantum mechanical phenomena restrict the stability and dependability of spin-based devices.

Despite these challenges, spin-based architectures hold the future for exponential performance gains, opening up new applications in machine learning and artificial intelligence, among other fields. As we stand at the threshold of a new era in electronics, the transition from traditional electronics to spintronics signifies a step into the efficient one that will undoubtedly provide difficulties and many opportunities. By welcoming the spin revolution and opening a path for innovation and discovery, we can realize the full potential of spintronics and reign in a time when the past will no longer limit technology. Let us take advantage of the chances that are just around the corner that lie ahead in our pursuit of advancement.



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Understanding Oral Cancer: Strategies for Prevention, Early Detection, and Effective Treatment

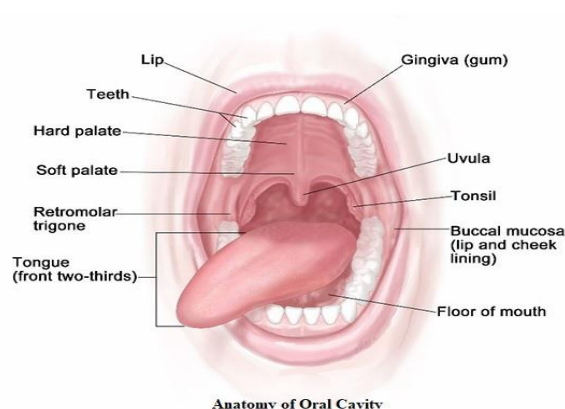
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The theme of World Cancer Day 2022-2024 is “Close the Care Gap: Everyone deserves access to cancer care”. World Cancer Day happens on the 4th of February every year. Its goal is to help reduce the impact of cancer by educating people, raising awareness, and encouraging governments and individuals worldwide to take action. Oral cancer is a significant health concern that demands attention worldwide. Oral cancer includes cancers of the lips, cheeks, tongue, floor of the mouth, hard and soft palate, sinuses, and throat (pharynx). Acknowledging the impact of too much use of tobacco and excessive alcohol consumption in elevating the risk of oral cancer, it is crucial to address this issue and take proactive measures to prevent, detect, and treat this disease.



Source: <https://www.indiancancersociety.org/oral-cancer/>

The burden of oral cancer is particularly prominent in South Asia, where two-thirds of global cases are reported, with India alone accounting for one-fourth of all oral cancer deaths. However, it is encouraging to note that in the United States, the incidence and mortality rates of oral cancer have been steadily declining over the past two decades. This positive trend can be attributed to the decreasing prevalence of smoking and alcohol consumption.

In India, one of the significant contributors to the high prevalence of oral cancer is the widespread habit of chewing betel quid and areca nut, especially among the youth. These practices significantly increase the risk of developing oral cancer. Other risk factors include mate drinking, viral infections, chronic trauma, and genetic predisposition.

Prevention and early detection are vital components in the fight against oral cancer. Visual screening of the oral cavity, primarily by healthcare professionals, has proven to be a cost-effective preventive method. This approach is precious in low- and middle-income countries with limited resources. By identifying potential lesions or abnormalities at an early stage, appropriate interventions can be initiated to prevent oral cancer progression. Preventive measures for oral cancer include the following: discontinuing the use of tobacco products, ceasing smoking, refraining from consuming betel nut and pan masala, abstaining from alcohol, practising good oral hygiene, conducting regular self-examinations of the oral cavity, scheduling regular dental check-ups, minimizing sun exposure, promptly addressing any ulcers, bleeding, or pain in the oral region, adopting a balanced diet, and maintaining a healthy lifestyle. These strategies are recognized as effective means of reducing the risk of oral cancer.

Treatment, such as for oral cancer, depends on the stage of the disease. It typically involves a combination of surgery, radiotherapy, immunotherapy, and chemotherapy followed by some other diagnosis like CT scan, magnetic resonance imaging (MRI), and positron emission tomography (PET). While these treatments are essential for combating the disease, they can also result in side effects, particularly from radiotherapy. Managing these side effects and providing supportive care during the treatment journey is crucial for improving patient outcomes and quality of life.

The insights presented in this research highlight the importance of public awareness and education about oral cancer prevention, early detection, and treatment. By understanding the risk factors of cigarettes, smokeless tobacco, chewing tobacco, dipping snuff, cigars, bidis, alcohol, lack of vitamin D, nutritional deficiency and papillomaviruses, and also socio-economic conditions associated with oral cancer, individuals can make informed choices to reduce their susceptibility to this disease. Moreover, healthcare professionals play a pivotal role in conducting oral and visual screenings, visual inspections, and questionnaires, providing necessary interventions, and ensuring comprehensive care for individuals affected by oral cancer.

Through ongoing research, collaborations, and advancements in healthcare, the battle against oral cancer continues. By promoting preventive measures, early detection strategies, and effective treatment options, we can work together to reduce the burden of oral cancer, improve patient outcomes, and ultimately save lives.

The Call for Skills

The world keeps turning, times they change,
New paths we tread, a different range.
While art and culture hold their sway,
Technical skills now light the way.

Once nimble hands with artist's touch,
Now, build and mend; they do so much.
Machines and tools, a helping hand,
To progress onward, across the land.

From screens that glow to gears that grind,
A world of knowledge we must find.
Engineers, technicians, side by side,
For a nation's growth, with purpose as their guide.

So let us learn, with minds alight,
These skills that make the future bright.
Education's flame, a guiding star,
To build a world that reaches far.

WritTaibur Rahman, PhD Scholar, MCS Lab, IASST.

मौन प्रतिवाद

देखा है आज मैंने फिर एक बार मौन प्रतिवाद
मनो जीवित हो आज भी कही न कही गांधीवाद
आखें कहती कितना कुछ, चुपी साधे हुआ है मुख
लगती बेबस फिर भी दृढ़, मन की शक्ति आज उन्मुक्त
ना नरम दल है ना गरम दल, और न ही कोई अन्य बल
बस दिखता दूर- दूर तक असंख्य मानवों का नव निर्मित समुद्र
जिसमे समाहित अनगिणत नव रत्न, जिसका शेष है अब भी मंथन
उमड़ती ज्वारभाटा की लहरों सी आगे बढ़ती प्रतिपल।
हां ! देखा है आज फिर वही मौन प्रतिवाद
जिसके बल पर बना था भारत का वह नव स्वरूप
अनेक आखें है अनेकों मन, मन में उठते कई प्रश्न, पर उत्तर आखिर देगा कौन।
थोड़ा क्रोध है कुछ आशंका, थोड़ा शोक है कुछ निराशा
प्रश्न अब केवल स्वतंत्रता तक नहीं बचा है शेष,
आहत हुआ है अंतर्मन, खोजे प्रतिपल नीरवता के पल।
पर लगता ऐसा मानो कुछ अब बचा ना शेष।
देखो क्या यही है वह मौन प्रतिवाद?
जो देगा सृष्टि को एक नया रुख।
निर्माली देवी
हिंदी सहायक
आई.ए.एस.एस.टी

“প্ৰযুক্তি আৰু মোৰ দেশ”

ৰাজলোচন বৰুৱা

(তথ্য-প্ৰযুক্তি শাখা)

শূণ্যৰে আৰম্ভ হোৱা বিজ্ঞানৰ যাত্ৰাৰ
পদ পথৰ যাত্ৰী তুমি,
বিজ্ঞান আৰু প্ৰযুক্তিৰ বিশাল ডাৱৰেৰে
গঢ়িছা এক নতুন পৃথিৱী আজি ।

বেদ, উপনিষদ আৰু পুৰাণৰ জ্ঞানেৰে
সমৃদ্ধ কৰি আহিছা মানৱ ইতিহাস,
গণিত, চিকিৎসা আৰু প্ৰযুক্তিৰ পথত
দি আহিছা তোমাৰ অলেশ উপহাৰ ।

আৰ্যভট্টৰ পৰা ৰামানুজনলৈ
পাৰমাণৱিকৰ পৰা মহাকাশ প্ৰযুক্তিলৈ
উৰা মাৰি আহিছা তোমাৰ বিশাল ডেউকা মেলি,
যেন তাৰেই সন্ধানত কিজানিবা পাণ্ট, জোনবাই দেশত নতুন ঘৰ এখনি।

যোগৰ পৰা আয়ুৰ্বেদলৈ
জ্ঞানৰ প্ৰসাৰেৰে তুমি বিশ্ব জিনিলা,
দেখুৱালা জীৱনৰ প্ৰতি এক সামগ্ৰিক দৃষ্টিভঙ্গী,
আগুৱাই যোৱা, তুমি প্ৰগতিৰ পথত
যেন এক ৰোমাঞ্চকৰ বাস্তৱ কাহিনী ।

राजभाषा प्रचार-प्रसार के उद्देश्य से आईएसएसटी द्वारा विश्व हिंदी दिवस का आयोजन

विश्व हिंदी दिवस के अवसर पर, विज्ञान एवं प्रौद्योगिकी उच्च अध्ययन संस्थान (आईएसएसटी) द्वारा संस्थान परिसर में उत्साहपूर्वक इसका आयोजन किया गया। कार्यक्रम का उद्देश्य भारतीय भाषा के उपयोग के बारे में जागरूकता फैलाना और हिंदी के उपयोग और प्रचार से संबंधित प्रासंगिक मुद्दों का समाधान करना था।

इस अवसर पर प्रो. आशीष कुमार मुखर्जी, निदेशक, आईएसएसटी ने हिंदी की व्यापकता पर प्रकाश डालते हुए, सभी आधिकारिक सेटिंग्स में हिंदी के कार्यान्वयन को बढ़ाने के लिए संस्थान के दृढ़ समर्पण के बारे में चर्चा की। अपने व्याख्यान में प्रो मुखर्जी समाज के उत्थान की दिशा में विज्ञान को बढ़ावा देने में वैज्ञानिकों की भूमिका पर जोर देते हुए इसे जनसाधारण में मध्य पहुंचाने में हिंदी की भूमिका को उल्लेखित किया।

कार्यक्रम का मुख्य आकर्षण संस्थान के शोधकर्ताओं के लिए आयोजित "समाज के लिए विज्ञान" विषयक भाषण प्रतियोगिता थी, जिसमें संस्थान के शोधकर्ताओं ने उत्साहपूर्वक भाग लेकर अपनी भाषाई कौशल का प्रदर्शन किया। प्रतियोगिता के दौरान ज्ञानवर्धक भाषणों ने भाषाई विविधता को बढ़ावा देने और देश की पहचान को आकार देने में हिंदी की महत्वपूर्ण भूमिका को दर्शाया।



विश्व हिंदी दिवस

विज्ञान अन्वेषण: 9वां भारत अंतर्राष्ट्रीय विज्ञान महोत्सव में आई.ए.एस.एस.टी

विज्ञान और नवाचार के क्षेत्र में उल्लेखनीय प्रगति को प्रदर्शित करने के उद्देश्य से दिनांक 17 से 20 जनवरी, 2024 के दौरान फरीदाबाद, हरियाणा में आयोजित- 9वां भारत अंतर्राष्ट्रीय विज्ञान महोत्सव (आईआईएसएफ) में आईएसएसटी द्वारा प्रतिभागिता की गई। विभिन्न सरकारी मंत्रालयों तथा विज्ञान भारती के सहयोग से आयोजित इस कार्यक्रम में विज्ञान, प्रौद्योगिकी और नवाचार में भारत की उपलब्धियों को परिदर्शित किया गया।

प्रो. आशीष कुमार मुखर्जी, निदेशक, आईएसएसटी सहित संस्थान के वैज्ञानिकों के दल द्वारा वैज्ञानिक ज्ञान को आगे बढ़ाने के लिए संस्थान की प्रतिबद्धता को प्रदर्शित करते हुए भारत के भविष्य को आकार देने में वैज्ञानिक अन्वेषण और नवाचार के महत्व पर प्रकाश डाला गया। इस अवसर पर दिनांक 31 दिसंबर, 2023 को स्कूली छात्रों के लिए एक आउटरीच कार्यक्रम भी आयोजित किया, जिससे छात्रों को आईएसएसटी की परिष्कृत प्रयोगशालाओं को जानने का अवसर प्रदान किया गया।



फरीदाबाद के आईआईएसएफ मैदान से आईएसएसटी पैवेलियन की कुछ झलकियां



आईआईएसएफ 2023 में आईएसएसटी टीम के साथ प्रोफेसर आशीष कुमार मुखर्जी

महिला सशक्तिकरण विषय पर आयोजित 75वां गणतंत्र दिवस समारोह

इस वर्ष संस्थान द्वारा आयोजित भारत का 75वां गणतंत्र दिवस समारोह महिलाओं के उत्थान और उनके सशक्तिकरण को समर्पित रहा जो महिलाओं को समाज के प्रत्येक क्षेत्र में अग्रणी बनाने के संस्थान की अटूट प्रतिबद्धता को प्रदर्शित करता है।

कार्यक्रम का आरंभ संस्थान के निदेशक प्रो. आशीष कुमार मुखर्जी द्वारा राष्ट्रीय ध्वजारोहण के साथ हुआ। प्रो. मुखर्जी ने विज्ञान, प्रौद्योगिकी और अनुसंधान सहित विविध क्षेत्रों में प्रगति को आगे बढ़ाने में महिलाओं की महत्वपूर्ण भूमिका पर जोर दिया।

इस अवसर पर एक रंगारंग सांस्कृतिक कार्यक्रम का भी आयोजन किया गया। इसके अलावा कार्यक्रम का मुख्य आकर्षण 'उपासना एथनिक फूड सोसाइटी' की दो प्रतिभाशाली महिलाओं की उल्लेखनीय उपलब्धियों पर उन्हें सम्मानित करना रहा। .



आईएसएसटी में 75वां गणतंत्र दिवस समारोह का भव्य आयोजन

माइक्रोबियल चमत्कारों की खोज: किण्वित खाद्य पदार्थों के माध्यम से एक यात्रा"

29 जनवरी से 2 फरवरी, 2024 के दौरान आईएसएसटी में एडवांस लेवल डीबीटी बायोटेक हब द्वारा "जातीय खाद्य और पेय पदार्थों के किण्वन में माइक्रोबियल गतिशीलता पर अध्ययन" विषय पर पांच दिवसीय व्यापक संकाय सुधार प्रशिक्षण कार्यक्रम आयोजित किया गया, जिसमें विभिन्न राज्यों के संकाय सदस्यों ने भाग लिया।

कार्यशाला के लक्ष्य के बारे में चर्चा करते हुए, आईएसएसटी के निदेशक प्रोफेसर आशीष कुमार मुखर्जी ने किण्वित खाद्य पदार्थों की तैयारी की गहरी समझ को बढ़ावा देने की आवश्यकता पर जोर दिया और इसके सांस्कृतिक एवं वैज्ञानिक महत्व पर प्रकाश डाला। इस 5 दिवसीय कार्यशाला में एक व्यापक पाठ्यक्रम, विशेषज्ञ व्याख्यान श्रृंखला और व्यावहारिक प्रशिक्षण सत्र शामिल थे।



5 दिवसीय प्रशिक्षण कार्यक्रम के लिए एकत्रित हुए विभिन्न संस्थानों के संकाय सदस्य

सर्पदंश चुनौतियों से निपटान: चिकित्सा शिक्षा की सफलता

8 फरवरी को आईएसएसटी द्वारा सतत चिकित्सा शिक्षा (सीएमई) सत्र का आयोजन किया। वर्ष 2017 में विश्व स्वास्थ्य संगठन द्वारा उपेक्षित उष्णकटिबंधीय रोग के रूप में घोषित किए गए सर्पदंश को एवं उसके प्रबंधन की जटिल चुनौतियों का समाधान करने पर केंद्रित, इस विशिष्ट सम्मेलन ने एक ज्वलंत मुद्दे से निपटने के लिए एक सहयोगी मंच के रूप में कार्य किया।

इंडियन मेडिकल एसोसिएशन, असम चैप्टर के सहयोग से आयोजित सीएमई सत्र ने सर्पदंश की घटनाओं की जटिलताओं को संबोधित करने की दिशा में एक महत्वपूर्ण कदम उठाया, जिसने चिकित्सा प्रबंधन के क्षेत्र में सहयोगात्मक शिक्षण के महत्व को पुष्ट किया।

विष विज्ञान में अपनी विशेषज्ञता के लिए प्रसिद्ध, आईएसएसटी के निदेशक और कार्यक्रम के मुख्य संरक्षक प्रोफेसर आशीष के मुखर्जी ने अनुसंधान के इस अक्सर नजरअंदाज किए जाने वाले क्षेत्र पर प्रकाश डालने की आवश्यकता पर जोर दिया। उन्होंने इस महत्वपूर्ण मुद्दे को संबोधित करने के लिए एक सहयोगी मंच प्रदान करके इस अंतर को पाटने के लिए आईएसएसटी की प्रतिबद्धता पर जोर दिया।

कार्यक्रम में राज्य के विभिन्न चिकित्सा विभागों के सम्मानित गणमान्य व्यक्तियों जैसे- आईएमए, असम चैप्टर की अध्यक्ष अरुणिमा गोस्वामी, डॉ. एन.एस. तिष्य, राज्य निगरानी अधिकारी, आईडीएसपी और डॉ. एस.ए. लस्कर, राज्य नोडल अधिकारी, एनएचएम की उपस्थिति दर्ज की गई। इसके अलावा इस कार्यक्रम में इस क्षेत्र के विशेषज्ञों जैसे- डॉ. दयाल बंधु मजूमदार, कलकत्ता मेडिकल कॉलेज; डॉ. सदानंद राउत, विघ्नहर नर्सिंग होम, पुणे; डॉ. सुरजीत गिरि, डेमो सामुदायिक स्वास्थ्य केंद्र, शिवसागर और डॉ. एम. वि. खांडेकर, तकनीकी निदेशक, पीएसवीपीएल, पुणे द्वारा सर्पदंश प्रबंधन से संबंधित विभिन्न विषयों पर बहुमूल्य जानकारी दी गई।



सीएमई कार्यक्रम का समूह चित्र

सर्पविष पर अत्याधुनिक संगोष्ठी: एक वैश्विक प्रयास

9 और 10 फरवरी को आईएसएसटी द्वारा सर्पविष से संबंधित विषय पर दो दिवसीय अंतर्राष्ट्रीय संगोष्ठी का आयोजन किया गया। आईएसएसटी के निदेशक प्रोफेसर आशीष के मुखर्जी की अगुवाई में आयोजित इस संगोष्ठी में सर्पविष पर वर्तमान चल रहे शोधकार्यों में वृद्धि संबंधी सहयोगात्मक चर्चा की गई। कार्यक्रम में विश्व के कई प्रतिष्ठित संस्थानों का प्रतिनिधित्व करने वाले विविध प्रतिभागियों की प्रतिभागिता देखी गई, जिनमें से अंतर्राष्ट्रीय स्तर पर नेशनल यूनिवर्सिटी ऑफ सिंगापुर, मलाया यूनिवर्सिटी, मलेशिया, और यूनिवर्सिटी ऑफ पोर्टो, पुर्तगाल के नाम शामिल हैं। वहीं दूसरी ओर भारत का प्रतिनिधित्व करते हुए मैसूर विश्वविद्यालय, आईआईसीबी कोलकाता, एसआरएमआईएसटी चेन्नई और आईआईएससी बेंगलुरु जैसे संस्थानों ने कार्यक्रम में भाग लेते हुए अपना महत्वपूर्ण योगदान दिया। इसके अलावा मिजोरम विश्वविद्यालय, तेजपुर विश्वविद्यालय, डेमो मॉडल अस्पताल सह स्वास्थ्य केंद्र जैसे स्थानीय संस्थानों के साथ-साथ असम के कई अन्य संस्थानों ने भी इसमें सक्रिय रूप से भाग लिया। संगोष्ठी में विस बायोप्रोडक्ट्स लिमिटेड हैदराबाद और प्रीमियम सीरम्स एंड वैक्सीन्स प्राइवेट लिमिटेड पुणे जैसे अग्रणी एंटीवेनम निर्माता शामिल हुए, और इस क्षेत्र में चल रहे कार्य पर अपनी विशेषज्ञता प्रदान की। कार्यक्रम में विष और विषाक्त पदार्थों में मूल शोध कार्य कर रहे युवा वैज्ञानिकों और पोस्टर प्रस्तुतकर्ताओं को उनके उत्कृष्ट योगदान के लिए प्रोत्साहित किया गया।



सेकसिम्प 2024 का एक समूह चित्र



सेकसिम्य 2024 में पोस्टर प्रस्तुति सत्र

विज्ञान के क्षेत्र में समर्पित महिलाओं का सम्मान और समर्थन

12 फरवरी को आईएसएसटी ने विज्ञान के क्षेत्र में समर्पित महिलाओं और बालिकाओं के अंतर्राष्ट्रीय दिवस के अवसर पर एक आकर्षक संवादात्मक सत्र का आयोजन किया, जिसमें उनके अमूल्य योगदान पर प्रकाश डाला गया।

सत्र की अध्यक्षता प्रोफेसर आशीष कुमार मुखर्जी, निदेशक, आईएसएसटी द्वारा की गई, जिसमें प्रोफेसर एन एस शर्मा और डॉ. एल बी महंत ने भाग लेते हुए विचारोत्तेजक पैनल चर्चा की और विज्ञान के क्षेत्र में अधिक महिलाओं को आकर्षित करने के उद्देश्य से विभिन्न रणनीतियों को अपनाने पर जोर दिया। इस क्षेत्र में मार्गदर्शन की महत्वपूर्ण भूमिका और समावेशी वातावरण को बढ़ावा देने के महत्व पर जोर देते हुए, पैनलिस्टों ने विज्ञान में महिलाओं को सशक्त बनाने हेतु अपनी अंतर्दृष्टि साझा की।



विज्ञान में महिलाओं और बालिकाओं के अंतर्राष्ट्रीय दिवस के अवसर पर आईएसएसटी की महिलाएं

फ्रांसीसी प्रतिनिधिमंडल के साथ सहयोगात्मक बैठक

21 फरवरी को, आईएसएसटी ने भारत स्थित फ्रांस दूतावास में वैज्ञानिक एवं शैक्षणिक सहयोग के लिए आए फ्रांसीसी दूत डॉ. डिडिएर राबोइसन और डॉ. मीनाक्षी सिंह, वैज्ञानिक समन्वयक, फ्रेंच इंस्टीट्यूट इन इंडिया, फ्रांसीसी दूतावास का संस्थान में स्वागत किया। इस अवसर पर आईएसएसटी के निदेशक की अध्यक्षता में, सभी संकाय सदस्यों के साथ बैठक आयोजित की गई थी, जिसका उद्देश्य फ्रांसीसी संस्थानों के साथ उद्योग-अकादमिक अनुसंधान और विकास साझेदारी पर गहन विचार-विमर्श करना था। चर्चा का मुख्य विषय वैज्ञानिक प्रयासों को आगे बढ़ाने के लिए संयुक्त प्रयासों के नए मार्ग प्रशस्त करना था।



बैठक का एक सैपशॉट



प्रोफेसर आशीष कुमार मुखर्जी, निदेशक, आईएसएसटी और डॉ. डिडिएर राबोइसन, वैज्ञानिक और शैक्षणिक सहयोग के लिए दूत

विज्ञान को नमन: डॉ. सी.वी. रमन और उनके नवाचार

राष्ट्रीय विज्ञान दिवस पर आईएसएसटी परिवार ने भौतिक विज्ञानी डॉ. सी.वी. रमन को भावभीनी श्रद्धांजलि अर्पित की।

प्रतिवर्ष 28 फरवरी को आयोजित किए जाने वाले इस समारोह का इस वर्ष का विषय- "विकसित भारत के लिए स्वदेशी प्रौद्योगिकी" था, जिसके अंतर्गत भारत की प्रगति को आकार देने में घरेलू नवाचारों की शक्ति पर प्रकाश डाला गया। प्रो. आशीष कुमार मुखर्जी, निदेशक, आईएसएसटी ने अपने विचार साझा करते हुए राष्ट्रीय शिक्षा नीति 2020 में निर्धारित राष्ट्रीय प्राथमिकताओं के अनुरूप वैज्ञानिक शिक्षा को बढ़ावा देने के लिए संस्थान की प्रतिबद्धता दोहराई।

कार्यक्रम का मुख्य आकर्षण में संस्थान के वैज्ञानिकों द्वारा दी गई वार्ताएं, बायोनेस्ट-आईएसएसटी स्टार्टअप उद्यमियों के साथ एक इंटरैक्टिव चर्चा सत्र, आईएसएसटी के शोधार्थियों द्वारा पोस्टर प्रस्तुति और एक विशेष प्रश्नोत्तरी प्रतियोगिता रहा



डॉ. सी.वी. रमन को श्रद्धांजलि अर्पित करता आईएसएसटी परिवार



पोस्टर प्रस्तुति के दौरान शोधार्थियों से बातचीत करते हुए आईएसएसटी के निदेशक



पोस्टर प्रस्तुति सत्र के दौरान शोधार्थियों से चर्चा करते बाहरी विशेषज्ञ

नवोन्मेष के लिए शिक्षा और उद्योग जगत के बीच सेतु का निर्माण

4 मार्च, 2024 को आईएसएसटी ने प्रौद्योगिकी हस्तांतरण पर एक महत्वपूर्ण उद्योग-अकादमिक सम्मेलन की मेजबानी की। आईएसएसटी द्वारा आयोजित इस सम्मेलन का उद्देश्य अकादमिक अनुसंधान और उद्योग के बीच संबंधों को मजबूत करना, नवाचार, व्यावसायीकरण को आगे बढ़ाना और समाज की बेहतरी के लिए अत्याधुनिक तकनीकों को व्यापक रूप से अपनाना था।

प्रोफेसर आशीष कुमार मुखर्जी, निदेशक, आईएसएसटी ने अनुसंधान और नवाचार को बढ़ावा देने के लिए प्रौद्योगिकी हस्तांतरण हेतु स्पष्ट दिशानिर्देश स्थापित करने के महत्व पर बल दिया, जिससे राष्ट्र को तकनीकी नेतृत्व की ओर अग्रसर किया जा सके।

कार्यक्रम में वैज्ञानिकों द्वारा ज्ञानवर्धक वार्ताओं की एक श्रृंखला शामिल थी, जिसमें प्रो. प्रदीप श्रीवास्तव, टीआईएफएसी, डीएसटी, डॉ. हरिकृष्ण वर्मा और डॉ. रॉय जोसेफ, एससीटीआईएमएसटी प्रो. आर.एन. सिंह, हिमालयन बायोकेमी हर्ब्स, और डॉ. सौरव मजूमदार, सीरम इंस्टीट्यूट ऑफ इंडिया प्राइवेट लिमिटेड के नाम शामिल हैं।



प्रौद्योगिकी हस्तांतरण पर उद्योग-अकादमिक सम्मेलन का एक महत्वपूर्ण दृश्य

अंतर्राष्ट्रीय महिला दिवस

8 मार्च, 2024 को, आईएसएसटी ने नवाचार और प्रगति को आगे बढ़ाने में महिलाओं की महत्वपूर्ण भूमिका का सम्मान करने के उद्देश्य से अंतर्राष्ट्रीय महिला दिवस का आयोजन किया। "महिलाओं में निवेश: प्रगति में तेजी" विषय के अंतर्गत आईएसएसटी ने एक पूरे दिन का सत्र आयोजित किया, जिसमें प्रतिष्ठित वक्ताओं ने राष्ट्रीय विकास में महिलाओं के योगदान के महत्व पर प्रकाश डाला।

सभा को संबोधित करते हुए आईएसएसटी के निदेशक देश को आगे बढ़ाने में महिलाओं की अपरिहार्य भूमिका को रेखांकित किया। आईसीसी की अध्यक्ष डॉ. अरुंधति देवी ने उपस्थित लोगों का गर्मजोशी से स्वागत करते हुए समावेशिता एवं सशक्तिकरण का माहौल बनाया

इस कार्यक्रम का मुख्य आकर्षण एक व्यावहारिक और संवादात्मक पैनल चर्चा थी, जिसमें प्रगति को गति देने में सभी क्षेत्रों में महिलाओं की प्रभावशाली भूमिका पर प्रकाश डाला गया। पैनलिस्टों में सेवानिवृत्त आईपीएस अधिकारी श्रीमती वायलेट बरुआ, इन्वेस्ट इंडिया में नॉर्थ ईस्ट डेस्क की प्रमुख डॉ. गीतिमा दास कृष्णा, भारतीय आसियान व्यापार परिषद की अध्यक्ष डॉ. अलकनंदा दास और रॉयल ग्लोबल यूनिवर्सिटी के रॉयल स्कूल ऑफ कॉमर्स में एसोसिएट डीन और एसोसिएट प्रोफेसर डॉ. अरुणा देब रॉय शामिल थे, जिन्होंने अपने अमूल्य अंतर्दृष्टि और अनुभव साझा किए। महिला उद्यमियों के लिए सहयोग और नेटवर्किंग के अवसरों को बढ़ावा देने के लिए, आईएसएसटी ने महिला उद्यमियों और बायोनेस्ट-आईएसएसटी इनक्यूबेटीज़ के उत्पादों और हथकरघों को प्रदर्शित करने वाली एक प्रदर्शनी का भी आयोजन किया।



अंतर्राष्ट्रीय महिला दिवस समूह चित्र

जिज्ञासा और खोज की भावना को प्रेरित करती: विशेषज्ञ व्याख्यान श्रृंखला

18 मार्च को "प्रोटीओमिक्स दिवस के अवसर पर संस्थान द्वारा एक लोकप्रिय व्याख्यान श्रृंखला" का आयोजन किया गया जिसके अंतर्गत विशेषज्ञों ने ज्ञानवर्धक वार्ताओं श्रृंखला के माध्यम से जैविक प्रक्रियाओं, प्रोटीओमिक्स और हरित रसायन विज्ञान विषय पर अपनी प्रस्तुतियाँ प्रस्तुत की। कार्यक्रम में निदेशक, आईएसएसटी और पूर्वोत्तर पर्वतीय विश्व विद्यालय के प्रोफेसर तिमिर त्रिपाठी सहित अन्य प्रतिष्ठित वक्ताओं ने अपने गहन विचार साझा किए और आकर्षक व्याख्यानों के माध्यम से प्रोटीन तंत्र की गहन समझ प्रदान की।



प्रोफेसर तिमिर त्रिपाठी

नेशनल यूनिवर्सिटी ऑफ़ सिंगापुर में सीनियर प्रिंसिपल साइंटिस्ट ॥ और सहायक संकाय सदस्य डॉ. सुदीप्तो राय ने 19 मार्च को 'सिलिया और सिलिओपैथीज़' विषय पर एक वार्ता प्रस्तुत की, जिसमें उन्होंने सिलिया की सूक्ष्म संरचनाओं और मानव स्वास्थ्य के लिए उनके महत्वपूर्ण निहितार्थों पर गहन चर्चा की।



डॉ. सुदीप्तो राय

22 मार्च को, दिल्ली विश्वविद्यालय के प्रो. पन्नूरु वेंकटसु ने “कई तनावों के खिलाफ प्रोटीन की बढ़ी हुई स्थिरता के लिए हरित विलायक के रूप में आयनिक तरल पदार्थ” विषय पर अपना व्याख्यान प्रस्तुत किया। उनकी प्रस्तुति में प्रोटीन स्थिरता को बढ़ाने के लिए पर्यावरण के अनुकूल विलायकों के उपयोग की आणविक जटिलताओं पर गहन चर्चा की गई।



प्रोफेसर पन्नूरु वेंकटसु

हिंदी कार्यशाला

दिनांक 26.03.2024 को आई.ए.एस.एस.टी में जनवरी- मार्च 2023-24 तिमाही कार्यशाला का आयोजन किया गया। उक्त आयोजन में प्रो. आशीष कुमार मुखर्जी, निदेशक,

आईएसएसटी द्वारा संस्थान के कार्मिकों को हिंदी कार्यान्वयन को बढ़ाने संबंधी विविध बिंदुओं पर जानकारी दी गई तथा संस्थान की हिंदी सहायक द्वारा हिंदी टाइपिंग से संबंधित प्रशिक्षण दिया गया। कार्यशाला में संस्थान के कुल 10 संकाय सदस्यों सहित 4 प्रशासनिक एवं तकनीकी अधिकारियों ने भाग लिया।



हिंदी कार्यशाला

नेक्टर कॉन्क्लेव में आईएसएसटी की प्रतिभागिता- पूर्वोत्तर में उद्यमिता विकास

27 मार्च, 2024 को श्रीमंत शंकरदेव कलाक्षेत्र में नेक्टर द्वारा आयोजित पूर्वोत्तर स्टार्टअप और उद्यमी सम्मेलन के उद्घाटन समारोह में प्रोफेसर आशीष कुमार मुखर्जी, निदेशक, आईएसएसटी की प्रतिभागिता पूरे आईएसएसटी परिवार के लिए हर्ष का विषय रहा।

प्रतिष्ठित गणमान्य व्यक्तियों और उभरते उद्यमियों के बीच आईएसएसटी का प्रतिनिधित्व करते हुए, उन्होंने पूर्वोत्तर क्षेत्र में स्टार्टअप के वर्तमान परिदृश्य पर एक विचारशील संभाषण प्रस्तुत किया और उद्यमिता पारिस्थितिकी तंत्र को बढ़ावा देने में बायोनेस्ट-आईएसएसटी इनक्यूबेशन सेंटर द्वारा किए गए योगदान पर प्रकाश डाला। कार्यक्रम में प्रो. मुखर्जी द्वारा एक पैनल चर्चा सत्र की अध्यक्षता की, जिसमें उन्होंने पूर्वोत्तर क्षेत्र में तकनीकी और उद्यमशीलता दोनों प्रयासों की मजबूती पर अपने दृष्टिकोण साझा किए।



आईएसएसटी के निदेशक प्रोफेसर आशीष कुमार मुखर्जी पैनल चर्चा में अंतर्दृष्टि साझा करते हुए



नॉर्थ ईस्ट स्टार्टअप एंड एंटरप्रेन्योर्स कॉन्क्लेव 2024 का समूह चित्र

रात्रि आकाश अवलोकन कार्यक्रम

28 मार्च, 2024 को आईएसएसटी ने अपनी इन-हाउस वेधशाला के माध्यम से रात्रि आकाश अवलोकन कार्यक्रम का आयोजन किया। इस कार्यक्रम में कुल 38 प्रतिभागियों ने हिस्सा लिया। कार्यक्रम का समन्वय आईएसएसटी की टेलीस्कोप समिति के समन्वयक डॉ. सुबीर विश्वास द्वारा किया गया जिसमें उन्होंने खगोलीय चमत्कारों के बारे में विशेषज्ञ जानकारी प्रदान की।



आकाश अवलोकन कार्यक्रम का एक दृश्य



डॉ. सुबीर विश्वास (आईएसएसटी दूरबीन समिति के समन्वयक) के साथ आईएसएसटी शोधकर्ताओं

आईएसएसटी के वैज्ञानिक हस्तक्षेप ने परंपरा को पुनर्जीवित करने का मार्ग प्रशस्त किया: असम का शिदल पाककला

सहयोग और सामुदायिक सशक्तिकरण के सार के साथ प्रतिध्वनित एक महत्वपूर्ण कार्यक्रम के तहत 5 अप्रैल, 2024 को करीमगंज में आयोजित शिदल बाजार लॉन्च में वैज्ञानिक कौशल, सामुदायिक भागीदारी और उद्यमशीलता के तालमेल को प्रदर्शित किया। डीएसटी-सीड द्वारा प्रायोजित एससी/एसटी सामुदायिक विकास नामक परियोजना के तहत की गई यह पहल असम के स्वदेशी समुदायों, विशेष रूप से करीमगंज के सोनबील के कैबार्ता समुदाय के लिए एक महत्वपूर्ण मील का पत्थर था। कार्यक्रम का नेतृत्व आईएसएसटी के निदेशक प्रोफेसर आशीष कुमार मुखर्जी सहित प्रोफेसर मोजीबुर आर खान, परियोजना प्रभारी और डॉ. जयराज भट्टाचार्य, परियोजना वैज्ञानिक द्वारा किया गया।

कार्यक्रम का आयोजन भारत विकास परिषद, करीमगंज द्वारा संयुक्त रूप से किया गया था, जिसमें काफी संख्या में लोगों की प्रतिभागिता दर्ज की गई।

इस कार्यक्रम का मुख्य उद्देश्य शिदल उत्पादन प्रक्रिया में वैज्ञानिक हस्तक्षेप के माध्यम से शिदल के पोषण संबंधी लक्षण-निर्धारण करना था। प्रो. मुखर्जी ने आशा व्यक्त करते हुए कहा कि शिदल को बाजार में उतारने से कैबार्ता समुदाय के सदस्यों को ठोस आर्थिक लाभ मिलने की संभावना है। मान्यता और समर्थन के प्रतीकात्मक चिन्ह के रूप में, सुदर्शन किष्किट मछली सोसायटी को भारतीय खाद्य सुरक्षा और मानक प्राधिकरण (एफएसएसआई) से आधिकारिक लाइसेंस और आईएसएसटी से ट्रेड लाइसेंस प्रदान किए गए।



करीमगंज से बाज़ार लॉन्च कार्यक्रम की झलकियाँ

वैज्ञानिक प्रतिभा का उत्सव: इनोवेशन फेस्टिवल 2024 में आईएसएसटी की प्रतिभागिता

दिनांक 22 और 23 फरवरी, 2024 को क्षेत्रीय विज्ञान केंद्र, खानापाड़ा में राष्ट्रीय नवाचार फाउंडेशन-डीएसटी, भारत सरकार के सहयोग से राष्ट्रीय विज्ञान संग्रहालय परिषद द्वारा आयोजित "नवाचार महोत्सव" में आईएसएसटी ने प्रतिभागिता की।

आविष्कारशील और मनमोहक प्रदर्शनों के बीच, आईएसएसटी टीम ने संस्थान में हो रहे कई अभूतपूर्व कार्यों का प्रदर्शन किया, जिसने सभी उम्र और पृष्ठभूमि के आगंतुकों को आकर्षित किया। वैज्ञानिक उद्यमिता की परिवर्तनकारी क्षमता पर प्रकाश डालते हुए बायोनेस्ट-आईएसएसटी के स्टार्ट-अप इनक्यूबेटियों द्वारा तैयार किए गए उत्पादों को प्रदर्शित करने में उनका समर्पण विशेष रूप से उल्लेखनीय था।

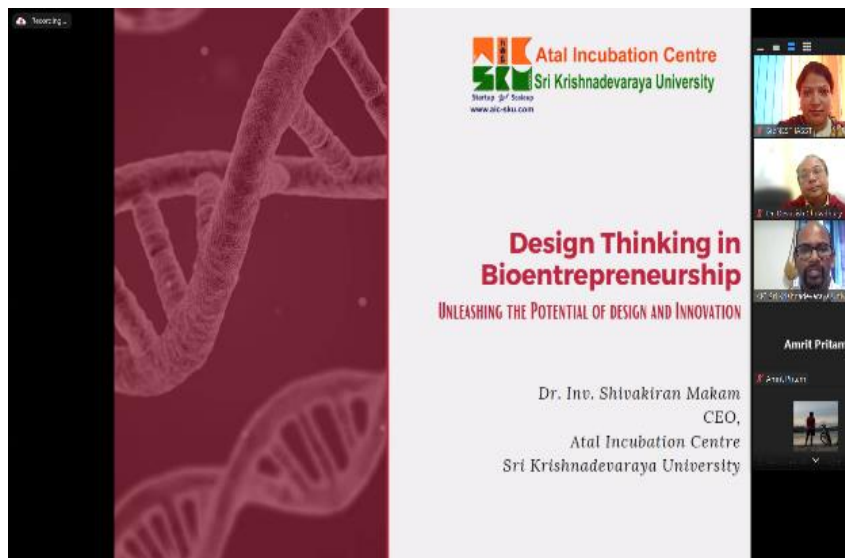


इनोवेशन फेस्टिवल 2024 में बायोनेस्ट-आईएसएसटी की भागीदारी की कुछ झलकियां

नवप्रवर्तन का मार्ग प्रशस्त करना: जैव-उद्यमिता में डिजाइन थिंकिंग की खोज

जैव-उद्यमिता की गतिशील दुनिया में, नवाचार ही गति है और आगे बने रहने का अर्थ है अत्याधुनिक रणनीतियों को अपनाना है। इसी विषय को ध्यान में रखते हुए बायोनेस्ट-आईएसएसटी द्वारा "बायो-उद्यमिता में डिजाइन थिंकिंग" विषय पर एक आकर्षक वेबिनार आयोजित किया गया। कार्यक्रम में अटल इनक्यूबेशन सेंटर- श्री कृष्णदेवराय विश्वविद्यालय के सीईओ डॉ. इनव शिवकिरण एम.एस. ने मुख्य वक्ता के रूप में भाग लिया।

25 जनवरी, 2024 को बायोनेस्ट-आईएसएसटी इनक्यूबेशन सेंटर में आयोजित इस ज्ञानवर्धक सत्र में डिजाइन थिंकिंग के क्षेत्र में गहन चर्चा की गई। डॉ. इनव शिवकिरण एम.एस. द्वारा प्रतिभागियों को इस क्षेत्र की जटिलताओं से अवगत करवाया गया तथा जैव-उद्यमिता में क्रांतिकारी बदलाव लाने की इसकी क्षमता पर जोर दिया। नवाचार के इस नए युग में बायोनेस्ट-आईएसएसटी द्वारा आयोजित यह वेबिनार नए उद्यमियों की प्रेरणा का स्रोत बना।



जैव उद्यमिता में डिजाइन थिंकिंग पर वर्चुअल वेबिनार सत्र का एक स्लैपशॉट

उद्यमी सशक्तिकरण: विश्व आईपीआर दिवस के अवसर पर नवाचारों हेतु बौद्धिक संपदा अधिकारों का निर्धारण

उद्यमियों के नवाचारों की सुरक्षा पर महत्वपूर्ण ज्ञान के साथ सशक्त बनाने के उद्देश्य से बायोनेस्ट-आईएसएसटी द्वारा दिनांक 26 अप्रैल, 2024 को 'बौद्धिक संपदा अधिकार दिवस के अवसर पर उद्यमियों के लिए नवाचारों की सुरक्षा से जुड़ी कानूनी बातों का अवलोकन विषयक एक सेमिनार आयोजित किया गया।

कार्यक्रम का आरंभ भौतिक विज्ञान प्रभाग के प्रो देवाशीष चौधरी के स्वागत संभाषण से हुआ, जिसमें उन्होंने नवाचार और उद्यमशीलता को बढ़ावा देने में बौद्धिक संपदा अधिकारों की महत्वपूर्ण भूमिका को रेखांकित किया।

सत्र का मुख्य आकर्षण गौहाटी उच्च न्यायालय के अधिवक्ता श्री तौहीद अलोम लस्कर का व्याख्यान रहा, जिसमें उन्होंने बौद्धिक संपदा अधिकारों से जुड़ी कानूनी पेचीदगियों पर विस्तार से प्रकाश डाला। उनके ज्ञानवर्धक चर्चा से कार्यक्रम में उपस्थित प्रतिभागियों को नवाचार संरक्षण के जटिल परिदृश्य को समझने में सहायता प्रदान की।



विश्व आईपीआर दिवस को चिह्नित करता समूह
चित्र



व्याख्यान देते हुए श्री तौहीद अल्लोम लस्कर