allotrope

One laboratory | Different forms

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Catalysing Innovation

The Golden Harvest: INDIA'S Way Forward for Pure and Premium HONEYS

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- *Innovation and the University*
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EDITORIAL

At CSIR-NCL, research is not pursued in isolation; it evolves into solutions that respond to national priorities, empower communities and contribute to a sustainable future. This issue of *Allotrope* reflects that spirit and demonstrates how fundamental science can evolve into solutions with lasting value.

Our cover story, *"The Golden Harvest: India's Way Forward for Pure and Premium Honeys,"* examines one such challenge where science intersects with public trust, rural livelihoods and heritage preservation. With honey adulteration emerging as a widespread concern, the development of an indigenous NMR-based authentication framework represents an important scientific milestone. Beyond ensuring quality and authenticity, this initiative supports India's beekeeping communities, strengthens rural economies and enhances the credibility of Indian honey in global markets. It illustrates how advanced analytical science can protect tradition while enabling economic resilience.

In *Curious Minds*, we feature the journey of Dr T. Raja, whose work in catalysis and energy systems exemplifies the translation of fundamental chemistry into scalable technologies. His work reflects a thoughtful integration of scientific insight and engineering application, advancing sustainable energy solutions while inspiring and mentoring young researchers.

This issue also reflects the dynamic and multifaceted ecosystem of CSIR-NCL. From advances in research and technology development to collaborations, outreach initiatives and student engagement, each activity contributes to a broader vision of science that is both innovative and inclusive.

Aligned with the theme *Allotropes of Science*, this edition captures the many forms of scientific endeavour at NCL. From decoding molecular signatures of honey to engineering catalysts for clean energy, these efforts illustrate how diverse research directions converge toward a common impact. As you turn these pages, you will encounter science in action - preserving authenticity and enabling sustainability.

We hope this issue informs, engages and inspires you.

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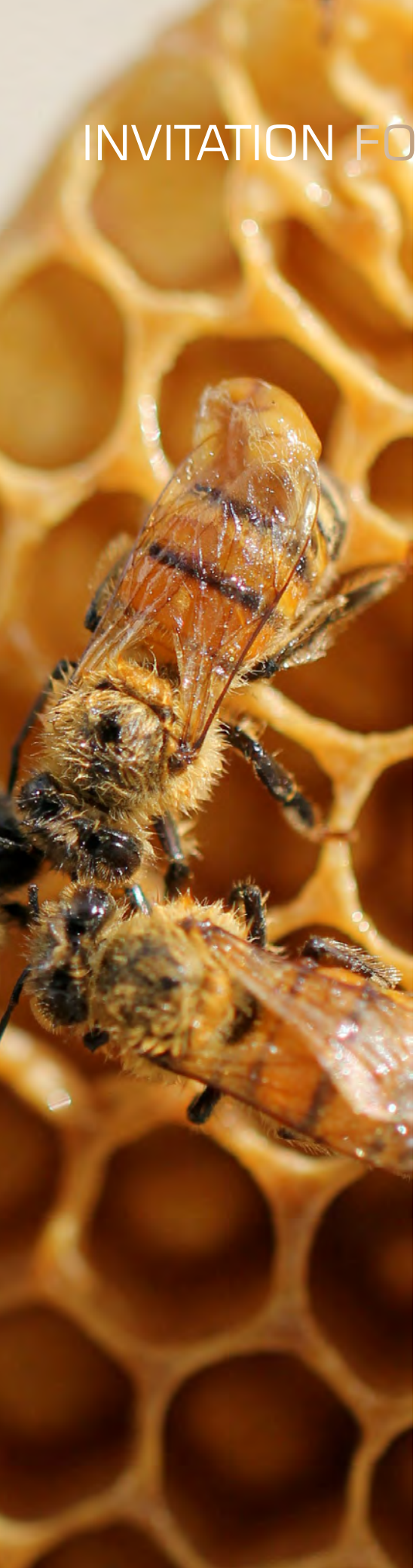


INVITATION FOR ARTICLES

We invite your contributions for Allotrope in the following capacities:

Research stories

Explain your research/ ongoing experiment in a simplified manner.

Science articles

Describe a contemporary science topic, a scientific concept, technology, or a scientist of interest.

Individual experiences

Write about your personal field research/ travel experiences, conferences, paper/ poster presentations, PhD journey, or others. Senior scientists and staff members are invited to share their work experiences and insights.

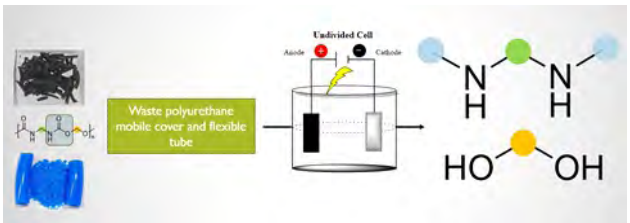
Visual narrations

Showcase your research or technology with the help of a schematic or a graphic. Photographs related to NCL are also welcome.

The word limit for writing stories and articles is 500 words.

Kindly send your entries to: allotrope.ncl@csir.res.in

CONTENT



THE GOLDEN HARVEST: INDIA'S WAY FORWARD FOR PURE AND PREMIUM HONEYS

India's mission on "Sweet Revolution" for pure honey calls for the synergy of science, traditional knowhow and bold initiatives to secure its future.

Derived from the remarkable collaboration in nature, honey is a luscious product born of honeybees' diligent efforts to gather nectar from a diverse array of vibrant flora. This ambrosial substance has enjoyed an enduring presence in the heritage of human civilisations since time immemorial. Respected by cultures across the globe, it found favour in the annals of Ayurveda, the ancient practices of traditional Chinese medicine, as well as being revered by Egyptian, Mesopotamian and Mayan civilisations. Recognised for its pivotal role in both culinary and medicinal applications, honey has consistently been harnessed to promote overall well-being. Beyond its historical significance, in the modern era, honey has assumed a substantial role in bakeries, confectioneries and the cosmetics industry.

India's Honey Industry: A Buzzing Economic Force

India boasts a sprawling honey industry that annually contributes approximately ₹3,000 crores to its GDP. As per estimates for the fiscal year 2024–2025, India emerges as the second-largest honey producer globally, with an impressive annual yield of around 150,000 metric tonnes. Notably, a substantial 55% of this honey production finds its way to international markets, underlining India's prominent position in the global honey trade.

The Indian government has demonstrated its commitment to nurturing this burgeoning industry by launching special initiatives such as the National Beekeeping & Honey Mission (NBHM), which stands as a vanguard for the advancement of scientifically driven commercial beekeeping practices. Presently, India boasts a remarkable 1.9 million honey bee colonies, with over 800,000 families actively engaged in beekeeping.

The significance of commercial beekeeping transcends mere economic incentives, as it profoundly impacts the grassroots level by bolstering agricultural output through the critical role of crop pollination. To further strengthen these efforts, government missions such as the CSIR Floriculture Mission and CSIR Aroma Mission lend vital support to beekeeping endeavours by ensuring the availability of essential floral resources for honeybees. In addition to the organised sector, India hosts a substantial unorganised sector dedicated to the harvesting of forest honey, where indigenous tribes and local villagers actively participate in the collection of this precious resource.

The Dark Side of Sweetness: The Honey Adulteration Crisis

However, honey has recently garnered infamy as the world's third most counterfeited product. The widespread adulteration of honey involving deceptive syrups such as rice bran syrup, corn syrup and jaggery syrup has become an alarming practice within the honey industry. Notably, such adulteration often evades detection through conventional analytical tests designed for authenticating honey, leaving consumers largely unaware.

In 2020, a troubling exposé revealed the extent of this malpractice within major Indian honey brands. An independent study conducted and published by the Centre for Science and Environment (CSE) in Delhi uncovered the distressing fact that 77% of India's leading commercial honey brands failed a rigorous test known as the 'NMR test for honey', a recent European development aimed at ensuring honey purity. This revelation cast a shadow over the credibility of Indian honey.

Recognising the gravity of this revelation, the findings received extensive coverage in prominent national newspapers and underwent thorough scrutiny in Parliament and the Supreme Court. An investigative report submitted by the Minister of State for Health and Family Welfare to Parliament in April 2022 exposed yet another disconcerting fact: around 30% of honey samples from various states and Union Territories' honey manufacturing units failed to meet even the most basic food safety standards, let alone concerns related to syrup adulteration.

NMR: A Game-Changer for Honey Purity

Nuclear Magnetic Resonance (NMR) is an advanced analytical technique employed in the characterisation of a wide range of substances, including chemicals, pharmaceuticals, food products, nutraceuticals and materials. The NMR test for honey, developed in Europe, is a state-of-the-art method for the qualitative and quantitative assessment of honey.

Distinguished by its ability to simultaneously detect and quantify multiple constituents within honey, the NMR test surpasses all other biophysical techniques used in honey analysis. Notably, it serves as an unparalleled tool for detecting adulteration with syrups and determining the floral and geographical origins of different honey varieties, thereby setting a benchmark for precision and accuracy.

However, the European NMR test faces limitations when applied to Indian honey. This stems from concerns regarding the European honey NMR master database upon which the method relies. Consequently, the existing database does not adequately represent the full spectrum of geographical, floral, seasonal and bee species-based variations unique to Indian honey.

India's rich diversity of honeys is a valuable national asset, necessitating comprehensive scientific exploration of all Indian honey varieties and the creation of an indigenous honey NMR master database tailored to national requirements. At present, when Indian honey samples are analysed using the European NMR test, the data are transferred to foreign entities for report generation, inadvertently limiting India's control over its own resource.

An Indigenous Scientific Breakthrough

Two reputed Pune based laboratories, the CSIR-National Chemical Laboratory (NCL) and the Central Bee Research and Training Institute (CBRTI) took the initiative to address this challenge by synergizing their domain expertise in honey and NMR. Aided by seed funding through in-house resources and a pilot project supported by the Khadi and Village Industries Commission (KVIC), the labs successfully developed a prototype NMR test specifically tailored for Indian honey varieties.

It has been demonstrated that the method, including sample preparation protocols, NMR parameters and statistical data analysis, can determine the type and extent of adulterants, thereby validating the authenticity and origin of Indian honeys. Furthermore, these efforts open avenues for identifying key metabolites that may be linked to unique medicinal properties of honey.

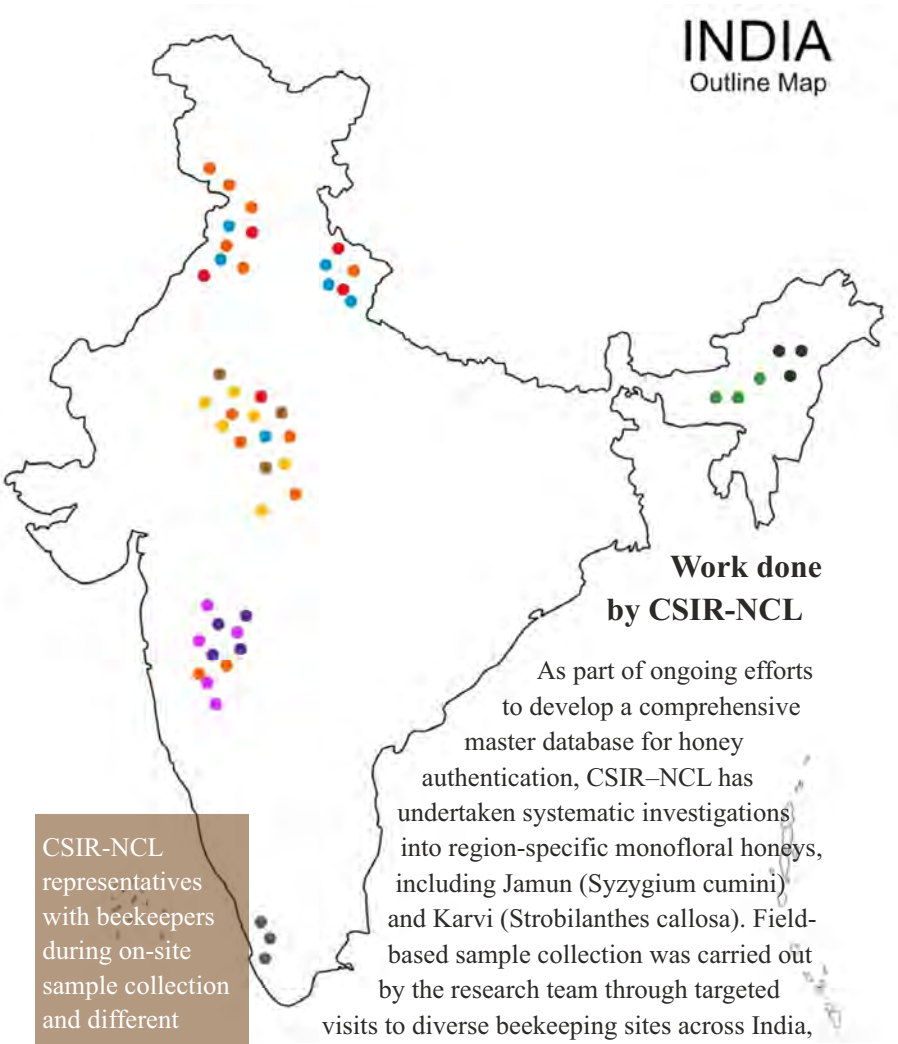
Scientific Preservation of India's Honey Heritage: Charting the Future

The potential outcomes of this initial work have so far been discussed in two important stakeholder meetings held in Pune (March 2023) and Shillong (September 2023) which were attended by the KVIC, Meghalaya Farmers Empowerment Commission (MFEC), North East Centre for Technology Application and Reach (NECTAR), National Bee Board (NBB), the National Dairy Development Board (NDDB), Forest-Based Industries and Institutes, Agricultural Universities, CSIR laboratories and various non-governmental organizations. In addition, CSIR-NCL has been approached by Food Safety and Standards Authority of India (FSSAI) and Tribal Cooperative Marketing Development Federation of India (TRIFED), Ministry of Tribal Affairs to showcase the work done by CSIR-NCL at their national platforms.

In a unanimous consensus, the experts agreed that this pivotal initiative opens the possibility of creating a Standard Honey NMR Master Database for Indian honeys. This is not only relevant in the current landscape which is marked by rampant adulteration of honey, but is also essential for instilling scientific credibility into the realm of Indian honey. This effort will pave the way for the creation of robust testing protocols specific to honey, the formulation of standards tailored to Indian honey varieties and the identification of unique or premium Indian honeys.

The foundation of this master data necessitates the collection of authentic samples following established Standard Operating Procedures (SOPs) and comprehensive metadata. Although this undertaking is undeniably challenging and labor-intensive, it is a feasible mission, which can be realized through the collaborative efforts and support of associated ministries, organizations, cooperative societies, NGOs, beekeepers and individual experts.

Ultimately, this undertaking will catalyze the growth of the honey industry, promising a prosperous future for beekeepers and honey producers alike. This ambitious endeavor is poised to unlock the commercial potential of Indian honey, delivering not only a treasure trove of knowledge but also promising significant economic opportunities.



CSIR-NCL representatives with beekeepers during on-site sample collection and different Indian regions (coloured dots) from where different honey samples were collected.

Work done by CSIR-NCL

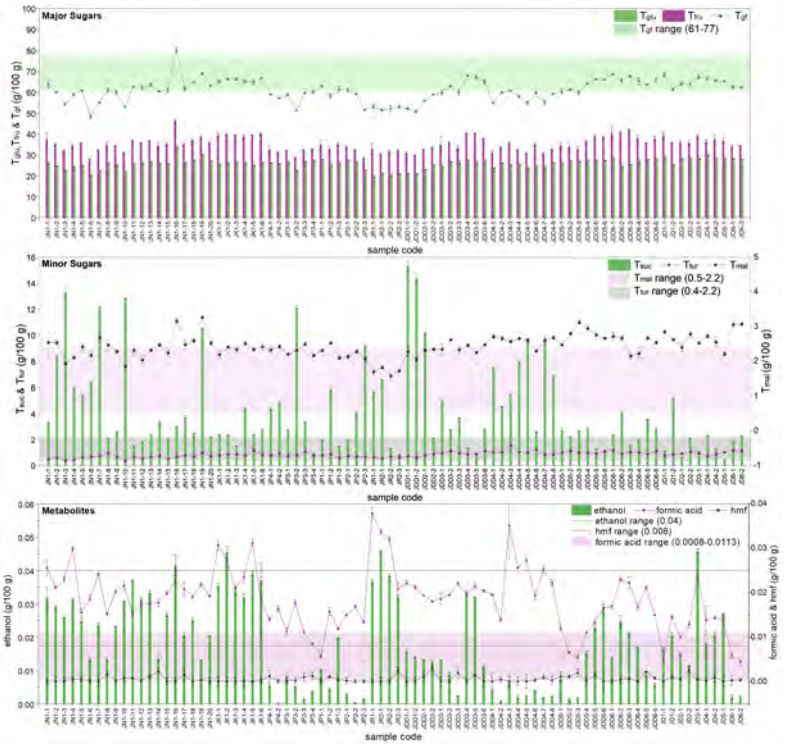
As part of ongoing efforts to develop a comprehensive master database for honey authentication, CSIR–NCL has undertaken systematic investigations into region-specific monofloral honeys, including Jamun (Syzygium cumini) and Karvi (Strobilanthes callosa). Field-based sample collection was carried out by the research team through targeted visits to diverse beekeeping sites across India, ensuring procurement of authentic, well-documented monofloral honey samples directly from natural and apicultural sources.

India's exceptional floral diversity underpins a vast spectrum of monofloral honeys, many of which remain underexplored despite their nutritional, functional and commercial potential. Within this landscape, Jamun honey and Karvi honey represent distinctive varieties that reflect ecological specificity and compositional uniqueness. Systematic investigation of such honeys is essential for elucidating their molecular composition, establishing authentication markers and generating high-quality datasets for scientific validation and value addition.

Flowers of a wild variety of Jamun and Karvi from the Mahabaleshwar region of the Western Ghats of India.

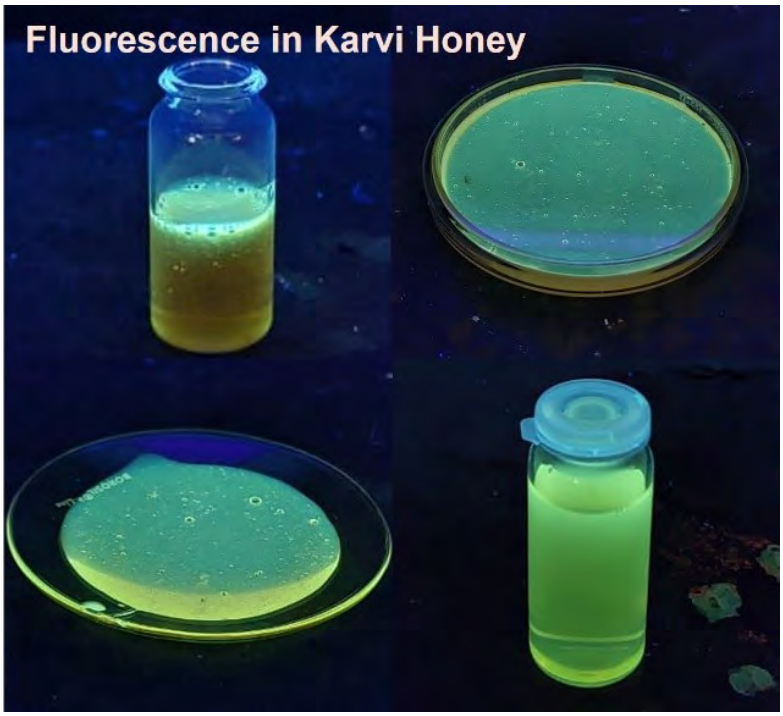
Jamun honey, produced by Apis cerana bees foraging on Syzygium cumini, has long been associated with notable medicinal and antioxidant properties. To characterise its composition, 82 samples from the Mahabaleshwar region were analysed. Nuclear Magnetic Resonance (NMR) spectroscopy was employed to profile saccharides, including glucose, fructose, sucrose, maltose and turanose, as well as metabolites such as ethanol, formic acid and 5-hydroxymethylfurfural (HMF). High-Performance Liquid Chromatography (HPLC) enabled identification of phenolic acids and flavonoids, including catechin, chrysin, kaempferol, luteolin, myricetin, naringenin and rutin. Antioxidant assays confirmed strong radical scavenging activity, consistent with its phenolic profile. Principal Component Analysis (PCA) revealed distinct clustering, underscoring its compositional identity.

Karvi honey, derived from Strobilanthes callosa in the Western Ghats, exhibits a composition shaped by its unique flowering cycle and ecological context. Analysis of Apis dorsata and Apis cerana samples revealed characteristic saccharides, metabolites and the amino acid phenylalanine, which may serve as a botanical marker. The presence of lumichrome and phenyllactic acid imparts antioxidant, antimicrobial and fluorescent properties.

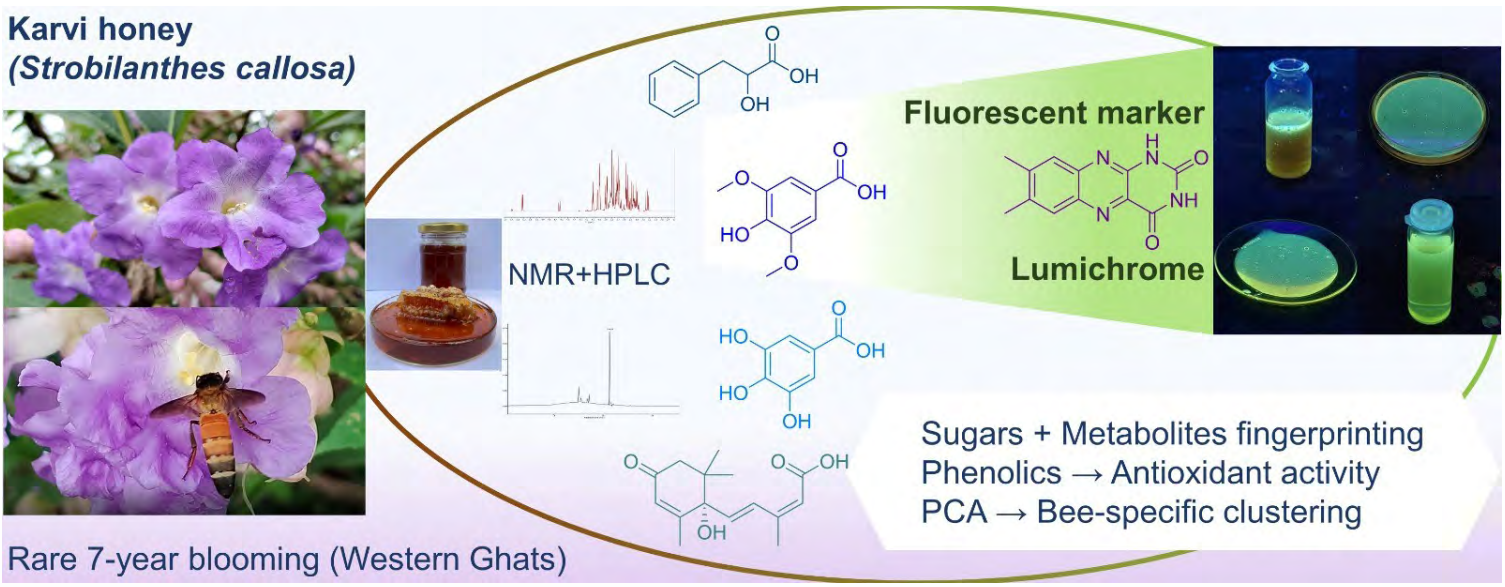


Histogram showing the quantitative profiles of major sugars (glucose and fructose), minor sugars (sucrose, maltose, turanose) and certain metabolites (ethanol, formic acid and 5-(hydroxymethyl)furfural (hmf)- a processing indicator) as obtained from NMR analysis of 82 Jamun honey samples from Mahabaleshwar, Western Ghats, India.

Phenolic constituents such as abscisic acid, syringic acid and gallic acid further enrich its profile. Intrinsic fluorescence under UV light provides an additional authentication parameter. PCA analysis highlights compositional variation linked to both botanical and entomological factors.



Karvi honey sample exhibiting characteristic fluorescence under UV light.



A general representation of the study on Karvi honey depicting various polyphenolic compounds (generally responsible for antioxidant properties of honey) identified in it.

The chemical profile is further enriched by phenolic constituents, including abscisic acid, syringic acid and gallic acid, alongside a range of unresolved phenolic-like compounds indicative of greater underlying complexity. Its intrinsic fluorescence under UV irradiation provides an additional parameter for authentication. Consistent with its compositional attributes, antioxidant evaluation indicates substantial radical scavenging activity. Multivariate analysis using Principal Component Analysis (PCA) further resolves compositional variation across samples, including distinctions associated with honeybee species, highlighting the capacity of metabolite profiling to capture both botanical and entomological influences. Taken together, these observations position Karvi honey as a chemically distinctive system with significant implications for authentication, functional evaluation and future standardisation efforts.

These efforts establish the foundation for a reliable, science-driven ecosystem for honey authentication in India. Strengthening the scientific basis for quality assurance enhances confidence in origin and compositional integrity, while extending its relevance beyond analytical validation. It directly supports beekeepers and rural communities whose livelihoods depend on the authenticity of honey production and reinforces the value of India's diverse indigenous honeys in both domestic and global markets. By enabling transparent, evidence-based verification, such approaches offer a clear pathway to curb adulteration, build consumer trust and elevate India's honey heritage as a well-recognised and protected natural resource.

In the process of building the fingerprinting master data for honeys, while parallelly profiling each honey and establishing its metabolic standards, CSIR-NCL has, to date, developed an in-house NMR-based honey authentication method and compiled a master database of approximately 500 authentic honey samples, forming a foundation for future quality assessment of honey.

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Dr T. Raja
The Catalyst of Possibility

Curiosity is the spark that ignites discovery. At the heart of our work are brilliant minds driven by knowledge and a deep desire to understand, innovate, and transform the world through research and innovation. These are the explorers of the unseen — the ones who see possibility in every molecule and progress in every reaction.

Dr T. Raja prefers to give thoughtful, detailed responses rather than answering questions directly. Ask him about careers, and he speaks of reactions. Ask about people, and he describes systems. Ask about the future, and he returns, almost instinctively, to molecules.

For him, chemistry is not confined to the laboratory. It is a way of understanding the world through interaction, transformation, and unseen forces. Even his long-standing interest in psychology follows the same logic.

"The mind is not good or bad. The problem is how much we poison it."

It is a thought that could just as easily describe a catalytic system, where outcomes depend entirely on conditions.

If life had followed his early ambitions, Dr Raja might have become a physician or a military officer. Neither happened. Instead, an unplanned turn led him toward catalysis, a field that would eventually define his life's work.

"Why I chose catalysis, I still do not know," he says with characteristic honesty.

The Making of a Scientist

Raised in Bhavani near Coimbatore, Dr. Raja grew up in a white-collar cum agricultural oriented family. His parents chose a Tamil-medium government school for him, ensuring he remained grounded in everyday realities.

After completing his BSc in Chemistry, he briefly entered business by starting a textile dyeing unit. Even there,

however, he found himself drawn less to operating processes and more to understanding them. “Build your intellect first,” his father advised him. That decision quietly redirected his life.

At the University of Madras, where he pursued his MSc and PhD, chemistry evolved from a subject into a way of thinking, “Chemistry is the key to mystery,” he says. Drawn to physical chemistry and surface science, he became fascinated by how molecules behave at interfaces.

Catalysis emerged naturally from that curiosity. It offered a way to study transformation at its most fundamental level, how small changes in conditions can completely alter outcomes. That instinct eventually brought him to CSIR-National Chemical Laboratory (NCL), Pune.

“I left, or ran away from, Tamil Nadu in southern India and came here, hoping to start a new chapter in my professional life,” he says with a laugh.

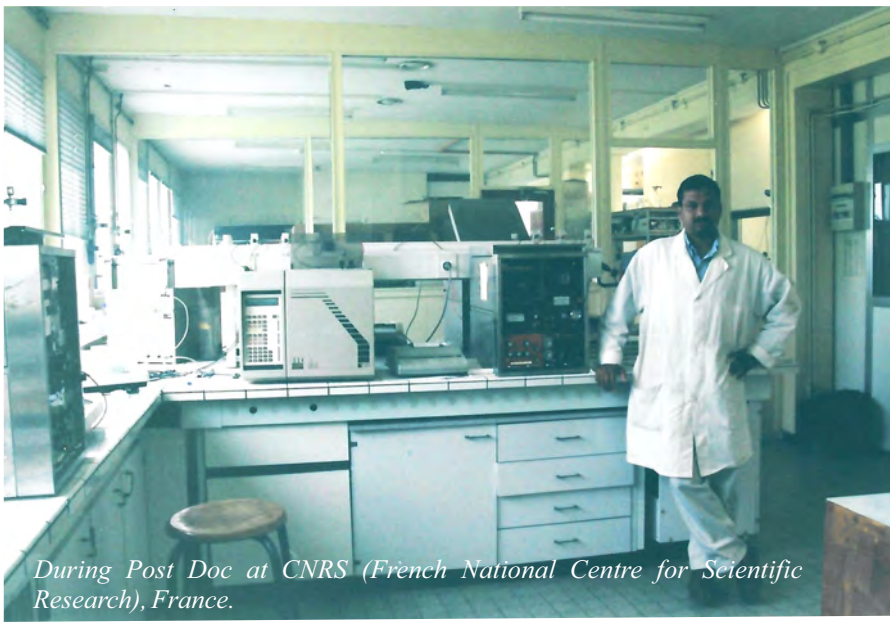
Learning Through Immersion

When Dr Raja arrived at NCL in 1998, the experience was overwhelming. “I had never seen so many instruments,” he admits. Techniques such as XRD, SEM and XPS were entirely new to him. Coming from an environment where resources were limited, the scale of scientific infrastructure felt almost unreal.

His response was complete immersion. “I decided the facilities must be used fully,” he says. Days stretched into nights, often involving 12 to 14 hours in the laboratory. There were no shortcuts, only discipline, repetition, and learning by doing. Within two years, he had published several strong research papers.

His postdoctoral years in France and Japan further shaped his scientific outlook. “Eight hours means eight hours of work. No distractions.” That discipline would later define the research culture he built within his own group.

Dr T. Raja (centre) with fellow researchers during his PhD at the University of Madras.



During Post Doc at CNRS (French National Centre for Scientific Research), France.

The Real Challenge: Scaling Up

“The chemistry we know. The challenge is industry.”

For Dr Raja, discovery is only the beginning. A catalyst that performs beautifully in the laboratory can fail completely in an industrial plant. Temperature fluctuations, impurities, pressure and operational demands introduce complexities that theory alone cannot solve.

One of the defining milestones of his career came when catalysts developed by his team were scaled to industrial production, with 110 tonnes supplied to an American company for the biodiesel plant.

“This is from a developing country to a developed country,” he says with quiet satisfaction. It was proof that Indian science could compete globally in real-world deployment. His team's catalyst systems have demonstrated over 12,000 hours of continuous operation, an indicator of true industrial reliability.

CSIR-NCL's Methanol to DME Pilot Plant (250 kg/day) using a patented indigenous catalyst.

The Aditi Urja Sanch burner being demonstrated as part of the successful validation of DME-LPG blended fuel technology.

Among his most ambitious contributions has been his work related to the ITER (International Thermonuclear Experimental Reactor) fusion program, where his team developed catalyst systems capable of functioning under extreme conditions involving hydrogen mitigation isotopes, radiation, and reactive dust.

"No one accepted the challenge; we took it." After several setbacks, the team developed a dual-layer catalyst system now progressing toward international validation.

Much of Dr Raja's recent work focuses on dimethyl ether (DME), a cleaner alternative fuel that can be blended with LPG. His work extends beyond catalyst development to include the design of complete industrial systems, including reactors and process integration strategies.

Even during the COVID-19 lockdown, his group continued working under severe constraints, resulting in multiple patents and a successful scale-up from milligram quantities to hundreds of kilograms.

For India, where energy dependence on imports remains significant, such technologies hold long-term importance. Yet Dr Raja remains pragmatic. Science alone, he believes, is not enough. Policy, infrastructure and industry must evolve alongside it.

Collaboration and Mentorship

A defining feature of Dr Raja's career has been his close engagement with industry. Collaborations with organizations such as IOCL, ONGC, and international partners have shaped his applied approach to research.

"In the lab, we get excited when something works. But industry asks: can you make it in tonnes?"

That philosophy strongly influences his mentorship as well. For his students, the expectations are clear: discipline, curiosity, and ownership of work. "Before you sleep, read at least one paper," he advises. He encourages students to ask questions freely and acknowledge what they do not know. "If you accept that you don't know, learning will come automatically."

Dr T Raja and his research group.

Dr Raja speaks about his students with genuine respect. "Even today, I learn from my students," he says. Most of his achievements, he insists, belong largely to them. "My students contribute more than 90 percent."

For him, mentorship is not instruction but a shared discovery. "Do not work for name and fame, let the data speak."

His philosophy toward work remains deeply simple: "Work never fails. Work is worship."

Life Beyond the Reaction

Beyond catalysis and reactors, Dr Raja reveals a deeply reflective side.

A passion for Carnatic music and an avid reader of psychology and philosophy, he remains deeply interested in understanding human behaviour.

"Understanding people is important, otherwise, how will you work with them?"

Influenced by thinkers such as Bertrand Russell, he often turns to books to explore relationships, thought processes and the human condition. For him, science is inseparable from life itself.

"Basic science gives applied science. Without basics, nothing will come."

Even as he speaks about the future, retirement appears not as an endpoint but as a transition. He hopes to continue contributing to applied science, possibly by founding his own company. "Without science, I am nowhere," he says simply. He speaks candidly about uncertainty, limitations and the continuous process of learning. "Even today, there are many things I don't know," he admits. "And I am still learning."

If one returns to where the conversation began, with reactions, systems and molecules, it becomes clear that Dr T. Raja is not only speaking about chemistry. He is speaking about change itself.

In his world, nothing transforms by accident, not a reaction, not a catalyst, not a career. Every outcome is shaped quietly by conditions: pressure, environment, time and persistence. Most people look for breakthroughs. Dr Raja looks for alignment.

"Stay with the problem. Then slowly it will tell you what to do."

And perhaps that is the real catalyst: not the material that accelerates change, but the patience to let conditions find their form.

CSIR-Technology Award 2015-16.

Electrochemical Activation of Urethane for Sustainable Polymer Transformation

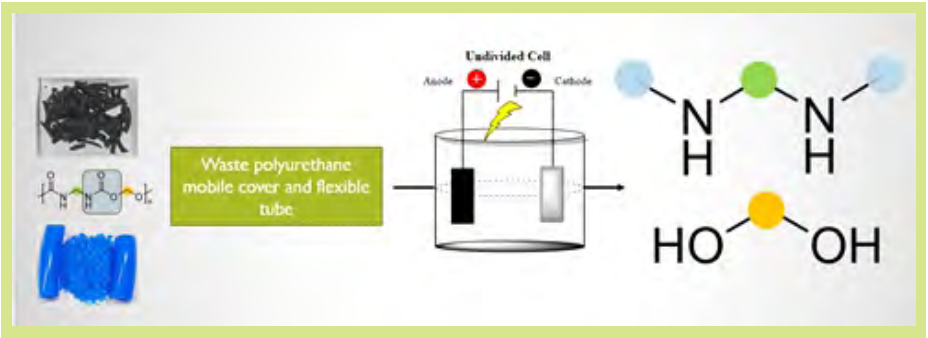
Urethane linkages, long considered chemically inert structural units in polymers, can be selectively activated under electrochemical conditions to function as carbamoylation reagents, enabling direct and controlled transfer of the carbamoyl unit for diverse bond-forming transformations.

A carbamoylation reagent is a chemical entity that enables the transfer of a carbamoyl group (–CONH–) to a target molecule, facilitating the formation of new C-N bonds in a controlled manner.

Plastics are an essential part of modern life, with polyurethane occupying a key place in applications ranging from various rigid and flexible foams and coatings to tubing and consumer electronics. However, this convenience carries a significant environmental burden. As global plastic production continues to rise, effective recycling rates remain very low, leading to the accumulation of discarded materials in landfills and natural ecosystems, including oceans.

Mechanical recycling, although widely practised, generally leads to downgraded materials with reduced performance, limiting its long-term sustainability. As a result, chemical recycling strategies capable of restoring or transforming polymer value have become an important research priority. Among common plastics, polyurethane presents a particularly difficult challenge due to its highly stable carbamate (urethane) linkages, which resist conventional degradation pathways.

Traditional approaches to polyurethane recycling reflect this challenge. They typically rely on harsh conditions such as temperatures above 150°C, high hydrogen pressures (30-70 bar) and expensive precious-metal catalysts such as iridium and ruthenium. While effective, such methods are energy-intensive and economically limiting, highlighting the need for more sustainable and accessible alternatives.



At CSIR-National Chemical Laboratory Dr Ramesh C. Samanta and Mr Adarsh Singh present a fundamentally different strategy; one that shifts the perspective from forceful bond cleavage to controlled bond activation. Their work reveals that **urethane linkages**, long regarded as chemically inert, can be transformed into reactive intermediates under electrochemical conditions.

The heart of this approach is the use of electricity as a clean and precise driving force. Under carefully controlled electrochemical conditions, the urethane functionality is selectively activated, enabling it to function as an efficient **carbamoylation reagent**. This activation allows the formation of a diverse set of bonds, including carbon-nitrogen (C-N), carbon-phosphorus (C-P) and carbon-carbon (C-C) linkages, all under relatively mild conditions of around 60°C.

This represents a notable conceptual shift. Rather than viewing urethane solely as a stable structural element within polymers, it is redefined here as a versatile and reactive synthon, capable of participating in a wide range of chemical transformations.

This reactivity extends beyond model systems to real-world materials. The researchers demonstrate that commercially available polyurethane products, including flexible tubing and mobile phone covers containing additives that can be effectively deconstructed using this electrochemical approach. In the presence of amines, the polymer network undergoes controlled breakdown through C-N bond formation, achieving deconstruction efficiencies of up to 84%. Importantly, these transformations

proceed under significantly milder conditions than those required by conventional methods.

Beyond depolymerisation, the work also introduces the concept of polymer backbone editing. When treated with diamines, the urethane linkages can be selectively converted into urea linkages, enabling precise modification of the polymer structure. This ability to *"rewrite"* the polymer backbone highlights a broader potential, not merely to recycle plastics but to redesign them.

The versatility of the method is particularly striking. The same electrochemical platform supports both small-molecule carbamoylation reactions and polymer transformations, effectively bridging the gap between synthetic organic chemistry and waste materials recycling. In doing so, it reframes polyurethane waste not as a terminal problem, but as a source of value-added chemicals.

Compared with established thermochemical and catalytic hydrogenolysis approaches, which often suffer from high energy demands and reliance on costly catalysts, this electrochemical strategy offers a more sustainable alternative. It operates under milder conditions, avoids precious metals and introduces new avenues for selective bond formation.

By demonstrating that urethane linkages can be selectively activated and repurposed through electrochemical control, this study opens a new direction in sustainable polymer recycling/upcycling chemistry. It addresses a pressing environmental challenge while simultaneously expanding the synthetic utility of one of the most robust functional groups in modern materials.

As efforts to manage plastic waste continue to evolve, strategies that combine molecular-level precision with scalable electrochemical techniques are likely to play an increasingly important role. This work represents a meaningful step in that direction; repositioning polyurethane from a persistent waste material to a chemically active resource capable of generating new valuable molecules.

Unveiling the Electrochemical Reactivity of Urethane Toward Different Bond Formations and Application to Polyurethane Deconstruction via C─N Bond Formation

*Adarsh Singh, Ramesh C. Samanta**

DOI: https://doi.org/10.1002/anie.202523229

ANRF SARAL AI Video

Featured Research

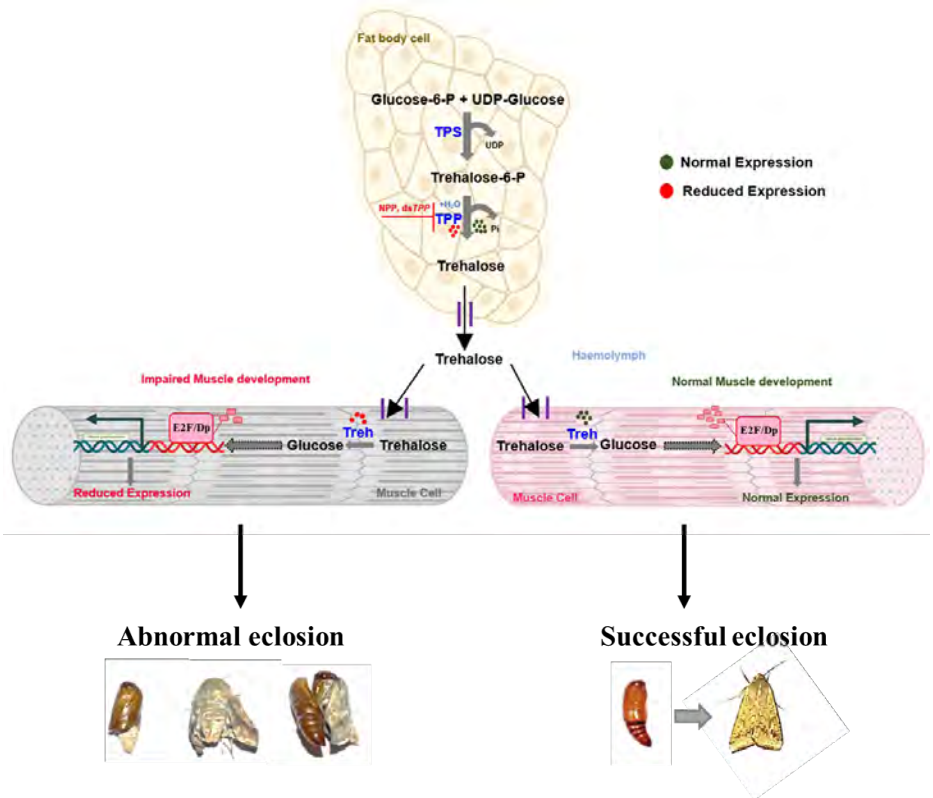
Trehalose is the primary circulating sugar in insects, has long been regarded as a metabolic substrate required for energy production during high-demand physiological stages such as flight and metamorphosis.

Trehalose Metabolism Links Energy Balance to Muscle Development in Insects

Metamorphosis is among the most energy-intensive and tightly coordinated phases in an insect's life. During this transition, larval tissues are dismantled and rebuilt into adult structures, including highly organised flight muscles essential for survival. While the role of hormones and developmental genes in this process is well established, the contribution of metabolism, particularly how energy availability influences muscle formation, has remained unclear.

A recent study at CSIR-NCL by Dr Rakesh Joshi and his team on the cotton bollworm moth, *Helicoverpa armigera,* now provides important insight into this connection. The work demonstrates that trehalose metabolism does far more than supply energy during metamorphosis; it actively regulates the genetic machinery required for muscle development.

Trehalose is the primary circulating sugar in insects, functioning as a major energy reservoir. During development, trehalose is converted into glucose, which enters glycolysis, the central pathway responsible for cellular energy production. To investigate the significance of this pathway, researchers disrupted genes involved in trehalose synthesis, specifically *trehalose 6-phosphate synthase/phosphatase* (*TPS/TPP*), along with *paramyosin* (Prm), a structural muscle protein.



Insects with impaired trehalose metabolism failed to complete normal eclosion and displayed fragmented, poorly organised muscle fibres. Microscopic analysis revealed disorganized muscle architecture, indicating that disruption of metabolic balance directly affects muscle formation during metamorphosis.

To understand the underlying biochemical changes, the researchers performed metabolic profiling. They observed broad depletion of glycolytic intermediates and key cellular cofactors, indicating a major reduction in energy production. Simultaneously, AMP levels increased significantly, indicating cellular energy stress. Together, these findings showed that trehalose-derived glucose flux is essential for sustaining glycolysis and maintaining energetic homeostasis during insect development.

This study reveals that E2F/Dp, a transcription factor complex, links trehalose metabolism to muscle development by regulating genes involved in cell-cycle progression and developmental tissue formation.

Beyond metabolism, the study showed an unexpected link between cellular energetics and gene regulation. Transcriptomic analysis showed significant downregulation of the transcription factor complex **E2F/Dp**, accompanied by reduced expression of cyclins and cyclin-dependent kinases involved in cell-cycle control. This suggest that energy stress caused by impaired trehalose metabolism disrupts transcription necessary for proper developmental progression.

Further investigation showed that repression of E2F/Dp reduced the expression of several genes essential for muscle development , including Myocyte enhancer factor (Mef2), paramyosin (Prm) and myosin heavy chain (MHC). As these proteins are critical for muscle assembly and contractile function, their reduced expression explains the defective muscle phenotype observed in the silenced insects.

The computational analyses, including gene regulatory network and promoter binding site analysis, identified E2F-binding motifs within promoters of both trehalose metabolism genes and myogenic genes. This highlights a coordinated metabolic-transcriptional regulatory system, where nutrient availability and energy balance directly influence developmental gene expression.

To further validate this relationship, the researchers supplemented the insects' diet with trehalose. Remarkably, trehalose feeding partially restored metabolic balance and rescued the expression of several myogenic genes and TFs, even in *TPS/TPP*- and *E2F/Dp*-silenced insects. The recovery of muscle-related transcription strongly supports the role of trehalose metabolism as a central regulatory node linking energy metabolism with developmental signaling.

The study provides new insights into insect physiology by demonstrating that metabolism is not merely a passive support system for development. Instead, metabolic pathways actively communicate with transcriptional networks to determine whether sufficient energy resources are available for tissue formation and differentiation.

Beyond its developmental significance, the work may also hold relevance for agricultural science. As *Helicoverpa armigera* is a major crop pest, understanding vulnerabilities in its metabolic and developmental pathways could potentially contribute to future pest management strategies targeting insect growth and metamorphosis.

The findings highlight an emerging theme in biology: metabolism and gene regulation are deeply interconnected. By uncovering how trehalose metabolism governs transcriptional control of muscle development, this study provides a molecular framework linking energy homeostasis, cell-cycle regulation and tissue development during metamorphosis

Trehalose metabolism regulates transcriptional control of muscle development in lepidopteran insects

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Featured Research

Metabolomics-based profiling enables the comprehensive identification and quantification of small molecules in honey, providing a chemical fingerprint that can be used for authentication and quality assessment.

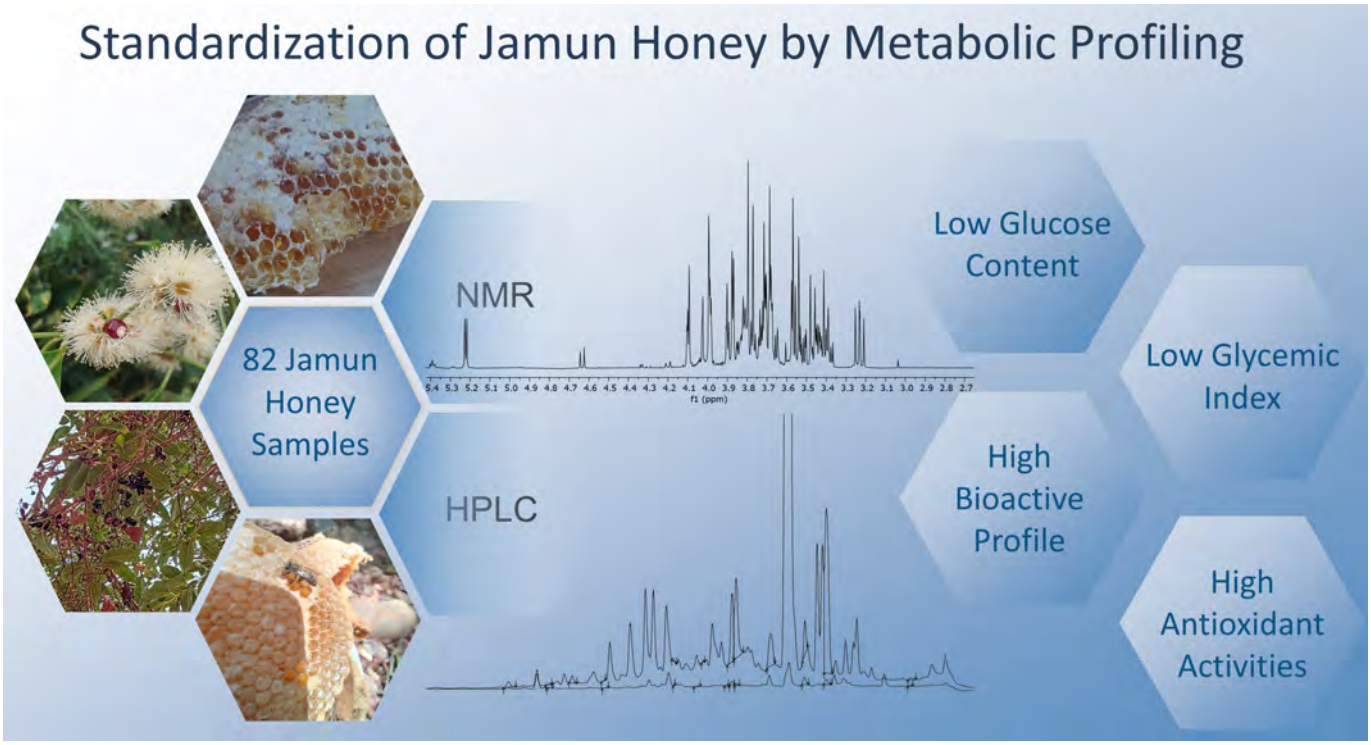
The fructose-to-glucose ratio in honey is a key compositional parameter; higher ratios are often associated with slower glucose release and a potentially lower glycaemic response.

A Molecular Approach to Decoding the Authenticity and Functional Value of Jamun Honey

Honey, one of nature's most valued products, is far more than a simple natural sweetener. Its composition reflects a complex interplay between botanical origin, geography and bee activity. Among India's diverse honey varieties, Jamun honey derived from *Syzygium cumini*, has long been recognised in traditional knowledge systems for its medicinal and wound-healing properties, attributed in part to its rich antioxidant and metabolite composition. However, scientific validation of these properties, alongside reliable authentication methods, has remained limited.

At CSIR-National Chemical Laboratory, Dr Udaya Kiran Marelli and his team have undertaken a comprehensive investigation into the **metabolomics-based profiling** of Jamun honey, adopting a data-driven approach that combines advanced analytical techniques with large-scale sampling. Their study presents one of the most extensive metabolic profiles reported for a single-origin honey, establishing a scientific foundation for both quality assessment and functional evaluation.

The work is centred on the analysis of 82 authentic Jamun honey samples collected from the Mahabaleshwar region, produced by *Apis cerana* bees. Using Nuclear Magnetic Resonance (NMR) spectroscopy, the researchers quantitatively mapped the sugar composition, including glucose, fructose, sucrose and other saccharides. Complementary analysis using High-Performance Liquid Chromatography (HPLC) enabled the identification and quantification of phenolic acids and flavonoids, key contributors to antioxidant activity.



A defining outcome of this study is the consistently low glucose content observed across all samples, along with reduced total glucose and fructose levels when compared with typical honey varieties. This results in a relatively high **fructose-to-glucose ratio**, an indicator often associated with a lower glycaemic response. These findings lend quantitative support to the long-standing perception of Jamun honey as a potentially suitable option for individuals managing blood sugar levels.

Beyond its sugar profile, the study reveals a rich composition of bioactive compounds. Several phenolic acids and flavonoids, including myricetin, kaempferol and 4-hydroxybenzoic acid, were identified in significant quantities. Their presence correlates with strong antioxidant activity, as confirmed through targeted biophysical assays. This supports Jamun honey not merely as a nutritional product, but as a functional food with measurable health-related properties.

Importantly, the study also highlights limitations in conventional methods of honey authentication. Melissopalynology, or pollen analysis, showed a surprisingly low presence of Jamun pollen in the samples. This observation highlights the challenges of relying solely on pollen-based identification and points to the growing relevance of metabolomics-driven approaches for accurate floral authentication.

The quality and integrity of the samples were further supported by minimal levels of fermentation markers such as hydroxymethylfurfural (HMF) and ethanol, indicating stable and well-preserved honey. Such consistency strengthens the reliability of the dataset and its potential use as a reference standard.

In the context of increasing concerns over honey adulteration, this work represents a significant advancement. By establishing a detailed compositional reference for authentic Jamun honey, the study lays the groundwork for improved quality control, fraud detection and development of standardised authentication protocols. More broadly, it contributes to the creation of a data-driven ecosystem for honey authentication in India, preserving the authenticity and economic potential of India's indigenous natural resources.

What emerges is more than just a chemical profile; it is a scientific validation of a traditional natural resource. By decoding its molecular signature, researchers are not only advancing analytical science but also enhancing the value, credibility and global potential of India's indigenous honeys. As efforts continue to strengthen trust and transparency in the honey industry, such approaches offer a clear pathway forward, where traditional knowledge is complemented by molecular-level precision.

Metabolic profiling of Jamun (Syzygium cumini) honey: NMR and HPLC driven studies uncover low glucose levels and high antioxidant properties

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Lectures: *CSIR-NCL 76th Foundation Day Lecture*

Innovation and the University

CSIR-National Chemical Laboratory celebrated its ***76th Foundation Day*** on 3rd January 2026 with a special lecture by Prof. M. S. Ananth, eminent chemical engineer and former Director of IIT Madras, on *"Innovation and the University"*. The event brought together scientists, researchers, students, staff members and invited guests to honour CSIR-NCL's legacy and reflect on the evolving role of research institutions in a knowledge-driven economy.

The event commenced with welcome remarks by Dr Praveen Goyal, who extended a warm welcome to the Chief Guest, Prof. M. S. Ananth and the assembled audience. Dr Goyal reflected on CSIR-NCL's achievements over the years and emphasised the relevance of the Foundation Day theme in the context of national and global challenges.

Dr Ashish Lele, Director of CSIR-NCL, presented the Director's Report for 2025, showcasing the laboratory's accomplishments across seven thematic areas of research. Among the highlights were advances in fuel cell technologies, hydrogen and green energy solutions, development of sodium-iron batteries, innovations in agrochemicals and breakthroughs in MiG zeolites with wide industrial application.

Dr Lele emphasised CSIR-NCL's focus on industry collaboration, technology transfer and nurturing young scientific talent, noting that these efforts continue to strengthen the laboratory's role in translational research and societal impact.

The centerpiece of the celebration was the Foundation Day Lecture by Prof. Ananth, formally introduced by Dr V. Premnath, Chief Scientist at CSIR-NCL. Prof. Ananth, who led IIT Madras from 2001 to 2011, is recognised for his transformative contributions to Indian higher education and pioneering work in **mathematical modelling** and **molecular thermodynamics**.

Speaking on *"Innovation and the University,"* Prof. Ananth traced the historical role of universities as centres of teaching and scholarship, before exploring their evolving function in the modern knowledge economy. He highlighted the expectation that universities today not only generate knowledge but also act as engines of **innovation, entrepreneurship and societal transformation**.

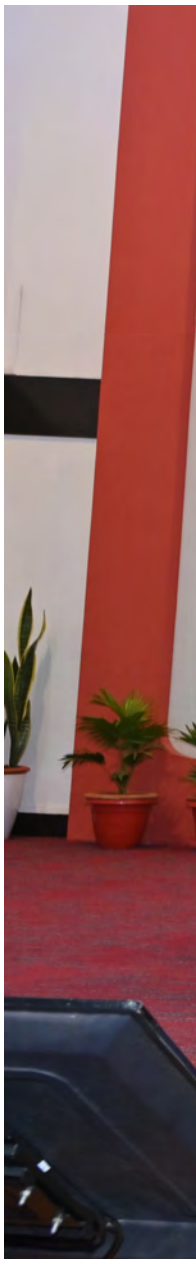
Drawing from his experience, he discussed the **IIT Madras Research Park**, India's first university-based research park, as a successful model bridging academia and industry. He also highlighted the impact of **NPTEL**, *(National Programme on Technology Enhanced Learning)*which has democratised access to world-class engineering education for millions across India and beyond.

"Universities must evolve to meet societal and economic needs while upholding the highest standards of academic and ethical integrity,"

Prof. Ananth emphasised. He further stressed the importance of **good governance** in higher education, advocating for institutional autonomy, transparency and accountability, alongside ethical leadership for sustaining public trust and long-term progress.

The celebrations also included the presentation of the **National Chemical Laboratory Research Foundation (NCLRF) Awards** for 2024-25, recognising outstanding contributions in research, innovation and technology development. The awards highlighted CSIR-NCL's commitment to nurturing scientific talent and fostering impactful research.

The 76th Foundation Day highlights CSIR-NCL's dedication to **scientific excellence, innovation-driven research and ethical leadership**. As the laboratory enters its 77th year, it continues to address national priorities through advanced research, interdisciplinary collaboration and meaningful engagement with both academia and industry. These efforts align with India's vision of **Atmanirbhar Bharat** and **Viksit Bharat**.



Lectures: *Green Hydrogen-Clean Energy Talk Series*

Potential Contribution of Green Hydrogen in India's Energy Transition

The Center of Excellence in Green Hydrogen Ecosystem Development at CSIR-NCL inaugurated its

"Green Hydrogen-Clean Energy" talk series with an engaging session titled *"Potential Contribution of Green Hydrogen in India's Energy Transition"*.

Delivered by Dr Ashish Lele, Director, CSIR-NCL, the lecture took place on 24th March 2026 in the SSBLT, PAM Lab, CSIR-NCL. The session attracted a diverse audience from academia, research institutions and industry, both in person and online.

The session was introduced by **Dr Magesh Nandagopal**, who welcomed the speaker and set the context for the lecture by highlighting the relevance of green hydrogen research to India's evolving energy landscape.

Dr Lele began by providing a comprehensive overview of the current energy landscape in India, emphasising the urgent need for sustainable alternatives to fossil fuels. Focusing on green hydrogen, he highlighted its potential as a clean energy vector capable of decarbonising hard-to-abate sectors such as steel, fertiliser and transportation. He elaborated on the technological and economic challenges, including production efficiency, storage and distribution, while emphasising the role of policy frameworks and industry-academia collaboration in accelerating adoption.

Dr Lele emphasised a pragmatic, data-driven approach: pilot multiple technologies across geographies, gather comprehensive performance data and make informed decisions for India's energy transition. He underscored that both battery-based and hydrogen-based solutions have roles to play and the optimal path will emerge from evidence, not assumptions.

He outlined key hydrogen production technologies, SOEC (Solid Oxide Electrolysis Cell), PEM (Proton Exchange Membrane), AEMW (Anion Exchange Membrane Water) and alkaline electrolysis emphasising that each suits specific use-cases. The importance of India's unified power grid and renewable integration, particularly wind mapping, was also discussed, alongside challenges in hydropower deployment.

Dr Lele highlighted India's growing hydrogen ecosystem, including large-scale electrolyser manufacturing and emerging applications in transport. He also stressed the importance of hydrogen certification and validation frameworks.

The lecture was interspersed with interactive discussions, where participants raised questions about scalability, infrastructure and India-specific case studies. Dr Lele's insights highlighted the strategic importance of green hydrogen in India's journey towards net-zero emissions.

The talk concluded with an optimistic outlook on India's energy future, encouraging researchers and students to explore innovative solutions in green hydrogen technologies. Overall, the event successfully highlighted CSIR-NCL's commitment to fostering scientific understanding and advancing India's clean energy ambitions through green hydrogen research and innovation.

Events

NCL Alumni Association Meet 2026

CSIR-National Chemical Laboratory organised the **NCL Alumni Association (NAA) Meet 2026** on 3rd January, bringing together distinguished alumni, laboratory leadership, researchers and stakeholders to strengthen alumni engagement and foster long-term institutional growth. The event marked the first major gathering of alumni under the NAA's new formal and legal framework as a Section 8 company.

The programme was anchored by **Dr Moneesha Fernandes**, who welcomed the attendees and set the context for the meet. **Dr Balu Uphade** felicitated the alumni and dignitaries, presenting saplings as a symbol of growth and sustainability. **Dr Santosh Mhaske** acknowledged the sustained efforts of past and present scientists in keeping the alumni spirit alive since 2007, noting the initiative's revival post-pandemic and its formal establishment.

Dr Samir Chikkali highlighted that the NCL Alumni Association aims to strengthen ties between CSIR-NCL and its alumni while being driven by alumni themselves. He emphasised that contributions could take the form of time, expertise, mentorship and active participation, with the laboratory serving as a facilitator for structured engagement.

In his address, **Dr Ashish Lele**, Director, CSIR-NCL, described the meet as a special homecoming, underscoring the importance of a shared vision, clear purpose and professional framework for the long-term success of an alumni network. He referred to NCL alumni as the laboratory's “living legacy” and global ambassadors, reinforcing the institution's continued focus on interdisciplinary research, industry collaboration and translational science.

Dr S. Sivaram, Former Director, delivered the keynote address, stressing the critical role of a sustainable alumni association in preserving institutional identity, connectivity and self-esteem. He highlighted the need for professional, technology-enabled engagement platforms, global participation, independent alumni leadership and recognition initiatives such as lecture series, student prizes and a potential alumni hall of fame.

Dr Balu Uphade provided alumni analytics, showcasing the diversity, global presence and potential of the NCL network, setting the stage for meaningful collaborations and mentorship opportunities.

A panel discussion coordinated by **Dr Udaya Kiran Marelli** and **Dr Dinesh Sawant** featured eminent alumni, including **Dr Jayant Khandare, Dr Yathiraj, Dr Milind, Dr Vijay and Dr Smita**, who shared insights on start-up leadership, industry–academia collaboration, networking, student-faculty exchange and sustainable alumni engagement models. The discussion encouraged active participation through Q&A sessions.

The meet concluded with an outline of future NAA initiatives by Dr Balu and a Vote of Thanks by **Dr S. Kiran**, followed by a group photograph, informal interactions over tea and guided visits to the CSIR-NCL Archives, offering alumni a glimpse into the laboratory's rich scientific heritage.

Events

Republic Day 2026

CSIR-National Chemical Laboratory celebrated India's 77th Republic Day on January 26, 2026, with great enthusiasm and patriotic fervor at its campus. The celebration commenced with the ceremonial hoisting of the national flag by Dr Ashish Lele, Director of CSIR-NCL.

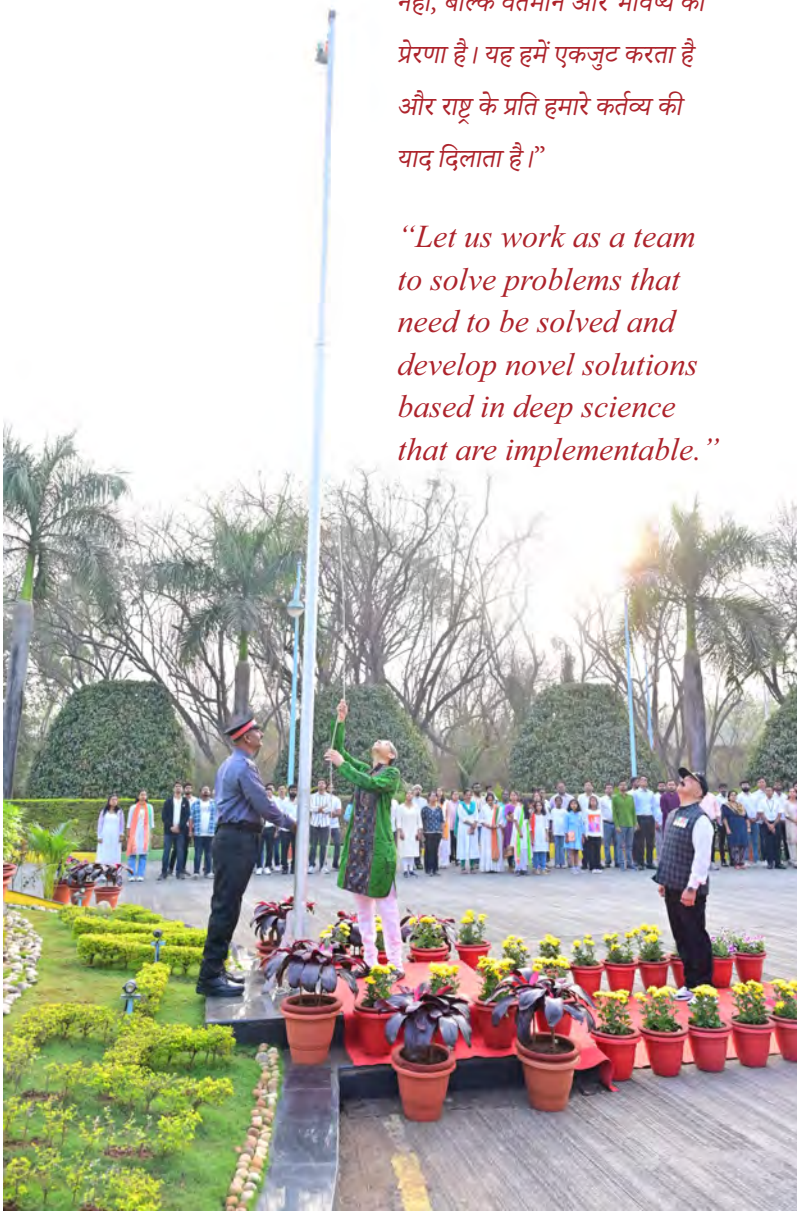
In his Republic Day address, Dr Lele extended his greetings to all members of the CSIR-NCL community and reflected on the significance of the day, marking the adoption of the Indian Constitution and the nation's journey as a democratic republic. He highlighted this year's official theme, *"150 Years of Vande Mataram,"* and spoke about its historical, cultural and emotional importance in inspiring India's freedom movement and shaping national consciousness.

Drawing connections to CSIR-NCL's work, Dr Lele emphasised three key messages from *Vande Mataram*; environmental sustainability, social responsibility and national strength. He noted that the laboratory's research initiatives in clean energy, circular economy, healthcare and strategic sectors are aligned with these ideals and contribute to building a self-reliant and developed India.

He also acknowledged the significant progress made by CSIR-NCL in areas such as sustainable chemical technologies, healthcare innovations and contributions to strategic and aerospace applications. Encouraging a spirit of teamwork and innovation, he urged scientists, staff and students to continue developing impactful solutions rooted in deep science for the benefit of society and the nation.

"वंदे मातरम् केवल अतीत की स्मृति नहीं, बल्कि वर्तमान और भविष्य की प्रेरणा है। यह हमें एकजुट करता है और राष्ट्र के प्रति हमारे कर्तव्य की याद दिलाता है।"

"Let us work as a team to solve problems that need to be solved and develop novel solutions based in deep science that are implementable."



Events

Tarang 2026

CSIR-National Chemical Laboratory celebrated National Science Day 2026 through *Tarang 2026*, a series of activities aimed at fostering scientific curiosity, critical thinking and community engagement among students, researchers and staff. Throughout the early months of 2026, the programme brought together members of the NCL community to celebrate science, innovation and the institution's rich legacy.

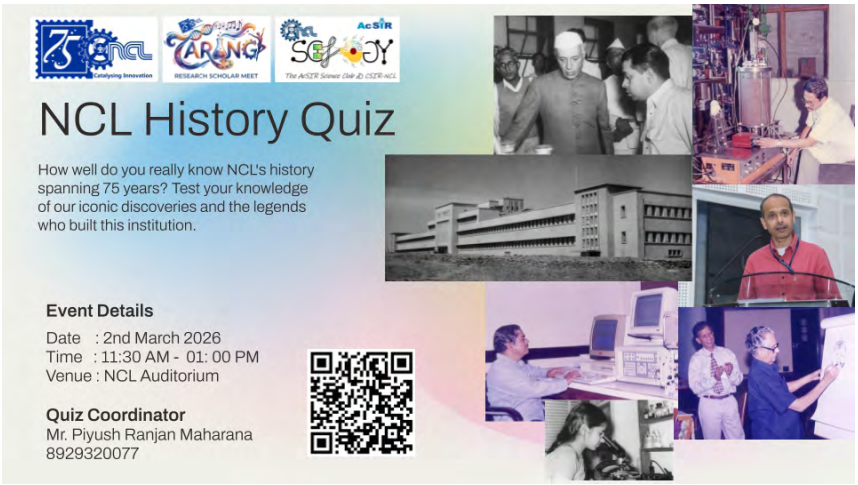
The celebrations culminated on 2 March 2026 with the formal inauguration of Tarang 2026 and the National Science Day programme at the CSIR-NCL Auditorium. The event was graced by Dr N. Kalaiselvi, Director General, CSIR and Secretary, DSIR, as the Chief Guest. The programme commenced with an introduction to Scilogy and Tarang by Mr Kiran Asokan, Research Scholar, CSIR-NCL, followed by the welcome and felicitation of Dr Kalaiselvi by Dr Ashish Lele, Director, CSIR-NCL.

In her address to staff and students, Dr Kalaiselvi highlighted the transformative role of science and technology in addressing societal challenges and advancing national development. She encouraged young researchers to pursue impactful research with integrity, perseverance and a collaborative spirit.

The National Science Day celebrations formed the culmination of a broader programme of events conducted under Tarang 2026. These included a SciFinder Workshop led by Dr Sunita Barve and Dr Nabin Sarkar, a Debate Competition, and a Table Topic Competition, all of which promoted scientific inquiry, effective communication and critical thinking. A History Quiz organised during the celebrations provided participants with an opportunity to revisit NCL's journey since its establishment in 1950 and reflect on its contributions to India's scientific progress.

Research Scholar Meet

Tarang-2026



Other highlights included the panel discussion, “Beyond Lab Coat: Where Careers Go Next?”, featuring insights from Dr Mahesh Dharne, Dr Anu Raghunathan, Dr Nalinee Suryawanshi, Dr Nitin Shukla, Dr Preeti Nema, Dr Santosh Kumar Sriramoju and Dr Magesh Nandagopal. The discussion offered valuable perspectives on career opportunities in policy, science communication, entrepreneurship and industry. An engaging alumni lecture by Dr Aarif L. Shaikh on opportunities in the CRO and CDMO sectors further enriched the programme. Together, these sessions provided valuable insights into emerging career pathways beyond conventional academic research.

The programme concluded with a vote of thanks delivered by Dr Varun Natu. Tarang 2026 concluded successfully, marking a vibrant celebration of science at CSIR-NCL.

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Events

One-Day Hindi Official Language Seminar and Prize Distribution Ceremony

One-Day Hindi Official Language Seminar and Prize Distribution Ceremony was organised CSIR-NCL on 17th February 2026 under the aegis of the City Official Language Implementation Committee, Pune, constituted by the Ministry of Home Affairs, Government of India. The programme, attended by around 180 representatives from 21 central institutions, aimed to promote the use of Hindi in official and administrative functions and recognise exemplary contributions in its implementation.

The seminar was held in two sessions. The inaugural session featured Dr Ajit Joshi, Chief Scientist, CSIR-NCL and Dr M. L. Gupta, Former Deputy Director of Implementation and Training, Department of Official Language and Director, Global Hindi Conference, Delhi, as chief guests. Mrs Sameera Kulkarni, Administrative Officer, NCL and Dr Swati Chadda, Senior Hindi Officer, NCL and Secretary, Narakas Pune, were also present. Welcoming the participants, Dr Swati Chadda introduced the programme and highlighted the importance of Hindi in administrative and professional communication. Mrs Sameera Kulkarni emphasised that, as Mahatma Gandhi stated, *"A nation without language is dumb,"* highlighting that Hindi is not just a medium of communication but also a symbol of self-respect and national identity.

In his address, Dr M. L. Gupta highlighted the Government of India's Official Language Policy, stressing the promotion of Hindi alongside other Indian languages and encouraged efforts to enhance the use of Hindi in administrative and professional work. Dr Ajit Joshi highlighted importance of integrating Hindi with employment, technology and national pride, urging participants to adopt the language wholeheartedly while respecting other languages.

The second session focused on the prize distribution ceremony. The 34th edition of NCL's semi-annual official language magazine, *'NCL-Alok'*, was released. Awards were presented for excellence in official language implementation and contributions to Hindi promotion. Dr Ashish Lele, Director, CSIR-NCL, highlighted the committee's efforts and the participation of multiple institutions, noting that Hindi had successfully connected all stakeholders during the programme.

The session concluded with presentations of mementos and shawls to chief guests and committee members, followed by a vote of thanks by Mrs Kanika Goyal, Controller of Administration, NCL, acknowledging the collective effort in fulfilling responsibilities entrusted by the Ministry of Home Affairs.

The seminar and prize distribution successfully reinforced the significance of Hindi in official functions, promoted active engagement across institutions and celebrated contributions toward the implementation of the Official Language Policy.

Events

National Safety Week 2026

Ensuring safe working conditions is of paramount importance in chemistry laboratories, where researchers routinely handle hazardous chemicals with diverse properties. Recognising that even minor lapses can result in injuries and disruption of scientific work, CSIR-National Chemical Laboratory (CSIR-NCL) observed **National Safety Week (NSW) 2026** from 4th to 10th March 2026 with the theme

"Engage, Educate & Empower People to Enhance Safety."

The theme highlighted the critical role of participation, awareness and empowerment in fostering a robust culture of safety.

"सुरक्षा बढ़ाने के लिए लोगों को जोड़ें, उन्हें शिक्षित करें और उन्हें सशक्त बनाएं।"

Throughout the week, a series of activities were organised to reinforce strengthen safety awareness among staff and research scholars. Informative standees at laboratory entrances highlighted key protocols, precautions and best practices, serving as constant visual reminders of safe working practices.

Competitions in drawing, safety memes and slogan writing encouraged creative engagement, with winners recognised through certificates and trophies. A demonstration of modern safety equipment by vendors showcased the latest protective devices and technologies, keeping the laboratory community informed of evolving safety standards.

Wet laboratories and supporting workplaces were evaluated on safety compliance and the best-performing labs in each division were awarded, reinforcing adherence to safety norms and promoting continuous improvement.

A major highlight of the week-long celebration was the safety drill-cum-training session conducted by the National Disaster Response Force (NDRF). This comprehensive programme included live demonstrations of rescuer evaluation techniques, firefighting procedures and pre-hospital treatment methods for open wounds, along with basic awareness protocols. The hands-on training session, where staff actively participated under expert guidance, received an overwhelming response and proved to be highly effective in enhancing practical preparedness for emergency situations.

The main programme on 10th March featured an expert talk by Mr Sanjay Giri, Joint Director, Directorate of Industrial Safety and Health, who stressed the importance of emergency drills, evacuation procedures, hands-on training and first aid in ensuring swift response during emergencies. The event also included a safety-themed poem and the administration of a safety pledge to all staff, reinforcing commitment to a responsible and safe workplace.

The week concluded with the distribution of certificates and trophies to competition winners, award-winning labs and individuals who made notable contributions to improving safety practices across CSIR-NCL. **National Safety Week 2026** successfully reinforced a proactive, participatory approach to safety, combining awareness, training and recognition. The initiative strengthened CSIR-NCL's commitment to creating a safe, informed and empowered scientific community.

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Events

Awareness-cum-Sensitisation Talk on POSH at the Workplace

On the occasion of International Women's Day, CSIR-National Chemical Laboratory, organised an awareness-cum-sensitisation talk on the *Prevention of Sexual Harassment (POSH) at the workplace* under the provisions of the Sexual Harassment of Women at Workplace Act. The programme was conducted by the **Internal Committee (IC)**, constituted under the provisions of the **Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013**. The session was held on 11 March 2026 and aimed to promote awareness, understanding and responsible conduct within the workplace.

The lecture was delivered by Rama Sarode, who provided an insightful and engaging overview of the POSH framework. Using real-life examples, she simplified the often complex provisions of the POSH Act, enabling participants to clearly understand the forms of sexual harassment, reporting procedures and the legal responsibilities of both employees and organisations. Her examples provided practical context, illustrating the impact of workplace harassment and the importance of addressing it proactively.

The session adopted an interactive format, encouraging participants to actively engage in discussions and share their perspectives. This approach provided a deeper understanding of the rights and responsibilities of employees, as well as the mechanisms available for the redressal of complaints. Key aspects of the POSH Act, including definitions, reporting procedures and the role of Internal Committees, were discussed in a clear and accessible manner.

In addition to legal awareness, the talk emphasised the importance of cultivating a safe, respectful and inclusive work environment. Participants were sensitised to behavioural expectations and the significance of maintaining professional boundaries in diverse workplace settings.

The session also addressed the concerns of Ph.D. students, researchers and staff members, particularly in relation to challenges encountered in academic and professional environments. Practical guidance was offered on managing stress and navigating sensitive situations, contributing to a more supportive and informed workplace culture.

Overall, the programme served as an important initiative in strengthening awareness of workplace ethics and legal safeguards. It reinforced CSIR-NCL's commitment to ensuring a safe and inclusive environment for all its members, while promoting a culture of respect, accountability and well-being.

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Events

Press Interaction on Dimethyl Ether (DME)

CSIR-NCL's homegrown DME tech promises cleaner alternative, eyes industrial scale production

Anuradha Mascarenhas
Pune, March 13

AMID THE ongoing LPG shortage caused by supply chain disruptions, the need for homegrown, sustainable and eco-friendly cooking fuel has become urgent, with Dimethyl Ether (DME) emerging as a promising alternative.

At the Council of Scientific and Industrial Research- National Chemical Laboratory (CSIR-NCL), scientists have developed a patent protected DME production process technology that utilises an indigenously invented highly active, selective and cost-effective catalyst, ensuring efficient conversion of methanol to DME.

Now, CSIR-NCL in collaboration with a processing engineering partner, is ready to scale up the technology to an industrial scale demonstration plant of 2.5 ton per day within 6-9 months. The demo plant could likely clear the way to set up commercial plants of 500-100 ton per day capacity. "CSIR-NCL is keen to explore partnerships with major oil PSUs and bioenergy companies for commercial scale production," Dr Ashish Lele, Director, CSIR-NCL said at a media conference on Friday.

"DME, a synthetic fuel boasts several advantages over conventional options. It burns cleaner, emitting minimal amounts of soot, nitrogen oxides (NOx), sulfur oxides (SOx), and particulate matter. Furthermore, DME exhibits thermal efficiency that is comparable to traditional fuels, making it a viable substitute," Dr Lele explained.

Chief scientist Dr Thirumalaiswamy Raja said they had developed a patent protected DME production process technology that utilises an indigenously invented highly active, selective and cost-effective catalyst, ensuring efficient conversion of methanol to DME.

"Our research team began integrating catalyst chemistry with reactor engineering—an approach that later became the hallmark of this technology," Dr Raja said. CSIR-NCL's technology allows production of DME at 10 bar pressure with minimal opex penalty so that it can be directly filled in LPG cylinders. This technology has already been successfully scaled up to a pilot capacity of 250 kg per day," Dr Raja said.

CSIR-NCL has further developed a burner prototype that can work on flex mode, from 100% LPG to 100% DME and all the compositions in between. This patented burner design has been tested for its efficiency at the LPG Equipment Research Centre (LERC), Bangalore. Domestic production of DME from methanol is the fastest way to reduce dependence on imported LPG, Date said, adding that this technology holds a promise to mitigate the LPG crisis and can be deployed at a larger scale.

पायलट प्रोजेक्ट पुणे में एनसीएल के वैज्ञानिकों ने विकसित किया ईंधन

एलपीजी का स्वदेशी विकल्प 'डायमिथाइल ईथर' तैयार

प्रतिदिन 250 किलो का हो रहा उत्पादन, एलपीजी की तुलना में डेढ़ गुना अधिक कारगर, कीमत भी कम

22 वर्षों के अथक शोध के बाद कामयाबी : एनसीएल के वैज्ञानिक डॉ. तिरुमलईस्वामी राजा और उनकी टीम ने 22 वर्षों के अथक शोध के बाद इसके लिए अत्यधिक 'उत्प्रेरक' विकसित किया है, जो इस ईंधन उत्पादन की कुंजी है। एनसीएल के निदेशक डॉ. आशीष लेले ने बताया, इस शोध की शुरुआत 2004 में हुई थी। 22 वर्षों की कड़ी मेहनत के बाद 2026 में यह तकनीक व्यावसायिक उत्पादन के लिए पूरी तरह तैयार हो गई है। पूरी प्रक्रिया के लिए 6 पेटेंट भी दर्ज किए गए हैं। वर्तमान में पायलट प्रोजेक्ट के तहत प्रतिदिन 250 किलो डीएमई का उत्पादन किया जा रहा है।

कृषि कचरे या बायोमास से बनता है : यह स्वदेशी ईंधन मुख्य रूप से कृषि कचरे या बायोमास से प्राप्त किया जाता है। बायोमास से पहले मिथेनॉल और फिर सांतत्यिक प्रक्रिया के जरिए डीएमई तैयार किया जाता है। सबसे बड़ी विशेषता यह है, यह एलपीजी की तुलना में डेढ़ गुना अधिक कार्यक्षम है। इतना ही नहीं, बड़े पैमाने पर उत्पादन शुरू होने से बाद इसकी लागत एलपीजी से भी कम होने का अनुमान है। भारत अभी एलपीजी जरूरतों का बड़ा हिस्सा आयात करता है। 2024 के आंकड़े बताते हैं इस दौरान लगभग 2.1 करोड़ टन एलपीजी आयात किया था। ऐसे में डीएमई का सफल उत्पादन न केवल विदेशी मुद्रा बचाएगा, बल्कि देश को ईंधन के मामले में आत्मनिर्भर भी बनाएगा।

'एलपीजी'ला पर्यायी इंधन तयार

'एनसीएल'चे स्वदेशी तंत्रज्ञान, पिरंगुटनजीक प्रायोगिक तत्त्वावर २५० टन क्षमतेचा प्रकल्प

लोकसत्ता प्रतिनिधी

पुणे : आखातातील युद्धामुळे देशात एलपीजीचा तुटवडा निर्माण झालेला असताना एलपीजीला पर्याय ठरू शकणारे 'डायमिथिल इथर' (डीएमई) हे इंधन संपूर्ण स्वदेशी तंत्रज्ञानातून तयार करण्याची कामगिरी पुण्यातील राष्ट्रीय रासायनिक प्रयोगशाळेने (एनसीएल) केली आहे. 'डीएमई'च्या रासायनिक प्रक्रियेसाठी आवश्यक संप्रेरक (कॅटलिस्ट) 'एनसीएल'ने विकसित केला आहे. 'डीएमई'चा इंधन म्हणून स्वतंत्रपणे, तसेच 'एलपीजी'मध्ये मिश्रण करून वापर शक्य असून, 'डीएमई'च्या प्रायोगिक तत्त्वावरील व्यावसायिक उत्पादनासाठी पिरंगुटनजीक २५० टन क्षमतेचा प्रकल्प उभारण्यात येत आहे.

'एनसीएल'चे संचालक डॉ. आशिष लेले यांनी याबाबतची माहिती दिली. शास्त्रज्ञ डॉ. तिरुमलाईस्वामी राजा, उद्योग भागीदार राजेश पाते, टेक्नॉस इंजिनीअरिंगचे व्यवस्थापकीय संचालक विजयकुमार या वेळी उपस्थित होते. भारतात एलपीजी मोठ्या प्रमाणात आयात करावा लागतो. २०२४ मध्ये भारताने २.१ कोटी टन एलपीजो आयात केला. जगभरात 'डीएमई'चा वापर केला जातो. आता देशात स्वदेशी तंत्रज्ञानातून 'डीएमई'चे उत्पादन करणे शक्य झाले आहे.

डॉ. लेले म्हणाले, 'डॉ. राजा यांच्या नेतृत्वाखाली 'डीएमई'च्या संशोधनाला २००४मध्ये सुरुवात झाली होती. आता २०२६मध्ये सर्व तांत्रिक प्रक्रिया पूर्ण होऊन उत्पादन होण्याच्या स्थितीपर्यंत आले आहे. या दरम्यान ६ एकस्व अधिकार (पेटंट) नोंदवण्यात आले. 'बायोमास'पासून (जैवइंधन) मिथेनॉल तयार करून त्यावर पुढे रासायनिक प्रक्रियेतून 'डीएमई' मिळते. या रासायनिक प्रक्रियेसाठीचा विशेष घट 'एनसीएल'मध्ये विकसित करण्यात आला. त्यानंतर 'एनसीएल'मध्ये १२ किलोग्रॅम प्रतिदिन उत्पादन प्रायोगिक तत्त्वावर करण्यात आले. आता हे तंत्रज्ञान उद्योगाला हस्तांतरित करून व्यावसायिक पद्धतीने उत्पादन शक्य होणार आहे. त्याची सुरुवात २५० टनांच्या प्रकल्पापासून होत आहे. डीएमई हे एलपीजीला पूर्णपणे पर्याय ठरू शकते. डीएमई एलपीजीच्या तुलनेत दोडपट अधिक कार्यक्षम आहे.'

पिरंगुटजवळ उरवडे येथे 'डीएमई'चा २५० किलो प्रतिदिन क्षमतेचा उत्पादन प्रकल्प उभारण्यात येत आहे. प्रकल्पाबाबत टाते म्हणाले, 'एनसीएलने विकसित केलेले तंत्रज्ञान अत्यंत मालकत्वाचे आहे. हे इंधन पर्यावरणपूरक आणि आर्थिकदृष्ट्या किफायतशीर आहे. १०० किलो बायोमासपासून २५० किलो डीएमई तयार होते. २५० टनांच्या प्रकल्पासाठी १५ एकर जागा आवश्यक आहे. त्यातून ७५ ते १०० प्रत्यक्ष रोजगार, तसेच अनेक अप्रत्यक्ष रोजगार निर्माण होतील.'

'डीएमई' वापरण्यासाठीची शेगडी तयार

'स्वयंपाकापासून इंधनापर्यंत पूर्णपणे 'डीएमई' वापरण्यासाठीची शेगडी तयार करण्यात आली आहे. त्याच्या चाचण्याही पूर्ण झाल्या आहेत. 'डीएमई' 'एलपीजी'प्रमाणेच सिलिंडरमध्ये साठवता येत असल्याने घरगुती, व्यावसायिक, औद्योगिक वापर करता येतो. त्यामुळे स्वयंपाकापासून मोटारीपर्यंत 'डीएमई'चा वापर शक्य आहे. मोटारीत इंधन म्हणून वापरण्यासाठीच्या चाचण्या करण्यात आल्या आहेत. 'डीआयएसी'च्या मानकांनुसार 'एलपीजी'मध्ये २० टक्के 'डीएमई'चे मिश्रण करता येऊ शकते. 'एलपीजी'मध्ये जात टक्क्यांपर्यंत 'डीएमई' मिसळल्यास सिलेंडर, जॅस्केट, रेग्युलेटर, बर्नर बदलण्याची गरज नाही,' असे डॉ. तिरुमलाईस्वामी राजा यांनी नमूद केले.

'कार्बन डाय ऑक्साइड'पासून 'डीएमई'चे उद्दिष्ट

देशाच्या वेगवेगळ्या भागात 'डीएमई' उत्पादन प्रकल्प उभारणे शक्य आहे. येत्या काळात प्रतिदिन २५०० टन क्षमतेचा प्रकल्प उभारण्यासाठी तेल कंपन्यांशी चर्चा सुरू आहे. असा 'बायोमास'पासून 'डीएमई'ची निर्मिती करण्यात आली आहे. मात्र, स्वच्छ कार्बन डाय ऑक्साइडपासून मिथेनॉल आणि मिथेनॉलपासून डीएमई तयार करण्याचेही उद्दिष्ट आहे, असे डॉ. आशिष लेले यांनी सांगितले.

देशाची बचत, ऊर्जासुरक्षा शक्य

"एलपीजी' आयात करावा लागत असल्याने देशाचा मोठ्या प्रमाणात खर्च होतो. 'एलपीजी'मध्ये केवळ आठ टक्के 'डीएमई' मिसळल्यास ९५०० कोटी रुपयांची बचत होऊ शकते. त्यामुळे 'डीएमई'च्या माध्यमातून देशाची ऊर्जासुरक्षा साध्य करणे शक्य आहे,' असे डॉ. आशिष लेले म्हणाले.

CSIR-National Chemical Laboratory recently hosted a press conference on 13 March 2026 to showcase its pioneering work on Dimethyl Ether (DME), positioning it as a promising clean-burning alternative to conventional fuels. The interaction brought together scientists, media representatives and industry stakeholders to discuss the strategic importance of DME in strengthening India's energy security and advancing the vision of *Atmanirbhar Bharat*.

The interaction opened by setting the context of India's increasing dependence on imported fossil fuels, particularly LPG, which currently accounts for more than 80% of consumption. Recent global supply disruptions and price volatility have further underscored the urgency of identifying sustainable and indigenous alternatives. In this context, DME has emerged as a compelling solution owing to its clean combustion characteristics and versatility.

Experts from CSIR-NCL elaborated on the scientific and technological advantages of DME. As a synthetic fuel, DME burns cleanly, emitting significantly lower levels of soot, nitrogen oxides (NOx), sulphur oxides (SOx) and particulate matter. Its thermal efficiency is comparable to that of LPG, making it a viable substitute for domestic as well as industrial applications. The audience showed particular interest in its compatibility with existing infrastructure, with it being noted that up to 8% blending with LPG can be achieved without requiring any modifications to cylinders, regulators or burners.

डायमिथिल ईथर : एलपीजीसाठी पर्यायी इंधन

डॉ. टी. राजा

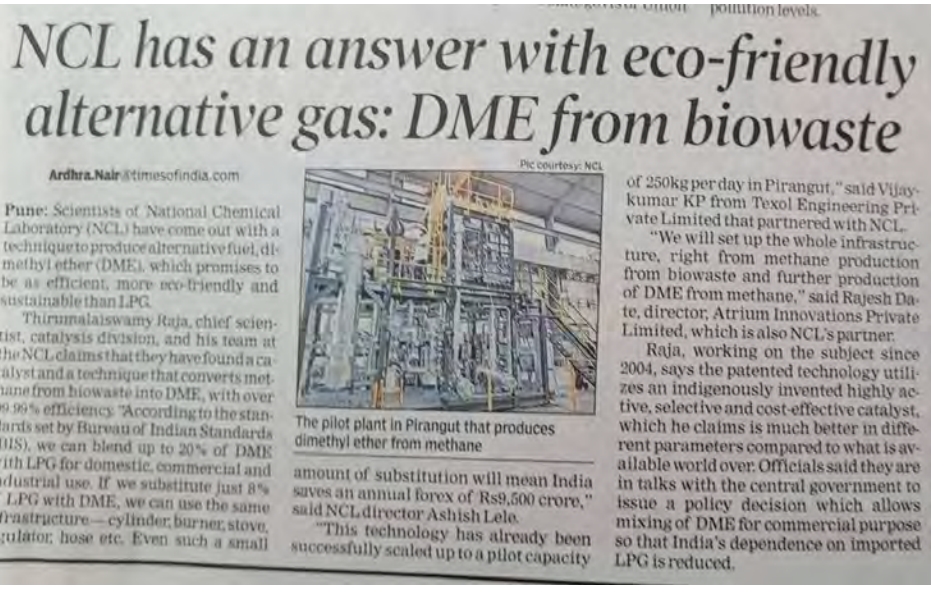
एलपीजी'ऐवजी 'डीएमई'चा पर्याय!

- एनसीएलने शोधले डायमिथील इथर
- स्वच्छ, ज्वलनशील इंधन असल्याचा दावा

डीएमईमुळे प्रदूषणच होत नाही

संशोधन ते व्यापारीकरण

शास्त्रज्ञांनी केलेले दावे



NCL has an answer with eco-friendly alternative gas: DME from biowaste

Ardhra.Nair@timesofindia.com

Pune: Scientists of National Chemical Laboratory (NCL) have come out with a technique to produce alternative fuel, dimethyl ether (DME), which promises to be as efficient, more eco-friendly and sustainable than LPG.

Pic courtesy: NCL

The pilot plant in Pirangut that produces dimethyl ether from methane

Dr Thirumalaiswamy Raja presented CSIR-NCL's indigenously developed DME production technology, integrating catalyst innovation with reactor engineering for efficient methanol-to-DME conversion at 10 bar. A pilot plant currently produces 250 kg/day, demonstrating the process's robustness. The institute also showcased a novel flex-fuel burner capable of operating from 100% LPG to 100% DME, ensuring user convenience and safety.

DME's broader applications including automotive fuel, aerosol propellants and chemical intermediates, were discussed, along with pathways for production from coal, biomass and captured CO_2. Plans for scaling up include a 2.5 t/day demonstration plant, with commercial units envisaged from 50-500 t/day, in collaboration with industry partners.

The press interaction concluded on an optimistic note, emphasising that DME represents not merely a technological innovation, but a strategic opportunity for India to reduce import dependence, conserve foreign exchange and transition towards a cleaner energy future. The initiative reflects CSIR-NCL's commitment to translating laboratory research into impactful, real-world solutions.

Symposium, Conference, Workshop

Workshop on Mass Spectrometry-Based Metabolomics

The Workshop on Mass Spectrometry-Based Metabolomics was successfully conducted from 23-25 March 2026 at the CSIR-National Chemical Laboratory. Organised under the aegis of Proteomics Day, the event brought together leading researchers, academicians and industry experts to provide an in-depth understanding of metabolomics workflows. The workshop was jointly organised by CSIR-NCL, C-OSM KSHEMA and the Proteomics Society of India, with generous support from the Department of Biotechnology and Bruker India.

The three-day programme was carefully designed to integrate theoretical knowledge with practical training, offering participants comprehensive exposure to modern metabolomics techniques.
The workshop commenced with an inaugural session, followed by engaging lectures on foundational aspects of metabolomics. Dr Shantanu Sengupta introduced participants to the metabolomics of the Phenome India cohort, while Dr T. S. Keshava Prasad elaborated on decoding biological pathways. Industry insights were shared by Dr S. Venkatesh, who highlighted the transformative potential of TIMS technology. Additional sessions by Dr Moneesha Fernandes and Dr Rakesh Joshi covered metabolite synthesis and open-source analytical tools respectively.

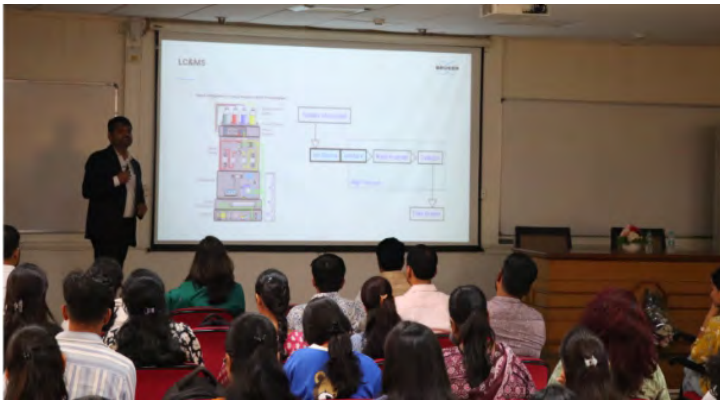
The afternoon session transitioned into hands-on training, during which participants performed sample extraction and LC-MS preparation under the guidance of Mr Shyam Gawari and Ms Preshita Bhatt. An introductory data analysis session was conducted by Ms Shivani Palkar.

The second day focused on specialised applications and advanced methodologies. Dr R. Uma Shankar discussed metabolomics in chemical ecology, with emphasis on camptothecin, while Dr Dhanasekaran Shanmugam presented isotope-labelling strategies.

Structural characterisation using X-ray diffraction was explained by Dr Rajesh Gonnade and Dr Yashwant Kumar highlighted the importance of standard libraries in metabolomics. The morning concluded with Dr Shrikant Rapole presenting on volitolomics using GC–MS.

The practical sessions included hands-on sample acquisition on mass spectrometry led by Ms Shivani Palkar and Ms Shrutika Shewale. A follow-up data analysis workshop was conducted by Dr Yashwant Kumar.
The final day emphasised data interpretation and biological applications. Dr Ashok Giri delivered a comprehensive lecture on omics-based metabolic pathway analysis. Additional talks included Dr Mahesh J. Kulkarni on novel glycated metabolites, Dr Vitthal Baravkar on untargeted plant metabolomics and Dr H. V. Thulasiram on the isoprenoid biosynthetic pathway in Azadirachta indica. A hands-on session featuring case studies on metabolite databases was conducted by Abhijit Kulkarni, followed by a concluding data analysis module led by Preshita Bhatt.

The workshop concluded with a formal valedictory function. Dr Ashish Lele delivered the closing remarks and distributed certificates to participants. The event concluded with a vote of thanks by Dr Mahesh Kulkarni, who acknowledged the contributions of the organisers, speakers and funding agencies.



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Symposium, Conference, Workshop

One-Day Symposium on Insights of Biomaterials for Biomedical Applications

A one-day symposium on *Insights of Biomaterials for Biomedical Applications* was jointly organised on 23rd March 2026 by the Polymer Science and Engineering Division, CSIR-National Chemical Laboratory and the Society for Polymer Science, India. The event was held at the SSBLT Lecture Hall, PAML Building, CSIR-NCL.

The symposium brought together nationally and internationally renowned experts in biomaterials, providing a platform for knowledge exchange on recent advances in biomedical applications of polymer-based systems and related materials.

The scientific programme comprised two sessions, featuring six invited talks. The distinguished speakers included Prof. K. Jayachandran (Canada Research Chair Tier 1, University of British Columbia), Dr Sutapa Ghosh (Chief Scientist, CSIR-IICT, Hyderabad), Dr Amandeep Jindal (IIT Kharagpur), Dr Lekha Dinesh Kumar (Former Chief Scientist, CCMB, Hyderabad), Dr Jayant Khandare (Actorius, Pune) and Prof. Dipakar Dhara (IIT Kharagpur).

The talks highlighted emerging areas in biomaterials research, including cell and organ transplantation, nanomaterials for drug delivery and nanobiotechnology for diagnostics and cancer therapy, particularly targeting colon and breast cancer. The presentations were highly informative and provided valuable insights into cutting-edge developments in biomedical science.

The symposium witnessed active participation from approximately 100 attendees, including researchers from CSIR-NCL, other academic institutions and industry representatives. The discussions fostered meaningful scientific exchange and offered directions for future research and innovation.

Overall, the event served as an effective platform for interaction among scientists, students and industry professionals, strengthening collaborations and advancing the understanding of biomaterials for biomedical applications.

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Featured Technology Of The Quarter

Making the Most of Sugarcane Bagasse: A Green Solution for a Brighter Future

Synopsis

Have you ever wondered what happens to the waste generated from sugarcane after the sugar is extracted? Scientists at CSIR-NCL have come up with a solution to make the most out of this waste, known as sugarcane bagasse. They have developed a simple and eco-friendly process to turn sugarcane bagasse into a valuable resource for producing various chemicals.

Background

Sugarcane bagasse is the leftover fibrous material after extracting juice from sugarcane. It is abundant and rich in cellulosic material, making it a promising feedstock for bioethanol production. However, before turning sugarcane bagasse into bioethanol, an essential step called 'pretreatment' is required to remove a substance called lignin from sugarcane bagasse. Pretreatment plays a crucial role in preparing sugarcane waste for the bioethanol-making process. Traditional methods, such as steam explosion, alkaline, or acid pre-treatment come with their own set of challenges. The use of high temperatures and pressure in these processes can lead to certain problems. First, it can negatively affect the growth of beneficial organisms involved in bioethanol production. Secondly, the equipment used in these processes might get damaged due to the harsh reaction conditions. Hence, while these methods are effective to some extent, finding a more efficient and gentle approach to pretreatment could enhance the overall bioethanol production process and make it more sustainable.

Catalytic delignification process developed by CSIR-NCL

CSIR-NCL has developed a catalytic delignification process that utilizes a reusable catalyst, resulting in reduced waste and a positive impact on the environment. It is a highly efficient and cost-effective process that requires only a small amount of catalyst. Furthermore, this process produces valuable byproducts like microcrystalline cellulose and lignin. These products open up new opportunities and revenue streams across various industries.

Value proposition

This process offers several advantages over conventional methods. The absence of acid and alkali in this process simplifies the management of effluent treatment and complex waste disposal. Additionally, this process eliminates the need for bleaching the pulp, streamlining the entire operation and making it more cost-effective and sustainable. The extracted lignin is of high quality because it is entirely free from sodium and sulfur. This purity of lignin makes it suitable for a wide variety of applications. Furthermore, the production of microcrystalline cellulose and lignin as by-products enhances the attractiveness of this process. Also, the diverse utilization of microcrystalline cellulose across various industries presents avenues for market share acquisition and revenue generation. All in all, this new process presents a promising approach to promoting sustainable practices to maximize the value of lignocellulosic materials.

Lucrative Markets

The global market for microcrystalline cellulose is projected to grow from $1.2 billion to $1.85 billion between 2023 and 2030, with an annual growth rate of 6.78%. Likewise, the global lignin market is expected to reach $5.6 billion by 2031. These statistics indicate promising opportunities to tap into the emerging market.

Versatile Applications:

- Bioethanol and Bio-chemicals: By utilizing delignified sugarcane bagasse, the process efficiently produces bioethanol, a valuable biofuel. Additionally, it yields various bio-chemicals like xylitol, furfural, vanillin and bio-polymers, offering sustainable alternatives to conventional chemical production.
- Paper and Pulp Industry: By utilizing sustainable catalysts and optimizing biomass value, the technology offers a sustainable and efficient approach to manufacturing paper products.

Current Status and Future Possibilities

CSIR-NCL's catalytic delignification of sugarcane bagasse has been successfully demonstrated and validated at the lab scale. CSIR-NCL is now actively pursuing partners for technology commercialization via licensing and co-development, offering industries a chance to leverage an efficient and sustainable process to contribute to an eco-conscious future.

In summary, CSIR-NCL's delignification process offers an eco-friendly alternative to traditional methods and produces pure lignin without the need for bleaching. The technology utilizes very low concentrations of the catalyst and since the catalyst used is also recyclable results in a cost-effective process. It produces products like microcrystalline cellulose and lignin, creating opportunities for various industries. This technology has many applications, like in bioethanol, bio-chemicals and the paper industry thus presenting lucrative opportunities. This technology is available for licensing and co-development.

For further information and enquiries, please write to asktmg.ncl@csir.res.in.

Technology Management Group
asktmg.ncl@csir.res.in

MOUs/ MOAs SIGNED (Jan to Mar 2026)

Sr. No.	Client Name	Title of MoU/ MoA	Project Leader
1	Jaywant Shikshak Prasarak Mandal	Collaborative Research Work in the Areas of Mutual Interest	Dr Rajesh Gonnade
2	UPL University of Sustainable Technology	Academic and Research Corporation in the field of Science and Technology	Dr Amol Kulkarni
3	LPG Equipment Research Center	Product Development, Arrangement of Technology/ Appliances/ Cooking System of 100% DME_Flex Fuel for LPG for Domestic & Commercial Cook Stoves and 100% Methanol for Domestic Cook Stoves Design both for 2-3-4 Burners & Cook top's for India's need	Dr T. Raja
4	Patanjali Research Foundation	Research Collaboration in the area of Mutual Collaboration	Dr Mahesh Kulkarni

TECHNOLOGIES AVAILABLE FOR LICENSING

Sr. No.	Technology	Sector
1	Continuous catalytic process for the production of 4,4' Bisphenol-A (BPA)	Chemical
2	Novel, Eco-friendly & Autocatalytic process for the synthesis of Tributyl citrate (TBC)	Chemical
3	A patented catalytic process for making Diphenylmethane (DPM)	Chemical
4	Novel process platform for the manufacturing and purification of biosimilar rHu Ranibizumab	Biopharma
5	Novel process platform for the manufacturing and purification of Anakinra	Biopharma
6	Targeted glycosylation modulating process for recombinant proteins (Including monoclonal antibodies)	Biopharma
7	High-yield production of high-value Bacterial Nano Cellulose (BNC) films from low-cost crude glycerol feed	Health
8	Efficient manufacturing process For Na-LSX (13 X) & Li-LSX Zeolite	Specialty materials
9	Continuous process for manufacturing precision Silver Nanowires at scale	Specialty materials
10	Continuous & tunable process for the large-scale synthesis of Mesoporous & Nanoporous Silica	Specialty materials
11	Simple, eco-friendly catalytic delignification process for sugarcane bagasse (SB)	Biomass valorisation
12	Dietary Supplement Formulation of Probiotic Strain for Organic Poultry Production	Agriculture/ poultry
13	Efficient catalytic process & novel reactor design for hydrogen sulfide (H2S) removal from different gas streams	Gas separation
14	Process for the novel thermostable Biosurfactant production	Environmental
15	Efficient recovery process for metals from Spent Li-ion batteries (LIBs)	Environmental
16	Novel Process for the Production of IMEGLIMIN	Biopharma
17	Novel process for manufacturing p-Aminophenol (PAP) from p-Chloronitrobenzene (PCNB)	Chemical

Contact:
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Head, Technology Management Group
md.vetal.ncl@csir.res.in (020-2590-2125)

INSTITUTE HONORS

Institute Honors

CSIR-NCL was awarded Technology Transfer Impact Award 2026 by the Society for Technology Management (STEM).

FACULTY RECOGNITIONS

Name of Faculty

Dr Nagaraju Barsu was awarded the Thieme Chemistry Journals Award 2026.

Dr Kishor L. Handore was awarded the Thieme Journals Award 2026.

Dr Rakesh Joshi was invited to serve as an Editorial Board Member of Psyche: A Journal of Entomology, published by Wiley.

CSIR-NCL RF AWARDS FOR SCIENTISTS - STAFF FOR 2024-25

The NCL Research Foundation Awards for 2024-25, honoring scientists and staff, were presented by Prof M. S. Ananth, Former Director, IIT Madras, on January 03, 2026 during the Foundation Day function at CSIR-NCL.

NAME OF AWARD	AWARD WINNER
NCL RF Scientist of the Year Award For scientists in the age group above 40 years.	**Dr Kurungot Sreekumar** For his key contributions to high-quality fundamental R&D in the development of efficient green energy technologies such as PEM fuel cells, hydrogen generating systems, and batteries, as well as his continuous efforts with the CSIR team to demonstrate fuel systems for a range of applications over the years.
NCL RF Scientist of the Year Award For scientists in the age group below 40 years.	**Dr Nagaraju Barsu** For his notable achievements in depolymerization by developing efficient methods to upcycle plastic waste (such as polyethylene, polycarbonates, polyurethanes) into valuable products, enabling improved chemical recycling and sustainable materials reuse.
NCL RF Award for the Best Process of the year	**Dr Amol Kulkarni, Mr Tabrez R. Shaikh (SRF), Mr. Arshad Hussain, Dr Ranjit Atapalkar Mr Anil Palghadmal (Team Members)** A continuous ultrafast solvent free process for synthesis of paracetamol has been developed that gives 99.89% purity product within a few seconds. The process has been licensed exclusively to an industry for production of 5000 TPA of paracetamol.
NCL RF Award for Best Commercialized Technology of the Year	**Dr Amol A. Kulkarni, Dr Ranjit Atapalkar, Mr Anil V. Palghadmal, Dr Satyam Naidu Vasireddy, Mr Arshad Hussain, Mr Tabrez R. Shaikh, Mr Ganthimeri Vishnu, Ms Suneha Patil, Dr D. Srinivas Reddy, Dr Paresh Athavale (Team Members)** A continuous ozonolysis based process for the production of azelaic acid from oleic acid has been commercialized based on know-how from CSIR-NCL. The plant is in operation for a year. This is the first fully integrated, continuous, zero discharge plant for Azelaic acid in the country.
NCL RF Award for “ew Initiative taken by R&D Support System”	Enhancing Laboratory Safety Infrastructure and Raising Safety Awareness **Dr Santosh Ghuge, Dr Ravindar Kontham** In recognition of their outstanding efforts to strengthen laboratory safety infrastructure and raise awareness, ensuring strict adherence to safety protocols in handling hazardous chemicals and fostering a secure working environment.

NAME OF AWARD	AWARD WINNER
NCL RF Individual Merit Award	**Mr Gati Nayak** For his exemplary dedication. In addition to his assigned Library duties, he has voluntarily undertaken responsibilities in the management and smooth functioning of the Student Academic Office, NCL Guest House, and NCL Canteen, thereby mitigating staff shortages and ensuring the effective functioning of these units.
	Mr Sachin Gawali For his exceptional efficiency and dedication in managing the Purchase Section despite staff shortages. In addition to his role as Section Officer, he effectively discharged the duties of the dealing hand, ensuring uninterrupted processing of purchase files and procurement of high-value instruments, while maintaining accurate records in both physical and eOffice systems.
	Mr Swapnil Aherrao For his significant contribution to the development of fully indigenous Fuel Cell Test Stations, from concept studies to detailed design. His work includes system design, control hardware interfacing, P&IDs, and the development of a novel bubbler unit for single-cell testing.
	Mr Vishwanath Bagalkoti For his diligent and dedicated efforts in supporting the Admin Team to complete the recruitment of JSAs and Junior Stenographers in a rule-compliant, transparent, and efficient manner in a record short time.
	Mr Prashant Mane, Mr Umesh Katamkar For their exemplary work on NMR probes and the autosampler, resulting in substantial savings of time and resources. Their exceptional contributions have significantly strengthened the NMR facility, benefiting the entire NCL community.
	Mr Dayal Ram Saini For his exceptional administrative efficiency and dedication. He managed a large volume of over 350 RTI applications (2022–025) with accuracy and timeliness, and, despite severe staff shortages, ensured uninterrupted handling of all Establishment Section-I matters, including pay, leave, recruitment, and statutory compliance, significantly strengthening CSIR-NCL' administrative functioning.
	Mr Amol Pathak, Mr Amol Bhagat For their exceptional efforts to complete pending technical staff promotion assessments in record time, coordinating internal and external committee members and managing all logistics. Their timely actions have fostered a motivated workforce, enhancing efficiency and positively impacting scientific and administrative outcomes.

NAME OF AWARD	AWARD WINNER
NCL RF Director' Commendation Award	**Dr V. Premnath** **Chief Scientist CSIR-NCL, and Director, Venture Center** For his exceptional leadership in building Venture Center as India' finest science-led incubator that has nurtured more than 1000 startups in the past 19 years.
	Mr Dipak Jori For his exceptional support in the management of Director' office.
	The NCL Alumni Association Committee comprising: **Dr Santosh Mhaske, Dr Udaya Kiran Marelli, Dr Samir Chikkali, Dr Nikhlesh Yadav, Dr Rakesh Joshi, Dr S. Kiran, Dr Dinesh Sawant, Dr Moneesha Fernandes, Dr Rajesh Gonnade, Dr Manohar Badiger, Dr Balu Uphade, Dr Datta Ponde, Dr Harshawardhan Pol, Dr Ulhas K. Kharul** For successfully creating and launching the NCL Alumni Association, a Section 8 company whose mission is to connect the past, present and future vibrant community of CSIR-NCL.
	Mr Anil Malusare For his exceptional contributions in aligning the new accounting system (AMS) with the earlier software system (IMPACT), thereby ensuring a smooth transition in the accounting process of the laboratory.

NCL Research Foundation Awards for Research Scholars for 2025

Best Research Scholar 2025

NAME OF AWARD	AWARD WINNER
''Mrs. Uma Devaguptapu and Prof. Ashwini Kumar Nangia Award'For "est Woman Research Scholar In Interdisciplinary Research"	**Ms. Priyanka P. P.** Best Woman Research Scholar In Interdisciplinary Research
NCL RF-Keerthi Sangoram Memorial Endowment Award for "est Research Scholar"in the area of Physical Chemistry/Materials Science, Biological Sciences, Chemical Sciences, Catalysis and Engineering Sciences.	**Mr Sidharth Barik** Physical Chemistry / Materials Science
	Mr Kiran Asokan Chemical Sciences
	Ms Jyotsna P. Bajpai Catalysis
	Mr Nishant Markandeya Engineering Sciences
	Mr Vinay Rajput Biological Sciences

Best Ph.D THESIS AWARD 2025

NAME OF AWARD	AWARD WINNER
"NCL RF BEST Ph.D. Thesis Award" FOR THE YEAR 2025	**Dr Chandini Pradhan** **Title:** Iron-Catalyzed Regioselective Transformations of Heterocycles and Alkynes: Unveiling Mechanistic Insights **Research Guide:** Dr Benudhar Punji

Best Research Papers 2025

NAME OF AWARD	AWARD WINNER
"Dr Rajappa Award"to Research Scholars / Project Assistants for "est Published Research Paper in Organic Chemistry"with highest impact factor for the year 2025.	**Ms Supriya M. Bodake** **Title:** Ketenimine Multicomponent Strategy for Multifaceted Amidine Functionalization of Peptides on the Solid Phase **Journal:** Angewandte Chemie International Edition
"CLRF - Nanai Natu Award"to Research Scholars / Project Assistants for "est Published Research Paper in Organic Chemistry"with second highest impact factor for the year 2025.	**Mr Devendra K. Dewangan** **Title:** Phosphite Mediated Molecular Editing via Switch to meta-C– Alkylation of Isoquinolines: Emergence of a Distinct Photochemical [1,3] N to C Rearrangement **Journal:** Chemical Science
"CLRF - Gupta - Pardeshi - Sainani Award"to Research Scholars / Project Assistants for "est Published Research Paper in Biological Sciences"with highest impact factor for the year 2025.	**Ms Kaumudi S. Joshi** **Title:** LDH-dsRNA Nanocarrier-Mediated Spray-Induced Silencing of Juvenile Hormone Degradation Pathway Genes for Targeted Control of *Helicoverpa Armigera* **Journal:** International Journal of Biological Macromolecules
"Dr Krishnan Award"to Research Scholars / Project Assistants for "est Published Research Paper in Materials Science"with highest impact factor for the year 2025.	**Mr Sangram D. Dongre** **Title:** Chiroptical Amplification of [7]-Helicene Nanographene by Additional Helical Chirality **Journal:** Angewandte Chemie International Edition
"Dr Krishnan Award"to Research Scholars / Project Assistants for "est Published Research Paper in Computational Sciences"with highest impact factor for the year 2025.	**Ms Bhavana R. Shivankar** **Title:** In Silico Designing of Electrocatalysts for Hydrogen Evolution Reaction: A Focus on Titanium Metal-Based Diboride Monolayers **Journal:** International Journal of Hydrogen Energy Letters

NAME OF AWARD	AWARD WINNER
"Dr Joshi - Dr Sivaram Award"to Research Scholars / Project Assistants for "est Published Research Paper in Polymer Science & Organic-Inorganic Hybrid Materials"with highest impact factor for the year 2025.	**Ms Kritika Gour** **Title:** Germylene Mediated Reductive C-C and C-N Coupling of an Isocyanide and its Device Application **Journal:** Angewandte Chemie International Edition
"Dr B. D. Kulkarni Award"to Research Scholars / Project Assistants for "est Published Research Paper in Chemical Engineering/Technology"with highest impact factor for the year 2025.	**Ms Athira Yoyakki** **Title:** A Pt-Based Carbon-Free Cathode with Embedded Oxygen Nanoreservoirs: A Promising Approach for Oxygen Buffering to Aid Oxygen Reduction Reactions of PEMFCs **Journal:** ACS Catalysis
"Dr Paul Ratnasamy and Dr Ms. Suneeta B. Kulkarni Award" to Research Scholars / Project Assistants for "est Published Research Paper in Catalysis"with the highest impact factor for the year 2025.	**Mr Ganeshdev Padhi** **Title:** Ruthenium-Catalyzed Deconstruction of Polyolefins: A Strategy to Up-cycle Waste Polyethylene to Value-Added Alkene **Journal:** Angewandte Chemie International Edition
"Dr Pattayil Joy Award"to Research Scholars / Project Assistants for "est Published Research Paper in Physics"with Publication in highest H-index journal for the year 2025.	**Mr Tubai Chowdhury** **Title:** Probing solvent fluctuations in deep eutectic solvents: Influence of probe charge and nano-domain localization **Journal:** The Journal of Chemical Physics
"Dr Sourav Pal Award"to Research Scholars / Project Assistants for "est Published Research Paper in Physical Chemistry/Chemical Physics"with Publication in highest H-index journal for the year 2025.	**Ms Neha V. Dambhare** **Title:** Fermi-Level Equilibrium-Driven Trap Filling in Multibandgap PbS Quantum Dot Solids Enabling Record Voltage Generation and Improved Carrier Transport in High-Performance Solar Cells **Journal:** ACS Energy Letters

SPICMACAY Classical Music Evening

On 26th March 2026, CSIR-National Chemical Laboratory hosted its inaugural SPICMACAY event - *an enchanting evening dedicated to Carnatic classical music*. Organised by NCL-SciLogy in collaboration with SPICMACAY (Society for the Promotion of Indian Classical Music And Culture Amongst Youth), the event marked a significant addition to the institute's cultural initiatives.

The evening featured a mesmerising performance by the esteemed Padma Shri Vidushi A. Kanyakumari, one of India's most celebrated violinists, renowned for her mastery in Carnatic music. Accompanied by accomplished artists Sekar on Thavil, Anirudh Athreya on Kanjira and Mallikarjun Joysula on violin, the concert presented a rich tapestry of traditional Indian classical music, captivating an enthusiastic audience.

Held at the NCL Main Auditorium, the event was open to all NCL members, including staff, students and their families. The programme successfully brought the timeless heritage of Indian classical arts to the institute, fostering cultural appreciation and community engagement.

SPICMACAY has long been instrumental in promoting India's classical music and arts among youth across the nation. This collaboration enabled NCL to embrace and celebrate this artistic legacy for the first time on its campus.

The event saw strong participation, facilitated by a smooth registration process, which ensured an organised and enjoyable experience for attendees.

The performance by Padma Shri Vidushi A. Kanyakumari and her ensemble was lauded for its artistry and depth, leaving a lasting impression on all who attended. This cultural evening not only enriched the musical landscape of the institute but also reinforced CSIR-NCL's commitment to promoting diverse educational and cultural initiatives.

Overall, the SPICMACAY Classical Music Evening at NCL was a remarkable success, setting the stage for future cultural programmes and continuing the tradition of bringing classical arts to the scientific community.

Good Genes Gone Bad

NCL Book Club is a forum to bring together all reading enthusiasts to review and discuss books/plays/biographies. On behalf of the NCL Book Club, NCL KRC/Library conducts Book Review talks.

Mr Jayateerth S Bhavikatti, Research Scholar, Chemical Engineering and Process Development (CEPD) Division, CSIR-NCL, reviewed the book "Good Genes Gone Bad" By Dr Narendra Chirmule.

Dr Narendra Chirmule, an accomplished immunology and vaccine expert with extensive experience in both academia and industry, is currently the co-founder and CEO of SymphonyTech Biologics. I recently had the privilege of meeting him and found him to be both deeply knowledgeable and remarkably grounded. The timing of his book *Good Genes Gone Bad* is particularly significant, as it emerged during the global upheaval of the COVID-19 pandemic. Drawing on his vast expertise, Dr Chirmule presents an insightful account of diseases, therapeutic strategies and most importantly, the lessons learnt from both successes and failures in biomedical science.

The book may be broadly viewed in three sections: diseases and disorders, therapeutic approaches, and the author's professional journey at Biocon.

In the first section, the author explores three major medical conditions: Haemophilia, Rotavirus infection, and Acquired Immunodeficiency Syndrome. Particularly compelling is the discussion on haemophilia, where Dr Chirmule recounts the story of a close friend affected by the disorder. This personal narrative effectively illustrates how mutations in otherwise “good” genes can lead to serious health conditions, aptly reflecting the book's title.

The subsequent chapters on rotavirus and HIV infections shed light on the immense scientific effort, the challenges encountered, and the gradual emergence of effective treatments and preventive strategies.

The second section provides a concise yet illuminating overview of modern therapeutic approaches, including gene therapy, immunotherapy, and cell therapy. These advancements represent transformative milestones in medicine. The concept of gene therapy; correcting defective genes to treat disease is particularly promising, though complex in practice. The discussion on immunotherapy highlights breakthroughs such as CAR-T cell therapy, while the chapter on cell therapy examines its potential in treating disorders like Severe Combined Immunodeficiency (SCID), where functional cells can restore immune competence.

In the third section, Dr Chirmule reflects on his tenure as R&D Head at Biocon. This part of the book serves as valuable guidance for young researchers, particularly those pursuing careers in biology and biotechnology. He shares practical insights into leadership, research management, and organisational dynamics, along with key lessons from his professional journey.

The book concludes with a timely bonus chapter on COVID-19 and vaccine development, offering readers a contextual understanding of recent scientific achievements during a global crisis.
One area where the book could have been strengthened is in providing a more detailed exploration of its title, *"Good Genes Gone Bad,"* supported by additional illustrative examples. Nevertheless, this remains a minor shortcoming in an otherwise engaging and informative work.

What stands out most is the book's accessibility. Complex biological concepts are explained with remarkable clarity, making it suitable even for readers without a scientific background. This quality greatly enhances its appeal and educational value.

Overall, *Good Genes Gone Bad* is an insightful and reader-friendly exploration of modern biomedical science. It is highly recommended for anyone with an interest in diseases, therapies, and the evolving landscape of healthcare, irrespective of their academic background.

Mr Jayateerth S Bhavikatti,
Research Scholar,
Chemical Engineering and Process Development Division
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To strengthen scientific skills aligned with evolving industry needs, CSIR-NCL continued its Skill Development Program under CSIR's Integrated Skill Development Initiative. These expert-led workshops and training courses provide participants with hands-on experience and theoretical knowledge in advanced scientific domains. During this quarter, ten specialised courses were conducted, benefiting a total of 103 participants.

Mass Spectrometry-based Proteomics (06 January - 06 February 2026)

Led by Dr Nilakshi Sadavarte and Dr Mahesh Kulkarni, this workshop offered an in-depth introduction to proteomics technologies crucial for modern biological research. Participants gained expertise in peptide mapping, protein identification and the characterisation of post-translational modifications. Emphasis was placed on advanced quantitative proteomics techniques such as iTRAQ, SILAC, SWATH, MRM and PRM, enabling participants to analyse complex proteomes with high accuracy. The course combined lectures with practical demonstrations, fostering proficiency in mass spectrometry workflows for proteomic applications.

Food Safety and Quality Assessment (09 - 20 February 2026)

Under the guidance of Dr Koteswara Rao, this comprehensive course was designed to impart practical skills for the detection and assessment of microbial and chemical hazards in food and feed samples. Participants were introduced to microbiological techniques for identifying bacteria, fungi and yeast, supported by advanced genomic approaches for species- and strain-level identification. The program also covered analytical methods to detect contaminants such as mycotoxins, antibiotics and pesticides. Integrating HACCP principles, regulatory compliance frameworks and laboratory safety, the course prepared participants to ensure food quality and public health protection effectively.

Analytical Techniques for Material Characterisation (23 - 27 February 2026)

Dr Rajesh Gonnade conducted an intensive training covering critical analytical methods including Gas Chromatography (GC), X-ray Diffraction (XRD), Electrospinning, Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA) and Gel Permeation Chromatography (GPC). Participants engaged in both theoretical sessions and practical laboratory work focused on instrument calibration, method development, data interpretation. The hands-on approach enabled trainees to perform qualitative and quantitative analysis, gaining competencies aligned with industry standards for material characterisation.

Lithium-ion Battery Cells: Fundamentals to Fabrication (23 - 27 February 2026)

This course, led by Dr Manjusha Shelke, Dr Varun Natu and Dr G. P. Nayaka, provided participants with detailed knowledge of lithium-ion battery technology. Topics included battery working principles, materials such as cathodes, anodes, separators and electrolytes and fabrication processes like electrode formulation, coating, drying and calendaring. Hands-on sessions allowed trainees to fabricate coin and small pouch cells, followed by testing, performance evaluation and safety training. Participants also visited NCL's Venture Center for exposure to start-up innovations in battery technology.

Drug Polymorphism and Pharmaceutical Multicomponent Solids (09 - 16 March 2026)

Coordinated by Dr Rajesh Gonnade and Dr Manish Kumar Mishra, this program delved into solid-state chemistry relevant to pharmaceuticals. Participants explored the preparation and characterisation of polymorphs, salts, co-crystals and co-amorphous systems. Techniques covered included Single Crystal X-ray Diffraction (SCXRD), Powder X-ray Diffraction (PXRD), Differential Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA). The course addressed thermodynamics, crystal engineering, phase transformations and regulatory aspects. Practical sessions enabled participants to understand and control the solid forms critical for drug formulation and stability.

Women's Day Special Batch of Polymer Characterisation by GPC Techniques (12 - 13 March 2026)

This focused program, conducted by Mrs Poorvi Purohit, trained participants on Gel Permeation Chromatography (GPC), a key technique in polymer analysis. The workshop covered theoretical foundations, sample preparation, instrument operation, data acquisition and analysis. Participants learned to determine molecular weight and polydispersity indices of polymers, with detailed troubleshooting guidance. Practical exercises enhanced their ability to analyse polymer samples used in pharmaceutical, food and material industries, building confidence in applying GPC for research and quality control.

Women's Day Special Batch on HPLC and LC-MS (24 - 25 March 2026)

Dr Nilakshi Sadavarte and Dr Snehal More conducted this introductory course focused on chromatographic techniques vital for qualitative and quantitative analysis. The program covered principles and applications of High-Performance Liquid Chromatography (HPLC) and Liquid Chromatography-Mass Spectrometry (LC-MS). Participants received training on sample preparation, instrument operation, data interpretation and troubleshooting, developing practical expertise essential for analytical and research laboratories.

Workshop on Mass Spectrometry-based Metabolomics (23 - 25 March 2026)

Led by Dr Ashok Giri and Dr Mahesh Kulkarni, this workshop provided a comprehensive overview of metabolomics, including sample preparation, data acquisition using the Q-Exactive Orbitrap LC-MS/MS and advanced data analysis and interpretation techniques. The program blended lectures with hands-on training to equip participants with the skills needed for metabolomic profiling, facilitating biomarker discovery and systems biology research.

Quality Control Chemist (23 March - 02 April 2026)

This ongoing program, led by Dr Rajesh Gonnade, emphasised the role of quality control in ensuring product integrity across manufacturing and research environments. Participants learned about qualitative and quantitative testing protocols, regulatory compliance, data documentation and maintaining accurate records. The curriculum covered Standard Operating Procedures (SOPs) and Good Laboratory Practices (GLP), focusing on analytical methods from raw material inspection through finished product evaluation, reinforcing participants' readiness for quality assurance roles

Synthetic Organic Chemistry (15 December 2025 - 27 March 2026)

Under the supervision of Dr Utpal Das and the Organic Chemistry Division, this extended program offers immersive training in synthetic organic chemistry. Following an initial two-week module on laboratory safety, chemical handling, literature mining and data management, participants joined research groups to perform organic transformations and multistep synthesis. Training emphasised reaction planning, monitoring, product isolation, purification, analysis and rigorous documentation.

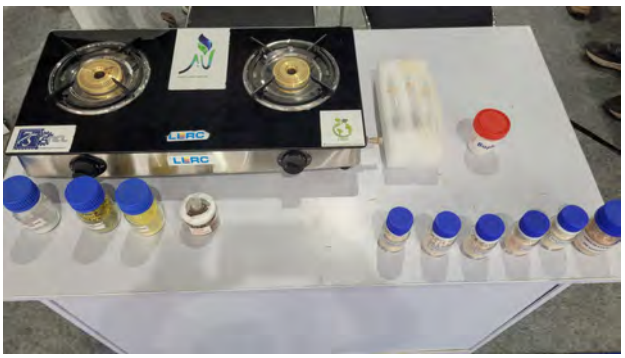
ChemTECH World Expo 2026

CSIR-National Chemical Laboratory marked a strong and impactful presence at the ChemTECH World Expo 2026, held from 3rd to 6th February 2026 at the Bombay Exhibition Centre in Goregaon, Mumbai. Recognised as a leading international exhibition and conference for the chemical, pharmaceutical, petrochemical and allied industries, the event brought together a wide spectrum of stakeholders. It provided an excellent platform for technology dissemination, industry engagement and the exploration of strategic collaborations.

CSIR-NCL's participation was centred on showcasing a diverse portfolio of ready-to-license technologies, process innovations and research-driven solutions aligned with contemporary industrial requirements. The stall attracted considerable attention from industry professionals, technology licensors, start-ups and academic researchers, reflecting the relevance and applicability of NCL's work to real-world challenges.

Among the highlights were the Continuous Flow Synthesis (CFS) platforms, which demonstrated advanced reactor systems and scalable, industry-ready processes for pharmaceuticals and speciality chemicals. These platforms drew significant interest for their potential to enhance efficiency, safety and sustainability in chemical manufacturing. In addition, process technologies for Bisphenol-A and Paracetamol were presented, highlighting NCL's expertise in chemical and pharmaceutical process development and optimisation.

Another key attraction was the Dimethyl Ether (DME) production process technology, displayed along with catalyst and burner models. This technology emphasises clean fuel alternatives and improved process efficiency, aligning with global efforts towards sustainable energy solutions. Equally noteworthy were the applications of CSIR-NCL's NaLi-LSX zeolite granules in gas separation. Catalyst samples on display attracted attention from stakeholders in the energy and industrial gas sectors, opening avenues for potential industrial deployment.



The NCL CRTDH programme was also featured, with reactive dye samples illustrating successful translational research and support for micro, small and medium enterprises (MSMEs). Bio-manufacturing initiatives highlighted advancements in industrial biotechnology and fermentation technologies, reflecting NCL's expanding capabilities in this rapidly growing domain.

Further, CSIR-NCL presented its strengths in separation science and process engineering through distillation and separation technologies. Exhibits included a vapour-liquid equilibrium (VLE) apparatus model and samples of essential oil active ingredients, demonstrating practical applications in process optimisation. Bio-agrochemical innovations were also showcased, underlining the laboratory's commitment to developing sustainable and environmentally responsible solutions for agriculture.

In addition to individual technologies, the stall featured a consolidated portfolio of NCL's technology offerings, along with an institutional overview highlighting its multidisciplinary research capabilities and state-of-the-art infrastructure. This comprehensive presentation enabled visitors to gain a holistic understanding of the laboratory's strengths and its potential as a technology partner.

ChemTECH World Expo 2026

Throughout the four-day event, the CSIR-NCL stall witnessed a steady flow of visitors, including representatives from chemical and pharmaceutical manufacturing companies, EPC firms, start-up founders and investors, technology licensors and academic institutions. The interactive displays and physical exhibits facilitated meaningful technical discussions, resulting in several business enquiries and promising collaboration leads. Notably, multiple organisations expressed interest in licensing CFS processes, DME technology and gas separation materials.

CSIR-NCL's participation in ChemTECH World Expo 2026 effectively demonstrated its commitment to translating scientific research into industrially relevant technologies. The exhibition served as a strategic platform to strengthen industry linkages, promote licensable innovations and enhance the laboratory's visibility at both national and international levels.

Foldscope Microscope Hands-on Workshop (12-13 February 2026)

CSIR-National Chemical Laboratory, under the CSIR Jigyasa Programme, organised a two-day Foldscope microscopy workshop in collaboration with the International Centre for Genetic Engineering and Biotechnology (ICGEB). Conducted by the Science Outreach Resource Centre, the programme aimed to promote experiential learning and scientific curiosity among school students.

A total of 356 students and 19 teachers from 10 schools, including institutions from Uruli Devachi, Sangamner, Yamunanagar, Panmala and Sinhagad, participated across four batches. The workshop began with an overview of CSIR-NCL's outreach initiatives and the Jigyasa Student–Scientist Connect programme.

Dr Wajahat Ali Khan and Dr Priya Yadav, certified ICGEB trainers, guided students in assembling Foldscope microscopes and introduced the basics of microscopy. Participants built paper-based microscopes and observed samples such as water, plant tissues and microorganisms, along with pre-stained slides of fern rhizomes and mosquito legs.

Students also learned to capture images using smartphones, linking digital tools with scientific observation. The final session at PMC Hutatma Balbir Shirishkumar High School involved 65 students and three teachers.

Each participant received a Foldscope kit, encouraging continued exploration. The workshop highlighted the value of hands-on learning in developing scientific inquiry and curiosity.

Robotics Rover

Robotics Rover Hands-on Workshop (17-18 March 2026)

CSIR-National Chemical Laboratory, under the CSIR Jigyasa Programme, organised a two half-day hands-on *"Robotics Rover"* workshop on 17-18 March 2026 in collaboration with Saras Robotics, Pune. Conducted by the Science Outreach Resource Centre, the programme introduced school students to the fundamentals of robotics through experiential learning.

A total of 81 students and four teachers from three schools participated. The sessions began with an overview of CSIR-NCL outreach activities and the Jigyasa Student-Scientist Connect programme, followed by a brief address by Dr Wafia Masih, Chief Scientist, highlighting the importance of scientific outreach.

Technical sessions were led by Ms Deepali Bhangale and Ms Rashmi Sapdhare, founders of Saras Robotics. Students, working in teams, assembled robotic rovers using provided kits and explored key concepts such as sensors, automation and basic robotics principles. They also learnt block-based programming to control robot movements.

Using ultrasonic sensors, participants conducted obstacle-detection experiments, observing real-time navigation and autonomous responses. The hands-on activities enabled students to understand how mechanical, electronic and programmed systems integrate in robotics.

The workshop was highly engaging and helped build curiosity, problem-solving skills and foundational knowledge of robotics, effectively demonstrating the value of learning through direct experimentation.

स्थानीय भाषा के साथ राजभाषा हिंदी का प्रयोग करें

भास्कर न्यूज | पुणे

गृह मंत्रालय, भारत सरकार द्वारा गठित नगर राजभाषा कार्यान्वयन समिति (2), पुणे के तत्वावधान में राष्ट्रीय रासायनिक प्रयोगशाला (एनसीएल) में एक दिवसीय हिंदी राजभाषा संगोष्ठी का आयोजन किया गया। प्रातःकालीन उद्घाटन सत्र की अध्यक्षता मुख्य वैज्ञानिक डॉ. अजित जोशी ने की, जबकि मुख्य अतिथि के रूप में पूर्व उपनिदेशक (कार्यान्वयन एवं प्रशिक्षण), राजभाषा विभाग डॉ. एम.एल. गुप्ता उपस्थित रहे। डॉ. गुप्ता ने कहा कि भारत सरकार की राजभाषा नीति केवल हिंदी ही नहीं, बल्कि सभी भारतीय भाषाओं के समन्वित विकास पर बल देती है। स्थानीय भाषाओं के साथ संतुलन बनाते हुए संघ की राजभाषा हिंदी के प्रयोग और प्रसार को बढ़ाने पर उन्होंने जोर दिया।

एनसीएल के हिंदी राजभाषा संगोष्ठी में

समारोह की शुरुआत सरस्वती वंदना से हुई। द्वितीय सत्र में पुरस्कार प्रदान किया गया। इसकी अध्यक्षता एनसीएल के निदेशक डॉ. आशीष लेले ने की। प्रयोगशाला की अर्धवार्षिक राजभाषा पत्रिका 'एनसीएल-आलोक' के 34वें अंक का विमोचन किया गया। केंद्रीय संस्थानों को राजभाषा कार्यान्वयन और हिंदी गृहपत्रिका हेतु सम्मानित किया गया। कार्यक्रम में लगभग 180 प्रतिनिधियों तथा 21 केंद्रीय संस्थानों के प्रमुखों ने भाग लिया। अंत में प्रशासकीय नियंत्रक कनिका गोयल ने धन्यवाद ज्ञापन प्रस्तुत किया। डॉ. स्वाति चड्ढा ने स्वागत किया।

Tarang 2026: CSIR-NCL Pune Celebrates National Science Day with Focus on Research, Innovation and Entrepreneurship

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Pune: CSIR-National Chemical Laboratory (CSIR-NCL) organized the National Science Day Celebrations – 2026 with its flagship student and research scholars' event Tarang 2026 at the CSIR-NCL Auditorium.

पायलट प्रोजेक्ट | पुणे में एनसीएल के वैज्ञानिकों ने विकसित किया ईंधन

एलपीजी का स्वदेशी विकल्प 'डायमिथाइल ईथर' तैयार

प्रतिदिन 250 किलो का हो रहा उत्पादन, एलपीजी की तुलना में डेढ़ गुना अधिक कारगर, कीमत भी कम

भास्कर न्यूज | पुणे. अमेरिका और ईरान में युद्ध के चलते देशभर में एलपीजी की किल्लत हो गई है। एलपीजी सिलेंडर लेने के लिए लोग लंबी-लंबी कतारें लगा रहे हैं। इन परेशानियों के बीच लोगों के लिए पुणे से राहतभरी खबर आई है। पुणे स्थित नेशनल केमिकल लेबोरेटरी (एनसीएल) के वैज्ञानिकों ने एलपीजी का विकल्प तलाश लिया है। वैज्ञानिकों ने 'डायमिथाइल ईथर' (डीएमई) नामक ईंधन बनाने में सफलता हासिल की है। विशेषज्ञों का मानना है, यदि औद्योगिक स्तर पर इसका बड़े पैमाने पर उत्पादन शुरू किया जाता है, तो यह देश की 10 से 20 प्रतिशत ईंधन जरूरतों को पूरा करने में सक्षम होगा।

22 वर्षों के अथक शोध के बाद कामयाबी : एनसीएल के वैज्ञानिक डॉ. तिरुमलाईस्वामी राजा और उनकी टीम ने 22 वर्षों के अथक शोध के बाद इसके लिए आवश्यक 'उत्प्रेरक' विकसित किया है, जो इस ईंधन उत्पादन की कुंजी है। एनसीएल के निदेशक डॉ. आशीष लेले ने बताया, इस शोध की शुरुआत 2004 में हुई थी। 22 वर्षों की कड़ी मेहनत के बाद 2026 में यह तकनीक व्यावसायिक उत्पादन के लिए पूरी तरह तैयार हो गई है। पूरी प्रक्रिया के लिए 6 पेटेंट भी दर्ज किए गए हैं। वर्तमान में पायलट प्रोजेक्ट के तहत प्रतिदिन 250 किलो डीएमई का उत्पादन किया जा रहा है।

कृषि कचरे या बायोमास से बनता है : यह स्वदेशी ईंधन मुख्य रूप से कृषि कचरे या बायोमास से प्राप्त किया जाता है। बायोमास से पहले मिथेनॉल और फिर रासायनिक प्रक्रिया के जरिए डीएमई तैयार किया जाता है। सबसे बड़ी विशेषता यह है, यह एलपीजी की तुलना में डेढ़ गुना अधिक कार्यक्षम है। इतना ही नहीं, बड़े पैमाने पर उत्पादन शुरू होने के बाद इसकी कीमत एलपीजी से भी कम होने का अनुमान है। भारत अपनी एलपीजी जरूरतों का बड़ा हिस्सा आयात करता है। 2024 के आंकड़े देखें तो इस दौरान हमने 2.1 करोड़ टन एलपीजी आयात किया था। ऐसे में डीएमई का सफल उत्पादन न केवल विदेशी मुद्रा बचाएगा, बल्कि देश को ईंधन के मामले में आत्मनिर्भर भी बनाएगा।

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NCL has an answer with eco-friendly alternative gas: DME from biowaste

Ardhra.Nair@timesofindia.com

Pune: Scientists of National Chemical Laboratory (NCL) have come out with a technique to produce alternative fuel, dimethyl ether (DME), which promises to be as efficient, more eco-friendly and sustainable than LPG.

Thirumalaiswamy Raja, chief scientist, catalysis division, and his team at the NCL claims that they have found a catalyst and a technique that converts methane from biowaste into DME, with over 99.99% efficiency. "According to the standards set by Bureau of Indian Standards (BIS), we can blend up to 20% of DME with LPG for domestic, commercial and industrial use. If we substitute just 8% of LPG with DME, we can use the same infrastructure — cylinder, burner, stove, regulator, hose etc. Even such a small amount of substitution will mean India saves an annual forex of Rs9,500 crore," said NCL director Ashish Lele.

"This technology has already been successfully scaled up to a pilot capacity of 250kg per day in Pirangut," said Vijay kumar KP from Texol Engineering Private Limited that partnered with NCL.

"We will set up the whole infrastructure, right from methane production from biowaste and further production of DME from methane," said Rajesh Date, director, Atrium Innovations Private Limited, which is also NCL's partner.

Raja, working on the subject since 2004, says the patented technology utilizes an indigenously invented highly active, selective and cost-effective catalyst, which he claims is much better in different parameters compared to what is available world over. Officials said they are in talks with the central government to issue a policy decision which allows mixing of DME for commercial purpose so that India's dependence on imported LPG is reduced.

Pic courtesy: NCL

The pilot plant in Pirangut that produces dimethyl ether from methane

SATURDAY MARCH 14, 2026

Hindustan Times

MY PUNE

Surge in demand for coal, wooden gas stoves amid LPG shortage

With many facing delays in LPG refills they are turning to reliable alternatives

Dheeraj Bengrut

PUNE: Amid the ongoing shortage of LPG cylinders across Maharashtra and other parts of the country, the demand for traditional- coal and wooden gas stoves has risen sharply in Pune city and across Pune district. With many households facing delays in LPG refills and uncertainty around supply, citizens as well as commercial establishments are increasingly turning to these traditional stoves as a reliable alternative for daily cooking. This shift, in turn, has led to a significant spike in the production and sale of these stoves.

According to local manufacturers, demand has risen dramatically over the last few days. Shreyas Bhole, owner of Samruddhi coal gas stoves from Dhankawadi, said that his business has experienced an unprecedented surge in orders. "In the last four to five days, we have seen a huge increase in demand for coal gas stoves from customers across Pune and nearby areas. We manufacture different models for home and commercial use, and the prices range from ₹3,000 to ₹22,000 depending on the size and capacity..." Bhole said.

A similar trend is being observed in rural parts of the district as well. Suresh Mandhare, owner of Tej wooden gas stoves from Daund, said that the demand is particularly high from commercial establishments including roadside hotels and highway dhabas that see uninterrupted cooking operations. "For the past one week, the demand for wooden gas stoves has increased significantly, expe-

The demand for traditional stoves is increasing in both urban and rural areas.

Dimethyl ether emerges as clean, indigenous alternative to LPG

Kimaya Boralkar

PUNE: At a time when global supply disruptions and rising prices are heightening concerns over India's dependence on imported fossil fuels, scientists are highlighting Dimethyl Ether (DME) as a promising clean-burning alternative to Liquefied Petroleum Gas (LPG).

DME is developed and scaled by researchers at CSIR-National Chemical Laboratory in Pune.

DME is a synthetic fuel known for its clean combustion characteristics, emitting very low levels of soot, nitrogen oxides (NOx), sulphur oxides (SOx) and particulate matter. Scientists say its thermal efficiency is comparable to conventional fuels, making it suitable for both domestic and industrial applications.

Apart from cooking fuel, DME has several potential uses. It can serve as an automotive fuel, replace ozone-depleting chlorofluorocarbons (CFCs) in aerosol propellants, and act as a

Experts note that replacing up to 8% of LPG with DME requires no modification to existing infrastructure, including cylinders, regulators, hoses, gaskets and burners.

"DME burns cleaner than conventional fuels, emitting minimal amounts of soot, nitrogen oxides (NOx), sulphur oxides (SOx) and particulate matter. It also offers thermal efficiency comparable to traditional fuels, making it suitable for household and industrial applications," CSIR-NCL said in a statement.

Scientists at CSIR-NCL have developed a patented process technology for DME production using an indigenously designed catalyst that enables efficient conversion of methanol to DME. The work was led by Thirumalaiswamy Raja, chief scientist at the Catalysis Division.

"We are now preparing to scale up the technology to a demonstration plant with a capacity of 2.5 tonnes per day, which we expect to be operational within six to nine months

Long queues were seen for LPG cylinders across the city on Friday. HT PHOTO

Unauthorised warehouse busted in Kasarwadi area

Shrinivas Deshpande

PUNE: Following frequent complaints from residents, the Pune district administration and Pimpri Chinchwad police jointly raided an alleged illegal LPG cylinder storage facility in the Kasarwadi area.

Police said the raid was conducted on Friday at a private gas agency.

A flying squad appointed by Pune district collector Jitendra Dudi raided the warehouse and recovered 54 filled and 207 empty LPG cylinders stored in the premises without proper authorisation.

Vijay Kshirsagar, the nayab tahsildar who led the flying squad, said: "We received many

FLYING SQUAD RECOVERED 54 FILLED AND 207 EMPTY LPG CYLINDERS STORED AT THE PREMISES WITHOUT PROPER AUTHORISATION

they created a panchanama of the recovered items and submitted a detailed report to the district collector's office by late evening that same day. He added that further action would be taken based on the report, as directed by senior authority.

Kshirsagar also said that during the raid, many customers approached the squad offi-

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CSIR- National Chemical Laboratory

Catalysing Innovation

Eco-efficient & Autocatalytic Process for the Manufacturing of Tributyl Citrate (TBC)

- CSIR-NCL has developed an auto-catalytic and patented process for manufacturing Tributyl Citrate (TBC) (CAS No. 77-94-1) — a biodegradable and non-phthalate plasticizer
- TBC is a safe and versatile alternative to conventional phthalates, widely used in toys, medical devices, printing inks, coatings, and cosmetics.
- Developed through an innovative reactive distillation process using citric acid and butanol as raw materials. This technology ensures high purity, efficiency, and sustainability.
- The process has been validated at laboratory scale and is available for licensing or co-development with industry partners.

Technology Available For Licensing/ Co-development

BACKGROUND

- Organic esters are key intermediates in chemical and pharmaceutical industries. TBC stands out for its versatility, safety, and performance, finding wide use in cosmetics, personal care, coatings, and plastic formulations.
- Traditionally made by esterifying citric acid with alcohol, TBC production faces issues like acidic catalysts, corrosion, and by-products.
- Our patented auto-catalytic process overcomes these challenges, delivering high purity, minimal waste, and lower operational costs in an eco-efficient way.

TECHNOLOGY OFFERING

- Auto-catalytic process
- Based on Reactive distillation
- No separation step required
- Raw material: Citric acid
- Purity: >95 % & Yield: >85 %
- Product: Colorless
- Optimized process

CURRENT STATUS

- Lab scale (5 L Demonstration/TRL 4).
- This technology is available for licensing and co-development.

TBC MARKET

TBC Market Revenue was valued at USD 1.2 billion in 2024 and is estimated to reach USD 1.8 billion by 2033, growing at a CAGR of 5.0% from 2026 to 2033.

(https://www.verifiedmarketreports.com/product/tributyl-citrate-market/)

VALUE PROPOSITION

- Patent protected process
- Reactive distillation-based process
- Auto-catalytic & cost-effective process
- No catalyst required
- Eco-friendly
- Water is the only discharge
- No separation step needed

APPLICATIONS

- A non-toxic plasticizer in toys, medical products, printing ink, coatings, pharmaceuticals, cosmetics, flavours and fragrances
- Used for granulation of non-toxic PVC
- TBC is a biocompatible substitutes for phthalic acid esters

IP: IN337784, WO2017085745, US 10604472

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