美东华美化学与化工学会

Chinese American Chemical Society – East Chapter

E-CACS News Letter

March 2026

March Issue Chief Editor: Xiaozhou Feng

Editor's Note

This issue reflects both momentum and transformation across our community and the broader scientific landscape. From Dr. Yuan Cheng's leadership in pharmaceutical development and his continued dedication to East-CACS, to groundbreaking advances in CAR-T technologies and emerging innovations across materials science, biotech, and consumer products, a common theme emerges: innovation is no longer confined to discovery alone—it is increasingly defined by translation, scalability, and real-world impact.

At the same time, shifting industry dynamics—from evolving funding environments to global manufacturing strategies—remind us that science operates within a larger ecosystem shaped by policy, investment, and collaboration. Our recent 45th Anniversary and Lunar New Year celebration beautifully captured this balance, honoring our heritage while energizing the path forward.

As always, we hope this newsletter not only informs but also connects—bridging disciplines, industries, and generations within our vibrant community.

45th Anniversary & Chinese New Year Celebration

Contributor: Chongsong Xu

South Plainfield, NJ – On February 28, 2026, the Chinese American Chemical Society, East Chapter (East-CACS) hosted a spectacular Lunar New Year Gala. The event was a double celebration, marking both the Year of the Horse and the 45th Anniversary of the association's founding. The evening was a vibrant blend of professional heritage, cultural excellence, and community spirit.

Honoring the Past, Mapping the Future The gala commenced with an opening address by President Kevin Wang, who unveiled the current organizational structure and shared a comprehensive roadmap for the 2026 event calendar. Highlighting the association's commitment to excellence, President Wang presented the Excellent Service Awards to five distinguished members for their outstanding contributions.

Following the roadmap, former President Dujuan Lu provided a heartfelt retrospective of the association's 2025 achievements. The spirit of the wider scientific community was felt through video greetings from Marinda Wu (Former ACS President) and Qiang Yuan (CACS Board Chair). On-site, Wei Gao (Philadelphia ACS Chair & CACS 2026 President) offered warm remarks, joined by a gathering of former East-CACS Presidents for a historic group photo.

A Feast of Art and Culture The evening's performances, hosted by a dynamic team including Jian Wang, GiGi Zhao, Chongsong Xu, and talented youth hosts Amy Cheng and Grace Zhu, showcased world-class artistry:

• **Traditional Melodies:** Renowned pipa soloist Jin Yang and the Silk and her band opened the show with "Jasmine Flower" and "Racing Horses," taking the audience on a musical journey from delicate blossoms to the thundering Steppe. • **Dynamic Dance:** Yong Ma, a celebrated dance educator, performed the Hebei folk dance "Pie Shan" (Fanning), followed later by a high-energy performance of "Apt." • **Martial Arts:** Yongchu Song, a Tai Chi champion, demonstrated the profound depth of Chinese martial arts through "Chen-style Tai Chi Sword" and "Tai Chi Quan Er Lu." • **The Next Generation:** The gala highlighted the "Rising Stars": Jennie Zhang (National Champion) performed the ethereal peacock dance

"Spirit of the Bird"; Helen & Jessica Hao performed a touching rendition of "The Olive Tree"; Sophia Cheng presented the modern ballet "Gemini"; Jinyi Feng performed "Let Us Sway the Oars"; and Daniel Zhu delivered a sophisticated clarinet solo, "Allegretto Fantasia."

Community Engagement & Heritage The celebration was peppered with interactive traditions. Liwei Fang, Director of the American Calligraphers Association, inscribed a special Spring Festival couplet for the 45th Anniversary. Jumin Hao further engaged the audience with a traditional idiom riddle challenge, while GiGi Zhao led energetic games for the children.

The evening also honored the future of science, as former Presidents Dujuan Lu and Yingchun Lu presented the Young Scientist Awards to the year's rising researchers.

Gratitude to Our Sponsors The success of the gala was bolstered by the generous support of our sponsors, whose representatives participated in the highly anticipated lucky draw sessions:

• **Diamond Sponsors:** Jk.com, Fox Rothschild, Waters • **Gold Sponsors:** Precise PEG, ALFA Chemistry, IFF, Johnson & Johnson, THC Lawyers • **Silver Sponsors:** ChemExpress, Primera • **Bronze Sponsor:** Apex 974

The night concluded on a high note with a group chorus of "In the Spring" by the EC members and Jian Wang. As the Year of the Horse begins, East-CACS gallops into 2026 with renewed vigor, celebrating 45 years of bridging chemistry and community.

Member Highlight

Yuan Cheng, PhD, Associate Director, Regeneron

Dr. Yuan Cheng is the 2024 Chair of the East Chapter of the Chinese American Chemical Society and has served as a board member since 2015. He earned his Ph.D. in Biochemistry and Biophysics from the University of North Carolina at Chapel Hill in 2011 and completed his postdoctoral training in the lab of Nobel Laureates Dr. Mike Brown and Dr. Joe Goldstein at the University of Texas Southwestern Medical Center.

With over a decade of experience in the pharmaceutical industry, Dr. Cheng has held key positions at companies such as Bristol Myers Squibb and Regeneron. Currently serving as an Associate Director, he leads a team focused on formulation and process development for antibody and gene therapy.

Dr. Cheng has authored more than 25 publications in peer-reviewed journals and is an active member of the American Association of Pharmaceutical Scientists (AAPS) and the American Society of Gene and Cell Therapy (ASGCT). In 2023, he served as the President of AAPS Protein Purification, Storage, Transportation and Drug-Device Combination Community.

Dr. Cheng plays an active role in the Chinese American Chemical Society East Chapter (ECACS), currently serving as Treasurer and as a member of the Executive Committee. He contributes meaningfully to the Budget & Finance Team, helping to strengthen the organization's operations and outreach with Dr. Ho and Dr. Mao.

Across his professional and volunteer work, Dr. Yuan Cheng is recognized for his leadership in pharmaceutical development, dedication to scientific excellence, and active contributions to professional societies and the Chinese American scientific community.

Academic News

Contributor: Xiaozhou Feng

Dr. Harris Goldstein's lab reports an innovative approach to manufacturing CAR-T cells that may overcome a major limitation in current therapies: poor long-term persistence. Traditional CAR-T production relies on anti-CD3/CD28 activation, which often pushes T cells toward terminal differentiation, limiting their durability and effectiveness.

Researchers developed a novel protein scaffold, HCW9206, that delivers combined signals from IL-7, IL-15/IL-15Rα, and IL-21 without strong TCR activation. This strategy promotes the generation of stem-like, long-lived T cells with enhanced functionality. The study showed that HCW9206-generated CAR-T cells contained over 50% T memory stem cells—approximately 14 times higher than conventional methods. In leukemia mouse models, these cells demonstrated superior persistence and completely eliminated tumors upon rechallenge. In humanized HIV models, the engineered CAR-T cells achieved about 92% suppression of infected cells, nearly doubling the efficacy of standard approaches.

Additionally, the cells maintained strong cytotoxic activity, produced higher levels of key cytokines such as TNF-α and IFN-γ, and exhibited reduced exhaustion markers. Importantly, the method was effective using T cells from people living with HIV, highlighting its translational potential.

Overall, this simplified manufacturing strategy could enable more durable cancer immunotherapies and advance efforts toward functional cures for HIV.

Dr. Mark A. Sellmyer lab introduces an innovative strategy to control CAR-T cell activity by merging two rarely combined technologies: PROTACs and engineered cell therapies. The team designed CAR-T cells incorporating a degradable tag (eDHFR) on the CAR receptor and paired this with light-responsive PROTAC molecules. Upon light exposure, these PROTACs selectively degrade the CAR receptor, effectively dialing down CAR signaling. This reduces tumor-killing activity and inflammatory cytokine release—without eliminating the T cells themselves.

This approach offers several important advantages. First, it provides a potential method to mitigate serious CAR-T–associated toxicities such as cytokine release syndrome (CRS) and neurotoxicity. Second, it enables precise spatiotemporal control, allowing clinicians to regulate CAR-T activity in specific tissues and at specific times. Third, it introduces photopharmacology as a new regulatory layer in cell therapy, expanding the toolkit for next-generation immunotherapies.

The study demonstrated that photocaged PROTACs enable rapid and robust suppression of CAR activity, while reversible photoswitchable systems suggest future possibilities for dynamic “on/off” control. Although challenges remain—particularly related to light penetration in vivo and efficient delivery, the concept represents a significant step forward.

Rather than a simple technical advance, this work establishes a new paradigm: externally controllable, tunable cell therapies with improved safety and precision.

Industry News

Advanced Materials & Electronics

Engineering matter to control energy, signals, and durability

Contributor: Jin Zhu

Beamsteering Metasurfaces That Tune 5G Indoors

Engineers have fabricated next generation reconfigurable intelligent surfaces (RIS) using densely packed metal–dielectric metaatoms, each incorporating tunable components—such as varactors or phase change films—that alter their electromagnetic phase shift in real time. This structure allows a wall mounted panel to dynamically redirect, focus, or scatter mmWave signals with high angular precision, overcoming the notorious line of sight limitations of 5G indoors. Beyond simply reinforcing coverage, these metasurfaces accomplish wavefront shaping at sub-wavelength resolution, enabling complex functions such as splitting a single incident beam into multiple controlled outputs or selectively suppressing interference. Their negative index and custom permittivity behavior is achieved through nano structured patterning that forces electromagnetic fields to travel along engineered paths not found in nature. Early demonstrations show that integrating RIS into building materials—like ceiling tiles or window coatings—reduces the need for small cell densification by ensuring signal uniformity through intelligent reflection rather than transmission, greatly lowering infrastructure cost while improving energy efficiency in dense environments.
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Microcapsule Patched Circuitry That Restores Conductance on Impact

A newly developed electronic laminate introduces mechanically sensitive microcapsules loaded with conductive monomers and catalysts positioned directly at high stress copper trace regions. When thermal cycling, flexion, or micro vibration causes a trace to fracture, these capsules burst and release their payload, which rapidly polymerizes into a metallic grade conductive network that chemically bonds to the ruptured copper. Laboratory testing shows recovery of up to 95% of original conductance within minutes, even after repeated damage cycles. By integrating this autonomous healing layer into multilayer PCBs, researchers have demonstrated mission critical electronics—such as satellite circuits or deep sea sensors—can maintain function despite micrometeorite strikes, pressure cycling, or radiation induced micro cracking. The material's tunable capsule rupture thresholds mean engineers can design different capsule densities for flex PCBs, rigid boards, or stretchable substrates. When applied at scale, analysts estimate the technology could reduce total electronic waste streams substantially by prolonging device lifetimes and avoiding preemptive component replacement.

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Energy & Sustainability

Scaling next-generation solutions for constrained environments

Contributor: Jin Zhu

34%Efficient Perovskite–Silicon Tandems for Tight Spaces

Hybrid tandem photovoltaics achieve record performance by stacking a wide band gap perovskite top absorber over a traditional silicon bottom cell, optimizing the capture of high energy photons while allowing lower energy light to pass into the silicon layer. Researchers have achieved >34% certified efficiency through advances such as interface passivation layers that suppress recombination, alkali metal (Rb/Cs) doping that improves lattice stability, and graded mixed halide compositions that maintain performance under heat and illumination stress. These improvements allow tandems to outperform single junction silicon by a significant margin without requiring new factory equipment—manufacturers can integrate perovskite layers atop existing wafers using scalable coating methods. Their high power density makes them ideal for locations where surface area is limited: compact rooftops, RVs, marine vessels, and urban mobility solutions like ebikes and solar augmented cars. With the first commercial entries expected in 2026, these cells could redefine distributed solar by offering utility scale efficiency in portable formats.

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Digital Health, Pharma & Biotech

From molecule discovery to market dynamics

Contributor: Scarlett Jiatong Liu, Chongsong Xu, Jin Zhu

Eli Lilly's $3 Billion China Manufacturing Expansion: Strategic Brief

Executive Summary

Eli Lilly has announced a significant expansion of its manufacturing footprint in China, committing approximately $3 billion over the coming decade. This investment is primarily aimed at supporting the production of its next-generation oral GLP-1 therapies, including orforglipron, and strengthening its position in the rapidly growing diabetes and obesity market.

The move reflects a broader strategic shift among multinational pharmaceutical companies toward localized manufacturing, supply chain resilience, and intensified competition in China. Beyond capacity expansion, Lilly's initiative underscores the transition of the GLP-1 market into a supply-driven competitive phase, where manufacturing scale, cost efficiency, and market access are becoming as critical as innovation.

Main Analysis

The investment will focus on expanding Lilly's existing manufacturing footprint in China, including facilities in Suzhou, and developing localized production capacity for oral GLP-1 drugs such as orforglipron. The company also plans to collaborate with local contract development and manufacturing organizations (CDMOs), allowing it to scale production more efficiently while leveraging local expertise. This combined approach suggests a hybrid operating model that balances direct investment with external partnerships.

This expansion is driven by the strong growth outlook for the GLP-1 market in China, which is projected to reach approximately $14 billion by 2030. Lilly faces increasing competition both from global peers, particularly Novo Nordisk, and from a large number of domestic pharmaceutical companies developing similar therapies. At the same time, persistent global supply constraints in the GLP-1 category have made manufacturing capacity a key bottleneck, elevating its importance as a competitive differentiator.

From a strategic perspective, the investment reflects a clear emphasis on localization. Establishing production capacity within China allows Lilly to reduce costs, improve supply reliability, and better align with local regulatory and reimbursement frameworks. It also mitigates risks associated with global supply chains, including geopolitical uncertainties and logistical disruptions. More broadly, the move illustrates a shift in the competitive landscape: success in high-demand therapeutic areas such as GLP-1 increasingly depends not only on innovation, but also on the ability to manufacture at scale and deliver efficiently in key markets.

Conclusion

Eli Lilly's manufacturing expansion in China represents a proactive response to both market opportunity and structural changes in the pharmaceutical industry. By investing in local production and partnerships, the company is positioning itself to compete more effectively in a supply-constrained, highly competitive market. The initiative underscores a broader trend in which operational execution, supply chain resilience, and regional manufacturing capabilities are becoming central to long-term competitiveness.

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U.S. Biotech Funding Rounds Fall to a Five-Year Low — What's Behind the Slowdown?

The U.S. biotech sector is navigating one of its most challenging fundraising climates in recent memory. According to S&P Global Market Intelligence, the number of biotech funding rounds has dropped to its lowest level in five years — a stark signal that investor caution is reshaping how capital flows into life sciences.

A Shrinking Share of the Venture Pie

Biotech's share of total U.S. startup investment has hit its lowest point in over two decades. So far in 2025, investors deployed approximately $16.6 billion into seed-through-growth-stage biotech rounds — just over 8% of all U.S. startup investment, well below the 15%+ share the sector had reliably commanded in prior years. A key culprit: the explosive rise of generative AI, which has redirected enormous pools of capital away from biopharma and toward tech.

Macro Headwinds Are Piling Up

The funding squeeze isn't just about competition from AI. Early-stage biotech companies have historically leaned heavily on non-dilutive funding from sources like the NIH — traditionally the world's largest single source of life sciences capital with over $40 billion at its disposal. Proposed federal budget cuts would reduce that figure to $27.9 billion, significantly tightening the pipeline for pre-revenue companies that depend on government grants before attracting venture capital.

Additional headwinds stem from the Trump administration, including cuts to public research funding, leadership upheaval at the FDA and public health agencies, and ongoing uncertainty around drug pricing policy — all of which have made investors more risk-averse toward early-stage biotech bets.

A "Haves and Have-Nots" Market

The funding environment has created a stark divide: companies with strong clinical or commercial traction continue to attract capital, while those without clear proof points struggle to close rounds. Market volatility earlier in 2025 derailed multiple fundraising efforts, forcing companies to pivot to alternative financing strategies.

Meanwhile, more than half of publicly traded biotech firms ended 2024 with less than two years of cash runway, pushing many toward partnerships with larger pharmaceutical companies or royalty-based financing arrangements — a non-dilutive route estimated to generate around $14 billion annually across the sector.

Fewer Rounds, But Bigger Checks at the Top

Despite the overall contraction in deal count, large rounds are still getting done for the right assets. Funding in early 2026 has concentrated around neuropsychiatry, immunology, and respiratory disease, with AI and machine learning increasingly embedded across target identification, molecule design, and trial analytics — drawing sustained venture interest in both platform and asset-centric models.

The Road Ahead

The funding landscape remains cautiously optimistic for the second half of 2026, with more deals closing in the latter half of 2025 signaling a gradual recovery. However, the slowdown in early-stage financing raises a longer-term concern: even if market enthusiasm rebounds, a thinner pipeline of early-stage companies today means fewer assets ready to scale in the years ahead.

For chemistry and chemical biology professionals watching the intersection of science and capital markets, the message is clear — the biotech funding cycle is tightening its filter, and scientific differentiation and clinical de-risking have never mattered more.

AI and RWD Engines That Compress Clinical Trial Timelines

Modern clinical trial optimization platforms now integrate real world data (RWD) from EHRs, imaging archives, pharmacy records, and wearables to prescreen enormous patient pools using AI driven eligibility models. Natural language processing tools extract phenotypes,

comorbidities, and biomarker indicators that would traditionally require manual chart review. These platforms dynamically match trial protocols to available patient populations, cutting recruitment delays significantly. Parallel to this, decentralized trial toolkits enable remote telemedicine visits, home sample collection, and continuous monitoring, reducing participant burden and expanding geographic access. Block chain secured audit logs ensure each datapoint—whether collected onsite or at home—maintains traceability and compliance. Predictive analytics also forecast dropout risks, prompting targeted retention interventions tailored to individual patient behavior. Collectively, these systems reduce operational cost, shrink recruitment from months to weeks, and support more inclusive participant representation, especially for underrepresented populations historically excluded from research.

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Oneshot Biologics and Gene Therapies Nearing Approval

Next generation biologics entering the 2026 pipeline include long duration gene therapies, engineered enzymes, and highly specific monoclonal antibodies designed for single dose or ultra low frequency administration. A notable example is ABBVRGX314, which introduces an antiVEGF genetic payload directly to retinal tissues to produce therapeutic proteins continuously, replacing monthly injections for eye diseases like wet AMD. Similarly, the enzyme modulating therapy imlifidase aims to cleave IgG antibodies in transplant patients, enabling successful organ acceptance for individuals previously considered too sensitized. Other candidates, such as tividenofusp alfa, target rare cancers by delivering highly selective immune engaging molecules. Regulatory forecasts highlight a rising proportion of biologics in overall approvals due to their precision, durability, and disease modifying potential, with several candidates projected to reach blockbuster status given the large patient populations affected and the clear unmet medical need. Manufacturing innovations and streamlined regulatory frameworks are further accelerating these therapies toward market availability.

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In Vivo CART That Programs T Cells Inside the Patient

The emerging in vivo CART paradigm bypasses the traditional multi week manufacturing pipeline by delivering genetic instructions directly to a patient's circulating T cells using vectors engineered to selectively target immune cells or using lipid nanoparticles carrying mRNA that encodes the CAR construct. Once inside the body, these delivery systems exploit natural T cell biology to produce CAR receptors endogenously, effectively turning the patient into a self contained bioreactor for therapeutic cell production. Early trials—such as antiBCMA constructs tested for multiple myeloma—show that within days of a single infusion, reprogrammed T cells expand and begin attacking malignant cells. This approach eliminates leukapheresis, viral vector transduction, bioreactor expansion, and cryogenic logistics, which currently account for a significant portion of CART cost and delay. By simplifying the workflow to a single bedside administration, in vivo CART could dramatically expand access to cell therapy, potentially lowering costs and enabling treatment at community hospitals rather than specialized centers.

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Cosmetics & Personal Care

Bridging science, regulation, and consumer-driven innovation

Contributor: Mingxiao Li, Guangru Mao

Henkel Invests in North America R&D Hub

Henkel has announced a $70 million investment to build a new Consumer Brands Center of Research & Development in Trumbull. The 110,000-square-foot campus will unify three existing Connecticut R&D sites into one collaborative hub supporting over 200 employees, 27 laboratories, and three pilot plants.

Scheduled to open in 2027, the facility will focus on innovation across hair care, laundry, home care, and related functions. Designed with sustainability in mind, the new hub underscores Henkel's long-term commitment to North America innovation, strengthening Connecticut's role as a center for advanced product development.

The Verbal Gymnastics of Cosmetic Claims

In this refreshingly candid piece, a veteran of the industry tackles the "verbal gymnastics" required to market high-performance chemistry within strict cosmetic bounds. The author shares a humorous yet practical look at how R&D breakthroughs must be carefully translated into benefit-driven language to avoid the dreaded "drug" classification. For those of us used to precise molecular data, it's a witty reminder that in the personal care world, a single misplaced word can be just as disruptive as a failed stability test. It is an essential, lighthearted guide to navigating the fine line between scientific efficacy and regulatory reality.

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The Commercial Face of Sunscreen Innovation

As we head into the warmer months, this industry roundup offers a high-level look at how brands are currently pitching and innovating sun protection. The piece highlights the latest market directions in daily protection, skincare-SPF hybrid etc., for the current market product lineups. For the technical side of the house, these consumer-facing claims offer a great window into current market gaps that can serve as a spark for sun care innovation.

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Accelerating Ingredient Discovery via In Silico Modeling

The integration of computational chemistry and AI-driven virtual screening is fundamentally transforming the R&D pipeline for personal care. This featured article explores how in silico innovation allows researchers to predict molecular performance and toxicological profiles at an atomic level before physical synthesis. By shifting from traditional trial-and-error to these high-precision digital workflows, the industry is drastically compressing development timelines and optimizing ingredient efficacy. It is a compelling look at how "materials intelligence" is redefining the future of chemical formulation.

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Sensory & Consumer Experience Tech

Expanding human–machine interaction beyond sight and sound

Contributor: Jin Zhu

Millisecond Olfactory Actuators for Phones and VR

Ultra responsive olfactory actuators now use micro electrothermal or piezoacoustic valves capable of ejecting scent molecules in precisely metered bursts of only a few milliseconds—orders of magnitude faster than traditional atomizers. Their internal cartridges contain multichannel reservoirs, each holding unique volatile compounds that can be blended algorithmically to construct complex accords on demand. This speed allows precise alignment between sensory cues and digital media; for example, a VR simulation can trigger a warm, woody note exactly when a virtual campfire ignites or shift to a cool marine accord as a scene transitions. Despite their performance, these actuators run on milliwatt power budgets, making them suitable for smartphones, AR glasses, smart jewelry, and gaming headsets. Their compact form factor stems from removing pumps entirely, replacing them with solid state diffusion layers that respond instantly to electrical stimuli. This invention opens the path for "scent augmented computing," where notifications, navigation, or emotional cues are delivered not just visually and auditorily, but olfactorily with subsecond precision.

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Gestureactivated, Roomscale Aroma Displays

Researchers have developed addressable, multi nozzle diffusion grids that form an invisible olfactory display spanning an entire room. These devices incorporate overhead or wall mounted modules containing tens to hundreds of independently triggered scent channels, each capable of issuing micro plumes in directional patterns. Activation is governed by gesture recognition systems—ranging from optical tracking to short range radar—that interpret user movements (such as a swipe, point, or circular motion) as control signals to select, intensify, or transition scents. In practical use, a visitor in a retail store could wave toward a product shelf and instantly experience its associated fragrance as a localized plume, or a therapy patient could adjust calming scents by simple hand motions without touching any interface. The system can create multi zone scent fields, such as warm spices on one side of a gallery and brisk mineral notes on another, enabling designers to craft atmospheres with spatial narrative. Importantly, airflow modeling ensures that scents remain partitioned and updated rapidly, keeping the experience dynamic and minimizing lingering cross contamination.

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Food Science & Agriculture

Balancing safety, sustainability, and next-generation production

Contributor: Yanpeng Hou

EU Intensifies Action on PFAS as Health and Economic Risks Grow

A recent European Commission study warns that PFAS ("forever chemicals") could cost the EU up to €440 billion (≈$520 billion) by 2050 if contamination is not addressed. PFAS are widely used for their water and oil repellent properties, particularly in food packaging, but are highly persistent and linked to longterm health concerns.

Data from the European Food Safety Authority (EFSA) shows that fish consumption can increase blood PFAS levels by 20–40%, with fish, fruits, and eggs among the highest contributors to dietary exposure. PFAS have also been detected in beer in the U.S., fruits and vegetables in the EU, and food packaging in Canada, underscoring the global scope of the issue. While monitoring efforts are ongoing, experts note that data gaps remain, making it difficult to fully assess exposure levels.

In response, the EU plans to ban PFAS in certain food packaging starting August 2023, accelerating industry efforts to transition away from these chemicals. Although replacing PFAS presents technical challenges, food companies are increasingly investing in biobased and PFAS free barrier technologies, driven by both regulatory pressure and growing consumer demand for safer, PFAS free products.

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Why Precision Fermentation Is Shaping the Future of Food Innovation

Precision fermentation is emerging as a key technology for the future of food innovation, offering a scalable way to meet rising demand for protein and specialty ingredients. The process uses microorganisms such as yeast or bacteria as “mini factories,” converting simple inputs like sugars into targeted outputs including proteins, sweeteners, natural colorants, and specialty oils. While often confused with cultivated meat, precision fermentation focuses on producing specific molecules rather than growing animal cells.

Technology delivers major sustainability and efficiency benefits. Compared with traditional agricultural or extraction methods, precision fermentation can reduce water and energy use by more than 90% while improving yield, consistency, and supply stability. It also allows greater control over ingredient composition, enabling tailored functionality and potential reductions in allergens. Companies like Cargill, which has invested heavily in fermentation infrastructure over decades, see it as a proven yet rapidly evolving platform.

Looking ahead, precision fermentation is expected to complement existing food technologies rather than replace them. As consumer needs become more personalized, the ability to produce precise ingredients and formulate them into diverse applications—from nutrition bars to soups—positions precision fermentation as a flexible and powerful tool for innovation across the food industry.

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