

# Bulletin Board

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**\* While Chemwatch has taken all efforts to ensure the accuracy of information in this publication, it is not intended to be comprehensive or to render advice. Websites rendered are subject to change.**

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## ASIA PACIFIC

## Chemicals added to the Inventory 5 years after issue of assessment certificate – 24 January 2024

2024-01-24

The following industrial chemicals have been added to the Australian Inventory of Industrial Chemicals in accordance with section 82 of the Industrial Chemicals Act 2019 because 5 years have passed since the assessment certificates for the industrial chemicals were issued.

A list of chemicals added to the Inventory 5 years after issue of assessment certificate:

<b>CAS Number</b>	<b>1777808-07-7</b>
<b>Chemical Name</b>	Fatty acids, tall-oil, polymers with acrylic acid and styrene, <i>tert</i> -Bu peroxide-initiated, polymers with Bu acrylate, 2-ethylhexyl acrylate, Me methacrylate and styrene, ammonium salts
<b>Molecular Formula</b>	Unspecified
<b>Specific information requirements</b>	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
<b>Listing date</b>	15 January 2024
<b>CAS Number</b>	71512-90-8
<b>Chemical Name</b>	Poly(oxy-1,2-ethanediyl), .alpha.-[4-(dimethylamino)benzoyl]-.omega.-[[4-(dimethylamino)benzoyl]oxy]-
<b>Molecular Formula</b>	(C <sub>2</sub> H <sub>4</sub> O) <sub>n</sub> C <sub>18</sub> H <sub>20</sub> N <sub>2</sub> O <sub>3</sub>
<b>Specific information requirements</b>	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
<b>Listing date</b>	15 January 2024
<b>CAS Number</b>	880105-45-3

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<b>CAS Number</b>	<b>1777808-07-7</b>
<b>Chemical Name</b>	Ethanesulfonic acid, 2-[(2-aminoethyl) amino]-, sodium salt (1:1), polymer with 1,6-diisocyanatohexane, dimethyl carbonate, 1,6-hexanediol and .alpha.-hydro-.omega.-hydroxypoly[oxy(methyl-1,2-ethanediyl)], polyethylene-polypropylene glycol mono-Bu ether-blocked
<b>Molecular Formula</b>	Unspecified
<b>Specific information requirements</b>	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
<b>Listing date</b>	15 January 2024
<b>CAS Number</b>	26040-51-7
<b>Chemical Name</b>	1,2-Benzenedicarboxylic acid, 3,4,5,6-tetrabromo-, 1,2-bis(2-ethylhexyl) ester
<b>Molecular Formula</b>	C <sub>24</sub> H <sub>34</sub> Br <sub>4</sub> O <sub>4</sub>
<b>Specific information requirements</b>	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
<b>Listing date</b>	17 January 2024
<b>CAS Number</b>	2016755-66-9
<b>Chemical Name</b>	Propanoic acid, 3-hydroxy-2-(hydroxymethyl)-2-methyl-, polymer with .alpha.-hydro-.omega.-hydroxypoly(oxy-1,4-butanediyl), 5-isocyanato-1-(isocyanatomethyl)-1,3,3-trimethylcyclohexane and 1,2-propanediamine, compd. with N,N-diethylethanamine
<b>Molecular Formula</b>	(C <sub>12</sub> H <sub>18</sub> N <sub>2</sub> O <sub>2</sub> .C <sub>5</sub> H <sub>10</sub> O <sub>4</sub> .(C <sub>4</sub> H <sub>8</sub> O) <sub>n</sub> H <sub>2</sub> O.C <sub>3</sub> H <sub>10</sub> N <sub>2</sub> ) <sub>x</sub> .x.C <sub>6</sub> H <sub>15</sub> N
<b>Specific information requirements</b>	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.

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<b>CAS Number</b>	<b>1777808-07-7</b>
<b>Listing date</b>	22 January 2024

Read More

AICIS, 24-01-24

<https://www.industrialchemicals.gov.au/news-and-notice/chemicals-added-inventory-5-years-after-issue-assessment-certificate-24-january-2024>

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### Chemical added to the Inventory following issue of assessment certificate - 4 January 2024

2024-02-04

The following industrial chemical has been added to the Australian Inventory of Industrial Chemicals (the Inventory) under section 83 of the Industrial Chemicals Act 2019.

<b>CAS number</b>	<b>854737-09-0</b>
<b>Chemical name</b>	2H-Pyran, 3-heptyltetrahydro-
<b>Molecular formula</b>	C12H24O
<b>Defined scope of assessment</b>	The chemical has been assessed: as a fragrance component imported into Australia at up to 1 tonne/year as imported in fragrance formulations at up to 1% concentration for reformulation into end use cosmetic and household products in continuous action air fresheners at up to 0.3% concentration fine fragrances at up to 0.1% concentration instant action air fresheners at up to 0.03% concentration other cosmetic and household products at up to 0.01% concentration. as imported in finished products for sale in: continuous action air fresheners at up to 0.3% concentration fine fragrances at up to 0.1% concentration instant action air fresheners at up to 0.03% concentration other cosmetic and household products at up to 0.01% concentration.
<b>Listing date</b>	2 January 2024

Chemical added to the inventory following issue of assessment certificate.

Read More

AICIS, 04-02-24

<https://www.industrialchemicals.gov.au/news-and-notice/chemical-added-inventory-following-issue-assessment-certificate-4-january-2024>



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### Call for comment on food made from a new type of genetically modified corn

2024-01-25

Food Standards Australia New Zealand (FSANZ) is calling for comment on an application to permit the sale and use of food made from a new genetically modified (GM) corn.

FSANZ CEO Dr Sandra Cuthbert said corn line DP910521 was genetically modified to provide it with herbicide tolerance and protection from insect pests.

"If approved, food made from this type of GM corn could be imported into Australia and New Zealand in the form of starch, grits, meal, flour, oil and sweetener," Dr Cuthbert said.

She said safety assessments are a key part of the approval process for all GM foods.

"Our safety assessment considered the specific genetic modification process, the nutrient content compared to a non-GM food of its type, and any potential allergic or toxic effects in humans," Dr Cuthbert said.

"FSANZ found no potential public health and safety concerns with this GM corn. It is as safe as non-GM corn varieties."

Read More

FSANZ, 25-01-24

<https://www.foodstandards.gov.au/news/call-comment-food-made-new-type-genetically-modified-corn>

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FEB. 09, 2024

### TGA issues safety alerts regarding recall of several 0.9% sodium chloride products

2024-01-15

The Therapeutic Goods Administration (TGA) has issued safety alerts for the following 0.9% sodium chloride products:

Products	ARTG number/s	Batches	Action
InterPharma Sodium chloride 0.9% 30 mL ampoules	370471 (inhalation) 370408 (irrigation)	All batches	<u>Recall</u>
YES Medical – Nonantimicrobial wound irrigation solution, saline, sterile Product also known as: LEGENCY REMEDIES sodium chloride 0.9% irrigation (ampoules)	409695	All batches	<u>Recall</u>
Irrigation fluid, medical/	404417	All batches	<u>Recall</u>
Aero Healthcare – Irrigation fluid, medical/surgical procedure Product also known as: AEROWASH Eyewash and Wound Irrigation (15 mL and 30 mL)	159438	All batches	<u>Recall</u>

The above actions have been taken by the TGA while investigating the potential contamination of certain saline products with *Ralstonia pickettii*.

The TGA has lifted quarantine for InterPharma Sodium Chloride 0.9% 10 mL ampoule (ARTG – 235989).

Note that no registered veterinary products are affected by this issue; however, it is possible that veterinarians may use the affected products for reconstitution of veterinary medicinal products.



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**URL:** <https://www.apvma.gov.au/news-and-publications/news/tga-issues-safety-alerts-regarding-recall-several-09-sodium-chloride-products>

**Content last updated:** 15 January 2024

**Content last reviewed:** 15 January 2024

Read More

TGA, 15-01-24

<https://www.apvma.gov.au/news-and-publications/news/tga-issues-safety-alerts-regarding-recall-several-09-sodium-chloride-products>

## AMERICA

### State approves bold plan to reduce ozone pollution

2023-12-15

**DENVER (Dec. 15, 2023):** Today, Colorado's Air Quality Control Commission adopted a bold and comprehensive plan to reduce ozone pollution across the state. The commission took action to ensure that new measures to reduce ozone pollution prioritize protections for communities most burdened by environmental health risks.

"It's been a busy year for cleaning up Colorado's air. The commission has adopted many rules in 2023 that will help reduce air pollution now and in the years to come," said Commissioner Curtis Rueter. "With our adoption of Colorado's State Implementation Plan and other regulations, we have a clear path forward to bring cleaner air to our vibrant communities."

Ground-level ozone is an air pollutant that can lead to or exacerbate health conditions such as heart and lung disease when inhaled. It is formed when certain air pollution emissions known as "ozone precursors" combine in the presence of heat and sunlight. Ozone precursors include nitrogen oxides and volatile organic compounds, which come from sources such as car tailpipes, manufacturing facilities, and oil and gas production.

"Colorado has to work extra hard to reduce ozone pollution because of the state's topography, but we are up to the task," said Michael Ogletree, the director of the state health department's Air Pollution Control Division. "These new measures demonstrate our commitment to improving our air quality, protecting communities overburdened by pollution, and making sure companies are doing their part too."

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The division went above and beyond federal requirements by conducting environmental justice analyses to inform new measures. As a result, they contain new protections for communities that are cumulatively impacted by pollution. These are communities that are overburdened by the impacts of environmental health risks.

"The state may have drafted this plan, but community members made it really shine. They helped us add in even more ways to reduce ozone pollution," said Trisha Oeth, the state health department's director of Environmental Health and Protection. "Our policies are stronger when we work together with a diverse set of stakeholders. We all share the goal of making sure every Coloradan has clean air to breathe."

### Colorado's State Implementation Plan to curb ozone pollution

The federal government sets standards for ozone pollution at levels that protect public health and the environment. EPA requires Colorado to draft and submit a State Implementation Plan that details how the state will meet incremental goals to reduce ozone pollution and meet these standards. The State Implementation Plan that the Air Quality Control Commission approved is to meet 2008 federal standards. It will also make progress toward meeting the more rigorous 2015 federal standards.

Read More

Colorado Department of Public Health & Environment, 15-12-23

<https://cdphe.colorado.gov/press-release/state-approves-bold-plan-to-reduce-ozone-pollution>

### First 'Spare the Air' alert of the season sees wood burning banned in San Francisco

2023-12-15

Today marks the first day of the season on which the Bay Area Air Quality Management District has felt it necessary to announce a Spare the Air Alert for fine particle pollution in San Francisco, a move which bans people from burning wood while the alert is in place.

The announcement reads: "The Bay Area Air Quality Management District is issuing the winter season's first Spare the Air Alert for tomorrow, Friday, December 15, which bans burning wood, manufactured fire logs or any other solid fuel, both indoors and outdoors."



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'Smoke from increased wood burning combined with light winds and low overnight temperatures is expected to cause unhealthy air quality. High pressure over northern California will act like a lid, trapping smoke at ground level. Offshore winds may also transport air pollution from the Central Valley into the Bay Area.'

The only exceptions to the rule are for houses in which wood stoves are the only source of heating but even in these cases, only an EPA-certified or pellet-fueled device that is registered with the Air District can be used.

[Read More](#)

Air Quality News, 15-12-23

<https://airqualitynews.com/health/first-spore-the-air-alert-of-the-season-sees-wood-burning-banned-in-san-francisco/>

### EPA Pushes Forward with Final PFAS Reporting Regulations

2023-12-18

On Nov. 13, 2023, the U.S. Environmental Protection Agency's ("EPA") final rule went into effect requiring companies to report the manufacture or import of per- and poly- fluoroalkyl substances ("PFAS"), also known as "forever chemicals," under the Toxic Substances Control Act ("TSCA"). On Nov. 30, another EPA final rule went into effect on the Toxics Release Inventory ("TRI"), which eliminates the Trump-era reporting exemption for de minimis amounts of PFAS and removes the de minimis exemption for all chemicals of special concern when notifying downstream manufacturers and purchasers.

EPA will continue to finalize PFAS regulations, including a hazardous substance designation under CERCLA and establishing enforceable levels for six PFAS known to occur in drinking water, before the 2024 presidential election. The list of "Key EPA Actions to Address PFAS" can be found here. Both the TSCA and TRI final rules are part of the Biden administration's commitment to addressing PFAS and EPA's PFAS Strategic Roadmap.

**A summary of the TSCA and TRI final rules is below:**

#### TSCA Final Rule

Congress amended TSCA by adding Section 8(a)(7), 15 U.S.C. Section 2607(a)(7) as part of the National Defense Authorization Act for Fiscal Year 2020 (2020 NDAA) and directed EPA to require certain PFAS reporting

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under TSCA. In turn, EPA promulgated the TSCA final rule to require companies that have manufactured or imported PFAS for commercial purposes since 2011 to report, among other things, PFAS uses, production volumes, transmission offsite, concentration in consumer or commercial products, byproducts, disposal, exposures, and environmental or health effects information. Generally, manufacturers must file their one-time reports by May 8, 2025.<sup>1</sup> "Small manufacturers" that only import "articles" containing PFAS must file reports by Nov. 10, 2025.<sup>2</sup> EPA will use the reports to create a comprehensive database of previously manufactured PFAS, improve EPA's understanding of PFAS in commerce, and support actions to address PFAS exposure and contamination.

Unlike TSCA Section 8(a) reporting requirements for chemical manufacturers, the TSCA final rule does not have a minimum threshold for reporting; all manufacturers or importers of PFAS must report commercial use of PFAS. EPA estimates that about 97% of entities impacted by this rule meet the Small Business Association's definition of small business. EPA created a small business compliance guide for PFAS reporting to assist small businesses.

[Read More](#)

BHFS, 18-12-2023

<https://www.bhfs.com/insights/alerts-articles/2023/epa-pushes-forward-with-final-pfas-reporting-regulations>

### Texas grapples with environmental fallout from frequent oil and gas wastewater spills

2023-12-19

Produced water spills in Texas are causing significant environmental damage, but in a fossil-fuel friendly state known for lax environmental regulations, remedies are few.

#### In short:

- Texas faces widespread environmental damage from fracking wastewater.
- The regulatory body, Texas Railroad Commission, resists implementing stricter spill management rules.
- The spills pose threats to wildlife, groundwater safety and land integrity.



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### Key quote:

“They didn’t line the pit, and they didn’t pay attention to the leak detection of their tank.”

— Carl Craigo, Midland, Texas, Utility Director

### Why this matters:

Oil and gas wastewater spills in Texas are an environmental crisis affecting water quality, wildlife and land health. With few regulations and scant reporting requirements, harmful practices mostly go unchecked and unpunished.

Read More

EHN, 19-12-23

<https://www.ehn.org/texas-grapples-with-environmental-fallout-from-frequent-oil-and-gas-wastewater-spills-2666634381.html>

## Texas Law About Hair: Overview of Regulations and Guidelines

2023-12-18

In Texas, there are various laws and regulations that govern different aspects of daily life, including personal grooming practices such as haircuts, hairstyles, and haircare products. This article aims to provide a comprehensive overview of the relevant Texas laws and guidelines related to hair. Whether you are a hairstylist, a salon owner, or an individual looking to understand your rights and limitations, this article will help you navigate the key regulations.

### Key Terms:

Before diving into the specifics, let’s define some key terms used in Texas laws regarding hair:

1. **Licensed Cosmetologist:** An individual who has obtained a license from the Texas Department of Licensing and Regulation (TDLR) to practice cosmetology, which includes various hair-related services such as cutting, styling, coloring, and more.
2. **Salon:** Any establishment where cosmetology services, including hair services, are provided for compensation. Salons must be licensed by the TDLR to operate legally and must adhere to specific standards and regulations.

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3. **Sanitation and Safety:** The procedures, protocols, and measures put in place to maintain cleanliness, disinfection, and safety within salons to prevent the spread of diseases, infections, or any other health hazards.
4. **Chemicals:** Chemical substances used in hairstyling, hair treatments, and haircare products, such as dyes, relaxers, and straighteners.

### Texas Laws and Regulations:

5. **Licensing:** To perform cosmetology services for compensation in Texas, individuals must obtain a cosmetology license from the TDLR. This applies to hairstylists, barbers, and other professionals providing hair services. Licenses are granted after completing the required education and passing the appropriate examinations.
2. **Health and Safety:** Texas law emphasizes the importance of maintaining proper sanitation and safety practices in salons. Cosmetologists and salon owners must follow strict guidelines set by the TDLR to prevent the transmission of diseases or infections. This includes sterilizing tools, using disposable materials where necessary, and practicing personal hygiene.

Read More

Energy Portal, 18-12-23

<https://www.energyportal.eu/texas-law-about-hair-overview-of-regulations-and-guidelines/#gsc.tab=0>

## EUROPE

### Council adopts its negotiating position on new rules for more sustainable packaging in the EU

2023-12-19

Today, the Council has reached an agreement (‘general approach’) on a proposal for a regulation on packaging and packaging waste. The aim is to tackle the increase in packaging waste generated in the EU, while harmonising the internal market for packaging and boosting the circular economy.

The proposal considers the full life cycle of packaging. It establishes requirements to ensure that packaging is safe and sustainable, by requiring that all packaging is recyclable and that the presence of substances of concern is minimised. It also sets labelling requirements



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to improve consumer information. In line with the waste hierarchy, the proposal aims to minimise the generation of packaging waste by setting binding re-use targets, restricting certain types of single-use packaging and requiring economic operators to minimise the packaging used.

Once the packaging becomes waste, the proposal aims to ensure that packaging is collected, sorted and recycled to the highest possible standard. To this end, it sets criteria for the extended producer responsibility schemes, and lays down provisions on waste management, while ensuring that member states have sufficient flexibility to maintain existing well-functioning systems.

The general approach will serve as a mandate for negotiations with the European Parliament on the final shape of the legislation.

### Main changes agreed by the Council

The Council's text strikes a balance between keeping the proposal's ambition to reduce and prevent the generation of packaging waste, and allowing member states sufficient flexibility in the implementation of the regulation.

Read More

FreshPlaza, 19-12-23

<https://www.freshplaza.com/europe/article/9586992/council-adopts-its-negotiating-position-on-new-rules-for-more-sustainable-packaging-in-the-eu/>

### Upcoming GB active substance expiry dates

2024-01-16

#### Biocidal products must be phased off the GB market

The active substance/product type combinations listed below are due to expire under the GB BPR on the following dates:

- (RS)-4-hydroxy-3-(3-oxo-1-phenylbutyl)coumarin (Warfarin) (CAS 81-81-2 EC 201-377-6) in product type 14

#### 30 June 2024

- Polyhexamethylene biguanide hydrochloride with a mean number-average molecular weight (Mn) of 1600 and a mean polydispersity (PDI) of 1.8 (PHMB (1600;1.8)) (CAS 27083-27-8 / 32289-58-0 EC n/a) in product types 02, 03 and 11

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#### 30 June 2024

- Chlorophacinone (CAS 3691-35-8 EC 223-003-0) in product type 14

#### 30 June 2024

- 4-bromo-2-(4-chlorophenyl)-1-ethoxymethyl-5-trifluoromethylpyrrole-3-carbonitrile (Chlorfenapyr) (CAS 122453-73-0 EC 602-782-4) in product type 08

#### 30 April 2025

- 1-[[2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl]methyl]-1H-1,2,4-triazole (Propiconazole) (CAS 60207-90-1 EC 262-104-4) in product type 09

#### 31 May 2025

Once the approvals expire, the active substances can no longer be used in biocidal products or treated articles of the relevant product types in GB.

Read More

HSE UK, 16-01-24

<https://www.hse.gov.uk/>

## INTERNATIONAL

### Single-Use Food Packaging from 17 Countries Contains PFAS "Forever Chemicals"

2023-12-18

Göteborg City, Sweden/Quezon City Philippines. A study released today by the International Pollutants Elimination Network (IPEN) and 18 IPEN member groups found toxic per- and polyfluoroalkyl substances (PFAS) chemicals, including globally banned substances, in single-use, paper, cardboard, and plant-based molded fiber food containers and tableware purchased from 17 countries across Africa, Asia, Europe, North America, and Latin America and the Caribbean.

PFAS chemicals have been linked to cancer, infertility, and endocrine disruption. Prior studies have shown that PFAS in food packaging can leach into food and higher levels of PFAS have been found in blood testing of people who regularly eat types of foods that are typically sold in PFAS-containing packaging.



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PFAS, called “Forever Chemicals” due to their extreme persistence in the environment, are widely used in food packaging and single-use tableware to confer grease-resistance. But the study found some packaging made without PFAS, demonstrating that alternatives to the toxic substances are available. The findings also show that some leading global food companies sell food in PFAS-free packaging in some countries but continue to use PFAS-tainted wrapping in other countries.

“PFAS are widely used in single-use food packaging and tableware especially for fast food, and people are exposed when they eat PFAS-packaged food. Since fast food is especially popular among youth, and PFAS can disrupt the bodies’ natural hormones, there is a serious concern that young people may be impacted at critical periods of development,” said IPEN’s Global Researcher Jitka Straková, the lead author of the study.

“The food industry needs to quickly phase-out PFAS and governments should move swiftly toward a global ban on PFAS as a group to stop environmental releases of and human exposure to PFAS.”

In the study, food packaged in paper, cardboard, and plant-based molded fiber was purchased and 119 samples of packaging and tableware were tested. Samples were collected from 17 countries: Tunisia, Egypt, Jordan, Kuwait, Morocco, Iraq, Montenegro, Jamaica, Mexico, Argentina, Benin, Zambia, Cameroon, Philippines, Taiwan, Nepal, Nepal, and India. Tests for 58 specific PFAS and for extractable organic fluorine (EOF), a measurement that correlates with the use of any PFAS, were conducted.

Read More

Journal Online, 18-12-23

<https://journal.com.ph/single-use-food-packaging-from-17-countries-contains-pfas-forever-chemicals/>

### BPA’s evil cousin

2023-08-04

Most people have heard of BPA — but researchers say its chemical cousin, BADGE, is leaving scores of workers, artisans and individuals at risk.

BADGE, short for bisphenol-A diglycidyl ether, BADGE, has gotten far less attention than BPA (bisphenol-A), though it shows potentially equal endocrine-disrupting potential (meaning it interferes with the proper functioning of hormones), as well as other possible harmful impacts, including liver and kidney effects and cancer. It is the predominant

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chemical used in epoxy resins — ubiquitous on construction sites, providing strong, durable corrosion-resistant adhesion. But it is also broadly used beyond the construction site — you can find it in glues, boat repair and refinishing, in powdered coatings in automotive and other metal finishing, and in can linings.

Zero workplace exposure limits on BADGE leave the door open for potentially harmful worker exposures, and sketchy, or even false, advertising about the safety of construction, woodworking and art supplies.

Read More

EHN, 04-08-23

<https://www.ehn.org/epoxy-chemicals-2660287969.html>

### ISO 3758:2023 Textiles - Care labelling code using symbols

2023-12-30

#### Abstract

This document establishes a system of graphic symbols, intended for use in the marking of textile articles, and for providing information on the most severe treatments that do not cause irreversible damage to the article during the textile care process, and specifies the use of these symbols in care labelling.

This document is applicable to all textile articles, except:

- non-removable covers of upholstered furniture;
- non-removable covers of mattresses;
- carpets and rugs which require professional carpet cleaning.

These products are excluded due to specific cleaning processes not specified in this document.

The graphical symbols described in this document are intended to give care information to the end user.

The following domestic treatments are covered: washing, bleaching, drying and ironing. Professional textile care treatments in dry and wet cleaning, but excluding industrial laundering and professional carpet cleaning, are also covered. However, it is recognized that information



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imparted by the domestic symbols will also be of assistance to the professional cleaner and launderer.

Read More

ISO, 30-12-23

<https://www.iso.org/standard/74401.html>

### What PFAS producers should do instead of burying their heads in the sand

2024-01-24

Why do some PFAS companies continue to invest tons of money and fight tooth and nail to keep producing these harmful and contested chemicals? Because many are stuck in their old ways, unwilling to change. But not all. Some companies have started to future-proof their businesses by developing PFAS-free alternatives.

PFAS have been used in our society for a long time. These harmful “forever chemicals” are used in countless products, everything from frying pans to advanced weapons materials. They’re an essential chemical component in modern society if you ask the PFAS producers themselves. Their latest shtick is that PFAS is necessary for the green transition and that without these chemicals we won’t be able to reach our climate goals.

While it is true that PFAS chemicals are still needed in a few select applications that are essential for society where there currently are no other alternatives, only a tiny share of the world’s PFAS production is used for that purpose.

PFAS producers are fighting tooth and nail to keep these harmful chemicals largely unregulated in a political and regulatory landscape that is steadily shifting. But PFAS aren’t seen as miracle chemicals anymore. Nowadays, they’re more closely associated with all the harm they are causing people and planet.

Read More

Chemsec, 24-01-24

<https://chemsec.org/what-pfas-producers-should-do-instead-of-burying-their-heads-in-the-sand/>

# Bulletin Board

## REACH Update

FEB. 09, 2024

### Publication of the second recommendation to include diisohexyl phthalate in the list of substances subject to authorisation (Annex 14) for UK REACH

2024-01-24

In September 2023, HSE published a draft recommendation for the inclusion of diisohexyl phthalate (EC: 276-090-2 and CAS: 71850-09-4) in Annex 14 of UK REACH. The 3-month commenting period on this draft recommendation closed in December.

The recommendation has been updated and now finalised as the second recommendation from HSE (as the Agency for UK REACH) to the Appropriate Authorities (the (Defra) Secretary of State and the Scottish and Welsh Ministers), who will make a decision on the inclusion into Annex 14.

Documents can be found in “Recommendations to add substances to Annex XIV” available on the HSE website.

Read More

HSE, 18-01-24

[https://www.hse.gov.uk/reach/recommendations.htm?utm\\_source=govdelivery](https://www.hse.gov.uk/reach/recommendations.htm?utm_source=govdelivery)



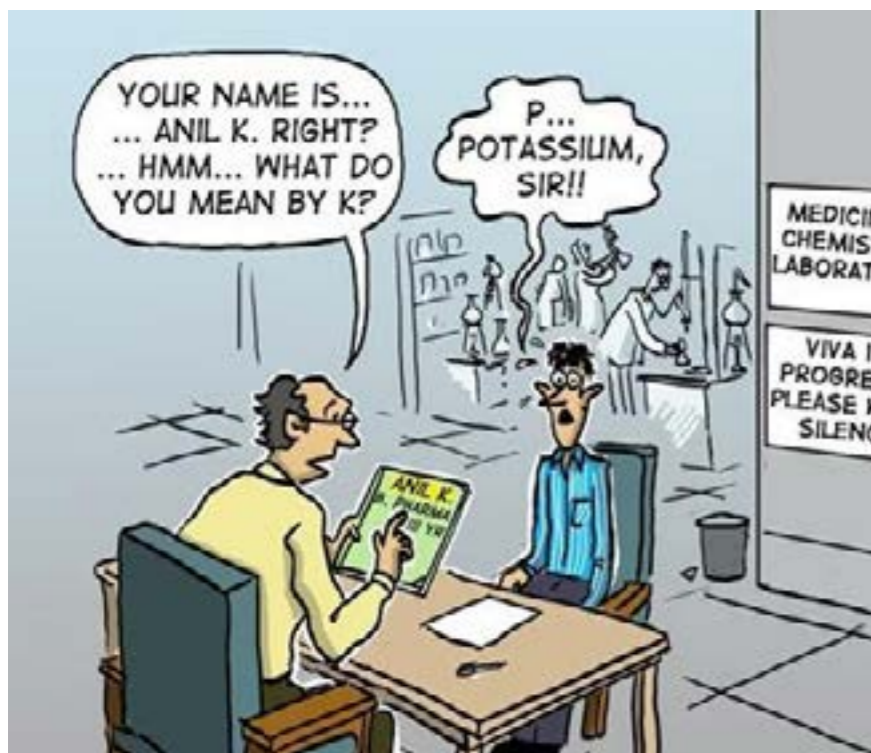
## Bulletin Board

## Janet's Corner

FEB. 09, 2024

## Potassium Sir!

2024-02-09



<https://chemistryit.wordpress.com/typical-chemistry-jokes/>

## Bulletin Board

## Hazard Alert

FEB. 09, 2024

## Isophorone

2024-02-09

## USES [2,3]

Isophorone is used mainly as a solvent for concentrated vinyl chloride/acetate-based coating systems for metal cans, other metal paints, nitrocellulose finishes, and printing inks for plastics. It is also used in some herbicide and pesticide formulations and in adhesives for plastics, polyvinylchloride, and polystyrene materials. Isophorone is an intermediate in the synthesis of 3,5-xyleneol, 3,3,5-trimethylcyclohexanol, and plant growth retardants.

## EXPOSURE SOURCES &amp; ROUTES OF EXPOSURE [3]

## Exposure Sources

- Major sources of airborne isophorone are the printing and the metal coating industries. Coal-fired power plants may also emit isophorone to the air.
- Individuals may be exposed to isophorone through breathing contaminated air, especially people who work with inks, paints, lacquers, and adhesives.
- Isophorone has been detected in the drinking water of several cities at very low concentrations.

## Routes of Exposure

- Breathing low levels found in air.
- Drinking water contaminated with isophorone.
- Eating food that contains isophorone.
- Working in the printing, adhesives, and coatings industries where isophorone is used.

## HEALTH EFFECTS [4]

## Acute Health Effects

- The only acute effects of isophorone reported in humans are irritation of the skin, eyes, nose, and throat, headache, and dizziness.
- Exposure to high concentration of isophorone via inhalation in animals causes inactivity and coma.

**Isophorone is an  $\alpha,\beta$ -unsaturated cyclic ketone with the chemical formula  $C_9H_{14}O$ . [1] It is a clear liquid with a peppermint-like odour. [1,2]**



# Bulletin Board

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- Tests involving acute exposure of rats and guinea pigs have shown isophorone to have moderate toxicity from oral and inhalation exposure.

### Carcinogenicity

- No studies were found concerning the carcinogenicity of isophorone in humans.
- One study demonstrated an increased incidence of kidney tumours and preputial gland (a male reproductive gland) tumours in male rats exposed to isophorone by gavage. However, the type of kidney tumour observed in male rats is of questionable relevance to humans.
- EPA considers isophorone to be a possible human carcinogen (cancer-causing agent) and has ranked it in EPA's Group C.

### Other Effects

- No studies were located regarding developmental or reproductive effects in humans.
- Limited evidence in animal studies suggests that isophorone may cause birth defects such as foetal malformations and growth retardation from inhalation exposure to isophorone during pregnancy.

## SAFETY

### First Aid Measures [5]

- If inhaled: If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.
- In case of skin contact: Wash off with soap and plenty of water. Consult a physician.
- In case of eye contact: Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
- If swallowed: Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### Workplace Controls & Practices [4]

Control measures include:

- Handle in accordance with good industrial hygiene and safety practice.
- Wash hands before breaks and at the end of workday.

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### Personal Protective Equipment [5]

- Eye/face protection: Face shield and safety glasses. Equipment should be tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).
- Skin protection: Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
- Body Protection: Complete suit protecting against chemicals, the type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.
- Respiratory protection: Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

## REGULATION

### United States

**OSHA:** The Occupational Safety & Health Administration has set the following Permissible Exposure Limits (PEL) for isophorone:

- General Industry: 29 CFR 1910.1000 Table Z-1 - 25 ppm, 140 mg/m<sup>3</sup> TWA
- Construction Industry: 29 CFR 1926.55 Appendix A - 25 ppm, 140 mg/m<sup>3</sup> TWA
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards - 25 ppm, 140 mg/m<sup>3</sup> TWA

**ACGIH:** The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for isophorone of 5 ppm, 28 mg/m<sup>3</sup> Ceiling; Appendix A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans



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**NIOSH:** The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for isophorone of 4 ppm, 23 mg/m<sup>3</sup> TWA

### REFERENCES

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# Bulletin Board

## Gossip

FEB. 09, 2024

Biotrickling filter supports efficient hydrogen-methane conversion for biological biogas upgrading

2024-02-06

Previously, researchers from the Qingdao Institute of Bioenergy and Bioprocess Technology of the Chinese Academy of Sciences have domesticated and obtained microorganisms with high hydrogen-methane conversion efficiencies. They have also developed two production processes for in-situ and ex-situ biological hydrogen-methane conversion. However, the main factor limiting the efficiency of hydrogen-methane conversion remains the low gas-liquid mass transfer rate of hydrogen.

To address the limitations of low hydrogen mass transfer rates in the hydrogen-methane conversion process, the researchers developed a biotrickling filter (BTF), which facilitates microorganisms growth by using packing material with a rough internal surface. It ensures full contact between the gas and liquid phases, thereby increasing the efficiency of hydrogen utilization.

The study is published in Chemical Engineering Journal.

In this study, the researchers started by exploring the effects of temperatures (25°C, 37°C, and 55°C) on the hydrogen-methane conversion pathway to determine the optimal temperature for the biotrickling filters. During the operation of the biotrickling filter, the effects of the packing materials (ceramite, volcanic stone, activated carbon) and the optimal ratio of the input gas (H<sub>2</sub>/CO<sub>2</sub>, v/v) on the conversion process were evaluated.

According to the researchers, the selected packing materials were environmentally friendly, and their large specific surface area and porosity facilitated the growth and attachment of microorganisms. This ensures sufficient contact between the microorganisms and the gas phase, which greatly enhances gas-liquid mass transfer.

The results showed that higher temperature is conducive to hydrogen-methane conversion. At 25°C, the hydrogen-methane conversion efficiency was low (2.5 L/Lw·d), and most of the hydrogen and carbon dioxide were used to produce acetate.

At 55°C, although the reaction process was initially unstable, it eventually reached stability and obtained a hydrogen-methane conversion efficiency of 8.3 L/Lw·d. In contrast, the conversion efficiency was still substantial at 37°C, achieving 7.1 L/Lw·d. Notably, there was no significant difference in the overall methanogenesis process between 37°C and 55°C.

**Biological hydrogen-methane conversion refers to the production of methane through the action of microorganisms using hydrogen generated by electrolysis of water with residual power and carbon dioxide present in biogas.**



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In addition, the optimal input gas (H<sub>2</sub>/CO<sub>2</sub>) ratio was determined in the BTF experiment, achieving the most satisfactory ratio at 2.5:1 (H<sub>2</sub>/CO<sub>2</sub>, v/v), which was lower than previously reported values, but higher carbon dioxide removal efficiency was achieved.

The biofilms adhering to the three packing materials all achieved effective hydrogen-methane conversion efficiency at the ratio of 2.5:1, with the BTF using activated carbon as the packing material achieved the highest and the most stable conversion efficiency (91.9%).

The relative fluorescence intensity measurement confirmed that activated carbon had superior microbial immobilization. This study provides a promising approach for the application of BTFs in biogas hydrogen-methane conversion.

Phys Org, 06 February 2024

<https://phys.org>

### Nanostructured Surface Kills Viruses Without Chemicals

2024-01-31

A team of researchers from the URV and the RMIT University (Australia) has designed and manufactured a surface that uses mechanical means to mitigate the infectious potential of viruses. Made of silicon, the artificial surface consists of a series of tiny spikes that damage the structure of viruses when they come into contact with it. The research has revealed how these processes work and that they are 96% effective. Using this technology in environments in which there is potentially dangerous biological material would make laboratories easier to control and safer for the professionals who work there.

Spike the viruses to kill them. This seemingly unsophisticated concept requires considerable technical expertise and has one great advantage: a high virucidal potential that does not require the use of chemicals. The process of making the virucidal surfaces starts with a smooth metal plate, which is bombarded with ions to strategically remove material. The result is a surface full of needles that are 2 nanometers thick – 30,000 would fit in a hair – and 290 high. “In this case, we used silicon because it is less complicated technically speaking than other metals”, explains Vladimir Baulin, researcher from the URV’s Physical and Inorganic Chemistry Department.

This procedure is not new for Baulin, who has spent the last ten years studying mechanical methods for controlling pathogenic microorganisms

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inspired by the world of nature: “The wings of insects such as dragonflies or cicadas have a nanometric structure that can pierce bacteria and fungi”, he explains. In this case, however, viruses are an order of magnitude smaller than bacteria so the needles must be correspondingly smaller if they are to have any effect on them. One example of this is hPIV-3, the object of study of this research, which causes respiratory infections such as bronchiolitis, bronchitis or pneumonia. The so-called parainfluenza viruses cause a third of all acute respiratory infections and are associated with lower respiratory tract infections in children. “In addition to being an epidemiologically important virus, it is a model virus, safe to handle, as it does not cause potentially fatal diseases in adults”, says Baulin.

The process by which viruses lose their infectious ability when they come into contact with the nanostructured surface was analysed in theoretical and practical terms by the research team. The URV researchers, Vladimir Baulin and Vassil Tzanov, used the finite element method – a computational method that divides up the surface of the virus and processes each fragment independently – to simulate the interactions between the viruses and the needles and their consequences. At the same time, the RMIT University researchers carried out a practical experimental analysis, exposing the virus to the nanostructured surface and observing the results.

The findings show that this method is extremely effective and incapacitates 96% of viruses that come into contact with the surface within a period of six hours. The study has confirmed that the surfaces have a virucidal effect because of the ability of the needles to destroy or incapacitate viruses by damaging their external structure or piercing the membrane. Using this technology in risk environments such as laboratories or health centres in which there is potentially dangerous biological material would make it easier to contain infectious diseases and make these environments safer for researchers, health workers and patients.

Technology Networks, 31 January 2024

<https://technologynetworks.com>

**Engineers at the University of California San Diego have developed an ultra-sensitive sensor made with graphene that can detect extraordinarily low concentrations of lead ions in water.**



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### Ultra-sensitive lead detector could significantly improve water quality monitoring

2024-02-05

"With the extremely high sensitivity of our device, we ultimately hope to detect even the presence of one lead ion in a reasonable volume of water," said Prabhakar Bandaru, a professor in the Department of Mechanical and Aerospace Engineering at the UC San Diego Jacobs School of Engineering.

"Lead exposure is a serious health concern, and it has been indicated that a lead concentration at the level of parts per billion in drinking water could lead to pernicious outcomes, such as stunted human growth and development."

The work is described in a paper published recently in Nano Letters.

The device in this study consists of a single layer of graphene mounted on a silicon wafer.

Graphene, with its remarkable conductivity and surface-to-volume ratio, offers an ideal platform for sensing applications.

The researchers enhanced the sensing capabilities of the graphene layer by attaching a linker molecule to its surface.

This linker serves as the anchor for an ion receptor and, ultimately, the lead ions.

One of the key features of this work was making the sensor highly specific for detecting lead ions.

The researchers used an aptamer, which is a short, single strand of DNA or RNA, as the ion receptor.

These receptor molecules are known for their inherent selectivity toward specific ions.

The researchers further enhanced the receptor's binding affinity for lead ions by tailoring its DNA or RNA sequence.

This ensured that the sensor would only be triggered upon binding to lead ions.

Achieving the femtomolar limit of detection was made possible by studying in detail the molecular events occurring on the graphene sensor's surface.

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The researchers used a combination of experimental and theoretical techniques to monitor the stepwise adhesion of the linker to the graphene surface, followed by the binding of the receptor to the linker, and finally, the attachment of lead ions to the receptor.

The researchers analyzed thermodynamic parameters of the system such as binding energies, changes in capacitance, and molecular conformations and found that they played critical roles in optimizing the sensor's performance.

By optimizing each of these thermodynamic parameters, along with the design of the entire system, from the electronics and materials all the way down to the ion receptor, the researchers created a sensor that can detect lead ions with unprecedented sensitivity and specificity.

In addition to its superior sensitivity, the new sensor possesses other advantages over existing methods.

Traditional techniques for detecting lead with high accuracy and sensitivity often rely on expensive instrumentation, which limits their accessibility for widespread use.

Meanwhile, home kits, while more accessible, tend to be unreliable and exhibit a relatively poor limit of detection, typically within the micromolar range.

"The technology that we developed aims to overcome the issues of cost as well as reliability," said Bandaru.

"Our goal is for it to be eventually deployed in homes, given its relative ease of manufacture."

While the technology is currently at the proof-of-concept stage, Bandaru hopes to one day implement it in real-world settings.

Next steps include scaling up the production for commercial use, which will necessitate collaboration with industry partners.

This work was supported by the Army Research Office (W911NF-21-1-0041-(74813-MS)).

Science Daily, 05 February 2024

<https://sciencedaily.com>

**A team of molecular engineers have developed a type of plastic that can be shape-shifted using tempering.**



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**A type of plastic that can be shape-shifted using tempering**

2024-02-02

Haley McAllister and Julia Kalow, with Northwestern University, have published a Perspective piece in the same issue of Science outlining the work.

Over the past several years, it has become evident that the use of plastics in products is harmful to not only the environment but also human health—bits of plastic have been found in the soil, the atmosphere, the oceans, and the human body.

Consequently, scientists have begun looking for ways to reduce the amount of plastic that is created, used and dumped into the trash. In this new effort, the research team has created a type of plastic that can be converted to something new once its initial purpose has been exhausted—using tempering. A plastic bag holding food, for example, could be converted to a fork or spoon.

To allow for such shape-shifting, the researchers developed a type of plastic using a dynamic cross-linked approach that was based on the reversible addition of thiols to benzalcyanoacetates—a process known as a “Michael addition.” The resulting plastic was of a type that could be modified by tempering, which is where a material is heated to a certain point, then chilled quickly. Tempering is most often associated with metalwork.

The researchers found by that heating the plastic to temperatures ranging between 60°C and 110°C, then transferring it to a standard food freezer, they could create different objects from the same material based on a whim.

They created a spoon first, which they used to scoop peanut butter from a jar. They then used tempering to change the spoon to a fork, and then to an adhesive material capable of holding two panes of glass together. However, tests showed that there was a limit to the number of times the plastic could be changed, which was seven times. After that, it began to degrade.

Phys Org, 02 February 2024

<https://phys.org>

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**Protecting wine from wildfire smoke taint with a nanotech coating**

2024-02-07

The work was sparked by a series of major wildfires in 2020 during grape harvest season across Oregon, Washington and California. Questions about how the smoke compounds that settled on the grapes might affect wines prompted many vineyard managers to write off the entire year’s harvest in those regions. This led to estimated losses of \$3.7 billion (£2.9 billion) for the wine industry.

The nanofibre coatings the team created blocked deposition of guaicol and syringol and captured meta-cresol, wildfire smoke compounds that can taint wine made using these grapes. In the case of the first two compounds, they aren’t absorbed by the coating and don’t need to be washed off prior to winemaking, while the coating does absorb the third compound and so requires removal before the grapes can be turned into wine.

The coatings are produced by blending cellulose nanofibres and chitosan with several other ingredients. Previous studies showed that cellulose nanofibres’ porous structure can absorb and diffuse compounds of various sizes.

To test the coatings, the researchers applied them on vines at the university’s Woodhall Vineyard and installed smoke chambers to check how effective they were in blocking smoke. After working on their coating for two years, the team determined that they don’t affect grape growth and quality. The team is now refining its coatings and performing cost analysis studies.

‘Wildfire smoke is an increasing problem for wineries in the United States and around the world and right now vineyard managers really have no tools to manage the effects of the smoke,’ said Elizabeth Tomasino, an associate enology professor at OSU. ‘This coating has the potential to transform the wine industry.’

Chemistry World, 07 February 2024

<https://chemistryworld.com>

**New WSU research could ultimately help extend the lives of those with prostate cancer.**



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**Protein Could Help Overcome Prostate Cancer Drug Resistance**

2024-01-22

Researchers have identified a receptor protein known as CHRM1 as a key player in prostate cancer cells' resistance to docetaxel, a commonly used chemotherapy drug to treat advanced cancer that has spread beyond the prostate. The discovery opens the door to new treatment strategies that could overcome this resistance. This could ultimately help extend the lives of those with prostate cancer, one of the leading causes of cancer deaths among men.

Led by a team of scientists at Washington State University, the study showed that blocking CHRM1 in resistant prostate cancer cell lines and an animal model based on patient-derived resistant tissue restored docetaxel's ability to kill cells and stop tumor growth. The researchers did this by using dicyclomine, a drug that selectively inhibits CHRM1 activity. Dicyclomine is already on the market as a generic drug and is currently used to treat symptoms of irritable bowel syndrome.

"The effect was pretty dramatic in all the experimental models we tested," said Boyang (Jason) Wu, an associate professor in the WSU College of Pharmacy and Pharmaceutical Sciences and co-senior author on the study. "And because dicyclomine already has a clinical use, this work has immediate translational potential."

Published in the journal *Cell Reports Medicine*, the researchers' findings support clinical testing to confirm whether combined use of docetaxel and dicyclomine could help overcome treatment resistance in prostate cancer patients. Docetaxel resistance can develop in prostate cancer after about six months of treatment. Chemotherapy drugs like docetaxel are among very few options available to patients with castration-resistant prostate cancer, a lethal form of the disease that no longer responds to hormone therapy.

Wu said this type of combination therapy could also potentially be used for other cancers that are currently being treated with docetaxel, such as breast and lung cancer. It may also be possible to use the same combination strategy with other similar chemotherapy drugs.

In addition to testing resistant cancer cell lines, the research team also tested cells that still responded to docetaxel treatment. They found that using dicyclomine to block CHRM1 in these cells made docetaxel more efficient at killing them. Wu said that this shows that prostate cancer

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patients could potentially benefit from a combination treatment strategy even before docetaxel resistance develops.

"What this suggests is that the lowest effective dose of docetaxel may be lower when the drug is combined with dicyclomine, compared to when docetaxel is used alone," Wu said. "Being able to use a lower dose could help reduce unwanted side effects and make treatment more manageable for patients."

Technology Networks, 22 January 2024

<https://technologynetworks.com>

**Disturbing Finding: Scientists Discover Unexpected Effects of Common Food Preservative**

2024-02-05

To extend the shelf life of food items, manufacturers commonly incorporate preservatives into their products. These substances are intended to eliminate microorganisms that may cause the food to deteriorate. While traditional preservatives such as sugar, salt, vinegar, and alcohol have a long history of use, contemporary food products often list more obscure additives like sodium benzoate, calcium propionate, and potassium sorbate on their labels.

Bacteria produce chemicals called bacteriocins to kill microbial competitors. These chemicals can serve as natural preservatives by killing potentially dangerous pathogens in food. Lanthipeptides, a class of bacteriocins with especially potent antimicrobial properties, are widely used by the food industry and have become known as "lantibiotics" (a scientific portmanteau of lanthipeptide and antibiotics).

Despite their widespread use, however, little is known about how these lantibiotics affect the gut microbiomes of people who consume them in food. Microbes in the gut live in a delicate balance, and commensal bacteria provide important benefits to the body by breaking down nutrients, producing metabolites, and—importantly—protecting against pathogens. If too many commensals are indiscriminately killed off by antimicrobial food preservatives, opportunistic pathogenic bacteria might take their place and wreak havoc—a result no better than eating contaminated food in the first place.

**Research on a widely used food preservative known for its ability to eliminate pathogens indicates it also impacts helpful bacteria, posing a risk to the gut microbiome's equilibrium.**



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**Effects on good and bad bacteria**

A new study published in ACS Chemical Biology by scientists from the University of Chicago found that one of the most common classes of lantibiotics has potent effects both against pathogens and against the commensal gut bacteria that keep us healthy.

Nisin is a popular lantibiotic used in everything from beer and sausage to cheese and dipping sauces. It is produced by bacteria that live in the mammary glands of cows, but microbes in the human gut produce similar lantibiotics too. Zhenrun “Jerry” Zhang, Ph.D., a postdoctoral scholar in the lab of Eric Pamer, MD, the Donald F. Steiner Professor of Medicine and Director of the Duchossois Family Institute at UChicago, wanted to study the impact of such naturally-produced lantibiotics on commensal gut bacteria.

“Nisin is, in essence, an antibiotic that has been added to our food for a long time, but how it might impact our gut microbes is not well studied,” Zhang said. “Even though it might be very effective in preventing food contamination, it might also have a greater impact on our human gut microbes.”

He and his colleagues mined a public database of human gut bacteria genomes and identified genes for producing six different gut-derived lantibiotics that closely resemble nisin, four of which were new. Then, in collaboration with Wilfred A. van der Donk, Ph.D., the Richard E. Heckert Endowed Chair in Chemistry at the University of Illinois Urbana-Champaign, they produced versions of these lantibiotics to test their effects on both pathogens and commensal gut bacteria. The researchers found that while the different lantibiotics had varying effects, they killed pathogens and commensal bacteria alike.

“This study is one of the first to show that gut commensals are susceptible to lantibiotics, and are sometimes more sensitive than pathogens,” Zhang said. “With the levels of lantibiotics currently present in food, it’s very probable that they might impact our gut health as well.”

**Harnessing the power of lantibiotics**

Zhang and his team also studied the structure of peptides in the lantibiotics to better understand their activity, in the interest of learning how to use their antimicrobial properties for good. For example, in another study, the Pamer lab showed that a consortium of four microbes, including one that produces lantibiotics, help protect mice against antibiotic-

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resistant Enterococcus infections. They are also studying the prevalence of lantibiotic-resistant genes across different populations of people to better understand how such bacteria can colonize the gut under different conditions and diets.

“It seems that lantibiotics and lantibiotic-producing bacteria are not always good for health, so we are looking for ways to counter the potential bad influence while taking advantage of their more beneficial antimicrobial properties,” Zhang said.

Reference: “Activity of Gut-Derived Nisin-like Lantibiotics against Human Gut Pathogens and Commensals” by Zhenrun J. Zhang, Chunyu Wu, Ryan Moreira, Darian Dorantes, Téa Pappas, Anitha Sundararajan, Huaiying Lin, Eric G. Pamer and Wilfred A. van der Donk, 31 January 2024, ACS Chemical Biology.

DOI: 10.1021/acscchembio.3c00577

The study was supported by the GI Research Foundation, the Howard Hughes Medical Institute, the National Institutes of Health (grants R01AI095706, P01 CA023766, U01 AI124275, and R01 AI042135) and the Duchossois Family Institute at UChicago. Additional authors include Chunyu Wu, Ryan Moreira, and Darian Dorantes from the University of Illinois Urbana-Champaign, and Téa Pappas, Anitha Sundararajan, and Huaiying Lin from UChicago.

Sci Tech Daily, 05 February 2024

<https://scitechdaily.com>

**Sugar cane waste converted into concrete-beating Sugarcrete**

2024-02-06

First announced last May, Sugarcrete was developed via a partnership between the University of East London and British firm Tate & Lyle Sugars.

The material consists of sugarcane bagasse combined with proprietary mineral-based binders. This mixture is compressed and left to cure, resulting in high-strength blocks that can be used in place of traditional clay or concrete bricks.

But why would anyone want to make such a substitution?

**After sugarcane crops have been harvested, a great deal of fibrous stalk waste known as bagasse is left over.**



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Well, for starters, the university claims that Sugarcrete fully cures much faster than concrete (one week as opposed to four), it weighs one quarter to one fifth as much per same-sized block, and it's significantly less expensive to produce.

The latter is a particularly big consideration in regions where sugarcane is grown. Instead of being left with a waste product that is often just dumped in landfills, farmers could sell their bagasse to local companies which would use it in Sugarcrete. That material could in turn be utilized in local construction projects, which might not have been affordable if imported concrete was the only option.

Additionally, Sugarcrete's carbon footprint is reportedly only 15% to 20% that of concrete. According to some estimates, the generation of the heat used to produce traditional portland cement (which is used in concrete) is responsible for 5% to 8% of all human-made CO<sub>2</sub> emissions.

Sugarcrete has already been demonstrated in prototype modular floor slabs, in which loads are distributed throughout the structure via connections between interlocking blocks. Although some steel reinforcements are utilized, the Sugarcrete slabs utilize up to 90% less steel than slabs made of concrete, which is more likely to crack under pressure.

Late last year at the United Nations Climate Change Conference, environmental group Green Cross UK selected Sugarcrete to be the winner of the circular economy section of its Climate Positive Awards. The awards recognize initiatives that address climate change, with the circular economy section aimed specifically at projects which reduce waste by reusing existing materials.

The Sugarcrete team is now seeking agricultural partners in the Global South nations as a next step towards commercialization of the technology.

New Atlas, 06 February 2024

<https://newatlas.com>

### Lab-Grown Wheat Protein Grown To Form "Muscle" and "Fat" Layers

2024-01-30

As the world's population increases, cultivated or lab-grown meat — animal muscle and fat cells grown in laboratory conditions — has emerged as a potential way to satisfy future protein needs. And edible, inexpensive plant proteins could be used to grow these cell cultures. Now,

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researchers in ACS Biomaterials Science & Engineering report that the non-allergenic wheat protein glutenin successfully grew striated muscle layers and flat fat layers, which could be combined to produce meat-like textures.

Cultured cells need a base or scaffold to adhere to produce lab-grown meat. Plant proteins are appealing candidates for the scaffolds because they are edible, abundant and inexpensive. Previous researchers showed that a plant-based film made of glutenin was a successful base to cultivate cow skeletal muscle cells. But for this technique to produce a promising meat-like alternative, the muscle cells need to form aligned fibers, similar to the texture in real tissues. Additionally, fat needs to be included in the 3D structure to replicate the composition of traditional meat products. To take advantage of using glutenin, a protein in gluten that people with celiac disease or a gluten sensitivity don't typically react to, Ya Yao, John Yuen, Jr., Chunmei Li, David Kaplan and colleagues wanted to develop plant-based films with it to grow textured muscle cells and fatty layers.

The researchers isolated glutenin from wheat gluten and formed flat and ridge-patterned films. Then they deposited mouse cells that develop into skeletal muscle onto the protein bases and incubated the cell-covered films for two weeks. Cells grew and proliferated on both flat and ridged films. As expected, compared to cells grown on control films made of gelatin, the performance of the glutenin-based films was inferior but sufficient. The researchers say further work needs to be done to improve how cells attach to the plant-based film to get closer to the growth on the animal-derived biomaterial. During the second week of the culture, the cells on the patterned film formed long parallel bundles, recreating the fiber structure of animal muscles.

In another test, mouse cells that produce fat tissues were deposited onto flat glutenin films. During the incubation period, as cells proliferated and differentiated, they produced visible lipid and collagen deposits.

The cultured meat and fat layers attached to the edible glutenin films could be stacked to form a 3D meat-like alternative protein. Because the glutenin material base supported the growth of both textured animal muscle and fat layers, the researchers say it could be used in an approach for more realistic cultivated meat products.

**Edible, inexpensive plant proteins could be used to grow cultivated meat with layers of "fat" and "muscle".**

**Scientists have successfully engineered an enzyme capable of breaking down the stubborn man-made bonds between silicon and carbon that exist in widely used chemicals known as siloxanes, or silicones.**



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The authors acknowledge funding from MilliporeSigma and the U.S. Department of Agriculture. Some authors are employees of MilliporeSigma, Inc.

Technology Networks, 30 January 2024

<https://technologynetworks.com>

### Breaking the Unbreakable: Caltech Scientists Engineer Enzyme To Degrade Silicon-Carbon Bonds in Silicones

2024-02-05

“Nature is an amazing chemist, and her repertoire now includes breaking bonds in siloxanes previously thought to evade attack by living organisms,” says Frances Arnold, the Linus Pauling Professor of Chemical Engineering, Bioengineering and Biochemistry at Caltech and winner of the 2018 Nobel Prize in Chemistry for her pioneering work in directed evolution, a method for engineering enzymes and other proteins using the principles of artificial selection. Arnold and her colleagues, including Dimitris (Dimi) Katsoulis of Michigan-based Dow Inc. used directed evolution to create the new silicon-carbon bond-cleaving enzyme. The results are published in the January 26 issue of the journal *Science*.

The researchers say that while practical uses for their engineered enzyme could still be a decade away or more, its development opens the possibility that siloxanes could one day be degraded biologically. “For example, natural organisms could evolve in siloxane-rich environments to catalyze a similar reaction, or further improved versions of laboratory-evolved enzymes such as this one could possibly be used to treat siloxane contaminants in wastewater,” Arnold says.

Katsoulis explains that nature doesn’t use silicon-carbon bonds, “but we do and have been for about 80 years. The volatile nature of some of these compounds warrants health and environmental research to properly understand the degradation mechanisms of these materials in the environment.”

#### Silicones in Everyday Products

Siloxane chemicals can be found in countless products, including those used in household cleaning, personal care, and the automotive, construction, electronics, and aerospace industries. The compounds’ chemical backbone is made of silicon-oxygen bonds, while carbon-containing groups, often methyl, are attached to the silicon atoms.

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“The silicon-oxygen backbone gives the polymer an inorganic-like character while the silicon-methyl groups give the polymer organic-like characteristics. Thus, these polymers have unique material properties, such as high thermal and oxidative stability, low surface tension, and high backbone flexibility among others,” Katsoulis says.

Siloxanes are believed to persist in the environment for days to months, and, therefore, ongoing research aims to provide greater scientific understanding of the health and environmental safety of silicone materials. The chemicals naturally start to fragment into smaller pieces, especially in soil or aquatic environments, and those fragments become volatile or escape into the air, where they undergo degradation by reacting with free radicals in the atmosphere. Of all the bonds in siloxanes, the silicon-carbon bonds are the slowest to break down.

Katsoulis approached Arnold to collaborate on efforts to speed up siloxane degradation after he read about her lab’s work in coaxing nature to produce silicon-carbon bonds. In 2016, Arnold and her colleagues used directed evolution to engineer a bacterial protein called cytochrome c to form silicon-carbon bonds, a process that does not occur in nature. “We decided to get nature to do what only chemists could do—only better,” Arnold said in a Caltech news release. The research demonstrated that biology could make these bonds in ways that are more environmentally friendly than those traditionally used by chemists.

In the new study, the researchers wanted to find ways to break the bonds rather than create them. The scientists used directed evolution to evolve a bacterial enzyme called cytochrome P450. Directed evolution is similar to breeding dogs or horses in that the process is designed to bring out desired traits. The researchers first identified a variant of cytochrome P450 in their collection of enzymes that had a very weak ability to break silicon-carbon bonds in so-called linear and cyclic volatile methylsiloxanes, a common subgroup of the siloxane family.

#### Overcoming Obstacles in Enzyme Evolution

They mutated the DNA of the cytochrome P450 and tested the new variant enzymes. The best performers were then mutated again, and the testing was repeated until the enzyme was active enough to enable the researchers to identify the products of the reaction and study the mechanism by which the enzyme works.

“Evolving enzymes to break these bonds in siloxanes presented unique hurdles. With directed evolution, we must evaluate hundreds of new



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enzymes in parallel to identify a few enzyme variants with improved activity," says Tyler Fulton (PhD '22), co-lead author of the study and a postdoctoral scholar at Caltech in Arnold's lab. One challenge involved the siloxane molecules leaching plastic components from the 96-well plates used to screen the variants. To solve the problem, the team created new plates made from common lab supplies.

"Another challenge was finding the starting enzyme for the directed evolution process, one with even just a tiny amount of the desired activity," Arnold says. "We found it in our unique collection of cytochrome P450s evolved in the laboratory for other types of new-to-nature silicon chemistry."

The final improved enzyme does not directly cleave the silicon-carbon bond but rather oxidizes a methyl group in the siloxanes in two sequential steps. Basically, this means that two carbon-hydrogen bonds are replaced with carbon-oxygen bonds, and this change allows the silicon-carbon bond to break more readily.

The research draws parallels to studies involving a plastic-eating enzyme, explains Fulton, referring to a polyethylene terephthalate (PET)-degrading enzyme discovered in the bacteria *Ideonella sakaiensis* in 2016 by a different group of researchers. "While the PET-degrading enzyme was discovered by nature rather than by engineers, that enzyme inspired other innovations that are finally coming to fruition for plastic degradation. We hope this demonstration will similarly inspire further work to help break down siloxane compounds," he says.

Reference: "Directed evolution of enzymatic silicon-carbon bond cleavage in siloxanes" by Nicholas S. Sarai, Tyler J. Fulton, Ryen L. O'Meara, Kadina E. Johnston, Sabine Brinkmann-Chen, Ryan R. Maar, Ron E. Tecklenburg, John M. Roberts, Jordan C. T. Reddel, Dimitris E. Katsoulis and Frances H. Arnold, 25 January 2024, *Science*.

DOI: 10.1126/science.adi5554

The research was funded by Dow's University Partnership Initiative and the National Science Foundation. Other Caltech authors include co-lead author Nicholas Sarai (PhD '23), as well as graduate student Ryen L. O'Meara, Kadina E. Johnston (PhD '23), and Arnold lab manager Sabine

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### "Zombie" COVID particles may be responsible for lethal disease

2024-02-05

Why some coronaviruses are relatively harmless while others are incredibly lethal is still a bit of a mystery. Some answers lie in the proteins each individual virus uses to enter human cells, but what exactly makes SARS-CoV-2 so severe in some people and innocuous in others is unclear.

An impressive new study led by researchers from UCLA is offering a novel hypothesis to explain SARS-CoV-2 severity. Using an AI-driven machine-learning system the researchers discovered SARS-CoV-2 is broken down into fragments in a human body, and this viral debris can uniquely resemble endogenous peptides that overstimulate the immune system. This may play a significant role in the strange variable severity of disease from person to person.

"The textbooks tell us that after the virus is destroyed, the sick host 'wins,' and different pieces of virus can be used to train the immune system for future recognition," says corresponding author Gerald Wong.

But the story of a virus isn't exactly as simple as that. After a virus is neutralized by the immune system it is rapidly broken down, or dissolved, into tiny fragments. It has generally been assumed this stage of viral degradation was innocuous, but recent research has suggested some of these smaller viral fragments could trigger innate immune responses that account for severe disease associated with hyper inflammation.

To investigate this idea in the context of COVID, the researchers tracked all the possible peptide combinations that could be created through the degradation of SARS-CoV-2 proteins. They used a machine-learning system to measure the pro-inflammatory characteristics of all these potential peptides and discovered several of these viral fragments closely resemble molecules our immune system uses to heighten inflammatory responses.

"We saw that the various forms of debris from the destroyed virus can reassemble into these biologically active 'zombie' complexes," explains Wong. "It is interesting that the human peptide being imitated by the viral fragments has been implicated in rheumatoid arthritis, psoriasis and lupus, and that different aspects of COVID-19 are reminiscent of these autoimmune conditions."

**Following the emergence of SARS-CoV-2 in 2020 there are now seven different coronaviruses known to infect humans.**



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The researchers then directly compared these SARS-CoV-2 viral fragments to debris that comes from a more harmless common-cold-causing coronavirus (HCoV-OC43). The fragments were very different, and the OC43 debris was found to not at all stimulate the immune system in the same way as SARS-CoV-2.

Even more interestingly, the researchers looked at what kinds of gene expression were stimulated by these SARS-CoV-2 viral fragments. These novel peptides were found to trigger similar patterns of expression to the full virus.

“What’s astonishing about the gene expression result is there was no active infection used in our experiments,” Wong notes. “We did not even use the whole virus – rather only about 0.2% or 0.3% of it – but we found this incredible level of agreement that is highly suggestive.”

So these findings may somewhat account for why SARS-CoV-2 triggers more severe disease than its common-cold coronavirus counterparts. But the study can only speculate as to why the virus’s effects are so variable from person to person.

Here the researchers indicate the striking uniqueness in each individual person’s enzyme efficiency could likely account for why some people don’t even notice they have COVID, while others end up struggling in hospital. Essentially, each of us break down foreign particles differently, and these unique differences may be responsible for how mild our illness is.

“... proteolytic degradation of SARS-CoV-2 is likely to be heterogeneous, as individual hosts display distinctive patterns of enzyme efficiencies varying routinely by fourfold to 50-fold, with protein expression being ‘noisy’ even at the single cell level,” the researchers write in the new study. “That proteolytic degradation of SARS-CoV-2 is expected to be drastically different among hosts may explain why the infection outcomes of SARS-CoV-2 are so heterogeneous, ranging from asymptomatic hosts to fatalities.”

The idea that viral fragments can linger in the body and cause persistent longer-term health problems is still relatively new. Over the last few years there has been emerging evidence showing viral debris from influenza causing long-term lung disease in some people, for example. But what these findings actually mean for potential future treatments is still unknown.

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Wong does speculate the possibility that diseases such as COVID could be treated by inhibiting the actions of certain enzymes that are responsible for breaking the virus down into its more harmful components. Of course, to get to that point there will need to be lots more work done to systematically study exactly how certain viral fragments are created.

The new study was published in PNAS.

Source: UCLA

New Atlas, 06 February 2024

<https://newatlas.com>

### Rare medical transmission of Alzheimer’s disease from donor to patient discovered

2024-02-01

The hormones came from the pituitary glands of deceased individuals, a procedure banned in 1985 after it was linked to the transmission of misfolded proteins – prions – that cause Creutzfeldt–Jakob disease (CJD).

Between 1959 and 1985, at least 1848 patients were treated with human growth hormone from human pituitary glands, resulting in over 200 cases of CJD, with 80 in the UK alone. Now it seems the procedure also put people at risk of contracting Alzheimer’s disease. The UK research group behind the work has also warned that more growth hormone was likely to be contaminated with amyloid beta than with CJD prions and have a longer incubation period to Alzheimer’s than CJD.

The first hints that Alzheimer’s disease is transmissible in very specific circumstances emerged when neurologists at University College London (UCL) examined the brains of eight people with medically acquired CJD. They unexpectedly saw signs of Alzheimer’s disease in the form of clumps of amyloid beta protein, or amyloid plaques, in grey matter – a telltale hallmark of this progressive brain disease.

The UCL researchers’ suspicions were backed by the fact that tissue from human Alzheimer’s brains was known to be able to seed amyloid beta plaques in the brains of mice. In 2018, the team obtained stored batches of growth hormone extracted from pituitary glands and showed that they could seed plaques of amyloid beta in mice.

The eight patients who developed cognitive impairment had been referred to the National Prion Clinic in London and five of them went on to

**Alzheimer’s disease can be transmitted between people in rare circumstances as a result of medical procedures.**



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show symptoms that matched Alzheimer's disease. An autopsy of one of two patients who died during the course of the study revealed that they had signs of Alzheimer's disease.

The five who displayed Alzheimer's disease 'were a little bit different from what you might call classical Alzheimer's', says John Collinge, the neurologist at UCL who led the study. He adds that this wasn't a surprise as contaminated growth hormones are a very different way of developing the disease.

'It is a small number of subjects, but it is striking that their amyloid pathology looks like early-stage Alzheimer's yet you don't see a lot of tau pathology,' says Paul Murphy, an Alzheimer's researcher at the University of Kentucky. Tau tangles are thought to follow amyloid plaques and kill a lot of neurons, he explains, which then causes cognition problems.

The vast majority of Alzheimer's disease happens out of the blue, with patients showing symptoms after age 65. A second form can occur earlier in life as a result of certain genetic mutations. This new study points to a third, acquired form of Alzheimer's.

'You can have these very rare cases, just like in CJD, where people are accidentally exposed to these transmissible seeds as a result of a medical procedure,' says Collinge. 'The majority of this relates to medical procedures that are no longer used.'

For CJD, this includes the grafting of brain membrane to repair defects during neurosurgery and corneal transplants, as well as through contaminated surgical instruments. Most CJD happens sporadically or through inherited mutations, with around 1% estimated to be acquired.

Alzheimer's disease researcher Bart De Stroop at UCL, who was not involved in the new study, says increased vigilance is warranted, especially around procedures in early life that involve human fluids or tissues. He suggests closely following what happens to patient groups that have procedures such as blood transfusion or organ transplantation. 'That is what is needed most to understand how big an issue this is,' he notes. 'At this moment, it looks like a very rare phenomenon.'

Collinge also warns that their research suggests encouraging results from monoclonal antibody therapies for Alzheimer's disease could be premature. 'We know that in prion disease, if you develop a drug which binds to the majority of components of a main strain [of prion] that is

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propagating in the brain, you can get the rapid development of resistance from minor species that are present,' he says.

Murphy calls this idea 'fascinating,' but says that it appears that there is one type of amyloid beta protein that is particularly harmful in Alzheimer's disease and any therapy that can get rid of this early enough should make a difference to patients.

Chemistry World, 01 February 2023

<https://chemistryworld.com>

### Ocean Nanoplastics Identified for the First Time

2024-02-02

Millions of tons of plastic waste enter the oceans each year. The sun's ultraviolet light and ocean turbulence break down these plastics into invisible nanoparticles that threaten marine ecosystems.

In a new study, engineers at the University of Notre Dame have presented clear images of nanoplastics in ocean water off the coasts of China, South Korea and the United States, and in the Gulf of Mexico. These tiny plastic particles, which originated from such consumer products as water bottles, food packaging and clothing, were found to have surprising diversity in shape and chemical composition.

The engineers' research was published in Science Advances.

"Nanoplastics are potentially more toxic than larger plastic particles," said Tengfei Luo, the Dorini Family Professor of Aerospace and Mechanical Engineering at the University of Notre Dame. "Their small size makes them better able to penetrate the tissues of living organisms."

Previously, nanoplastic particles synthesized in laboratories had been used in toxicity studies to investigate their effect on marine life. Luo's team of researchers, in collaboration with the lab of Wei Xu at Texas A&M, decided to search for actual nanoplastics in the world's oceans, suspecting they might be significantly different from the lab-created versions, which are highly uniform in shape and composition. Any differences found may affect toxicity studies.

Nanoplastics are believed to exist at extremely low concentrations in the ocean. To find them in seawater, Luo's team used a unique bubble deposition technique that they had previously developed to find traces of DNA molecules for early detection of cancers.

**Engineers unmask nanoplastics in oceans for the first time, revealing their true shapes and chemistry.**



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The team mixed seawater samples with silver nanoparticles and heated the solution with a laser until a bubble formed. Variations in surface tension cause the nanoplastic particles to accumulate on the bubble's exterior. The bubble shrinks, then vanishes, depositing the particles in one concentrated spot. Electron microscopy and Raman spectroscopy are then used to reveal the nanoplastics' shapes and chemistries.

Luo's team found nanoplastics made of nylon, polystyrene and polyethylene terephthalate (PET) — plastic polymers used in food packaging, water bottles, clothing and fish nets — in these seawater samples. Some of the particles' diverse shapes can be traced back to the different manufacturing techniques used to create them. Surprisingly, PET nanoparticles were found in water samples collected approximately 300 meters deep in the Gulf of Mexico, suggesting nanoplastic contamination is not restricted to the ocean surface.

Follow-up studies will focus on quantifying ocean nanoplastics, Luo said.

"The nanoplastics we found in the ocean were distinctively different from laboratory-synthesized ones," Luo said.

"Understanding the shape and chemistry of the actual nanoplastics is an essential first step in determining their toxicity and devising ways to mitigate it."

In addition to Luo and Xu, other co-authors on this paper are Seunghyun Moon, Seongmin Kim, Qiushi Zhang and Renzheng Zhang at the University of Notre Dame, and Leisha Martin at Texas A&M.

Technology Networks, 02 February 2024

<https://technologynetworks.com>

### GPT-3 transforms chemical research

2024-02-06

However, to make reliable predictions, machine learning also demands large amounts of data, which isn't always available in chemical research. Small chemical datasets simply do not provide enough information for these algorithms to train on, which limits their effectiveness.

Scientists, in the team of Berend Smit at EPFL, have found a solution in large language models such as GPT-3. Those models are pre-trained on massive amounts of texts, and are known for their broad capabilities in

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understanding and generating human-like text. GPT-3 forms the basis of the more popular artificial intelligence ChatGPT.

The study, published in Nature Machine Intelligence, unveils a novel approach that significantly simplifies chemical analysis using artificial intelligence. Contrary to initial skepticism, the method doesn't directly ask GPT-3 chemical questions.

"GPT-3 has not seen most of the chemical literature, so if we ask ChatGPT a chemical question, the answers are typically limited to what one can find on Wikipedia," says Kevin Jablonka, the study's lead researcher.

"Instead, we fine-tune GPT-3 with a small data set converted into questions and answers, creating a new model capable of providing accurate chemical insights."

This process involves feeding GPT-3 a curated list of Q&As. "For example, for high-entropy alloys, it is important to know whether an alloy occurs in a single phase or has multiple phases," says Smit. "The curated list of Q&As are of the type: Q= 'Is the (name of the high entropy alloy) single phase?' A= 'Yes/No.'"

He continues, "In the literature, we have found many alloys of which the answer is known, and we used this data to fine-tune GPT-3. What we get back is a refined AI model that is trained to only answer this question with a yes or no."

In tests, the model, trained with relatively few Q&As, correctly answered over 95% of very diverse chemical problems, often surpassing the accuracy of state-of-the-art machine-learning models. "The point is that this is as easy as doing a literature search, which works for many chemical problems," says Smit.

One of the most striking aspects of this study is its simplicity and speed. Traditional machine learning models require months to develop and demand extensive knowledge. In contrast, the approach developed by Jablonka takes five minutes and requires zero knowledge.

The implications of the study are profound. It introduces a method as easy as conducting a literature search, applicable to various chemical problems. The ability to formulate questions like "Is the yield of a [chemical] made with this (recipe) high?" and receive accurate answers can revolutionize how chemical research is planned and carried out.

**Artificial intelligence is growing into a pivotal tool in chemical research, offering novel methods to tackle complex challenges that traditional approaches struggle with.**



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In the paper, the authors say, "Next to a literature search, querying a foundational model (e.g., GPT-3,4) might become a routine way to bootstrap a project by leveraging the collective knowledge encoded in these foundational models." Or, as Smit succinctly puts it, "This is going to change the way we do chemistry."

Phys Org, 06 February 2024

<https://Phys.org>

### **New drug could prevent both eye & kidney complications in diabetics**

2024-02-04

Even when it's well managed, diabetes can lead to complications that affect the body's small blood vessels or microvasculature. Two of the most common microvascular complications are diabetic retinopathy (DR), the leading cause of vision loss and blindness in diabetics, and diabetic kidney disease (DKD), which can result in kidney failure.

Although there are treatments directed at the symptoms of DR and DKD, there is currently nothing to prevent these complications. But with the University of Bristol researchers leading a study identifying a drug that prevented both diabetic eye and kidney complications in mice, a preventive treatment might soon exist.

"Our findings are exciting as we have shown that one type of medication might be able to prevent different diabetic complications, which is a global health problem for adults living with diabetes," said Rebecca Foster, senior author of the study.

Previous studies have suggested that DR and DKD have common mechanisms underlying their development and progression as both are caused by dysfunction of the microvasculature barrier, particularly the endothelial glycocalyx, a protective layer that lines the inner surface of all vascular endothelial cells and is a determinant of small blood vessel health.

The glycocalyx is made up of carbohydrates that include the heparan sulfate molecule. Heparan sulfate is synthesized into chains inside the cell that are moved to the cell's surface, where they can be directly modified (cleaved) by the enzyme heparanase at 'hot spots' along the chain, affecting the glycocalyx's barrier function. In diabetics, heparanase is

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systematically upregulated and elevated in the eye membranes of patients with DR and the kidneys of those with DKD.

The researchers used a unique heparanase inhibitor, OVZ/HS-1638, to therapeutically target the glycocalyx in type 2 diabetic mouse models. Starting with the eyes, they noticed that the depth of the retinal glycocalyx was reduced in the untreated mice, but it wasn't in mice treated with OVZ/HS-1638. They tested the 'leakiness' of the glycocalyx by measuring extracellular albumin, finding that the amount of albumin in the retinal tissue of the treated mice was significantly lower.

Moving on to the kidneys, the researchers found that, as they'd observed with the eyes, glycocalyx depth in the glomerulus (the network of small vessels that filter the blood) was significantly reduced in untreated diabetic mice but not in those given the heparanase inhibitor. When they measured the urine albumin-creatinine ratio (uACR), which shows whether albumin has leaked into the urine through the glomerular vessels, untreated mice had a significantly higher uACR than inhibitor-treated mice.

The findings provide evidence that protecting the glycocalyx using a heparanase inhibitor was an effective systemic approach to protect against microvascular complications in diabetes. Further studies into the drug's pharmacokinetics, bioavailability and safety are in progress to support its potential for clinical evaluation.

"We are currently conducting research to advance our novel class of inhibitors to clinical use," said Monica Gamez, lead and corresponding author of the study.

The study was published in the journal Cardiovascular Diabetology.

Source: University of Bristol

New Atlas, 04 February 2023

<https://newatlas.com>

### **New Zealand set to be first country to ban PFAS in cosmetic products**

2024-02-05

PFAS are sometimes used in products such as nail polish, shaving cream, foundation, lipstick and mascara. They are added to smooth the skin, or to make cosmetic products more durable, spreadable and water resistant.

**The New Zealand Environmental Protection Agency (EPA) will ban the use of per- and polyfluoroalkyl substances (PFAS) in cosmetic products starting in 2027.**



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In the announcement on 30 January, the EPA said that although research suggests that PFAS are only found in a small number of products it was taking a 'precautionary approach' to the potential risks.

'Banning these chemicals in cosmetics is part of our ongoing response, which includes phasing out all PFAS-firefighting foams and testing for background levels of PFAS in the New Zealand environment,' said Shaun Presow, hazardous substances reassessments manager at the EPA.

The decision on PFAS is one of a number of updates that have been made to the Cosmetic Products Group Standard, to ensure cosmetic products are safe.

Chemistry World, 05 February 2023

<https://chemistryworld.com>

### Ammonia attracts the shipping industry, but researchers warn of its risks

2024-02-05

In the search for viable fossil-free marine fuels, ammonia has been on the agenda for several years as one of the strongest alternatives.

Ammonia (NH<sub>3</sub>) is a carbon-free fuel and has the advantage of a higher energy density than, for example, hydrogen.

It can also be liquefied fairly easily although it is a gas at standard conditions.

However, a significant disadvantage is that the production of electro-ammonia -- which requires electricity -- is very energy intensive.

Moreover, the new study shows that an eagerness to rid the shipping sector of carbon emissions, by using ammonia, might create entirely new problems instead.

"Although ammonia is carbon-free, its combustion in engines is not free from greenhouse gas emissions," says Selma Brynolf, Chalmers researcher and co-author of the paper.

"Engine tests have shown varying degrees of emissions of laughing gas, which is a very potent greenhouse gas with more than 200 times the global warming impact than carbon dioxide."

**Switching to ammonia as a marine fuel, with the goal of decarbonisation, can instead create entirely new problems. This is shown in a study from Chalmers University of Technology in Sweden, where researchers carried out life cycle analyses for batteries and for three electrofuels including ammonia.**

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"There is simply a lack of deeper risk analyses of what a switch to ammonia could mean," says Fayas Malik Kanchiralla, PhD student at the Department of Mechanics and Maritime Sciences at Chalmers and lead author of the paper.

### The alternative with the lowest cost is environmentally problematic

The researchers used life cycle assessment and life cycle cost to evaluate technical viability, environmental impacts, and economic feasibility for four types of renewable energy carriers, for three different types of ships.

The energy carriers examined included electricity via batteries, and three electrofuels: hydrogen, methanol, and ammonia.

The energy carriers were in turn used in combination with both engines and fuel cells.

The study shows that ammonia and methanol have the lowest cost of the alternatives studied.

"The market is usually drawn by costs, and since electro-ammonia has the lowest cost, the market is aiming towards it. There is a hype around this fuel in shipping today. But if, and when, we make a shift to ammonia, it is to solve the problem of using fossil fuels, and at the moment it seems like we might end up creating more problems instead," says Fayas Malik Kanchiralla.

This is because ammonia comes with a set of environmental disadvantages.

Its use as a fuel can affect air and water quality due to ammonia leakage and emissions of nitrogen oxides (NO<sub>x</sub>), such as laughing gas (N<sub>2</sub>O). Fayas Malik Kanchiralla and his colleagues stress the importance of controlling this for ships operating in areas with emission controls, for example a sensitive marine area such as the Baltic Sea.

Electrofuels are synthetic fuels that are produced with electricity, in a process where energy-rich molecules are made from other molecules.

These fuels are defined as 'green' when they are produced with renewable electricity.

But the study shows that all three green electrofuels have a higher environmental impact than traditional fuels in terms of human toxicity, use of resources such as minerals and metals, and water use.



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### Eutrophication and acidification are some of the risks

The use of ammonia is associated with substantial toxicity challenges and risks, which are manageable, but would increase the complexity of the safety systems required.

This would potentially limit the use of the fuel to only deep-sea cargo ships.

“Among the environmental problems that can be traced to use of ammonia are eutrophication and acidification,” says Fayas Malik Kanchiralla.

“To sum up; even though green ammonia is a fossil-free and relatively clean fuel, it is probably not green enough for the environment as a whole. More risk assessments on the emissions of ammonia, and the related nitrogen compounds, need to be done before adopting this fuel for shipping.”

The study also shows that it is very difficult to find a simple non-fossil fuel solution that both works for all types of ships and is able to meet the goal of reducing greenhouse gas emissions in shipping.

Assessing the environmental and economic aspects of different fuel options for the shipping sector is complex, and several factors need to be considered when developing climate strategies for various types of ships and modes of operation.

“From a life cycle perspective, one needs to find different types of solutions for decarbonisation for different kinds of ships,” says Fayas Malik Kanchiralla. “There is no silver bullet. More research and more life cycle analyses need to be done.”

Science Daily, 05 February 2024

<https://sciencedaily.com>

### Experimental Insulin Pill Could Reduce Need for Injections

2024-01-22

Researchers have developed an oral form of insulin that lowers glucose levels in animal models. The oral insulin, encased in a nano-carrier that delivers insulin to the liver, is expected to begin human trials in 2025. The study is published in Nature Nanotechnology.

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### Overcoming a major challenge with encapsulated insulin

Of the approximately 422 million people with diabetes worldwide, around 75 million must self-inject insulin each day.

Insulin injections can be burdensome, expensive and tricky for patients; but what if these could be replaced with new “smart insulin” pills?

Researchers have developed insulin encased in tiny nano-carriers, each 1/10,000th the width of a human hair, that may enable insulin to be administered orally instead of injected.

“This way of taking insulin is more precise because it delivers the insulin rapidly to the areas of the body that need it most,” said Peter McCourt, study co-author and a professor at the University of Tromsø (UiT) Norway’s Arctic University. “When you take insulin with a syringe, it is spread throughout the body where it can cause unwanted side effects.”

#### Nano-carrier may make for fewer side effects

The nano-carrier approach was developed in collaboration with the University of Sydney and the Sydney Local Health District. The researchers found it was possible to use this method to direct the delivery of medicines, in this case insulin, to the liver.

However, one of the major problems is that the capsule gets broken down in the stomach before reaching its intended destination in the body – a major stumbling block for the development of oral diabetes medications.

But McCourt and colleagues describe how they have solved this issue. “We have created a coating to protect the insulin from being broken down by stomach acid and digestive enzymes on its way through the digestive system, keeping it safe until it reaches its destination, namely the liver,” McCourt explained.

The capsule’s coating is broken down only under specific conditions – when enzymes, produced only when blood sugar levels are high, are released from the liver. This releases the insulin from the capsule, allowing it to work in the liver, muscle and fat.

“This means that when blood sugar is high, there is a rapid release of insulin, and even more importantly, when blood sugar is low, no insulin is released,” said Nicholas J. Hunt, the lead author of the study and a senior lecturer at the University of Sydney.



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McCourt explains that insulin injections, in which the insulin is released all in one go, can lead to low blood sugar events, i.e., hypoglycemia. On the other hand, the capsules could be a more practical and patient-friendly method, allowing for more controlled insulin release.

In this way, the method works similarly to the healthy pancreas, where insulin is produced before passing through the liver for absorption and maintenance of blood sugar levels.

The method also allows for more discreet dosing and doesn't require refrigeration, unlike insulin injections.

### Human trials on the horizon

The oral insulin formulation has been tested in preclinical studies using nematodes (roundworms), mice, rats and now baboons.

In the baboon study, the insulin was prepared in sugar-free chocolate, which was well-received by the 20 baboons involved in the study from the National Baboon Colony in Australia. These animals were healthy, and the researchers observed that their glucose levels successfully dropped.

Additionally, mouse and rat models with diabetes showed that the oral insulin did not bring about hypoglycemia, weight gain or liver fat accumulation.

Now, the researchers' goals turn towards human trials, which they hope will begin in 2025.

"Our team is very excited to see if we can reproduce the absent hypoglycemia results seen in baboons in humans as this would be a huge step forward," said Hunt. "The experiments follow strict quality requirements and must be carried out in collaboration with physicians to ensure that they are safe for the test subjects."

"After this Phase 1 [clinical trials], we will know that it is safe for humans and will investigate how it can replace injections for diabetic patients in Phase 2 trials," he continued.

Technology Networks, 22 January 2024

<https://technologynetworks.com>

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### Researchers develop cluster glass for fluorescence and nonlinear optical properties

2024-02-06

However, how to induce the local structural disorder of crystalline materials to achieve glass transition remains a challenge because most of them undergo decomposition before melting.

In the metal-organic framework system, the exploration of glassy states is limited to a few model compounds such as ZIF-4, ZIF-62 and ZIF-8. There is a need to break the limitation of metals and ligands in the "crystal-liquid-glass" process and to develop the glass synthesis pathway of universal crystalline materials.

In a study published in *Angewandte Chemie International Edition*, a research group led by Prof. Zhang Jian and Prof. Fang Weihui from Fujian Institute of Research on the Structure of Matter of the Chinese Academy of Sciences reported the meltable aluminum molecular rings with fluorescence and nonlinear optical properties.

Inspired by the characteristics of deep eutectic solvent (DES) mixtures involving significant depressions in melting points compared to their neat constituent components, the researchers designed and synthesized the first examples of meltable aluminum oxo clusters via lattice doping with DESs at the molecular level.

This kind of molecular ring compound undergoes a crystal-liquid-glass process after heating. The abundant and strong hydrogen bonds between the aluminum molecular ring, DES components and the lattice solvent in the structure are considered to be the root cause of the lower melting point. This lattice doping bonding method provides a general preparation method for the development of cluster glass.

The researchers determined the composition changes of the compounds before and after melting and quenching by modern characterization methods and in situ temperature monitoring (TG-IR-MS). They tried to mix DES solvent with an empty Al<sub>8</sub> ring by physical doping, and found no melting phenomenon in the mixture after heating, which proves the importance of doping the DES component in the lattice, that is, DES component forms a "supracluster" structure with aluminum molecular ring.

Owing to the plasticity of the cluster glass "soft material," the researchers explored its machinability and optical properties. They prepared the bubble-free glass film by a simple "hot pressing" method under

**Glass can be synthesized through a novel "crystal-liquid-glass" phase transformation. Crystalline materials can be fine-tuned for desired properties such as improved mass transfer and optical properties through coordination chemistry and grid design principles.**



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atmospheric pressure, and well maintained the luminescence and third-order nonlinear effect similar to that of the original crystal.

The forming of this cluster glass film does not require additional mixed media, which is different from the traditional substrate bonding method, revealing the advantages of cluster glass.

This study demonstrates the potential of aluminum-related glass prepared by the third most abundant metal in the Earth's crust, for sustainable development. The strategy combining the aluminum molecular ring and ionic liquid component overcomes the limitation of metal and ligand type of crystal glass, and provides a better approach for the study of "crystal-liquid-glass."

Phys Org, 06 February 2024

<https://phys.org>

### What Happens in the Human Brain After Taking DMT?

2024-01-22

A growing number of psychedelic compounds are being explored clinically for the treatment of neurological conditions such as depression, anxiety and post-traumatic stress disorder (PTSD). One such promising chemical in this "psychedelics renaissance" is N,N-Dimethyltryptamine, or DMT.

DMT is a psychedelic compound that has been utilized in indigenous rituals for thousands of years. It is naturally produced by a variety of plant species, and is the primary psychedelic ingredient in ayahuasca.

In 1931, the chemist Richard Manske chemically synthesized DMT, but its hallucinogenic effects were not discovered or published in scientific literature until 1951.

DMT is an interesting psychedelic as, compared to other compounds in that same category, it produces short yet intense "trips" that can last for just a few minutes depending on the dose. The short duration of its effects is an appealing characteristic when exploring its use for psychedelic-assisted therapy.

Recently, the biotechnology company Small Pharma announced positive early results from a clinical trial testing pharmaceutical-grade synthetic DMT formulation in participants with major depressive disorder, or MDD. And according to Clinicaltrials.gov, a number of other trials are in

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progress to evaluate the safety, tolerability and efficacy of DMT in healthy participants, stroke patients, and individuals with alcohol use disorder, among other conditions.

How, exactly, DMT alters brain function to produce the effects observed so far in clinical trials is not yet clear, though a recent study from scientists at Imperial College London (Imperial) shed some light.

The research, published in PNAS, was led by Dr. Chris Timmermann at the Centre for Psychedelic Research at Imperial. It combined electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) to explore the effects of DMT on the human brain.

### What are EEG and fMRI?

EEG is a form of non-invasive electrophysiological monitoring. It measures electrical activity – also referred to as brain waves – generated by the brain via electrodes that are placed on the scalp. When neurons fire in sync, they generate an electrical field that quickly spreads through tissue, bone and the scalp. This electrical activity is detected by the electrodes, recorded, digitized and sent to an amplifier.

EEG is considered to have excellent temporal resolution, meaning it can accurately capture changes happening in the brain over time. This is important for understanding the dynamics of brain activity, but EEG is considered to have spatial resolution – i.e., it fails to present data on where changes in brain activity are happening.

In contrast to EEG, fMRI does not measure electrical responses. Instead, it is a technique based on the principle that the more active a brain region is, the greater the amount of blood flow to that region. fMRI measures changes in blood flow and oxygenation in different areas of the brain, and therefore provides high spatial temporal resolution.

EEG-fMRI combines both techniques to overcome the temporal and spatial limitations of using them separately. It is considered a mature cognitive neuroscience technique for multimodal brain imaging.

While Timmerman and colleagues' study is not the first to image the brain while a participant is under the effects of psychedelics, it is the first to combine EEG and fMRI to image the brain under a "highly immersive" psychedelic experience.

"Motivated by, and building on our previous research with psychedelics, the present work combined two complementary methods for imaging the



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brain imaging,” said Professor Robin Carhart-Harris, senior author of the study. Carhart-Harris is now a professor of neurology at the University of California, San Francisco. “fMRI allowed us to see the whole of the brain, including its deepest structures, and EEG helped us view the brain’s fine-grained rhythmic activity,” he continued.

### Testing the effects of DMT on the brain

The Imperial team recruited a total of 20 healthy participants aged 33.5 years on average for the study.

After initial assessments ensured the physical and mental health criteria of the study were met, the participants visited the Imperial College Clinical Imaging Facility for two visits that were two weeks apart.

The first session consisted of continuous EEG-fMRI scanning for 28 minutes while the participant was resting. The DMT/placebo was administered after eight minutes. “In this initial session (task free), they received intravenous (IV) administration of either placebo (10 mL of sterile saline) or 20 mg DMT (in fumarate form dissolved in 10 mL of sterile saline) – injected over 30 seconds, and then flushed with 10 mL of saline over 15 seconds – in a counter-balanced order (half of the participants received placebo and the other half received DMT);” Timmerman and colleagues described.

After the scans, the participants were handed questionnaires, which were designed to evaluate the subjective effects they had experienced.

The second session replicated the first; except participants were asked to audibly rate the intensity of the drug’s effects every minute that they were in the scanner. “This article reports the results concerning the resting-state scans in which no intensity ratings were asked, while using intensity ratings collected in other (non-analyzed) scan runs as covariates for dynamic fMRI and EEG analysis,” the researchers said.

### DMT breaks down the brain’s segregated networks of activity

The researchers found that DMT triggered changes within and between different brain regions. Under normal circumstances, brain activity is segregated into specific networks. After administration of DMT, the boundaries of these networks seem to collapse, resulting in what the authors describe as “global functional connectivity”. Compared to placebo, DMT administration significantly decreased the within-network integrity of all resting state networks, excluding the salience and limbic networks. The changes to activity were most prominent in brain areas linked with “higher level” functions, such as imagination.

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By simultaneously recording EEG and fMRI data, the researchers could study any changes in the types of electrical activity produced by the brain in conjunction with the fMRI measures of functional connectivity.

“Our results revealed that when a volunteer was on DMT there was a marked dysregulation of some of the brain rhythms that would ordinarily be dominant. The brain switched in its mode of functioning to something altogether more anarchic,” said Carhart-Harris.

“It will be fascinating to follow-up on these insights in the years to come. Psychedelics are proving to be extremely powerful scientific tools for furthering our understanding of how brain activity relates to conscious experience,” he added.

Technology Networks, 22 January 2024

<https://technologynetworks.com>



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