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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

New POPs added to Stockholm Convention list

2023-09-06

Three new chemicals have been listed under the Stockholm Convention on persistent organic pollutants (POPs) following the most recent Conference of the Parties to the convention held earlier this year:

New Zealand is a party to the convention, so the following chemicals will need to be restricted under the Hazardous Substances and New Organisms Act 1996 (HSNO Act):

- Methoxychlor (pesticide)
- Dechlorane Plus (industrial chemical)
- UV-328 (industrial chemical)

We will be publicly consulting on the proposals to restrict these chemicals in due course.

[Read More](#)

New Zealand EPA, 06-09-23

<https://chm.pops.int/TheConvention/Overview/tabid/3351/Default.aspx>

Recent EPA decisions

2023-09-06

Containment

APP204630 by Syngenta Crop Protection Limited to import or manufacture Syngenta Experimental Plant Protection Compounds in containment. Approved with controls 09/08/2023.

APP204663 by AsureQuality Ltd - Wellington Laboratory to import or manufacture POP Standards in containment. Approved with controls 17/08/2023.

APP204675 by Hill Laboratories to import or manufacture POPs RJ Hill Laboratories Ltd in containment. Approved with controls 17/08/2023.

APP204686 by Invasive Pest Control Limited to import or manufacture Norbormide pellet bait in containment. Approved with controls 18/08/2023.

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Insecticide

APP204456 by RB (Hygiene Home) New Zealand Limited to import or manufacture Mortein Naturgard Crawling Insect Control Bomb for release. Approved with controls 31/07/2023.

APP204586 by RB (Hygiene Home) New Zealand Limited to import or manufacture Mortein Naturgard Crawling Insect Surface Spray for release. Approved with controls 29/08/2023.

APP204587 by RB (Hygiene Home) New Zealand Limited to import or manufacture Mortein Powergard Crawling Insect Surface Spray for release. Approved with controls 31/07/2023.

Amendments to approvals

No section 67A amendments have been decided in August 2023.

See a summary of recent amendments to approvals.

[Read More](#)

New Zealand EPA, 06-09-23

<https://www.epa.govt.nz/industry-areas/hazardous-substances/chemical-reassessment-programme/amendments-to-approvals/>

More than 300,000 vapes seized from Perth warehouse in Australia's largest bust

2023-08-14

The WA Health Department has seized 15 tonnes of vapes from a warehouse in Perth's north-east in what it says is the biggest-ever bust of its kind in the state and nation.

Authorities say more than 300,000 vapes worth an estimated \$10 million were discovered.

WA Health Minister Amber-Jade Sanderson said the raid came after a tip-off.

Health Department officers also found more than 10 tonnes of illegal prescription drugs and "nangs", which are whipped cream chargers filled with nitrous oxide that are abused by being inhaled.

They can cause brain and nerve damage and even death.

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Ms Sanderson congratulated officers and said the seizure was part of a wider crackdown on the sale of illegal vapes and misuse of nitrous oxide.

[Read More](#)

ABC News, 14-08-23

<https://www.abc.net.au/news/2023-08-14/vapes-and-nangs-seized-from-perth-warehouse-in-record-wa-haul/102725616>

Have your say: changes to categorisation, reporting and record keeping

2023-09-15

We invite public comments on a suite of regulatory proposals relating to categorisation, reporting and record-keeping obligations. Consultation closes on 9 November 2023.

We've explored possible solutions to address stakeholder advice that certain requirements of the General Rules are challenging to comply with. AICIS has also identified aspects of the General Rules that we think should be strengthened to ensure protection of human health and the environment or clarify the intent of certain requirements.

These proposals were developed using an evidence- and risk-based approach to regulation that is appropriate to each circumstance. Some key proposals in this consultation:

- Replacing written undertakings with records that will make compliance easier.
- Greater acceptance of International Nomenclature of Cosmetic Ingredients (INCI) names for reporting and record keeping.
- Changes to the categorisation criteria to benefit:
 - soap makers
 - introducers of chemicals in flavour and fragrance blends
 - introducers of hazardous chemicals where introduction and use are controlled.
- Strengthening criteria and/or reporting requirements for health and environmental protection, for example, to prevent persistent organic pollutants (POPs) from being categorised as exempted or reported Introductions.

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None of the proposals involve changes to the Industrial Chemicals Act 2019. Proposals that would benefit introducers are based on mechanisms that may lower regulatory burden while maintaining regulatory intent.

Public comment period closes **9 November 2023**

[Read More](#)

AICIS, 15-09-23

<https://www.industrialchemicals.gov.au/news-and-notice/have-your-say-changes-categorisation-reporting-and-record-keeping>

AMERICA

Addition of Diisononyl Phthalate (DINP) Category; Community Right-to-Know Toxic Chemical Release Reporting

2023-08-14

On September 5, 2000, in response to a petition filed under EPCRA, EPA issued a proposed rule to add the DINP category to the list of toxic chemicals subject to the reporting requirements under EPCRA and the Pollution Prevention Act (PPA). EPA proposed to add this chemical category to the EPCRA toxic chemical list based on its preliminary conclusion that this category met the EPCRA toxicity criterion. EPA updated its hazard assessment for DINP and proposed to add DINP as a category defined to include branched alkyl di-esters of 1,2-benzenedicarboxylic acid in which alkyl ester moieties contain a total of nine carbons. In 2022, EPA issued a supplemental proposal to add the DINP category to the toxic chemical list based on hazard concerns described in the updated hazard assessment and requested comment on the updated DINP hazard assessment and associated updated economic analysis. EPA is considering the public comments received and next steps for this rulemaking. EPA intends to issue a final rule in August 2023.

[Read More](#)

The National Law Review, 14-08-23

<https://www.natlawreview.com/article/epa-s-spring-2023-unified-agenda-includes-proposed-and-final-tsca-and-tri-rules>

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PFAS Regulation in water supplies to affect Dallas and Fort Worth

2023-09-01

The federal government is planning much higher treatment standards for public water supplies because of chemicals known as PFAS.

The potentially cancer-causing chemicals have not been regulated in water supplies in the past.

They are known as “forever” chemicals because they linger indefinitely in water, ground and air.

Both the Dallas and Fort Worth water have tested positive for PFAS levels above the proposed U.S. Environmental Protection Agency regulation threshold.

Read More

NBC, 01-09-23

<https://www.nbcdfw.com/news/local/pfas-regulation-in-water-supplies-to-affect-dallas-and-fort-worth/3328946/>

Changes to Reporting Requirements for PFAS and to Supplier Notifications for Chemicals of Special Concern; Community Right-to-Know Toxic Chemical Release Reporting

2023-08-23

EPA is considering comments to its proposal to add PFAS subject to reporting under EPCRA and the PPA pursuant to the NDAA to the list of Lower Thresholds for Chemicals of Special Concern (chemicals of special concern). The addition of these PFAS to the list of chemicals of special concern will cause such PFAS to be subject to the same reporting requirements as other chemicals of special concern (i.e., it would eliminate the use of the de minimis exemption and the option to use Form A and would limit the use of range reporting for PFAS). According to EPA, “[r]emoving the availability of these burden-reduction reporting options will result in a more complete picture of the releases and waste management quantities for these PFAS.” In addition, EPA proposed to remove the availability of the de minimis exemption for purposes of the Supplier Notification Requirements for all chemicals on the list of chemicals of special concern. This change will help ensure that purchasers of mixtures

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and trade name products containing such chemicals are informed of their presence in mixtures and products they purchase. EPA submitted a proposed rule to OMB for review on August 7, 2023. EPA intends to issue a final rule in November 2023. More information on the proposed rule is available in our December 7, 2022, memorandum.

Read More

The National Law Review, 14-08-23

<https://www.natlawreview.com/article/epa-s-spring-2023-unified-agenda-includes-proposed-and-final-tsca-and-tri-rules>

Implementing Statutory Addition of Certain PFAS to the TRI Beginning with Reporting Year 2023

2023-08-14

On December 20, 2019, the NDAA was signed into law. Among other provisions, Section 7321 provides a framework for PFAS to be added automatically to the TRI list on January 1 of the year following certain EPA actions. This final rule will amend the EPCRA regulations to reflect the statutory addition of the PFAS that were automatically added to the TRI list pursuant to the NDAA and are subject to TRI reporting for Reporting Year 2023. EPA published a final rule on June 23, 2023. More information is available in our June 26, 2023, blog item.

Read More

The National Law Review, 14-08-23

<https://www.natlawreview.com/article/epa-s-spring-2023-unified-agenda-includes-proposed-and-final-tsca-and-tri-rules>

WVDEP Notifies Facilities of PFAS Reporting Requirements

2023-09-11

At the end of August 2023, the West Virginia Department of Environmental Protection (WVDEP) began sending letters to facilities that the agency believes may be subject to new requirements to report production or use of specific per- and polyfluoroalkyl substances (PFAS). The requirements are included in the recently passed House Bill 3189, also known as the PFAS Protection Act (“the Act”), which Governor Jim Justice signed into law on March 28, 2023.

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PFAS have been linked to effects on the human immune system, cardiovascular problems, and cancer. They are often referred to as “forever chemicals” because of their persistence in the environment and tendency to accumulate in people and animals over time. Broadly, the Act is intended to identify sources of PFAS that are impacting drinking water sources in West Virginia.

WVDEP's recent form letter notifies recipients that under the Act, facilities that discharge to surface water under an applicable National Pollution Discharge Elimination System (NPDES) permit or to a Publicly Owned Treatment Works (POTW) under an industrial pretreatment program, “which manufacture or knowingly use or have used” certain PFAS in their production process since January 1, 2017, are required to report such use to WVDEP on or before December 31, 2023. Specifically, the Act requires that these facilities report any PFAS that the United States Geological Service (USGS) found in its recent study of raw water from 279 West Virginia public water systems. Under the Act, facilities are also required to report their use of other PFAS that WVDEP identifies as harmful to human health and potentially present in detectable levels in West Virginia waters.

[Read More](#)

The National Law Review, 11-09-23

<https://www.natlawreview.com/article/wvdep-notifies-facilities-pfas-reporting-requirements>

EUROPE

New EU active substance non-renewal decision

2023-09-14

Biocidal products must be phased off the NI market

Following evaluation under the EU BPR, a decision has been taken not to renew the following active substance approval. This affects NI:

- Acrylaldehyde (Acrolein) (CAS 107-02-8 EC 203-453-4) in product type 12

Along with the non-renewal, Implementing Decision (EU) 2023/1423 repeals the previous decision on the postponement of the expiry date for acrolein.

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If you hold an affected EU BPR product authorisation or Control of Pesticides Regulations (COPR) product approval, we will contact you about cancelling or revoking your authorisation or approval. You will have an opportunity to submit comments or additional information and we will take account of these when finalising our decision.

If you are aware of any disproportionate negative impacts that are likely to arise from the non-renewal of any of the active substance/product type combinations listed above, please contact us.

[Read More](#)

HSE, 14-09-23

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

New EU active substance approval decisions

2023-09-14

Apply for product authorisation by the deadline to keep your products on the NI market

Following evaluation under the EU BPR, a decision has been taken to approve the following active substance/product type combinations. This will affect NI:

- Chrysanthemum cinerariaefolium, extract from open and mature flowers of Tanacetum cinerariifolium obtained with supercritical CO₂ (CAS 89997-63-7 EC 289-699-3) in product type 18
- Chrysanthemum cinerariaefolium, extract from open and mature flowers of Tanacetum cinerariifolium obtained with hydrocarbon solvents (CAS 89997-63-7 EC 289-699-3) in product type 18

Action for biocidal product suppliers

If you supply biocidal products containing these active substances in the relevant product types, you must apply for EU BPR product authorisation by 1 February 2025 to keep them on the NI market. New products (including new trade names) must not be supplied in NI until product authorisation is granted.

Action for active substance suppliers

If you supply these active substances for use in biocidal products of the relevant product types, you may need to apply for technical equivalence. If you haven't demonstrated technical equivalence for your manufacturing

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source, EU BPR product authorisation cannot be granted for biocidal products containing your active substance.

[Read More](#)

HSE, 14-09-23

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

Upcoming EU active substance approval dates

2023-09-14

Apply for product authorisation by the deadlines to keep your products on the NI market

The following EU BPR active substance approval dates are coming up:

- L-(+)-lactic acid (CAS 79-33-4 EC 201-196-2) in product type 06
1 November 2023
- Chrysanthemum cinerariaefolium, extract from open and mature flowers of Tanacetum cinerariifolium obtained with hydrocarbon solvents (CAS 89997-63-7 EC 289-699-3) in product type 19
1 February 2024
- Chrysanthemum cinerariaefolium, extract from open and mature flowers of Tanacetum cinerariifolium obtained with supercritical CO₂ (CAS 89997-63-7 EC 289-699-3) in product type 19
1 February 2024
- N,N-Didecyl-N,N-dimethylammonium chloride (Didecyldimethylammonium chloride) (DDAC) (CAS 7173-51-5 EC 230-525-2) in product types 01 and 02
1 February 2024

If you supply biocidal products containing these active substances in the relevant product types, don't forget to apply for EU BPR product authorisation by the dates above to keep them on the Northern Ireland market.

[Read More](#)

HSE, 14-09-23

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

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INTERNATIONAL

Microsoft Is Using a Hell of a Lot of Water to Flood the World With AI

2023-09-11

As artificial intelligence is increasingly developing and data centers are erected to further this tech, it's becoming clear that AI has a water usage problem.

Microsoft's latest sustainability report revealed that the software giant's water usage saw a tremendous spike between 2021 and 2022. In 2021, the company used up 4,772,890 cubic meters of water. In 2022 that went up to 6,399,415—which is around a 30 percent increase from one year to the next. That's almost 1.7 billion gallons of water in just one year, which is enough to fill more than 2,000 Olympic-sized swimming pools.

Why did Microsoft draw so much freaking water? Data centers that run AI supercomputers are hot. Equipment heats up, and if a center overheats, those computers can shut down. The increase in water use is directly tied to the company's investment and development of AI. Microsoft has backed OpenAI, which has a data center in Des Moines, Iowa. During the summer months, the center has to use a ton of water to keep equipment cool, especially as Iowa experiences rising temperatures due to climate change.

[Read More](#)

Gizmodo, 11-09-23

<https://gizmodo.com/microsoft-water-usage-ai-iowa-data-center-1850826419>

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REACH Update

SEP. 22, 2023

Advice on enforceability on restricting creosote now available

2023-09-13

ECHA/NR/23/22

ECHA's Enforcement Forum has started to publish its advice on enforceability of REACH restrictions.

Helsinki, 13 September 2023 – To improve transparency of the legislative process, the Forum decided to make its advice on enforceability of REACH restriction proposals public. The Forum advice will from now on be available on ECHA's website.

The first published advice is on the proposal to restrict creosote and related substances in treated wood. The Forum considers that the proposed restriction has clear scope and is enforceable but recommends some changes, such as setting a limit value and clarifications to the wording of the restriction.

ECHA's Committees for Risk Assessment (RAC) and for Socio-Economic Analysis (SEAC) will use the Forum's views in their opinion making. The advice is shared, together with the Committees' final opinion, with the European Commission to support their decision making.

Background

The Enforcement Forum provides advice on the enforceability of REACH restriction proposals, to help the evaluation and decision-making of restriction proposals. The aim is to ensure that the EU Member States' authorities will be able to enforce the restrictions after they enter into force.

Read More

ECHA, 13-09-23

<https://echa.europa.eu/-/advice-on-enforceability-on-restricting-creosote-now-available>

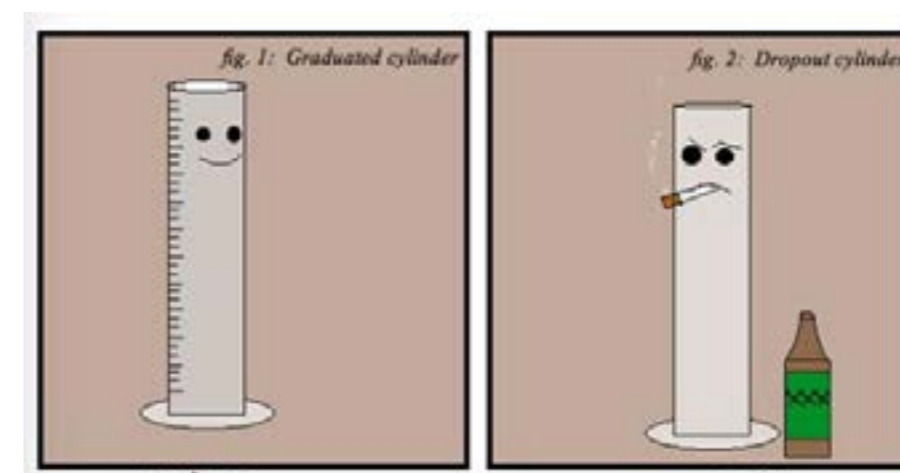
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Janet's Corner

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Graduated Cylinder

2023-09-22



<https://www.chemistryjokes.com/wp-content/uploads/graduated-cylinder.jpg>

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Hazard Alert

SEP. 22, 2023

Methyl Isocyanate

2023-09-22

USES [2,3]

Methyl isocyanate is used in the chemical industry to produce a number of important chemicals. It is also involved in the manufacture of synthetic rubbers, adhesives, herbicides and pesticides.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

- Methyl isocyanate has been found in the smoke from tobacco, so people who smoke or breathe second-hand smoke may be exposed to this compound.
- You can be exposed to methyl isocyanate by breathing or touching it at workplaces where this compound is produced or used.
- People living near facilities, which manufacture, store or use the chemical may breathe in low levels of it.

Routes of Exposure

- **Inhalation:** Inhalation is the major route of exposure to methyl isocyanate. The vapours are readily absorbed through the lungs. The odour threshold is approximately 100 to 250 times higher than the OSHA PEL-TWA (0.02 ppm). Significant exposures to methyl isocyanate occur primarily in occupational settings.
- **Skin/Eye Contact:** Direct contact with liquid or concentrated vapours of methyl isocyanate. This would not likely occur outside an occupational environment in which methyl isocyanate is stored or used.
- **Ingestion:** Although unlikely, ingestion of liquid methyl isocyanate is a possible route of exposure.

HEALTH EFFECTS [4]

Acute Health Effects

- In 1984, in Bhopal, India, an accidental Union Carbide gas leak of methyl isocyanate resulted in the deaths of more than 2,000 people and adverse health effects in greater than 170,000 survivors. Pulmonary oedema was the cause of death in most cases, with

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Hazard Alert

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many deaths resulting from secondary respiratory infections such as bronchitis and bronchial pneumonia.

- Other effects noted from acute inhalation exposure to methyl isocyanate in humans are respiratory tract irritation, difficulty breathing, blindness, nausea, gastritis, sweating, fever, chills, and liver and kidney damage. Survivors continue to exhibit damage to the lungs (e.g., bronchoalveolar lesions and decreased lung function) and the eyes (e.g., loss of vision, loss of visual acuity, and cataracts).
- Animal studies have reported pulmonary oedema, upper respiratory tract irritation, respiratory lesions, and weight loss from acute inhalation exposure to methyl isocyanate.
- Acute animal tests in rats have shown methyl isocyanate to have extreme acute toxicity from inhalation exposure and high acute toxicity from oral exposure.

Carcinogenicity

- No information is available on the carcinogenic effects of methyl isocyanate in humans.
- In a study in which animals were exposed once by inhalation, no tumours were significantly associated with methyl isocyanate exposure in mice and female rats; male rats had marginally increased rates of tumours of the pancreas. (2)
- EPA has classified methyl isocyanate as a Group D, not classifiable as to human carcinogenicity.

Other Effects

- After the Bhopal, India, accident, an unusually high percentage of survivors had disorders of the reproductive system, including leukorrhoea, pelvic inflammatory disease, excessive menstrual bleeding, and suppression of lactation.
- Other adverse effects included increases in the number of stillbirths, spontaneous abortions, and increased infant mortality.
- Animal studies have reported increased incidence of foetal deaths and decreased fertility, live litter size, foetal body weight, and neonatal survival following inhalation exposure to methyl isocyanate during pregnancy.

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SAFETY

First Aid Measures [5]

Respiratory distress/asthma: If the person is experiencing difficulty in breathing, the following steps should be followed as this condition may develop rapidly into a life-threatening situation:

- Remove the patient from the contaminated area and give them oxygen.
- If breathing has stopped, initiate artificial respiration.
- If first aid or nursing personnel are present and have received appropriate training, they may administer a bronchodilating drug such as salbutamol by nebuliser.

Seek medical attention urgently.

Splashes of isocyanate into eyes: Gently irrigate the eyes with a continuous stream of tepid water for at least 15 minutes. If contact lenses are worn, then irrigate the eyes thoroughly for a few minutes, remove the contact lenses and then continue with further eye irrigation. Refer the patient to a doctor or hospital.

Splashes onto skin: Remove contaminated clothing. Wash skin thoroughly with soap and water. Solvents, for example, methylene chloride, should not be used to remove isocyanates or polyurethane from the skin. Clothing should not be re-used until it has been decontaminated.

Workplace Controls & Practices [4]

Where there is a likelihood of worker exposure to isocyanates, steps should be taken to minimise that exposure. A thorough examination of work practices is essential. Procedures should be adopted to ensure that workers are not exposed to an extent likely to cause adverse health effects. Control measures include, but are not limited to, the following, which are ranked in priority of their effectiveness:

- elimination/substitution and process modification;
- engineering controls;
- administrative controls; and
- use of personal protective equipment.

Personal Protective Equipment [5]

In certain circumstances, personal protection of the individual employee is necessary. Personal protective devices should be regarded as being

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supplementary to substitution and engineering control and should not be used in preference to them as they do nothing to eliminate the hazard. However, in some situations, minimising exposure to isocyanates by enclosure and ventilation is not possible, particularly during on-site mixing of paints, spray-painting, foaming and maintenance of machine and ventilation systems. In these situations, air-line respirators or self-contained breathing apparatus complying with Australian Standard AS 1716 must be

used. The selection, use and maintenance of personal respiratory protective devices should be in accordance with the requirements of Australian Standard AS 1715. Organic vapour respirators with particulate pre-filters and powered, air-purifying respirators are not suitable. Personal protective equipment must be appropriately selected, individually fitted and workers trained in their correct use and maintenance. Personal protective equipment must be regularly checked and maintained to ensure that the worker is being protected. Air-line respirators or self-contained breathing apparatus complying with Australian Standard AS 1716 should be used during the clean-up of spills and the repair or clean-up of contaminated equipment and similar situations which cause emergency exposures to hazardous atmospheric concentrations of isocyanate. Eye and skin contact with isocyanates should be avoided. Particular attention should be given to personal protective equipment being resistant to isocyanates, for example, teflon, viton, nitrile rubber and some PVA gloves. Protective gloves and overalls should be worn as specified in Australian Standard AS 2161. Contaminated garments should be removed promptly and should not be re-used until they have been decontaminated.

REGULATION

United States

OSHA: The United States Occupational Safety & Health Administration has set the following Permissible Exposure Limit (PEL) for methyl isocyanate:

- General Industry: 0.02 ppm, 0.05 mg/m³ (Skin)
- Construction Industry: 0.02 ppm, 0.05 mg/m³ TWA (Skin)

ACGIH: The American Conference of Governmental Industrial Hygienists set a Threshold Limit Value (TLV) for methyl isocyanate of 0.02 ppm, 0.047 mg/m³ TWA (Skin)

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NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for methyl isocyanate of 0.02 ppm TWA (Skin)

REFERENCES

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Gossip

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The Body's Own Cannabinoids May Help Us Respond to Stress

2023-09-12

A new study has uncovered how circuits within the brain work to produce the body's own cannabinoids in order to cope with stressful experiences. The research, which opens up new possibilities for the development of drugs for stress-related psychiatric disorders, is published in Cell Reports.

The relationship between stress and psychiatric conditions

Stress can increase the risk of developing or worsening psychiatric conditions, such as anxiety, major depressive disorder (MDD) or post-traumatic stress disorder (PTSD).

However, the brain can release chemical signals to help us cope with stressful experiences. Our brains can even produce molecules, known as endocannabinoids, that activate the same brain receptors stimulated by tetrahydrocannabinol (THC) from cannabis plants. The endocannabinoid system has been implicated in stress adaptation and fear responses, but until now, the exact mechanisms were not well understood.

Studies in humans and rodents have linked endocannabinoid signaling between the amygdala – a key emotional processing region in the brain – and the hippocampus – involved in learning and memory – in fear learning and stress-related states such as PTSD, while also suggesting that endocannabinoids play a role in resilience to stress.

“We showed almost 20 years ago that these endogenous cannabinoids were made upon stress exposure in mice, but these were crude measurements and lacked temporal and synaptic precision,” said Dr. Sachin Patel, senior author of the study and professor of psychiatry and behavioral sciences at Northwestern University, speaking to Technology Networks. “We did not know the types of brain activity required for the release of these molecules because we did not have the tools.”

Patel and colleagues have uncovered the underlying mechanisms of these brain circuits in an effort to study these connections in more detail, potentially aiding future drug development to treat stress-related psychiatric disorders by targeting the endocannabinoid system.

Monitoring endocannabinoids and stress responses

To understand more about how endocannabinoid release influences the brain's circuitry, the researchers used a new protein sensor developed

Stress can increase the risk of developing or worsening psychiatric conditions, such as depression or PTSD.

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by study co-author Dr. Yulong Li, allowing them to detect the release of endogenous cannabinoids in the brain in real time.

“This tool allowed us to make several new discoveries,” explained Patel. “First, we defined the patterns of neuronal activity patterns that are required for the production of endogenous cannabinoids from the amygdala. Second, we showed that various types of stress cause increases at a specific synaptic input to the amygdala.”

Additionally, genetically removing the receptor that receives the endocannabinoid signal in mice decreased the animals’ ability to cope with stressful experiences. This was evidenced by reduced “struggle” behaviors while restrained and reduced mobility during tail suspension tests – in which mice were suspended by their tails for six minutes while connected to a force meter – and forced swim tests – in which they were placed under observation in a two-liter beaker of cold water for five minutes.

“The brain produced endogenous cannabinoid molecules when brain cells are highly active, like during stress exposure. When the receptor for these endogenous cannabinoids is removed from a specific brain connection, mice show more severe behavioral deficits after stress exposure,” added Patel.

These mice were also less likely to drink sweetened water after their stress exposure, a behavioral observation likened to anhedonia, a decrease in pleasure sometimes experienced by people affected by depression or PTSD.

Potential for treating stress-related disorders

“Using these new protein sensors to understand other situations when these endogenous cannabinoids are produced by the brain is critically important and not well understood. Understanding more about the specific types of cells that produce these molecules and cells that respond to these cannabinoids is also important,” said Patel.

Overall, the study supports the hypothesis that endogenous cannabinoids are the body’s natural coping response to stress, suggesting that the endocannabinoid system could be a promising candidate for drug development.

“If correct, that impairing the function of endogenous cannabinoids worsens the consequences of stress, perhaps increasing production of

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these cannabinoids could be used to treat stress-related disorders,” Patel explained. “Clinical studies remain to be completed.”

Technology Networks, 12 September 2023

<https://technologynetworks.com>

Chemical oscillator’s tick-tock action catalyses reaction regular as clockwork

2023-09-18

‘Catalysis and oscillations are two essential processes occurring in living cells,’ says Syuzanna Harutyunyan at the University of Groningen in the Netherlands who led the study. ‘We have successfully coupled these two processes for the first time in a synthetic system to build a catalytically active oscillator.’ Although oscillating reactions are common in many important biological processes, including cell division and heartbeat regulation, the development of synthetic oscillators with additional functions has remained a challenge.

‘Examples where one of the oscillating species is an organocatalyst didn’t exist,’ notes Harutyunyan. She explains that the main problem with introducing a secondary function into an oscillator is that the components of the oscillator must participate in the new function without compromising its role as a timekeeper. ‘We reasoned that if the secondary function is catalysis, this should be possible because the oscillator component is involved in the secondary function transiently.’

The team designed a modular system composed of simple and easily tuneable reactions and realised the arrangement through mechanistic analysis, kinetic studies and computer simulations. ‘Joining forces with the group of Wilhelm Huck was essential to quickly find the oscillatory conditions for our system,’ says Harutyunyan.

‘Our oscillator is based on autocatalytic 9-fluorenylmethoxycarbonyl (Fmoc) deprotection and acetylation reactions,’ adds Matthijs ter Harmsel, who constructed the catalytic oscillator. ‘By placing these reactions in a flow and tuning the conditions, we can make the system oscillate.’

Irving Epstein from Brandeis University in the US, who wasn’t involved in the study, explains that in the new oscillator, piperidine acts as a catalyst for several reactions. ‘The researchers show that when the substrates of a reaction catalysed by piperidine are introduced into their system, products

A piperidine-based oscillator has been made that can catalyse an independent reaction periodically without losing its oscillating properties.1 The discovery could be used to construct complex networks of reactions that would otherwise interfere with one another, opening new opportunities in chemical synthesis.

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are generated in an oscillatory fashion, and the features of the oscillation – period and amplitude – are only slightly perturbed,’ he says.

The scientists monitored the concentrations of the oscillator components using in situ IR spectroscopy and observed that the catalyst was only available in bursts roughly every two hours depending on the concentration of the piperidine. ‘We realised that we could use that to obtain selectivity in a mixture of reactants,’ notes ter Harmsel. To test this, the team carried out experiments using two different substrates for the Knoevenagel condensation – a modification of the aldol reaction – and found that only the more reactive substrate was converted during the concentration peaks of the catalysts.

‘The catalytically active oscillator promotes time-synchronised chemical reactions, improving product purity by suppressing slow competing reactions as products form and stopping degradation reactions after high levels of the desired product appear,’ comments Alexander Scheeline from the University of Illinois at Urbana-Champaign in the US. ‘There has been interest in using oscillating reactions for improved chemical synthesis for some time, but this work is – to my knowledge – the first where useful improvements were actually achieved,’ he adds.

Sergey Semenov at the Weizmann Institute of Science in Israel points out that the new findings demonstrate that the principles for designing oscillators using two inhibitors that were outlined by him and his colleagues in 2016 for the chemistry of thiols² can be applied to other chemistries. ‘Now, oscillations have been coupled to organocatalytic reactions,’ he says. ‘An exciting new step could be the coupling of oscillations to transition-metal catalysed reactions.’

Harutyunyan believes that the modular approach could also be used to make other amine-based oscillators. ‘Provided the amines are basic enough to perform autocatalytic deprotection of their Fmoc-protected counterparts,’ she notes. ‘Using the general design principles presented in our work, it should be possible, in theory, to take any known catalyst and build an oscillator around it.’ But the limiting factor is that you need an autocatalytic reaction, she adds. ‘If we want to go beyond catalytic oscillators operating through a base/amine/enamine mechanism, we first have to develop new autocatalytic reactions.’

, 18 September 2023

<https://chemistryworld.com>

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Turning mixed plastic into useful chemicals

2023-09-20

The paper is published in the journal *Materials Horizons*.

The technology, invented by ORNL’s Tomonori Saito and former postdoctoral researcher Md Arifuzzaman, uses an exceptionally efficient organocatalyst that allows selective deconstruction of various plastics, including a mixture of diverse consumer plastics. Arifuzzaman, now with Re-Du, is a current Innovation Crossroads fellow.

Production of chemicals from plastic waste requires less energy and releases fewer greenhouse gases than conventional petroleum-based production. Such a pathway provides a critical step toward a net-zero society, the scientists said.

‘This concept offers highly efficient and low-carbon chemical recycling of plastics and presents a promising strategy toward establishing closed-loop circularity of plastics,’ said Saito, corresponding author of the study.

Phys Org, 20 September 2023

<https://phys.org>

A Blood Factor Can Rejuvenate the Aging Brain

2023-09-27

In a trio of papers published in *Nature*, *Nature Aging*, and *Nature Communications*, the researchers have revealed platelet factor 4 (PF4)—a type of blood cell normally responsible for blood clot formation—as a pivotal element contributing to cognitive enhancement.

Systemic administration of PF4 in aging mice reduced brain inflammation, improved brain cell connections, and boosted memory and thinking abilities.

‘PF4 actually causes the immune system to look younger, it’s decreasing all of these active pro-aging immune factors, leading to a brain with less inflammation, more plasticity and eventually more cognition. We’re taking 22-month-old mice, equivalent to a human in their 70s, and PF4 is bringing them back to function close to their late 30s, early 40s,’ said Saul Villeda, PhD, associate professor of anatomy at UCSF and senior author of the *Nature* study.

Villeda had previously discovered that injecting plasma from younger mice into aging animals improved their cognitive abilities and strengthened

Almost 80% of plastic in the waste stream ends up in landfills or accumulates in the environment. Oak Ridge National Laboratory scientists have developed a technology that converts a conventionally unrecyclable mixture of plastic waste into useful chemicals, presenting a new strategy in the tool kit to combat global plastic waste.

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their muscles—seemingly bringing back their youth. While taking a closer look at the plasma, his team discovered a much higher PF4 content in young plasma compared to that of the older mice. According to the researchers, injecting PF4 only had the same restorative effect as using whole plasma.

A second team of UCSF scientists discovered that after injection of the longevity protein klotho—associated with improved cognition in young and old animals—mice platelets also released PF4. The protein then proceeded to have positive effects on the brain region responsible for making memories, while simultaneously boosting performance of young and old mice in behavioral tests.

“Ideally, we’ll have multiple shots on goal for one of our biggest biomedical problems, cognitive dysfunction, with the fewest side effects and the most benefit,” said Dena Dubal, PhD, professor of Neurology at UCSF and senior author of the Nature Communications study.

The third team, led by Queensland Brain Research Institute research fellow Tara Walker, PhD, discovered that platelets released PF4 into the bloodstream following exercise. When testing PF4 on its own, similar to Dubal and Villeda’s experiments, the protein also improved cognitive abilities in old animals.

“For a lot of people with health conditions, mobility issues or of advanced age, exercise isn’t possible, so pharmacological intervention is an important area of research. We can now target platelets to promote neurogenesis, enhance cognition and counteract age-related cognitive decline,” Walker concluded in a press statement.

Inside Precision Medicine, 17 August 2023

<https://insideprecisionmedicine.com>

A mysterious blue molecule will help make better use of light energy

2023-09-19

Azulene has piqued the curiosity of chemists for many years. The question of why it is blue, despite there being no obvious reason for this, was answered almost 50 years ago by a scientist of global importance, who, coincidentally, had close ties with IOCB Prague, Prof. Josef Michl.

Now, Dr. Tomáš Slanina is following in his footsteps in order to offer his colleagues in the field the solution to another puzzle. He and his

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colleagues have convincingly described why the tiny azulene molecule violates the universal Kasha’s rule.

This rule explains how molecules emit light upon transitioning to various excited states. If we use the analogy of an ascending staircase, then the first step (the first excited state of the molecule) is high, and each subsequent step is lower and therefore closer to the previous one. The smaller the distance between the steps, the faster the molecule tends to fall from the step to lower levels. It then waits the longest on the first step before returning to the base level, whereupon it can emit light. But azulene behaves differently.

To explain the behavior of azulene, researchers at IOCB Prague used the concept of (anti)aromaticity. Again, simply put, an aromatic substance is not characterized by an aromatic smell but by being stable, or satisfied, if you will. Some chemists even refer to it informally with the familiar smiley face emoticon.

An antiaromatic substance is unstable, and the molecule tries to escape from this state as quickly as possible. It leaves the higher energy state and falls downward. On the first step, azulene is unsatisfied, i.e. antiaromatic, and therefore falls downward in the order of picoseconds without having time to emit light.

On the second step, however, it behaves like a satisfied aromatic substance. And that is important. It can exist in this excited state for even a full nanosecond, and that is long enough to emit light. Therefore, the energy of this excited state is not lost anywhere and is completely converted into a high-energy photon.

With their research, Slanina’s team is responding to the needs of the present, which seeks a way to ensure that the energy from photons (e.g., from the sun) captured by a molecule is not lost and that it can be further used (e.g., to transfer energy between molecules or for charge separation in solar cells).

The goal is to create molecules that manage light energy as efficiently as possible. Additionally, in the current paper, the researchers show in many cases that the property of azulene is transferable; it can be simply attached to the structure of any aromatic molecule, thanks to which that molecule gets the key properties of azulene.

Tomáš Slanina adds, “I like theories that are so simple you can easily envision, remember, and then put them to use. And that’s exactly what

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we've succeeded in doing. We've answered the question of why molecules behave in a certain way, and we've done it using a very simple concept."

In their research, the scientists at IOCB Prague used several unique programs that can calculate how electrons in a molecule behave in the aforesaid higher excited states. Little is known about these states in general, so the work is also groundbreaking because it opens the door to their further study. Moreover, the article published in JACS is not only computational but also experimental.

Researchers from Tomáš Slanina's group supported their findings with an experiment that accurately confirmed the correctness of the calculated data. They also collaborated with one of the world's most respected authorities in the field of (anti)aromatic molecules, Prof. Henrik Ottosson of Uppsala University in Sweden. And this is the second time JACS has taken an interest in their collaboration; the first time was in relation to research on another primary molecule—benzene.

Yet the story of azulene is even more layered. It concerns not only photochemistry but also medicine. Like the first area, the second also bears the seal of IOCB Prague—one of the first drugs developed in its laboratories was an ointment based on chamomile oil containing a derivative of azulene.

Over the decades, the little box labeled Dermazulen, which contains a preparation with healing and anti-inflammatory effects, has found its place in first-aid kits throughout the country.

Phys Org, 19 September 2023

<https://phys.org>

Electrochemical conversion of acids to alkenes achieved on kilogram scale

2023-09-19

Both carboxylic acids and olefins are important chemical feedstocks and a reliable method to interconvert them would be a valuable addition to the synthetic toolkit. Hydrocarboxylation reactions – converting an alkene to the corresponding acid – are well-established but the limited repertoire of efficient and practical oxidation conditions make the reverse transformation far more challenging. Electrolysis is one of the few oxidative strategies that can transform carboxylic acids into their corresponding reactive intermediates – the reaction liberates carbon

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dioxide to produce either a radical or carbocation and variants giving different products have been known for more than 150 years. The Kolbe electrolysis, for instance, forms a hydrocarbon dimer via a radical mechanism while the Hofer–Moest reaction proceeds via a carbocation to form an alcohol. In each case, the reaction conditions are harsh and the reactive intermediates require a stabilising activated or tertiary system, limiting both the scope and product profile of these electrochemical reactions.

However, Phil Baran and his team at the Scripps Institute, US have now harnessed this electrochemical oxidation mechanism under milder conditions to efficiently convert a broader range of carboxylic acids into alkene products. The team began with a modified electrochemical decarboxylation setup, using graphite electrodes and a base to favour their desired reaction pathway. 'The base is partially neutralising the carboxylic acid to generate a carboxylate anion, which is the suitable form to be electrochemically oxidised,' explains Yu Kawamata, who co-led the project. 'Then the carboxylate is oxidised on the anode surface, generating a carbocation intermediate which immediately loses a proton to form an olefin as the final product. A sacrificial protecting agent is also added to avoid over-oxidation of the olefin.'

Importantly, the team applied an alternating polarity in this setup. Electrolysis typically uses DC current but, surprisingly, this completely suppressed the decarboxylation reaction. Analysis through a series of mechanistic and cyclic voltammetry studies revealed that DC current causes a localised buildup of electrogenerated acid around the anode, hindering deprotonation of the carboxylic acid and meaning only activated substrates can produce a measurable quantity of decarboxylation product. 'By contrast, the alternating polarity cancels local acid accumulation by flipping the electrode polarity,' explains Kawamata. 'As a result, smooth decarboxylation sustains under these conditions, rendering the reaction much more general.'

With an optimised system established, the team were keen to investigate the performance of this reaction at an industrially-relevant scale. In partnership with process chemists at AbbVie, they adapted their lab-scale setup to a continuous stirred tank reactor, trialling the reaction first at 7g, then 28g and finally at 1kg. Each time, the reaction scaled smoothly and predictably and Baran and Kawamata are now working on optimising the process further for industrial applications and expanding the scope to tolerate more-challenging electron-rich functional groups.

A mild and scalable electrolysis of carboxylic acids can provide streamlined access to valuable alkene feedstocks at kilogram scale. Using rapidly alternating polarity (rAP), the team in the US were able to boost the reaction performance and simultaneously expand the scope of these traditionally harsh reaction conditions to include pharmaceutically-relevant functional groups.

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Timothy Noël, a chemical engineer at the University of Amsterdam in the Netherlands, was impressed by the team's results. 'I really like this concept of rAP which allows one to reach higher reaction selectivity and greater functional group tolerance than you normally expect. Another strong feature is the seamless scale up from laboratory to kilogram range,' he says. 'There are some limitations to the scope but essentially the scale up shows the value and robustness of the chemistry. This method will find its way both in academia and industry.'

Chemistry World, 19 September 2023

<https://chemistryworld.com>

Scientists Discover Cancer Protein Enhancing Anti-Tumoral Immune Response

2023-09-15

In recent years, Immune checkpoint inhibitors such as the anti-PD-L1 antibody nivolumab have become increasingly effective options for the treatments of several cancers. Unfortunately, in some cases a lack of stimulatory co-signals for T cells can lead to an unsuccessful immunotherapy outcome.

One important signal for T cell activation is the co-stimulatory protein CD58. By binding to its receptor on an immune cell, an inflammatory signal is received leading to an improved response against tumors. Reporting in *Cancer Cell*, researchers have now found a protein expressed on the membrane of cancer cells known as CMTM6 that is able to interact with and positively regulate CD58.

"It is intriguing to observe that many cancer cells inherently express CD58, a molecule that essentially contradicts their own survival when they come under immune attack. We therefore wanted to understand what controls the expression of CD58," said Chong Sun, PhD, immunologist at the DKFZ and co-author of the study.

According to the researchers, CMTM6 surprisingly also interacts with PD-L1—a T cell blocking receptor expressed on cancer cells targeted by most checkpoint inhibitor treatments. In the study CMTM6 protected PD-L1 from degradation while simultaneously stabilizing CD58.

"It is fascinating that CMTM6 controls two important players in our immune system, CD58 and PD-L1, even though they have opposing functions. And what is more interesting is that when we dive into the

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analysis of tumor samples from patients who received ICI therapies, it appears that CD58 might just take a leading role in shaping the response, in most cases," explained Beiping Miao, PhD, postdoctoral researcher at DKFZ and first-author of the study.

To further understand CD58's role in anti-tumor immunity, the scientists used a model of T-cell receptor (TCR) treatment in a cell culture dish. Using this model, they were able to show that a loss of CMTM6 impairs T cell activation suggesting the importance of the protein in immunity.

Using mice containing grafted human leukemia cells, the team also demonstrated that a lack of CMTM6 proteins, protected cancer cells from CAR-T therapy. In human cancer cells from tumor biopsies, the researchers observed widespread expression of both CMTM6 and CD58 proteins, with higher levels correlating to a better immunotherapy response.

"Our findings highlight the importance of CMTM6 and CD58 expression in cancer cells during an immune response against tumors. Our next step is to explore the possibility of adjusting their expression in laboratory experiments. Our goal is thereby finding a way to improve cancer immunotherapies," Sun concluded in a press statement.

Inside Precision Medicine, 15 September 2023

<https://insideprecisionmedicine.com>

Phosphorus-based nanotech rips apart superbugs & accelerates healing

2023-09-12

With the challenge posed by the rise of superbugs, we need to come up with novel ways of tackling wound infections. That need is thrown into sharp relief when you consider that around 70% of bacteria have developed resistance to at least one common class of antibiotic, and since 2000, only five new classes of antibiotics have been discovered.

Recently, researchers from RMIT University in Australia proposed a novel, drug-free method of preventing post-op infections in people receiving titanium implants. Now, they've teamed up with researchers from the University of South Australia to develop another innovation, using nano-sized flakes of black phosphorus to tackle wound infection caused by superbugs.

"Superbugs – the pathogens that are resistant to antibiotics – are responsible for massive health burdens, and as drug resistance grows, our

Researchers have found that using nano-sized flakes of black phosphorus on wounds infected with drug-resistant superbugs not only kills the pathogens, but also promotes wound healing. More than a coating, the innovative antimicrobial can be incorporated into common materials such as dressings, gels, and plastics.

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ability to treat these infections becomes increasingly challenging," said Aaron Elbourne, one of the study's co-authors.

Black phosphorus has recently been identified as an effective antimicrobial agent. It's the most stable physical form of phosphorus and consists of 2D layers of phosphorus (called 'phosphorene'), the same way that graphite comprises many graphene layers. In their previous work, the researchers demonstrated how black phosphorus arranged in nano-thin layers killed microbes by its unique ability to produce reactive oxygen species.

"As the nanomaterial breaks down, its surface reacts with the atmosphere to produce what are called reactive oxygen species," said Sumeet Walia, a co-author of the study. "These species ultimately help by ripping bacterial cells apart."

In the current study, the researchers tested the safety and efficacy of using black phosphorus nanoflakes (BPNFs) on common bacteria, including drug-resistant *S. aureus* ('golden staph'), *P. aeruginosa*, and *E. coli*.

S. aureus treated with BPNFs showed a 62% loss of cell viability within two hours, with an 80% loss of viability after six hours. After 24 hours, over 99% of bacteria were killed. A similar trend was seen with *P. aeruginosa*, with BPNFs causing over 80% bacterial death after 24 hours. Not only did the BPNFs destroy the bacteria without damaging other cells, but they also self-decomposed after the infection threat had been eliminated.

"Our antimicrobial nanotechnology rapidly destroyed more than 99% of bacterial cells – significantly more than common treatments used to treat infections today," Walia said.

When the researchers tested the effectiveness of BPNFs as against ciprofloxacin, a commonly used broad-spectrum antibiotic, on mouse wounds, they found that both were comparably effective at clearing *S. aureus*.

BPNFs also demonstrated enhanced wound healing and tissue regeneration at a macro- and microscopic level, compared to controls. Daily treatment with BPNFs over seven days produced an 80% wound closure, with no evidence of redness or skin breakdown.

The researchers concluded that the observed improvement in the degree of re-epithelialization – the creation of a barrier between wound and environment – suggested that BPNFs promote wound healing even when wounds are infected with a highly resistant *S. aureus* bacteria. While

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the antimicrobial properties of black phosphorus are known, its wound healing properties are not well documented.

"This is exciting as the treatment was comparable to the ciprofloxacin antibiotic in eradicating wound infection and resulted in accelerated healing, with wounds closing by 80% over seven days," said Zlatko Kopecki, corresponding author of the study. "We urgently need to develop new alternative non-antibiotic approaches to treat and manage wound infection. Black phosphorus seems to have hit the spot and we look forward to seeing the translation of this research towards clinical treatment of chronic wounds."

The appeal of BPNFs, say the researchers, is that they can be incorporated into a range of materials.

"The beauty of our innovation is that it is not simply a coating – it can actually be integrated into common materials that devices are made of, as well as plastic and gels, to make them antimicrobial," said Walia.

The research team is looking to collaborate with industry partners to develop and prototype the technology.

"If we can make our invention a commercial reality in the clinical setting, these superbugs globally wouldn't know what hit them," Elbourne said.

The study was published in the journal *Advanced Therapeutics*.

New Atlas, 12 September 2023

<https://newatlas.com>

Common sweetener now linked to impaired memory and learning

2023-09-19

Researchers at Florida State University (FSU) College of Medicine have found that male mice consuming aspartame at significantly lower levels than deemed safe by the Food and Drug Administration (FDA) passed on spatial learning and memory deficits to their offspring.

These hereditary signs were absent from a control group not exposed to aspartame.

The findings follow on from a 2022 study by the researchers that linked aspartame consumption to inherited anxiety-like behavior that spanned two generations.

Two months on from it being declared safe by the FDA, aspartame is again making headlines for the wrong reasons, this time for its potential negative impact on learning and memory.

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“There is some overlap in terms of learning, memory and anxiety, in the sense that often there is an emotional component to our learning,” said co-author Pradeep Bhide, from FSU’s Department of Biomedical Sciences. “When there’s an emotional impact, you remember better. But this is a quite distinct function and brain network.

“The second thing we noticed here, unlike the anxiety (research), this went only one generation,” he added. “It was not seen in the grandchildren, only in the children [of the male mice], which is another line of support that these kinds of transmissions occur due to epigenetic changes in the sperm.”

Over 16 weeks, one group of mice ingested water mixed with 7% of the FDA’s maximum intake of aspartame – equivalent to two 8-ounce (237-ml) diet sodas daily – and another was given a higher dose, 15%. The control, of course, consumed only water.

The mice were tested on different cognitive tasks in weeks four, eight and 12, with the final test requiring the animals to learn to find a “safe” escape box out of 40 choices in a circular space.

The aspartame-free control mice found the box fast; both the 7% and 15% aspartame group took much longer to learn the task at hand.

Then, when the males were bred with females who were not exposed to aspartame, both male and female offspring in the first generation has similar deficiencies in learning and memory.

“We’re seeing they use a different strategy, but they do find the escape box,” said co-author Deirdre McCarthy, from the Department of Biomedical Sciences and the Center for Brain Repair. “They compensate in some sort of way.”

“Again, they can function, but they need longer time, or may need extra help,” said Bhide.

The researchers hope to look into the aspartame-induced epigenetic changes in sperm. Interestingly, the learning and memory deficits were not passed on to a second generation of mice.

Earlier studies have linked aspartame to other health issues, including disruption to the gut microbiome, blood sugar regulation and weight gain.

In July, the cancer-research arm of the World Health Organization (WHO) officially named aspartame as possibly carcinogenic to humans, which the FDA challenged soon after.

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Aspartame was first approved for use in tabletop sweeteners in 1981, diet sodas in 1983 and in other products in 1996. It’s now used in more than 6,000 products across the globe, including in toothpaste and chewable vitamins.

The study was published in the journal Scientific Reports.

New Atlas,

<https://newatlas.com>

Molecule found that inhibits the spread of the cold sore virus

2023-09-11

Many adults are infected with herpes simplex virus type 1 (HSV-1), a lifelong condition that often manifests as annoying cold sores but has the potential, albeit rare, to lead to more serious brain or eye infections. Previous studies have presented evidence implicating the enzyme heparanase (HPSE) in the spread of HSV-1, other viruses, and cancer.

Heparan sulfate is present in the extracellular matrix (ECM) of every tissue and on the surface of pretty much every cell and is responsible for regulating cell to cell interactions and maintaining the health of the ECM. The only known enzyme capable of breaking down – or cleaving – heparan sulfate is HPSE. Normally, it does so in a controlled way, freeing molecules needed for biological processes elsewhere in the body. But heparan sulfate also plays a role in the cell entry and release of many viruses, including HSV-1, and the overexpression of HPSE and uncontrolled cleavage of heparan sulfate can result in abnormal cell activation and significant tissue damage.

Because of its role in assisting the spread of viruses and cancer, research has been focused on developing a means of inhibiting HPSE. Now, researchers led by the University of Illinois Chicago have identified a molecule that inhibits the spread of HSV-1, bringing us closer to an effective treatment against viruses and cancer.

“We showed the inhibitor working against the herpes virus, but it has the potential to be used in all kinds of diseases,” said Deepak Shukla, a corresponding author of the study.

In a previous study, the researchers identified how HSV-1 modulated the synthesis of heparan sulfate to optimize infection and virus spread. In the current study, they designed and synthesized different saccharides and

Researchers have developed a molecule that effectively inhibits an enzyme instrumental in spreading the herpes simplex virus in humans. They say their discovery could lead to a new treatment for herpes simplex infections and other viruses, as well as diseases that rely on this enzyme to spread, such as cancer.

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evaluated their ability to inhibit HPSE activity. Saccharides are the building units of carbohydrates that are classified by the number of monomers that comprise them. For example, combining two monosaccharides (simple sugars) creates a disaccharide, whereas oligosaccharides contain two to 10 simple sugars.

Because HSV-1 can cause ocular herpes or herpes keratitis, an infection of the eye's cornea, the researchers tested their various saccharides on human corneal epithelial cells infected with the virus. Administering the compounds before or at the same time as infection with HSV-1, they found that treatment with the hexa- and octasaccharides produced substantial reductions in the amount of extracellular virus in the samples and inhibited viral spread.

Examining the cells treated with these saccharides, the researchers observed substantially higher levels of surface heparan sulfate, similar to non-HSV-1-infected cells. They also found that the cells exhibited a significant increase in migration, indicating improved wound healing abilities that the researchers attributed to the antiviral activity of the hexa- and octasaccharides.

From their findings, the researchers concluded that the saccharide compounds had a dual mode of action, impeding the virus' entry to the cells as well as its release.

Because HPSE plays a role in the pro-survival activity of cells, previous attempts to develop an HPSE inhibitor have run into issues with toxicity. Here, the researchers found no evidence that the effective compounds were toxic to the corneal cells. Additionally, HPSE inhibitors are often a form of the drug heparin, which is used to prevent blood clotting, so they can cause bleeding. As the hexa- and octasaccharides used by the researchers don't contain the disaccharide unit critical for activating heparin's anticoagulant activity, bleeding was not a problem.

"Inhibition of HPSE in corneal cells is important for wound healing and modulation of ocular inflammation," said the researchers. "Collectively, these observations demonstrate that HPSE inhibitors can prevent viral release and subsequent spread to other cells and tissues."

The researchers say there's still work to be done before their HPSE inhibitor is ready for clinical use. Nonetheless, it's an important step towards developing a novel treatment for HSV-1, other viruses and cancer.

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The study was published in the journal *Angewandte Chemie*.

New Atlas, 11 September 2023

<https://newatlas.com>

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Curiosities

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Sustainable glue made from soy oil and tannin outperforms best commercial adhesives

2023-09-20

Most adhesives are made from petroleum products and are difficult to recycle. They don't break down in landfills and cannot be separated from the material sent for recycling. According to Jonathan Wilker, a chemist at Purdue University, a sustainable replacement needs to be cheap, suitable for mass production and made from plant products.

Wilker's lab took up this challenge and chose epoxied soy oil as the first ingredient because it is already available in industrial quantities as it's used to make polyvinyl chloride (PVC) for pipes and cables. Plus, epoxies are currently the best type of adhesive available. Epoxies work by combining epoxy containing compounds with a nucleophilic amine. This opens the epoxy rings, forms strong carbon–nitrogen bonds and creates a crosslinking matrix that binds materials. However, polyamines don't work with epoxied soy oil. Substitutes like carboxylic acids or alcohols also produced a viscous oil and not the strong crosslinked matrix needed for adhesion. A third ingredient was required. 'The answer to all questions of chemistry in our lab is add some catechol chemistry and it actually worked,' says Wilker.

Catechol is an organic compound that forms part of a protein mussels use to adhere to surfaces. As Hongbo Zeng, a chemist at the University of Alberta explains, catechols are excellent for adhesives because they form multiple types of bonds. 'They can form physical bonds because they have OH groups and they can form hydrogen bonding because they have aromatic rings,' he says.

To produce a sustainable adhesive Wilker's group turned to catechol-like phenolic compounds derived from plants. 'The epoxied soy oils are locked in and then we'll pick one compound from a group that's acids or alcohols, something that reacts with the epoxy groups,' he explains, 'and then another group is some phenolic.'

Experiments found that combining malic acid and tannin, a polyphenol from woody plants, with the epoxied soy oil performed best. Testing against commercially available adhesives found the 'soy–mal–tan' adhesive was just as strong or stronger on a variety of surfaces including polished aluminium and steel, Teflon, wood and PVC.

Herbert Waite, a chemist at the University of California, Santa Barbra, says the study is 'a good example of how to think about the logistics of

A new sustainably sourced adhesive produced using soy oil and other plant-derived ingredients performed as well or better than the best commercially available petroleum-based options like epoxy resins.

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replacing a consumer product with a green alternative'. But cautioned further testing is needed for specific use cases. 'Anything to do with catechols or pyrogallols is highly prone to oxidation, and oxidation leads to brittleness and delamination – not acceptable outcomes for many applications,' he adds. Zeng agreed that optimisation is needed, noting the adhesive worked best when cured for 24 hours at 180°C, not ideal conditions for many applications.

The group did test practical applications like water resistance finding the adhesive was water resistant but could be loosened over time when submerged at higher (70°C or 180°C) temperatures. Again, further optimisation could produce adhesives that are degradable for recycling.

Wilker is confident the adhesive is optimisable and scalable due to the many combinations of oil, acid and polyphenols available. He adds that his group's work shows that sustainable adhesives are possible and that others can now build on this work.

ChemistryWorld, 20 September 2023

<https://chemistryworld.com/a>>

MDMA Helps To Reduce PTSD Symptoms in Confirmatory Clinical Trial

2023-09-19

Findings from a new confirmatory clinical trial have shown the potential for 3,4-methylenedioxymethamphetamine (MDMA) therapy in reducing post-traumatic stress disorder (PTSD) symptoms. The research, which builds upon previous studies by using a more diverse patient population, is published in Nature Medicine.

Exploring new therapies for PTSD

PTSD is a psychiatric disorder that affects 5% of the US population each year. It can arise after experiencing stressful and traumatic events, causing symptoms including flashbacks, nightmares and anxiety.

Treatments for PTSD largely consist of psychological therapies such as cognitive behavioral therapy and medications such as selective serotonin reuptake inhibitors (SSRIs). However, approximately 35–47% of patients do not respond to treatment with sertraline and paroxetine, two common SSRIs approved by the FDA to treat PTSD.

MDMA, also known as ecstasy, has shown promise in reducing the severity of PTSD symptoms in previous clinical trials.

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Given the complexity of the condition and the limitations of existing treatments, new therapies are needed to combat PTSD, particularly for diverse populations and racial minorities who are at a disproportionately higher risk of the disorder.

MDMA, also known as ecstasy, has shown promise in reducing the severity of PTSD symptoms in previous trials. This comes amid the growing momentum of psychedelics in clinical trials for psychiatric conditions. In the current study, researchers carried out a multi-site, confirmatory trial to evaluate the efficacy of MDMA further and investigate its effects in a more diverse patient population.

Clinically meaningful improvements

The Phase 3 randomized clinical trial aimed to test the efficacy and safety of MDMA and psychotherapy (53 patients) in comparison to placebo with psychotherapy (51 patients) for people with moderate to severe PTSD.

Of the 104 patients in the study, 28 (26.9%) identified as Hispanic/Latino and 35 (33.7%) identified as other than White.

The patients took part in three separate eight-hour dosing sessions one month apart, during which they received either MDMA or a placebo alongside therapy.

The efficacy of the treatment was measured using a scale called CAPS-5 (clinician-administered PTSD scale) used by doctors to assess the severity of PTSD symptoms.

The findings revealed that 86.5% of MDMA-treated patients experienced a clinically meaningful improvement after 18 weeks (defined as a ≥ 10 -point reduction in their CAPS-5 score) compared to 69% in the placebo group.

Additionally, 71.2% of MDMA-treated patients no longer met the criteria for PTSD at the end of the study, compared to 48% of patients who received the placebo.

Technology Networks, 19 September 2023

<https://technologynetworks.com>

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“Inverse vaccine” reverses autoimmune diseases like MS, diabetes & arthritis

2023-09-18

Normally, a vaccine teaches the body's immune system to recognize a viral or bacterial invader as an enemy that needs to be destroyed. Now, researchers from the University of Chicago have created an “inverse vaccine” that does the opposite.

The novel vaccine removes the immune system's memory of one molecule, which, when fighting pathogens, would be undesirable but, in the context of autoimmune diseases, may prove to be a cure.

It's the job of the immune system's T cells to recognize specific foreign antigens on the surfaces of unwanted cells and launch an attack against them. However, T cells can sometimes get it wrong. In the case of autoimmune diseases like multiple sclerosis (MS), type 1 diabetes, and rheumatoid arthritis, the T cells become self-reactive, mistakenly considering healthy organs and tissues to be foreign organisms.

The researchers were aware of the importance of the liver in mediating local and systemic tolerance to self-antigens and foreign antigens. They exploited the organ's natural mechanism of marking molecules from broken down cells with a 'do not attack' flag to prevent autoimmune reactions to cells that die by natural processes. By coupling an antigen with a molecule resembling a fragment of an aged cell, the liver recognized it as a friend rather than an enemy.

“In the past, we showed that we could use this approach to prevent autoimmunity,” said Jeffrey Hubbell, a corresponding author of the study. “But what is so exciting about this work is that we have shown that we can treat diseases like multiple sclerosis after there is already ongoing inflammation, which is more useful in a real-world context.”

The liver's role in ‘peripheral immune tolerance,’ a mechanism whereby self-reactive T cells are deleted or become anergic (functionally unresponsive to antigens), prevents the body from mounting an inappropriate immune response. In previous studies, the researchers had discovered that tagging molecules with a sugar known as N-acetylgalactosamine (pGal) mimicked this process, sending the molecules to the liver where tolerance to them developed.

“The idea is that we can attach any molecule we want to pGal, and it will teach the immune system to tolerate it,” said Hubbell. “Rather than rev up

Researchers have developed an “inverse vaccine” that reverses the damage caused when the immune system mistakenly attacks the body's healthy organs and tissues in autoimmune diseases like multiple sclerosis, type 1 diabetes and rheumatoid arthritis. It could pave the way to a treatment for these diseases that doesn't require suppressing the entire immune system.

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immunity as with a vaccine, we tamp it down in a very specific way with an inverse vaccine.”

In the current study, the researchers focused on a mouse model with MS-like disease, in which the immune system attacks myelin, the insulating sheath around nerves. They linked myelin proteins to pGal and tested the effect of the inverse vaccine and found the immune system stopped attacking myelin, allowing the nerves to function properly and reversing the symptoms of disease.

Currently, autoimmune diseases are generally treated with immunosuppressant drugs that inhibit the entire immune system, which is not ideal.

“These treatments can be very effective, but you’re also blocking the immune responses necessary to fight off infections, and so there are a lot of side effects,” Hubbell said. “If we could treat patients with an inverse vaccine instead, it could be much more specific and lead to fewer side effects.”

Phase 1 clinical trials are underway to evaluate the safety of the treatment in people with multiple sclerosis.

“There are no clinically approved inverse vaccines yet, but we’re incredibly excited about moving this technology forward,” said Hubbell.

New Atlas, 18 September 2023

<https://newatlas.com>

Rise of “Hypervirulent” Strains of *Klebsiella pneumoniae* Investigated

2023-09-20

“Hypervirulent” strains of the bacteria which cause severe infections, and their multidrug-resistant cousins, are beginning to evolve together, which has raised public health concerns. Now a team of Hackensack Meridian Center for Discovery and Innovation (CDI) scientists have partnered with colleagues at the National Institutes of Health’s National Institute of Allergy and Infectious Disease (NIAID) in a study which shows which strains are more likely to survive in human blood and serum - and which are more susceptible to the human immune system. The study was published in mBio.

A vaccine approach could be feasible to combat the new threat of “Hypervirulent” strains of *Klebsiella pneumoniae*.

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“This study is really about getting to know this emerging health threat,” said Barry Kreiswirth, Ph.D., member of the CDI, assistant professor at the Hackensack Meridian School of Medicine, and one of the authors. “It’s just part of the groundwork we’re laying to better understand, and fight, this germ.”

In the century since it was first identified, *K. pneumoniae* has evolved many different strains. Among these are multi-drug-resistant varieties found mostly in health care settings - and which mostly strike people with compromised immune systems. The “hypervirulent” strains, which are found in healthy people outside hospitals, can cause severe infections - but respond to existing antibiotics.

The concern is when new strains show both traits: drug resistance and dangerous virulence.

In the latest study, the researchers assessed some of these new germ varieties, seeing how they respond to human white blood cells and serum in test tubes.

Their findings show that a vaccine approach could be feasible to combat the new threat. The data also showed that, so far, the healthy human immune system can effectively attack the new strains which show both drug resistance and hypervirulence. The effective immune response thus far could be explained by the “molecular machinery” required by both resistance and virulence could exact a “fitness cost” which inherently weakens it in the face of healthy white blood cell response.

The next step is to assess the immune response to the strains in mouse models, according to the paper.

Though little-known beyond public health circles, *K. pneumoniae* has recently made national headlines. One outbreak of the germ at a hospital in Seattle sickened at least 31 and killed four over more than six months.

Technology Networks, 20 September 2023

<https://technologynetworks.com>

Brain chemical affects how women taste alcohol, changes drinking habits

2023-09-18

Globally, alcohol use contributes to around 3 million deaths annually. While previous studies have noted differences in alcohol misuse and

Researchers have discovered that a chemical in the brain makes alcohol taste bitter to women and may explain the difference in drinking habits between the sexes. The discovery could pave the way for novel treatments to help women curb excessive alcohol use.

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dependence between men and women, newer research suggests that, over the last 20 years, there's been an increase in risky drinking behaviors, such as binge drinking, in women.

On a molecular level, the neuropeptide protein cocaine- and amphetamine-regulated transcript (CART) has been implicated in a range of physiological and pathophysiological functions, including energy balance, depression, anxiety, and reward-related behaviors like alcohol use disorder. However, due to difficulties manipulating the CART system, it's remained relatively understudied.

Researchers from The Florey Institute for Neuroscience and Mental Health in Melbourne, Australia, examined the CART system in an effort to explain the differences in drinking habits between the sexes and found that it comes down to the chemical's effect on taste.

"The taste of alcohol is an important and often overlooked factor that drives alcohol preference, intake and use," said Leigh Walker, corresponding author of the study. "We have identified a chemical in the brain that makes alcohol taste bitter to females unless the drink is sweetened."

Male and female mice, including animals with the CART gene knocked out, were trained to consume high levels of alcohol (ethanol). They were then given continuous access to a bottle containing ethanol and one containing water for 10 weeks, and their intake was measured daily. To determine whether taste affected alcohol consumption in female mice, bottles of ethanol were then supplemented with sucrose.

"Alcohol has an underlying bitter taste," Walker said. "When we inhibited CART in male mice, their drinking increased. And when we knocked out the same brain chemical in female mice, they drank less. But when the alcohol was sweetened, the female mice drank more. This tells us that without CART, alcohol is unpalatable to females."

The researchers discovered that the differences they observed were not due to circulating levels of sex hormones but were related to a part of the brain where CART contributes to regulating alcohol consumption, the central nucleus of the amygdala (CeA). In mice where CeA CART has been neutralized, female mice consumed less plain but more sweetened alcohol.

They say their research has identified a novel mechanism by which CART mediates alcohol intake, specifically in female mice, by altering bitter

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taste sensitivity. It could pave the way for treatments designed to help women stop binge drinking or otherwise engaging in unhealthy drinking behaviors.

"If we can find a way in future to target the CART neuropeptide system, we may be able to create treatments to help women curb excessive alcohol use," said Walker. "And if we can work out how male and female brains differ, it will open unprecedented opportunity to treat disorders of the brain in women, including alcohol use disorders."

The study was published in the journal *Neuropsychopharmacology*.

Source: The Florey Institute of Neuroscience and Mental Health

New Atlas, 18 September 2023

<https://newatlas.com>

New self-cleaning membranes developed by researchers dramatically improve efficiency of desalination technologies

2023-09-20

The most energy-efficient desalination technologies are based on membrane desalination. However, the membranes used for desalination are prone to fouling, the accumulation of scale that results in decreased membrane performance, shorter lifespan, and the need for chemical cleaning, which has unknown environmental consequences.

Researchers at NYUAD's Smart Materials Lab and the Center for Smart Engineering Materials, led by Professor Panče Naumov and Research Scientist Ejaz Ahmed, together with their collaborators from the Institute for Membrane Technology in Italy, created a unique hybrid membrane by utilizing stimuli-responsive materials, thermosolient organic crystals, embedded in polymers. The thermosolient crystals are a new class of dynamic materials that are capable of sudden expansion or motion upon heating or cooling.

Combining these microcrystals with traditional, porous membranes, the researchers developed a "smart" membrane capable of deformation by self-modulating its pore size and surface properties in response to changes in temperature. The crystals on the surface of the membrane respond to short-term increase in temperature, which activates the

A team of NYU Abu Dhabi (NYUAD) researchers has developed a new kind of self-cleaning, hybrid membrane that provides a solution that overcomes significant challenges that have, until now, limited desalination technologies.

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membrane to effectively remove the deposited contaminants from its surface.

The researchers found that this “gating” process increased the flow of desalinated water by more than 43 percent through osmotic distillation and significantly extended the membrane’s operational lifetime.

The findings are presented in a paper titled “Smart Dynamic Hybrid Membranes with Self-Cleaning Capability,” published in the journal *Nature Communications*.

The ability of hybrid membranes to self-clean and minimize fouling could make desalination technologies more efficient and could increase the availability of freshwater. More than a third of the world’s population currently suffers from shortages of drinkable water, a number expected to reach 50 percent by 2025. In water-deficient countries, such as those in arid regions like the MENA region, membrane desalination of seawater helps coastal communities address local deficiencies.

“There is an urgent need for energy-efficient membranes capable of water desalination and other separation technologies that eliminate fouling issues without utilizing harsh chemicals as cleaners,” said Naumov.

“The hybrid membrane we have developed demonstrates favorable consistency in performance after several cycles of descaling. With more than twenty types of dynamic organic crystals available to use with different membrane compositions, our novel approach represents an important step forward towards the development of a new generation of ‘smart’ membranes that will be capable of self-cleaning in an energy-saving and environmentally benign manner, which will effectively improve the cost-effectiveness of the overall process of potable water production.”

Phys Org, 20 September 2023

<https://phys.org>

2 ways of knowing if there are PFAS in your drinking water

2023-09-17

Since then, these compounds have leached from industrial facilities and trash systems into our waterways, making our drinking supply one of the main ways forever chemicals are getting into our bodies.

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If you’re now eyeing your glass of water suspiciously, know that there are steps you can take to find out if there are PFAS in that H₂O, and lower the risk of exposure for you and your family.

Your water might have PFAS

Between 2016 and 2021, the US Geological Survey sampled the water from 716 different taps across the country and found that an estimated 45 percent of tested sites contained at least one kind of forever chemical. The study is the broadest of its kind in the US, making its main finding the best risk estimate we have for PFAS contamination in our drinking water.

While efforts to regulate these chemicals are gaining traction, there is no federal mandate limiting the amount of PFAS in our drinking supply. In March, the Environmental Protection Agency proposed a nationwide enforceable limit of four parts per trillion for each of the six types of PFAS in our drinking water. But while the EPA weighs public comments on the bill, millions of people might still be exposed to these persistent pollutants, as not all public water systems in the country are required to monitor and remove them.

Even if the EPA’s proposal succeeds, imposing legal PFAS limits doesn’t necessarily mean our water will be safe to drink. For example, the EPA’s maximum contaminant level goal for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS), the most notorious cancer-causing PFAS, is zero.

For these two compounds, “there’s no known safe level,” says Kelly Smalling, a USGS environmental chemist and lead author of the national tap water study.

Researchers are still looking into how forever chemicals impact our health and how to efficiently dispose of them. This is particularly important because there are vast geographical areas in the US where PFAS levels are high enough to pose a health risk over time, but low enough to make it hard to remove them from the environment.

By understanding the risk of PFAS exposure in your drinking water, you can find the best prevention strategy to mitigate it accordingly.

Know thy water source

The easiest step in understanding your risk of PFAS exposure is knowing where you get your water from, says Jamie DeWitt, a pharmacologist at East Carolina University. If it comes from a public supply, you have it easier

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than those getting their H₂O from private wells, as utility companies have to regularly test for contaminants and report the results to the public.

The Environmental Working Group, an advocacy non-profit, has a nifty online tap water database that shows the servicing utility and contaminants detected where you live—just search using your zip code. You can also use this platform to gather information before you talk to your public water provider, which the EPA encourages you to do. If you find high PFAS levels in your water supply, DeWitt recommends you reach out and find out what your utility company is doing to reduce them.

There's a caveat, though—the data included in the EWG's database are of contaminants tested by and at the utility plant, which are a few steps removed from the actual amount that you might imbibe at home. A 2022 study published in the journal *Environmental Science and Pollution Research*, shows that PFAS can leak into the water through the distribution infrastructure, so real PFAS levels might actually be higher than those reported by the EWG. For a more downstream estimate of PFAS contamination, the authors of the USGS study have fashioned an interactive map including data from private wells.

If you live in or near an area where PFAS were detected, there's a good chance these chemicals are in your tap water, as their footprint tends to spill far and wide. As a proxy for estimating contamination levels in areas where researchers didn't test directly, the map also includes industry facilities that might be sources for PFAS.

Although the EWG's tap water database pertains to public utilities only, it could still help the 40 million Americans whose water comes from private wells. Smalling explains this is because neighboring water supplies, whether public or private, usually originate from a common reservoir in the same catchment area. This makes it highly likely that PFAS detected in one source might be present in others nearby.

At-home PFAS tests

There are several PFAS testing kits for household water in the market, where you mail a sample and get results after a week or so.

If you're thinking about testing your water for PFAS, pick a test kit that follows the EPA's Method 537.1 and Method 533. The easiest way to know which ones comply with these standards is to follow your state's recommendations or refer to the EPA's list of approved manufacturers.

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Choosing which test to go with is a delicate balancing act between cost, exposure risk, convenience, and the scope of the test. Lydia Jahl, a science and policy manager at the environmental advocacy nonprofit Green Science Policy Institute, recommends you look for the number of PFAS species a kit can detect (the more the better), and its detection threshold: the lower it is, the more sensitive.

Money can also be an important deciding factor, as these services can cost up to a few hundred dollars. However, the investment might be warranted if you own a well or live near a high-risk zone. For those on a budget, a good alternative is Cyclopure's PFAS test, which is only \$79. While the test meets a slightly older standard and is not government-certified, it does a good job at detecting a whopping 55 types of PFAS and their precursors.

Test kits come with their own instructions, but you'll find there are general guidelines that apply to most cases:

- Start by thoroughly washing your hands before collection, and make sure you wear a fresh pair of surgical gloves to avoid contaminating the water sample.
- Avoid touching the inside of the collection bottle and its lid. If you must set the lid down, keep the inside facing up.
- For the most accurate measurement, run your faucet on low for at least three minutes to flush the pipes before filling the collection bottle. Do not overfill the container.
- If the sampling bottle contains a preservative, thoroughly mix in the water by carefully inverting the closed container a few times.
- Make sure to have a watch or clock handy, as you'll need to indicate the location and exact time you collected the sample. If applicable and per the test's instructions, you can also specify which tap you collected the water from.
- Have some ice ready, as most samples have to be at 43 degrees Fahrenheit when they arrive at the lab. Some tests come with their own ice packs, but depending on the instructions, you may have to make your own with a zip-top bag and some ice cubes.
- Make sure to overnight your specimen or drop it off at a designated site within 24 hours of collection.

Currently, there is no consensus on how often drinking water supplies should be tested for PFAS. For example, the state of New Hampshire recommends testing private wells every three to five years, while Massachusetts only once a decade after an initial negative PFAS result.

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You've tested your water for PFAS. Now what?

If you are particularly concerned about your risk of exposure, you can take a blood test to learn about your body's PFAS levels. You can find such tests from manufacturers like EmpowerDX, but they don't come cheap and they're likely not covered by insurance, DeWitt says.

Whether your water management company is acting against PFAS or not, an easy way to reduce your exposure to these chemicals is to filter your water supply. You can install filters that clean the water for your entire household at once (point-of-entry filtration), or just that from the specific tap you drink from (point-of-use system).

The market is filled with a wide range of options at varying prices, so choosing a solution for you can be confusing. The EWG has a list with several point-of-use filters, which takes into consideration their ability to remove PFAS, and their associated costs. There are also offerings such as Cyclopure's \$45 filter cartridges, which have been certified by the National Sanitation Foundation.

But any filter is better than nothing, says Jahl, and even traditional, lower-end countertop filters can remove some PFAS from drinking water. She personally opts for the ubiquitous Brita pitcher filter, which relies on activated carbon to filter a broad spectrum of contaminants, including PFAS. To keep the filtration performance in top condition, just remember to switch out your filters as instructed.

Popular Science, 17 September 2023

<https://popsci.com>

Highly sensitive portable sensor developed for formaldehyde detection

2023-09-20

HCHO is an important gaseous pollutant. In atmospheric chemistry, HCHO serves as a vital intermediate in the oxidation of both man-made and natural volatile organic compounds, contributing to our understanding of photochemical pollution formation mechanisms. Excessive formaldehyde levels in indoor environments are known to be a major risk factor for cancer, particularly leukemia. Therefore, real-time monitoring of atmospheric formaldehyde is essential for studying the chemistry of air pollution and its potential health impacts.

Researchers led by Prof. Zhang Weijun from the Hefei Institutes of Physical Science of the Chinese Academy of Sciences (CAS) have developed a highly sensitive portable laser absorption spectroscopy formaldehyde (HCHO) sensor using a compact spherical mirror multi-pass cell. The results were published in Sensors and Actuators B: Chemical.

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In this work, a compact multi-pass optical cell with a high fill factor was proposed to meet the development needs of miniaturized, fast-response, and highly sensitive TDLAS instruments. Its size of $46 \times 28 \times 16$ cm³ made it easily transportable.

"We have already carried out some relevant work in 2019," said Prof. Zhao Weixiong, corresponding author of the study, "a novel spherical mirror cell with a long optical path length was used in a mid-infrared tunable laser absorption spectroscopy (TDLAS) device for atmospheric formaldehyde measurements."

Building on the previous experiment, further optimizations were made in this study.

The key innovation was the design of a compact, improved multi-pass spherical mirror cell consisting of two 5 cm diameter spherical mirrors separated by 17.7 cm. The optimized design ensures the long absorption path length and helps improve the compactness of the device.

Another notable feature of this sensor is its fast-sampling response time of less than one second. This allows for the effective application of the fast optical fringes that can interfere with measurement sensitivity.

"This work has laid the foundation for further development of portable hand-held or in-vehicle formaldehyde detection devices," said Dr. Fang Bo, first author of the study.

Phys Org, 20 September 2023

<https://phys.org>

Plant Compound Inhibits Candida Fungi

2023-09-14

A new study finds that a natural compound found in many plants inhibits the growth of drug-resistant *Candida* fungi — including its most virulent species, *Candida auris*, an emerging global health threat. The journal *ACS Infectious Diseases* published the discovery led by scientists at Emory University.

Laboratory-dish experiments showed that the natural compound, a water-soluble tannin known as PGG, blocks 90% of the growth in four different species of *Candida* fungi. The researchers also discovered how PGG inhibits the growth: It grabs up iron molecules, essentially starving the fungi of an essential nutrient.

A natural compound in many plants has been found to inhibit the growth of drug-resistant *Candida* fungi.

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By starving the fungi rather than attacking it, the PGG mechanism does not promote the development of further drug resistance, unlike existing antifungal medications. Laboratory-dish experiments also showed minimal toxicity of PGG to human cells.

“Drug-resistant fungal infections are a growing healthcare problem but there are few new antifungals in the drug-development pipeline,” says Cassandra Quave, senior author of the study and assistant professor in Emory School of Medicine’s Department of Dermatology and the Center for the Study of Human Health. “Our findings open a new potential approach to deal with these infections, including those caused by deadly *Candida auris*.”

C. auris is often multidrug-resistant and has a high mortality rate, leading the Centers for Disease Control and Prevention (CDC) to label it a serious global health threat.

“It’s a really bad bug,” says Lewis Marquez, first author of the study and a graduate student in Emory’s molecular systems and pharmacology program. “Between 30 to 60% of the people who get infected with *C. auris* end up dying.”

An emerging threat

Candida is a yeast often found on the skin and in the digestive tract of healthy people. Some species, such as *Candida albicans*, occasionally grow out of control and cause mild infections in people.

In more serious cases, *Candida* can invade deep into the body and cause infections in the bloodstream or organs such as the kidney, heart or brain. Immunocompromised people, including many hospital patients, are most at risk for invasive *Candida* infections, which are rapidly evolving drug resistance.

In 2007, the new *Candida* species, *C. auris*, emerged in a hospital patient in Japan. Since then, *C. auris* has caused health care-associated outbreaks in more than a dozen countries around the world with more than 3,000 clinical cases reported in the United States alone.

A ‘natural’ approach to drug discovery

Quave is an ethnobotanist, studying how traditional people have used plants for medicine to search for promising new candidates for modern-day drugs. Her lab curates the Quave Natural Product Library, which

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contains 2,500 botanical and fungal natural products extracted from 750 species collected at sites around the world.

“We’re not taking a random approach to identify potential new antimicrobials,” Quave says. “Focusing on plants used in traditional medicines allows us to hone in quickly on bioactive molecules.”

Previously, the Quave lab had found that the berries of the Brazilian peppertree, a plant used by traditional healers in the Amazon for centuries to treat skin infections and some other ailments, contains a flavone-rich compound that disarms drug-resistant staph bacteria.

Screens by the Quave lab had also found that the leaves of the Brazilian peppertree contain PGG, a compound that has shown antibacterial, anticancer and antiviral activities in previous research.

A 2020 study by the Quave lab, for instance, found that PGG inhibited growth of Carbapenem-resistant *Acinetobacter baumannii*, a bacterium that infects humans and is categorized as one of five urgent threats by the CDC.

The Brazilian peppertree, an invasive weed in Florida, is a member of the poison ivy family. “PGG has popped up repeatedly in our laboratory screens of plant compounds from members of this plant family,” Quave says. “It makes sense that these plants, which thrive in really wet environments, would contain molecules to fight a range of pathogens.”

Experimental results

The Quave lab decided to test whether PGG would show antifungal activity against *Candida*.

Laboratory-dish experiments demonstrated that PGG blocked around 90% of the growth in 12 strains from four species of *Candida*: *C. albicans*, multidrug-resistant *C. auris* and two other multidrug-resistant non-*albicans* *Candida* species.

PGG is a large molecule known for its iron-binding properties. The researchers tested the role of this characteristic in the antifungal activity.

“Each PGG molecule can bind up to five iron molecules,” Marquez explains. “When we added more iron to a dish, beyond the sequestering capacity of the PGG molecules, the fungi once again grew normally.”

Dish experiments also showed that PGG was well-tolerated by human kidney, liver and epithelial cells.

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"Iron in human cells is generally not free iron," Marquez says. "It is usually bound to a protein or is sequestered inside enzymes."

A potential topical treatment

Previous animal studies on PGG have found that the molecule is metabolized quickly and removed from the body. Instead of an internal therapy, the researchers are investigating its potential efficacy as a topical antifungal.

"If a Candida infection breaks out on the skin of a patient where a catheter or other medical instrument is implanted, a topical antifungal might prevent the infection from spreading and entering into the body," Marquez says.

As a next step, the researchers will test PGG as a topical treatment for fungal skin infections in mice.

Meanwhile, Quave and Marquez have applied for a provisional patent for the use of PGG for the mitigation of fungal infections.

"These are still early days in the research, but another idea that we're interested in pursuing is the potential use of PGG as a broad-spectrum microbial," Quave says. "Many infections from acute injuries, such as battlefield wounds, tend to be polymicrobial so PGG could perhaps make a useful topical treatment in these cases."

Technology Networks, 14 September 2023

<https://technologynetworks.com>

Combustion powers bug-sized robots to leap, lift and race

2023-09-19

The group's paper, "Powerful, Soft Combustion Actuators for Insect-Scale Robots," was published Sept. 14 in Science. The lead author is postdoctoral researcher Cameron Aubin, Ph.D. '23.

The project was led by Rob Shepherd, associate professor of mechanical and aerospace engineering in Cornell Engineering, whose Organic Robotics Lab has previously used combustion to create a braille display for electronics.

As anyone who has witnessed an ant carry off food from a picnic knows, insects are far stronger than their puny size suggests. However, robots at

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that scale have yet to reach their full potential. One of the challenges is "motors and engines and pumps don't really work when you shrink them down to this size," Aubin said, so researchers have tried to compensate by creating bespoke mechanisms to perform such functions. So far, the majority of these robots have been tethered to their power sources -- which usually means electricity.

"We thought using a high-energy-density chemical fuel, just like we would put in an automobile, would be one way that we could increase the onboard power and performance of these robots," he said. "We're not necessarily advocating for the return of fossil fuels on a large scale, obviously. But in this case, with these tiny, tiny robots, where a milliliter of fuel could lead to an hour of operation, instead of a battery that is too heavy for the robot to even lift, that's kind of a no brainer."

While the team has yet to create a fully untethered model -- Aubin says they are halfway there -- the current iteration "absolutely throttles the competition, in terms of their force output."

The four-legged robot, which is just over an inch long and weighs the equivalent of one and a half paperclips, is 3D-printed with a flame-resistant resin. The body contains a pair of separated combustion chambers that lead to the four actuators, which serve as the feet. Each actuator/foot is a hollow cylinder capped with a piece of silicone rubber, like a drum skin, on the bottom. When offboard electronics are used to create a spark in the combustion chambers, premixed methane and oxygen are ignited, the combustion reaction inflates the drum skin, and the robot pops up into the air.

The robot's actuators are capable of reaching 9.5 newtons of force, compared to approximately 0.2 newtons for those of other similarly sized robots. It also operates at frequencies greater than 100 hertz, achieves displacements of 140% and can lift 22 times its body weight.

"Being powered by combustion allows them to do a lot of things that robots at this scale haven't been able to do at this point," Aubin said. "They can navigate really difficult terrains and clear obstacles. It's an incredible jumper for its size. It's also really fast on the ground. All of that is due to the force density and the power density of these fuel-driven actuators."

The actuator design also enables a high degree of control. By essentially turning a knob, the operator can adjust the speed and frequency of sparking, or vary the fuel feed in real time, triggering a dynamic range of responses. A little fuel and some high-frequency sparking makes the robot

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skitter across the ground. Add a bit more fuel and less sparking and the robot will slow down and hop. Crank the fuel all the way up and give it one good spark and the robot will leap 60 centimeters in the air, roughly 20 times its body length, according to Aubin.

“To do all those multi-gait movements is something that you don’t typically see with robots at this scale,” Aubin said. “They’re either crawlers or jumpers, but not both.”

The researchers envision stringing together even more actuators in parallel arrays so they can produce both very fine and very forceful articulations on the macro scale. The team also plans to continue work on creating an untethered version. That goal will require a shift from a gaseous fuel to a liquid fuel that the robot can carry on board, along with smaller electronics.

“Everybody points to these insect-scale robots as being things that could be used for search and rescue, exploration, environmental monitoring, surveillance, navigation in austere environments,” Aubin said. “We think that the performance increases that we’ve given this robot using these fuels bring us closer to reality where that’s actually possible.”

Co-authors include E. Farrell Helbling, assistant professor of electrical and computer engineering; Sadaf Sobhani, assistant professor of mechanical and aerospace engineering; Ronald H. Heisser, Ph.D. ’23; postdoctoral researcher Ofek Peretz; Julia Timko ’21 and Kiki Lo ’22; and Amir Gat of Technion-Israel Institute of Technology.

The research was supported by the Air Force Office of Scientific Research; the National Science Foundation; and the Office of Naval Research.

Science Daily, 19 September 2023

<https://sciencedaily.com>

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