THE HEALTH IMPACTS OF MICROPLASTICS

Consequences of Living in a Plastosphere



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Your Presenter



Gemma Martin

B.Nat

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What We Will Cover

Overview of Microplastics

- What are microplastics
- How we are exposed to them
- The known impacts of microplastics on human health
- Plastic-associated chemicals and their health impacts

How to Reduce Health Impact

- Avoid and eliminate strategy
- Pathways of elimination
- The power of binders
- Kitchen tricks for harm reduction

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Microplastics and Plastic-associated Chemicals

Growing Concern for Microplastics and Other Modern Toxins in the Community

Every NSW waterway contaminated with microplastics, study finds

By Kelly Fuller and Tony Ibrahim

ABC Illawarra | Water Pollution

Mon 16 Mar

yahoo!news

Disturbing find exposes problem taking over Aussie waterways: 'Eating a whole dose'

Globally, there's some 5.25 trillion plastic particles floating on the ocean's surface. In Australia, we've found 70,000 pieces per square metre in some areas.



Joe Attanasio, Senior Reporter
Updated Tue 1 October 2024 at 2:36 pm ACST · 4 min read

Published: 19 Jun 2025
2 min read

Doctors sound alarm over microplastics as health and environmental fears mount

It's been detected in breast milk and can even affect our reproductive system.

By Jennifer Bechwati, National Health Editor

Our homes are full of hidden microplastics that could be harming our health

By Norman Swan | 7.30 | Health

Wed 22 Oct 2025

78% of Australians are concerned about the use of plastic in the nation

April 19, 2024

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Living in a Plastosphere

75%

of all plastic ever manufactured still persists today — 8.3 billion metric tons, mostly in landfill or the natural environment

8M

tons of plastic waste enter the oceans every year, degrading ecosystems and exposing us to toxic substances

2050

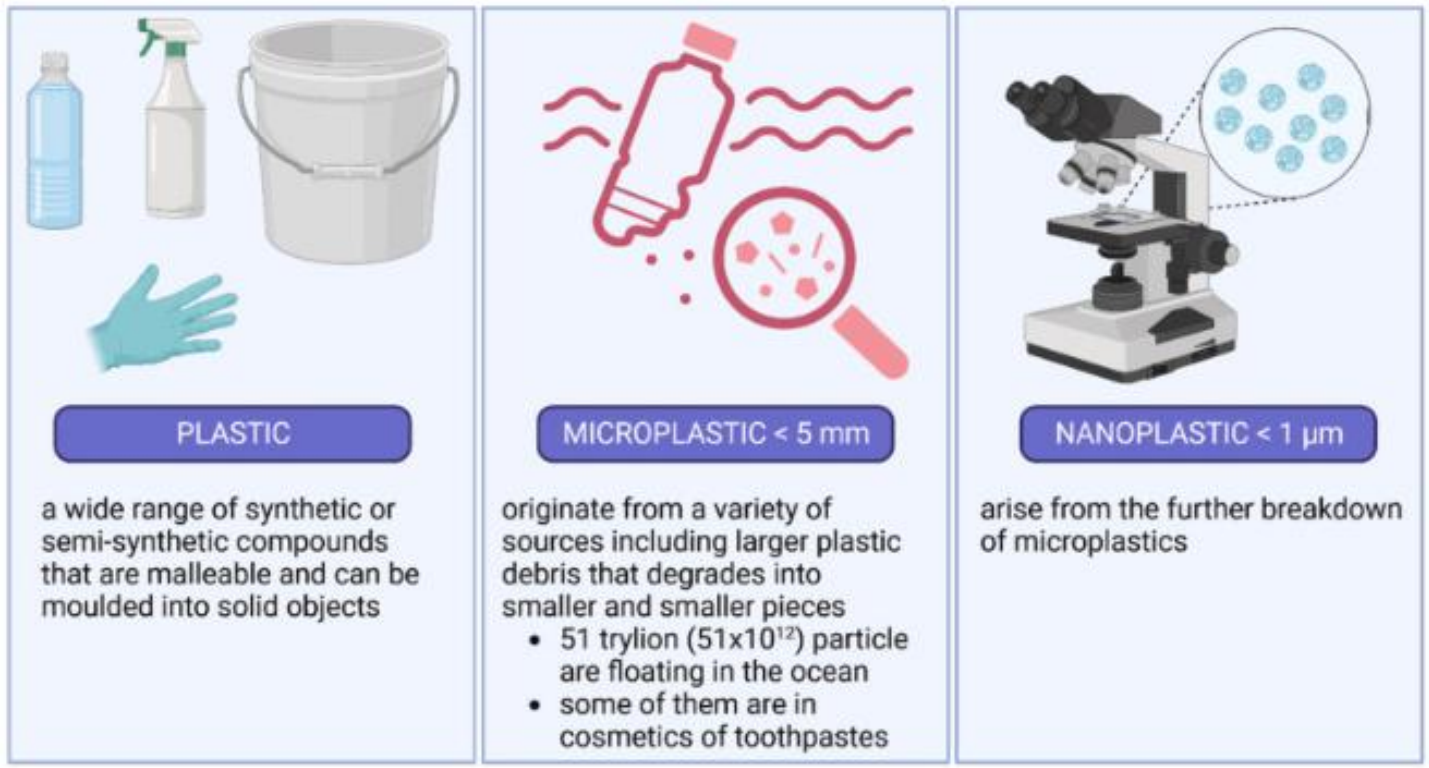
the year there is predicted to be more plastic in the oceans, by weight, than fish

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Alijagić et al. (2024), Sheriff et al. (2025)

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What are Microplastics?



Factors affecting microplastic toxicity:

1. **Particle size** – smaller = more damage
2. **Shape** – random shapes are more harmful than spherical
3. **Weathering and ageing** – release more additives

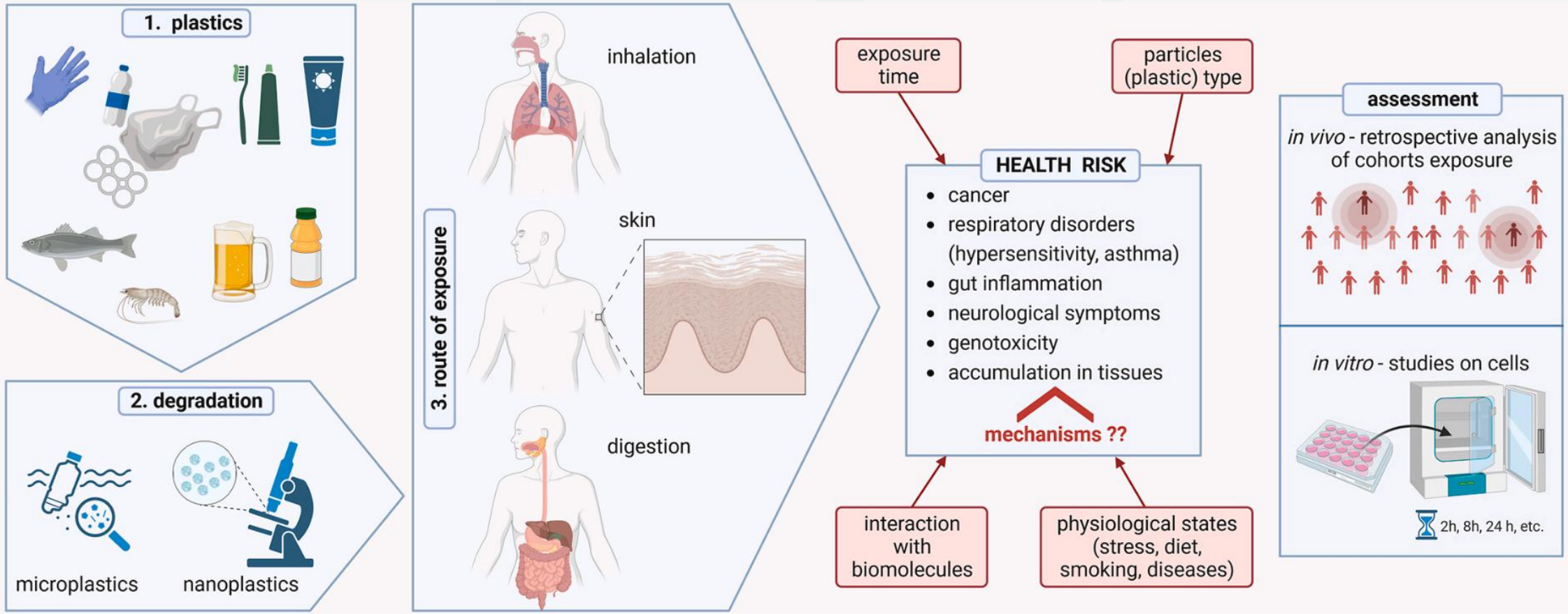
Microplastic adsorb other environmental agents such as heavy metals and hydrophobic organic chemicals

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Winiarska, et al. (2024), Li, et al. (2023)

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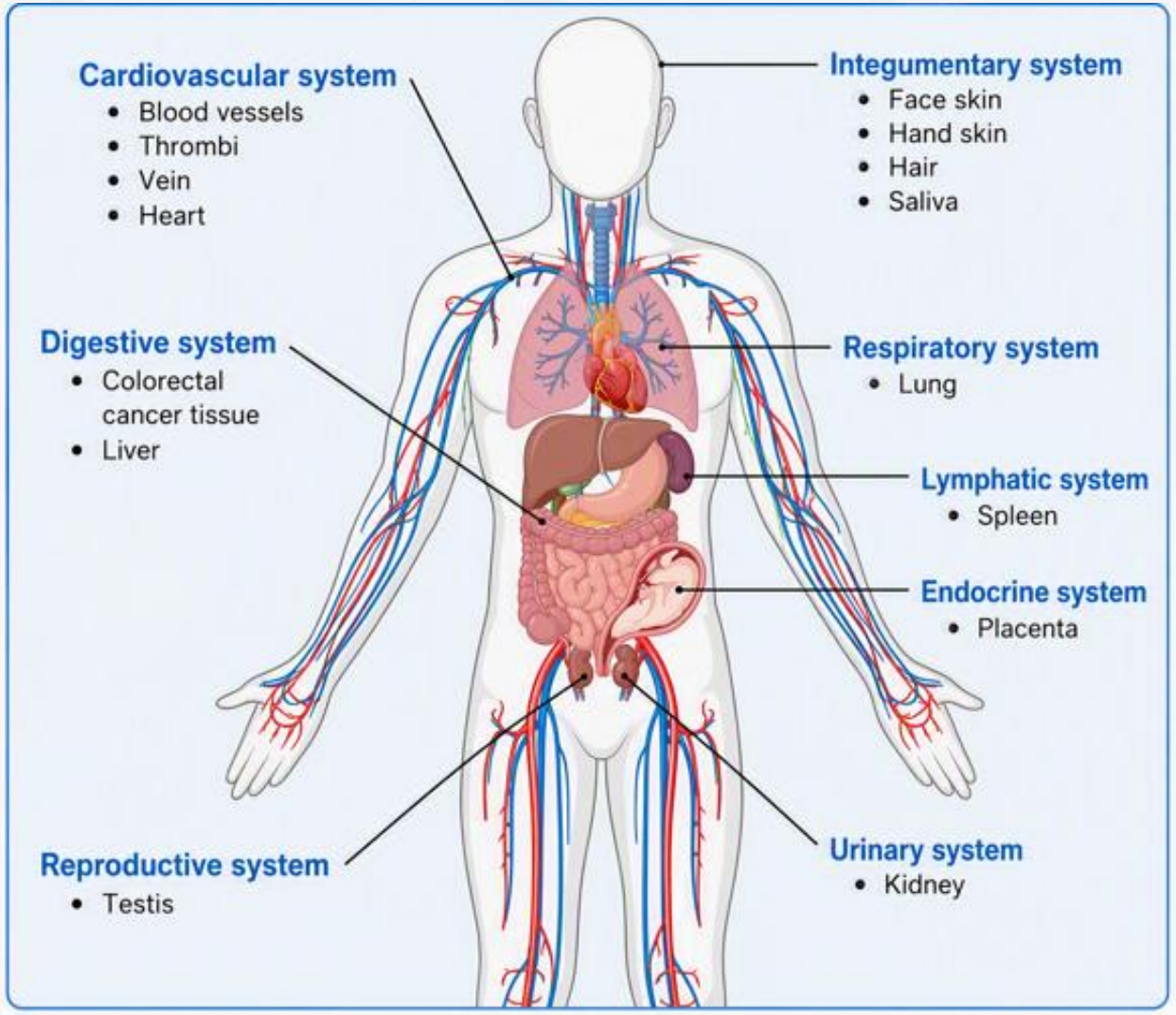
Microplastics – Routes of Exposure and Health Risks



Winiarska, et al. (2024)

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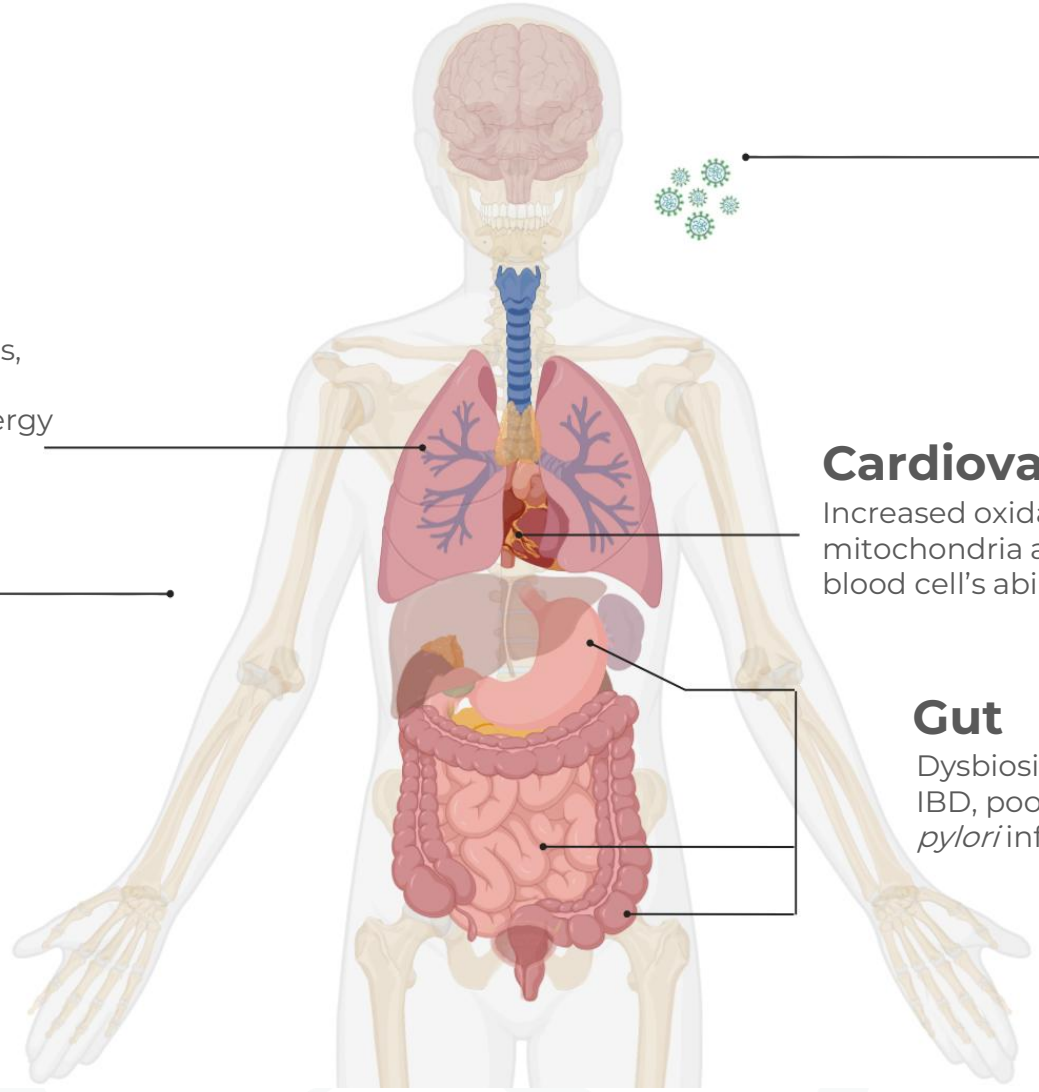
Evidence for Deposition of Plastic Microparticles in Human Organs, Tissues and Fluids



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Roslan, et al. (2024)

Health Impacts of Microplastics



Infectious Disease

Pathogenic organisms on plastic debris may be transmitted to humans

Lungs

Inflammation, altered surfactant properties, inhibition of alveolar cell proliferation, reduced cell viability, impaired cellular energy metabolism, histological changes, fibrosis

Cardiovascular System

Increased oxidative stress, inflammation, dysfunctional mitochondria and energy metabolism. May impede red blood cell's ability to transport oxygen

Inflammation

Exposure activates immune responses, damaging immune cells and increasing production of inflammatory cytokines

Gut

Dysbiosis, barrier dysfunction, inflammation, IBD, poor fat digestion, worsens *Helicobacter pylori* infection

Pregnancy

Negatively impacts maternal and foetal health via inflammation and endocrine disturbance. Observed impacts include changes to lipid metabolism, brain, liver, testis and body weight, impaired learning and memory

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Osman et al. (2023)

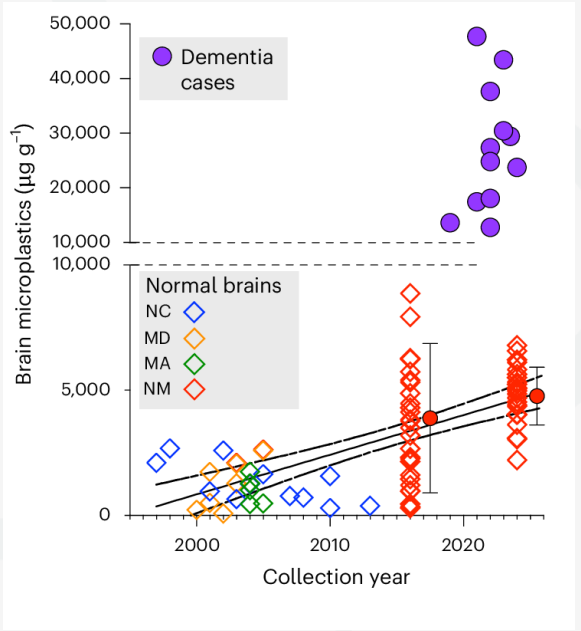
Microplastics on the Brain?

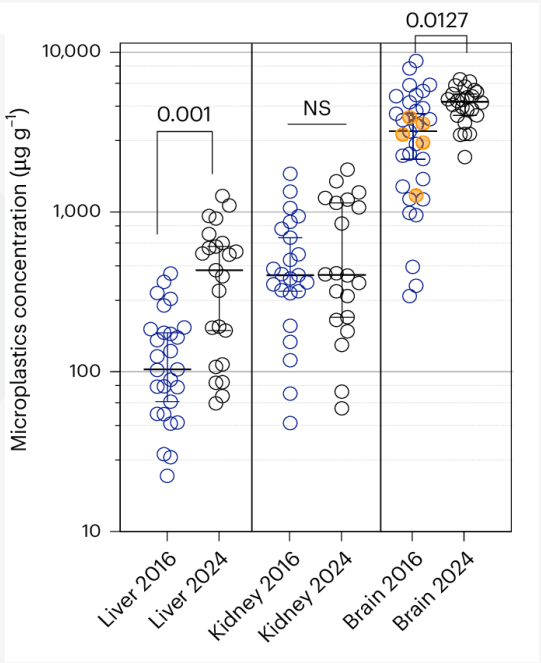
24 of the brain samples were **0.5% plastic** by weight

NEWS FEATURE | 11 February 2025

Your brain is full of microplastics: are they harming you?

Plastics have infiltrated every recess of the planet, including your lungs, kidneys and other sensitive organs. Scientists are scrambling to understand their effects on health.

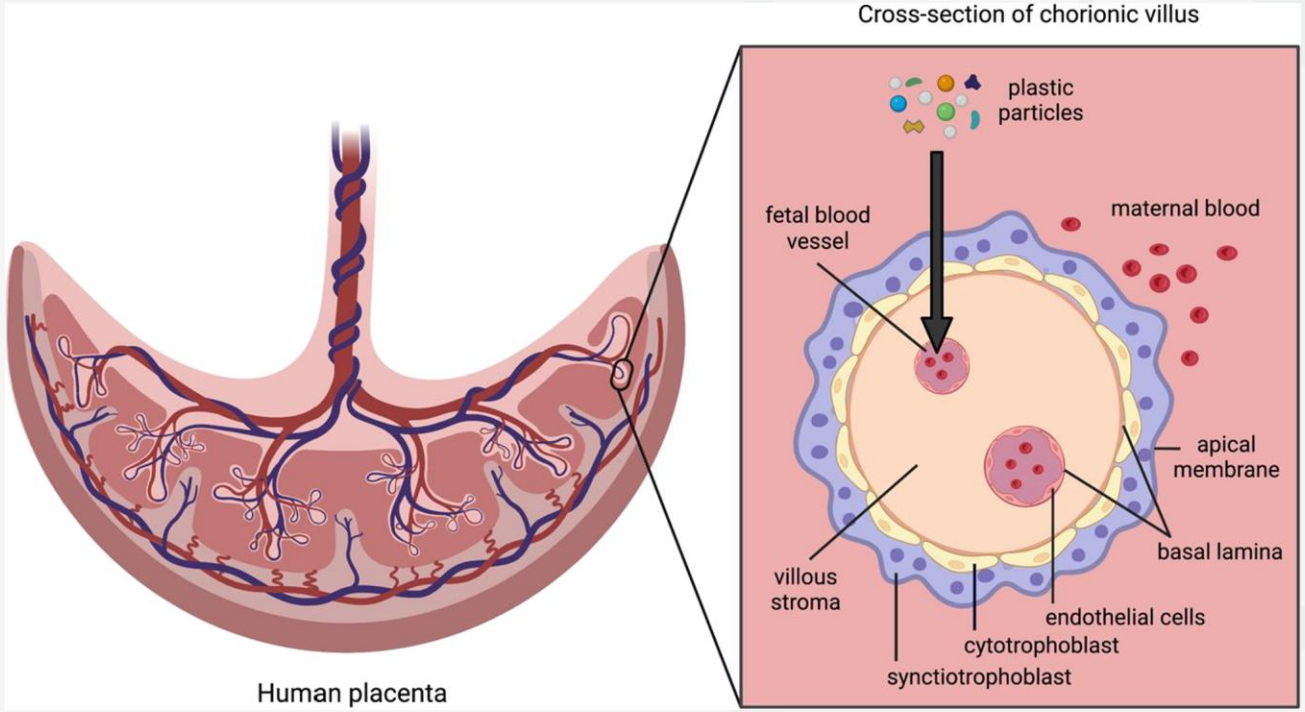




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Kozlov (2025), Nihart et al. (2025)

The Plasticenta – Microplastics Make it to the Placenta Too



9 out of 11 studies found that plastics cross the placental barrier

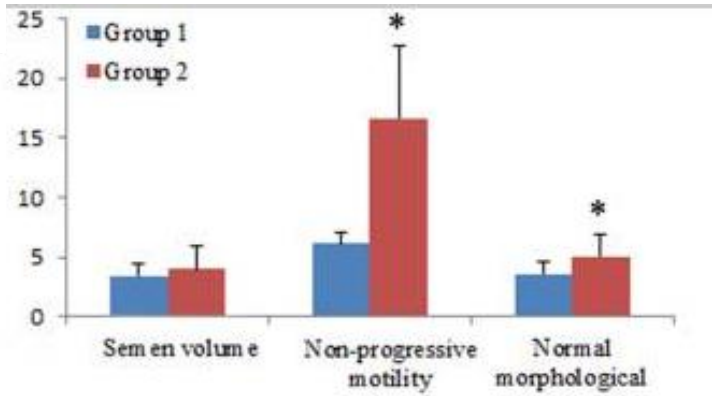
- Generally, smaller particle size = greater translocation
- NPs were observed in foetal **placenta, liver, lung, kidney, heart, and brain**
- Reduced placental and foetal weight
- Human study – **12 microplastics** found in the placentas of **4 women**

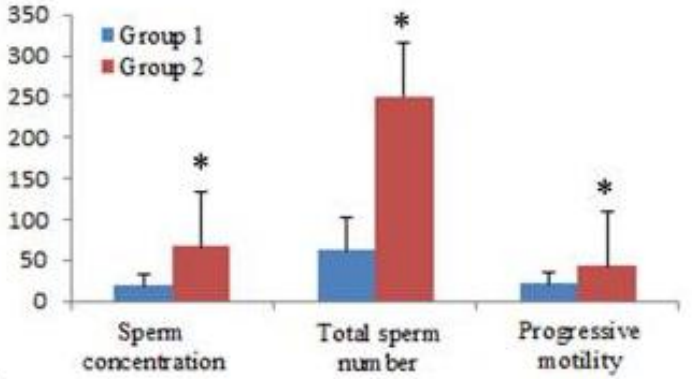
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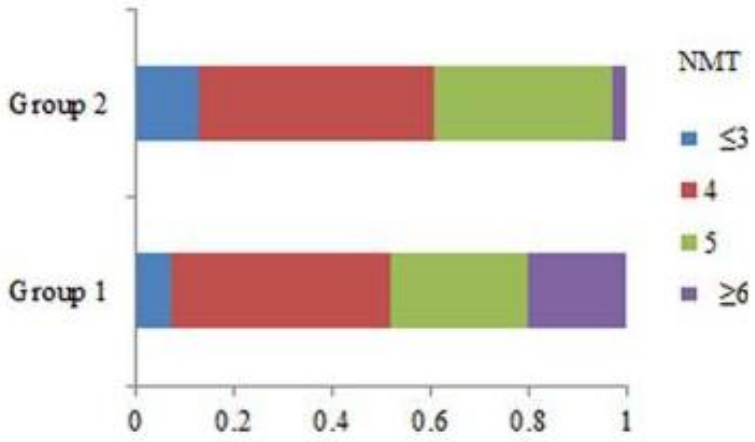
Medley, et al. (2023), Ragusa, et al. (2021)

Could Plastics be Part of the Sperm Problem?

- **Group 1** – poor semen quality
- **Group 2** – normal semen quality
- Males with ≥6 number of microplastics types in type 1 (20%) was higher than in group 2 (3%)







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Zhang, et al. (2024)

The NEW ENGLAND JOURNAL of MEDICINE

CURRENT ISSUE SPECIALTIES

ORIGINAL ARTICLE

Microplastics and Nanoplastics in Atheromas and Cardiovascular Events

Authors: Raffaele Marfella, M.D., Ph.D. , Francesco Prattichizzo, Ph.D., Celestino Sardu, M.D., Ph.D., Gianluca Fulgenzi, Ph.D., Laura Graciotti, Ph.D., Tatiana Spadoni, Ph.D., Nunzia D'Onofrio, Ph.D., +35 , and Giuseppe Pac M.D. Author Info & Affiliations

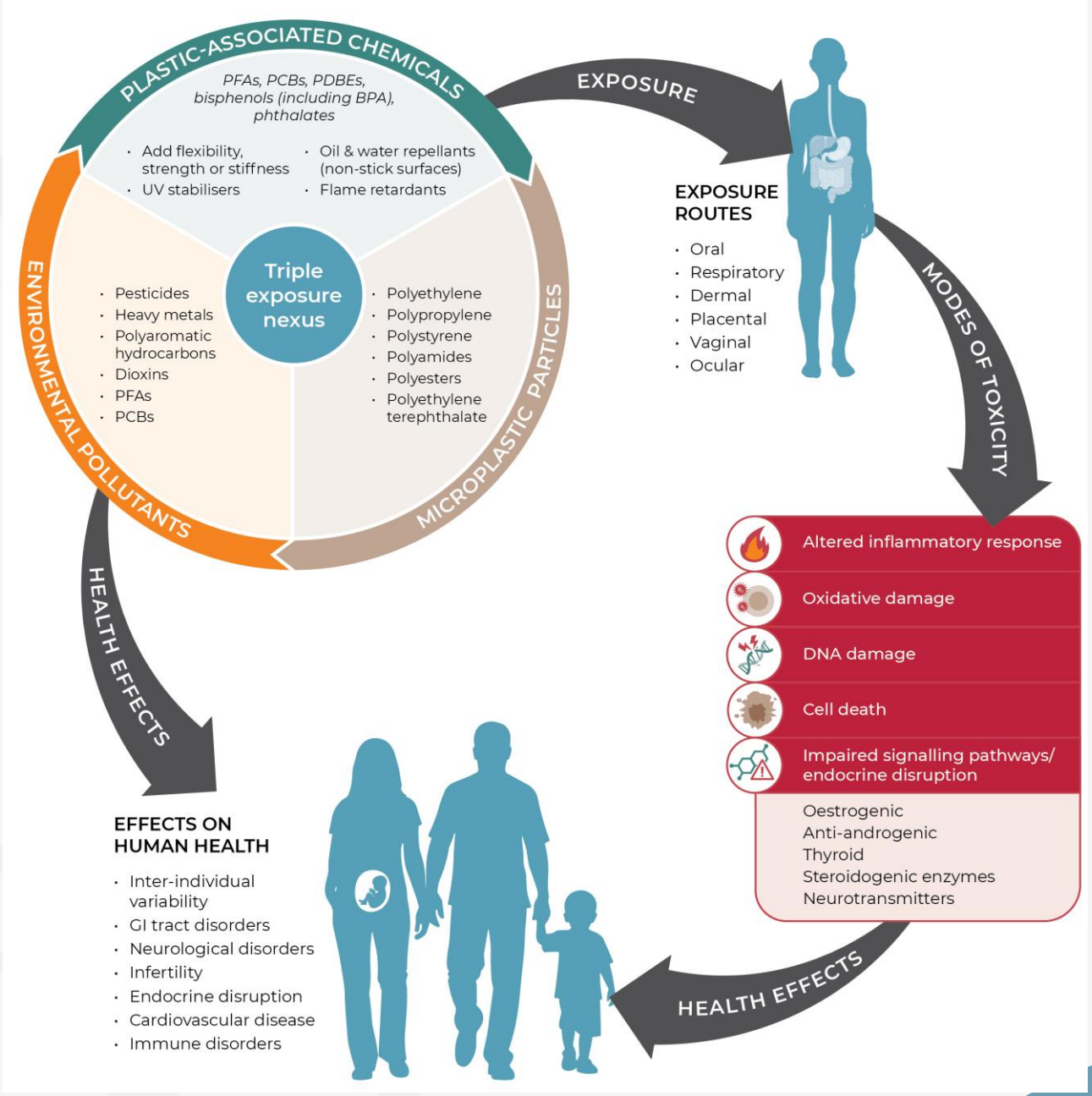
Published March 6, 2024 | N Engl J Med 2024;390:900-910 | DOI: 10.1056/NEJMoa2309822 | VOL. 390 NO.

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- 304 patients over three years
- Those MP in carotid artery plaque → **4.5 x** more likely to have a stroke, myocardial infarction or die than those without detection

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Environmental Plastic Pollution and Its Consequences



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Adapted from Alijagić et al. (2024)

Phthalates and PBDEs: Endocrine Disruptors

PHTHALATES

- Obesity
- Type 2 diabetes
- Oxidative stress
- Atherosclerosis
- Hypertension
- Coronary heart disease
- Myocardial infarction
- Impact coronary circulation, leading to atrial contractile dysfunction
- Attention Deficit Hyperactivity Disorder (ADHD)

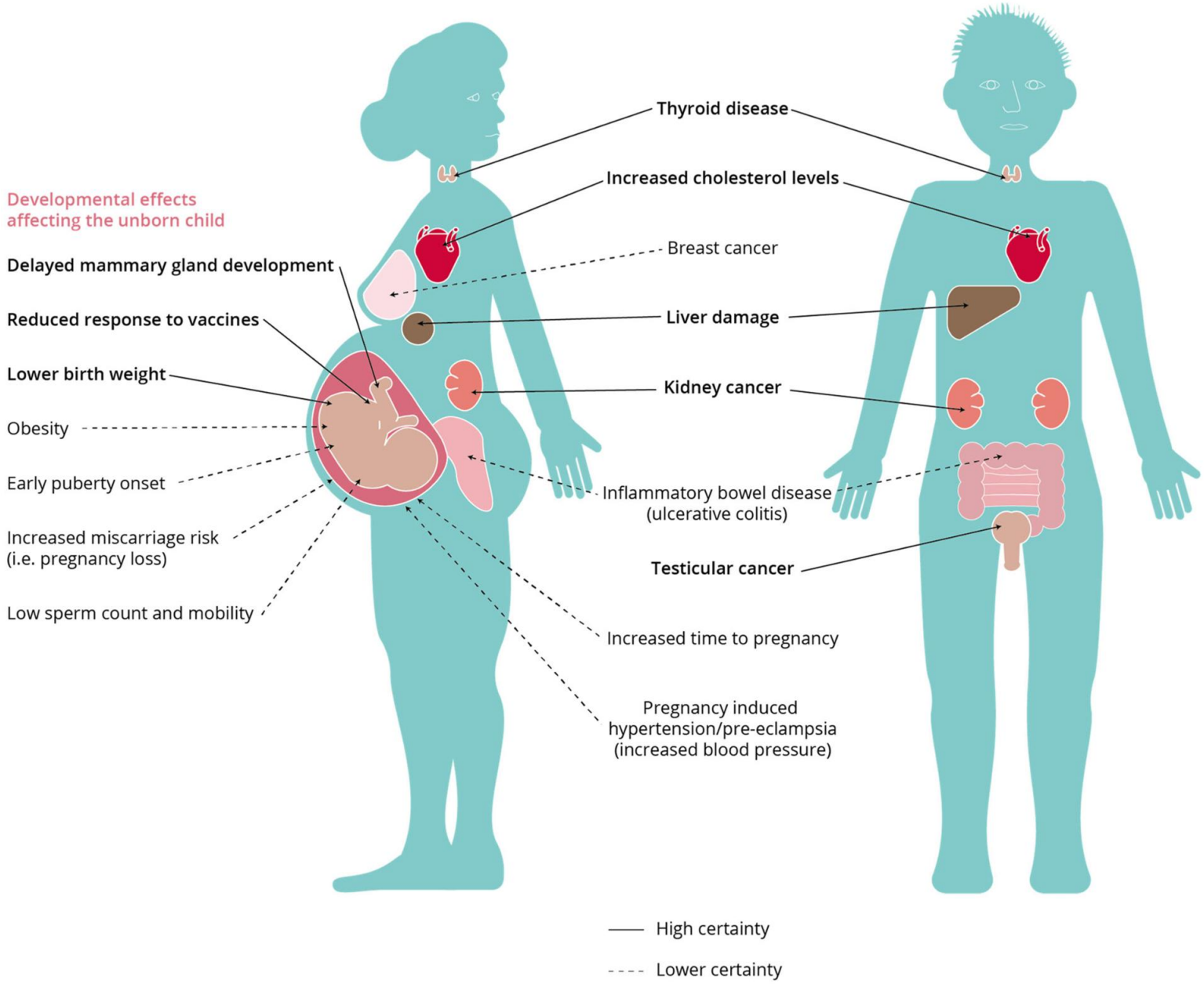
PBDEs

- Proliferation of normal human thyroid follicular epithelial cell line and papillary thyroid carcinoma-derived cells
- May induce carcinogenesis
- Increase glucose-stimulated insulin secretion
- Spermatogenic injuries
- Activate epithelial mesenchymal transition in colorectal cancer cells

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Perera et al. (2023), Osman et al. (2023), Alijagić et al. (2024), Best et al. (2025)

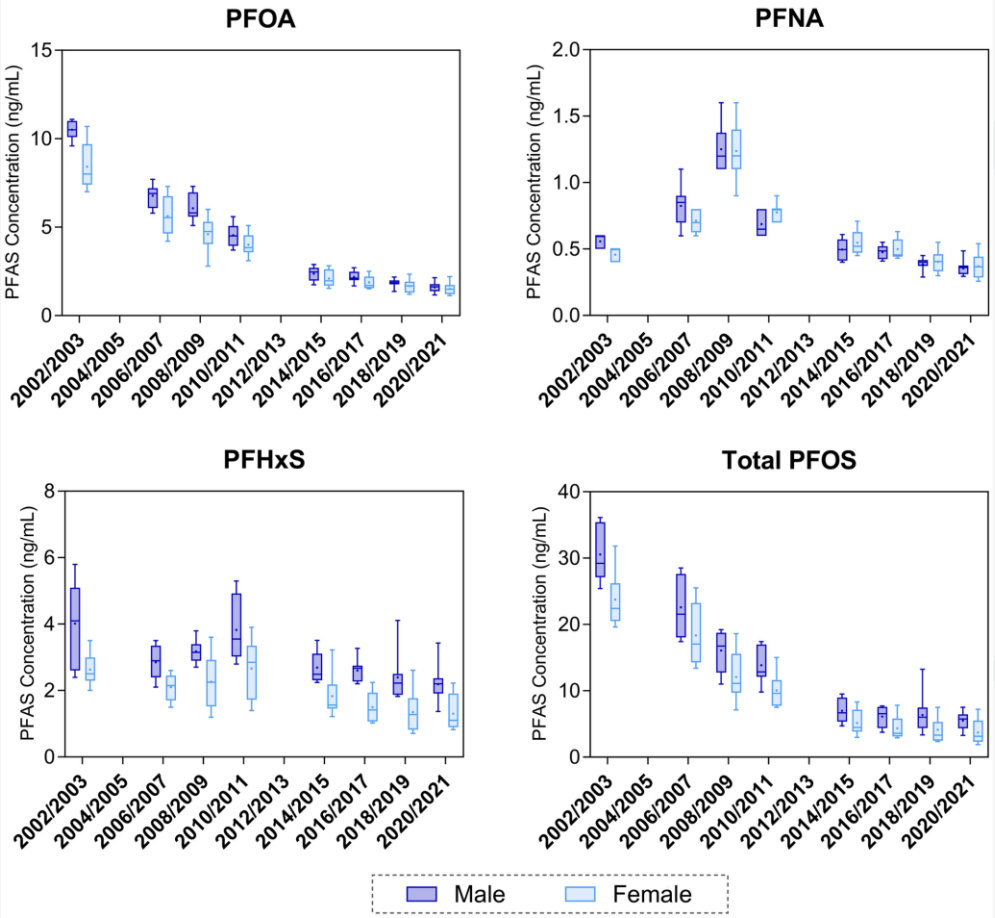
Effects of PFAS on Human Health



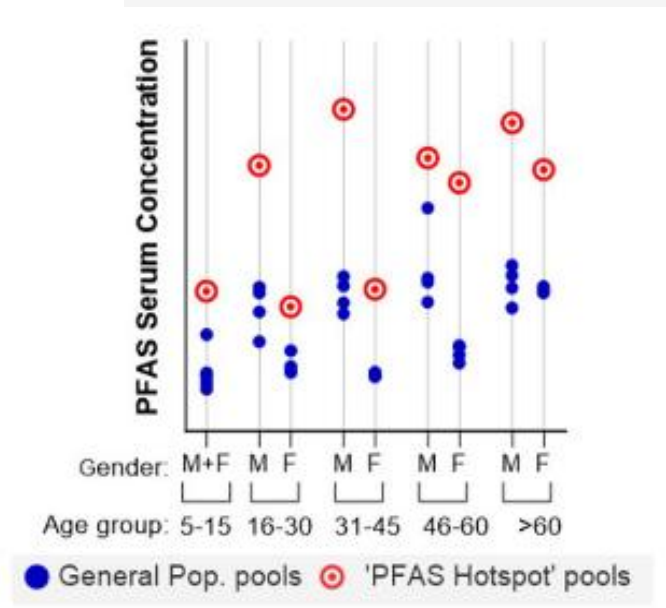
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Leonello, et al. (2021), Fenton et al. 2020

Good News! PFAS Levels are Declining – In Most Places



- From the Australian Human Biomonitoring project
- Human elimination half-lives commonly observed ranging from 3 to 8 years on average
- PFAS 'hot spots' exist and may include:
  - Airports, military bases, mining sites, fire stations, refineries and locations where flammable or combustible materials have been stored

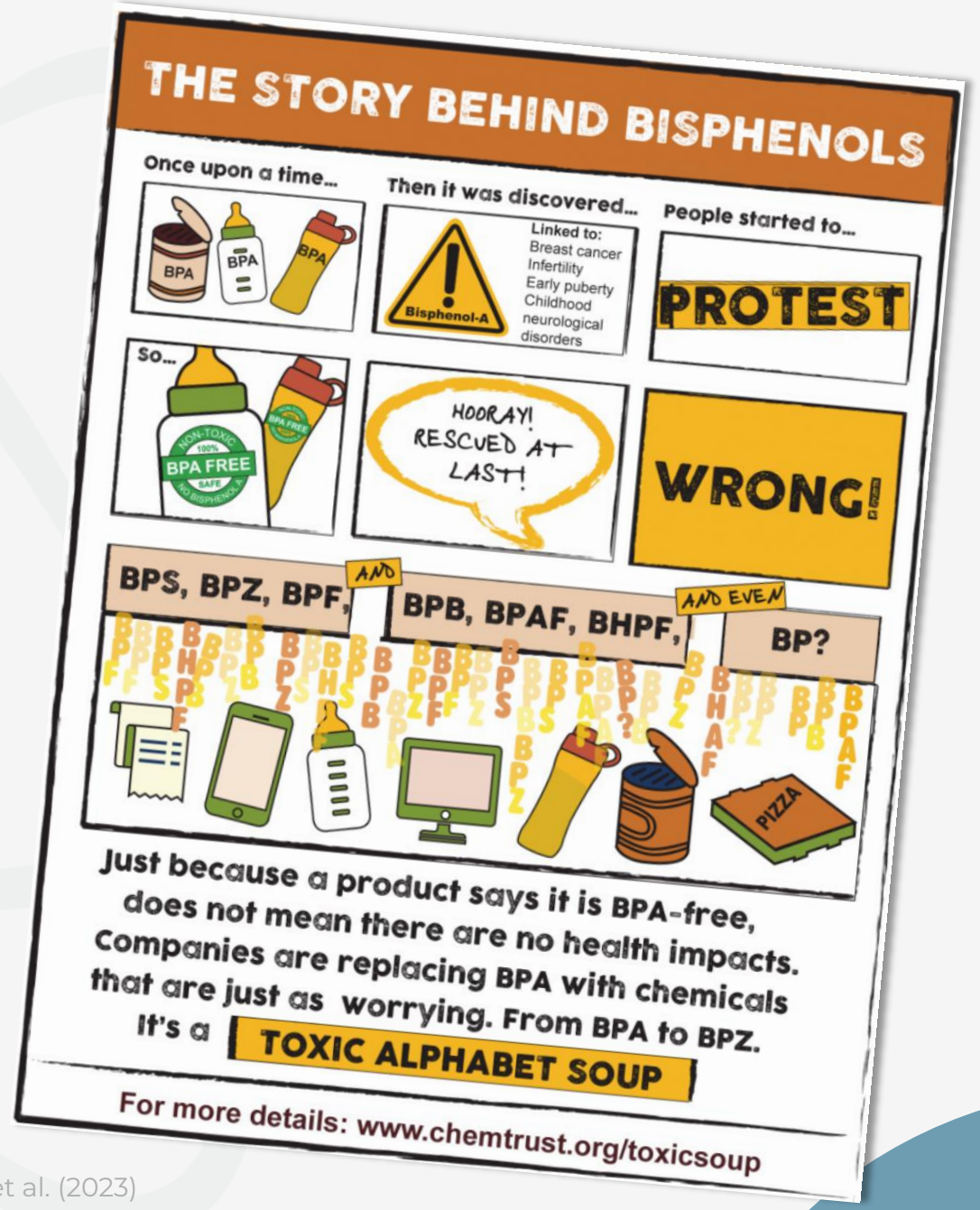


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Nilsson, et al. (2025)

Bisphenols

- Packaged foods and drinks are the main sources of exposure
- Polycarbonate plastics, thermal paper
- Dental resin composites
- Screw-in stabilisers in osteoporotic bones
- Industrial – production of epoxy resin for building and civil engineering industries, e.g. flooring compounds, adhesives, mortars and grouts



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Kim et al. (2019), https://chemtrust.org/bisphenol_group/, Rocca et al. (2023)

BPA Hazards

- Disrupts oestrogen, androgen, progesterone, thyroid, and aryl hydrocarbon receptor functions
- Can trigger agonistic or antagonistic responses
- Antagonistic action on hormone receptors in developing tissues and organs can result in developmental problems

Conditions Linked to BPA Exposure

Cancers

- Breast cancer
- Thyroid cancer
- Oral cancer

Reproductive and Hormonal

- Endometriosis
- PCOS / PMOS
- Infertility

Metabolic and Cardiovascular

- Diabetes
- Cardiovascular toxicity

Organ and Immune Dysfunction

- Renal dysfunction
- Immune system
- Mesenchymal Stem Cell (MSC) dysfunction
- Gut diseases

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Rocca et al. (2023), Kim et al. (2019), Upson et al. (2014)

How Plastic Toxicity Might Look in Clinic

- Preconception care / subfertility (M+F)
- Polyendocrine Metabolic Ovarian Syndrome (PMOS – was PCOS)
- Endometriosis
- Toxin exposure – pesticides, plastics, heavy metals, medications, air pollution
- Metabolic Syndrome
- Metabolic-associated fatty liver disease (MAFLD)
- Toxin-associated fatty liver disease (TAFLD)
- Overweight/obesity
- Liver or gallbladder dysfunction
- Chronic skin conditions
- Fatigue
- Digestive discomfort
- Brain fog
- Chemical sensitivity

Anyone exposed to modern day chemicals (everyone) can benefit from support of their organs of elimination

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What Do We Do About All of These Plastics?



Number 1: Reduce Exposure

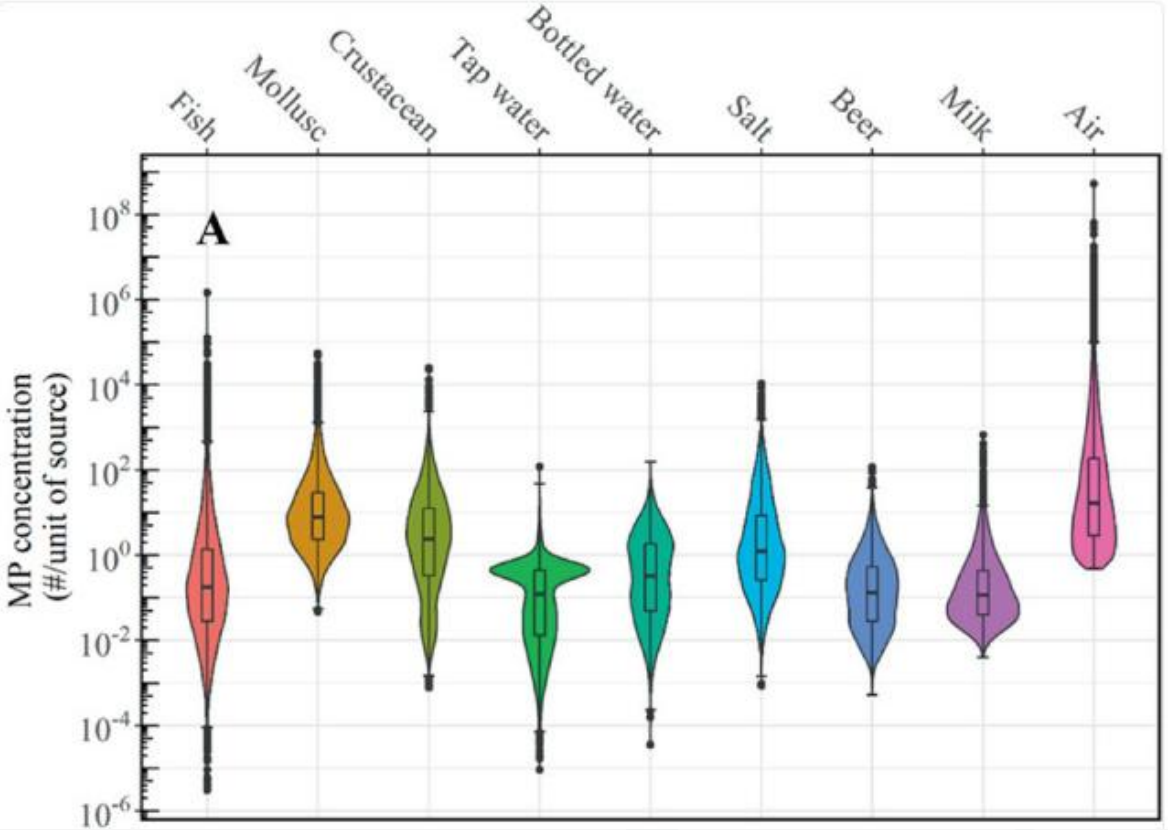
✕ Avoid / reduce

- Single-use plastics such as takeaway containers and plastic bags
- Heating foods in plastic containers in the microwave
- Hot foods or liquids in contact with plastic – coffee cups, 'boil-in-the-bag' products
- Non-stick cookware, plastic cooking utensils and cleaning sponges
- Toxic tea bags
- Canned foods
- Chewing gum
- Astroturf
- Thermal receipts
- Scented products – candles, cleaning products, air fresheners
- Plastic toys

✓ Choose to use

- Glass, ceramic or stainless-steel containers
- Food packaged in glass – check cans are bisphenol-free
- Fabric bags
- A water filter
- 'Natural-based' personal care products
- Natural fibre clothing and furnishings where possible
- Lots of dietary fibre
- Organic food where possible
- Vacuum regularly and dust with a damp cloth

Checking Up on Sources of Exposure

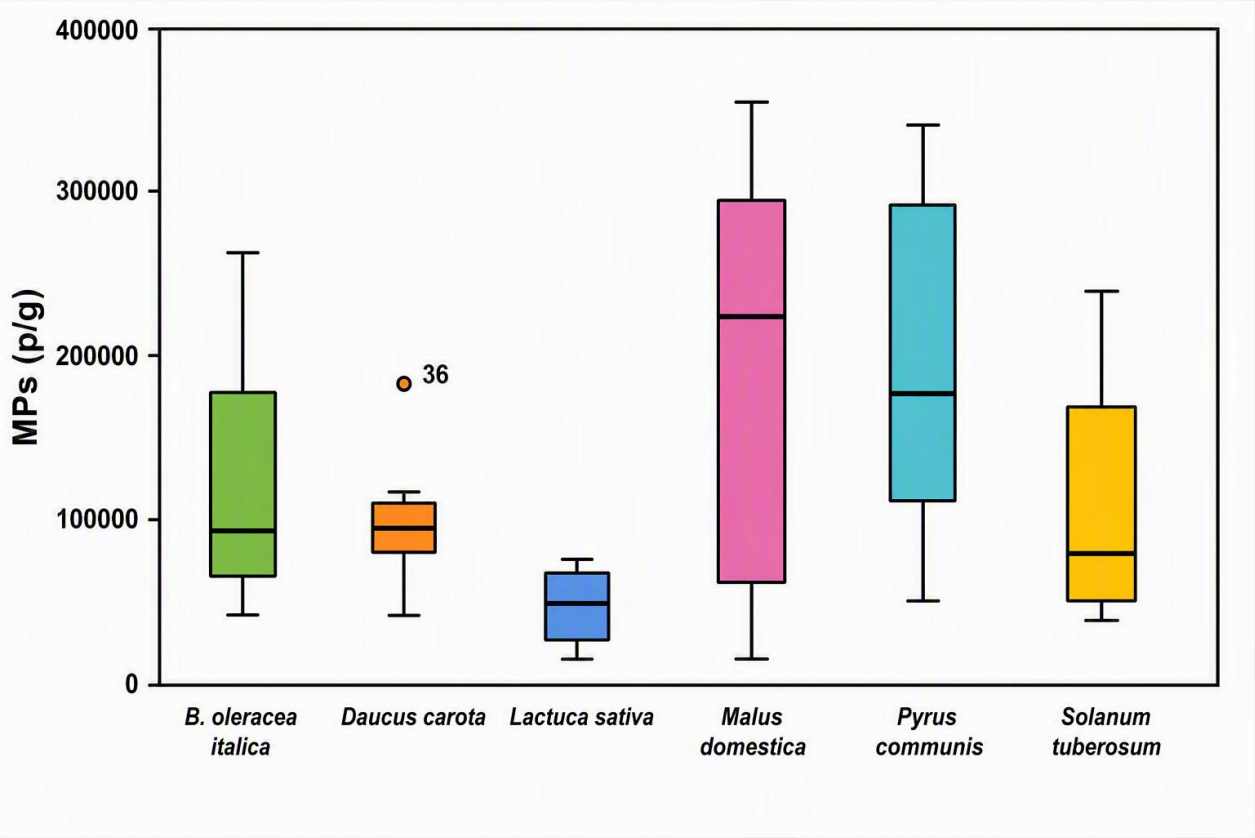


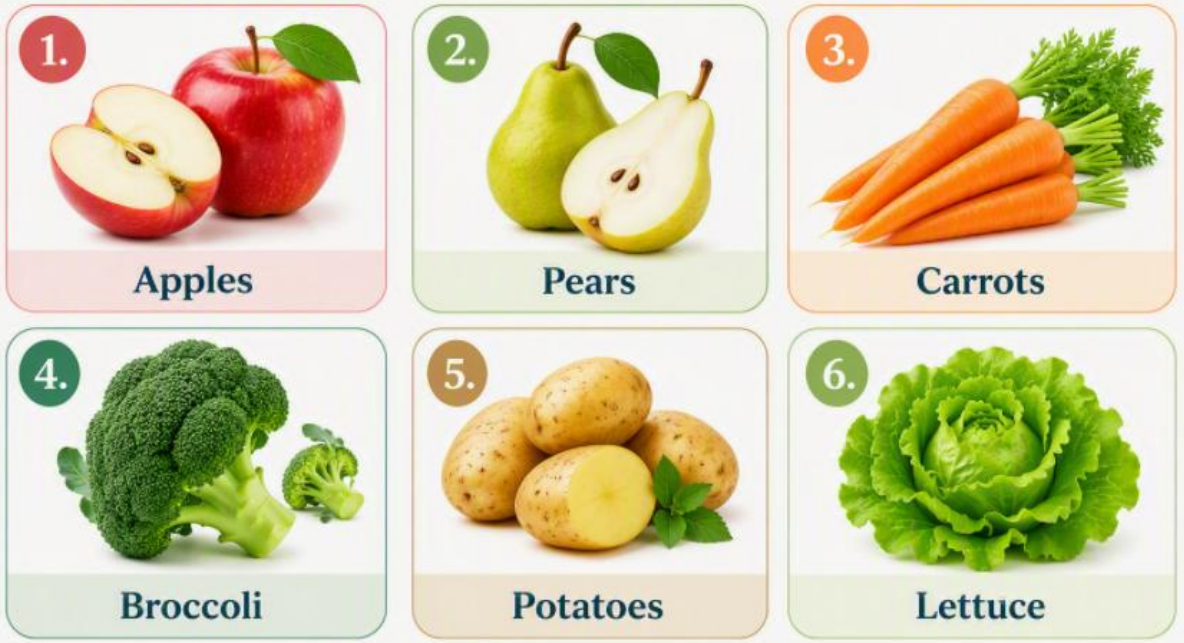
- Median intake rates are:
  - Children: 553 particles/capita/day
  - Adults: 883 particles/capita/day
- **Highest exposure from AIR**
  - Followed by seafood and salt

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Mohamed Nor, et al. (2021)

Microplastics in Fruits and Vegetables

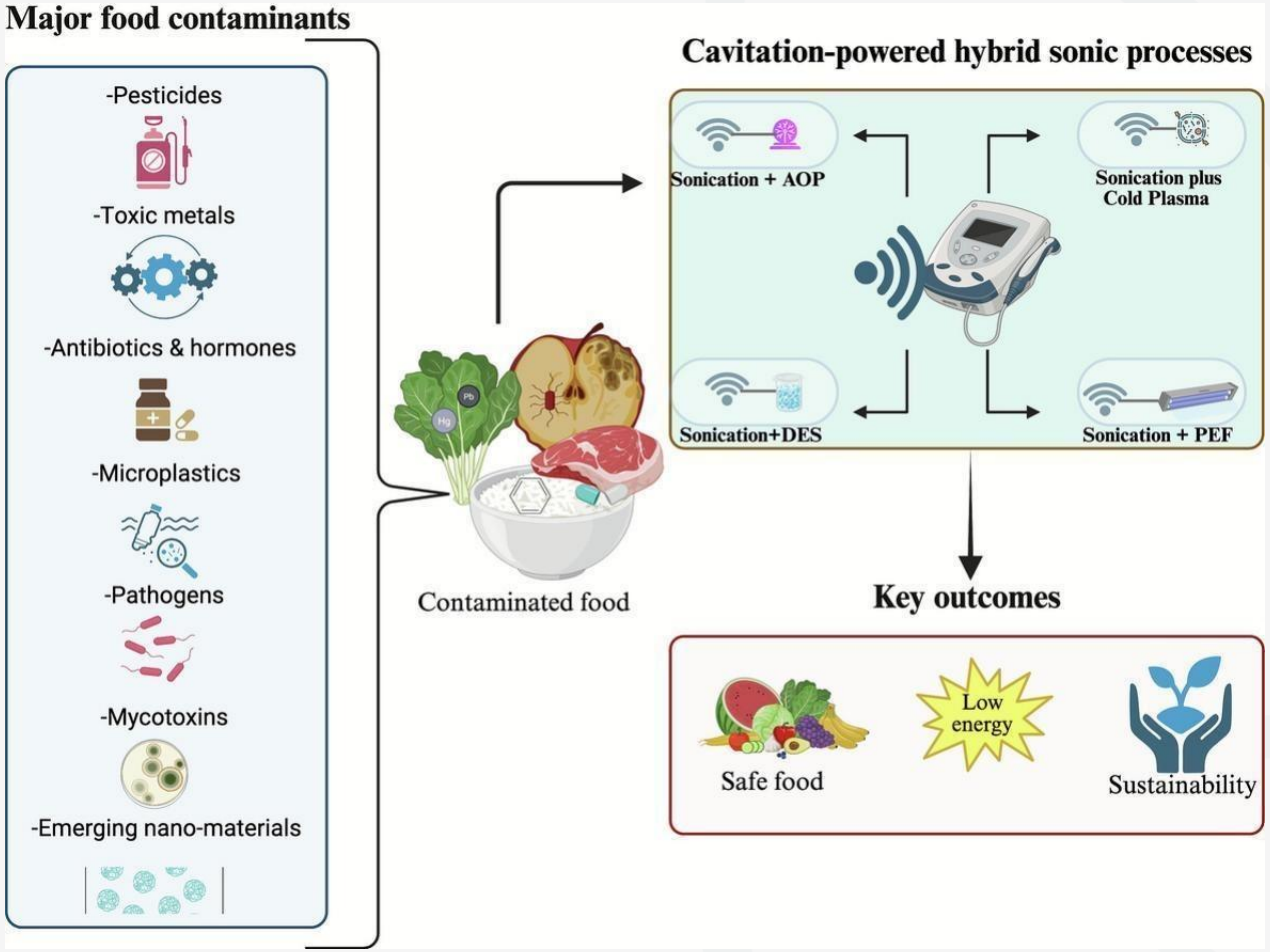


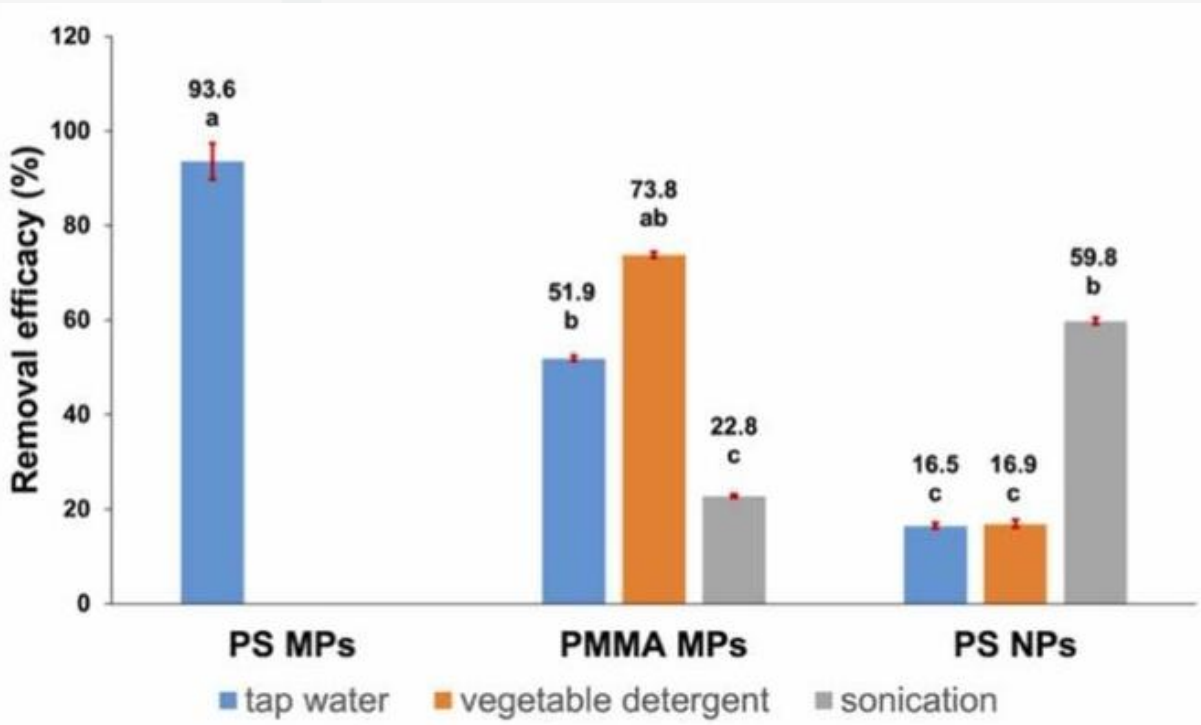


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Oliveri Conti, et al. (2022)

Methods for Reducing Plastic Residue on Food



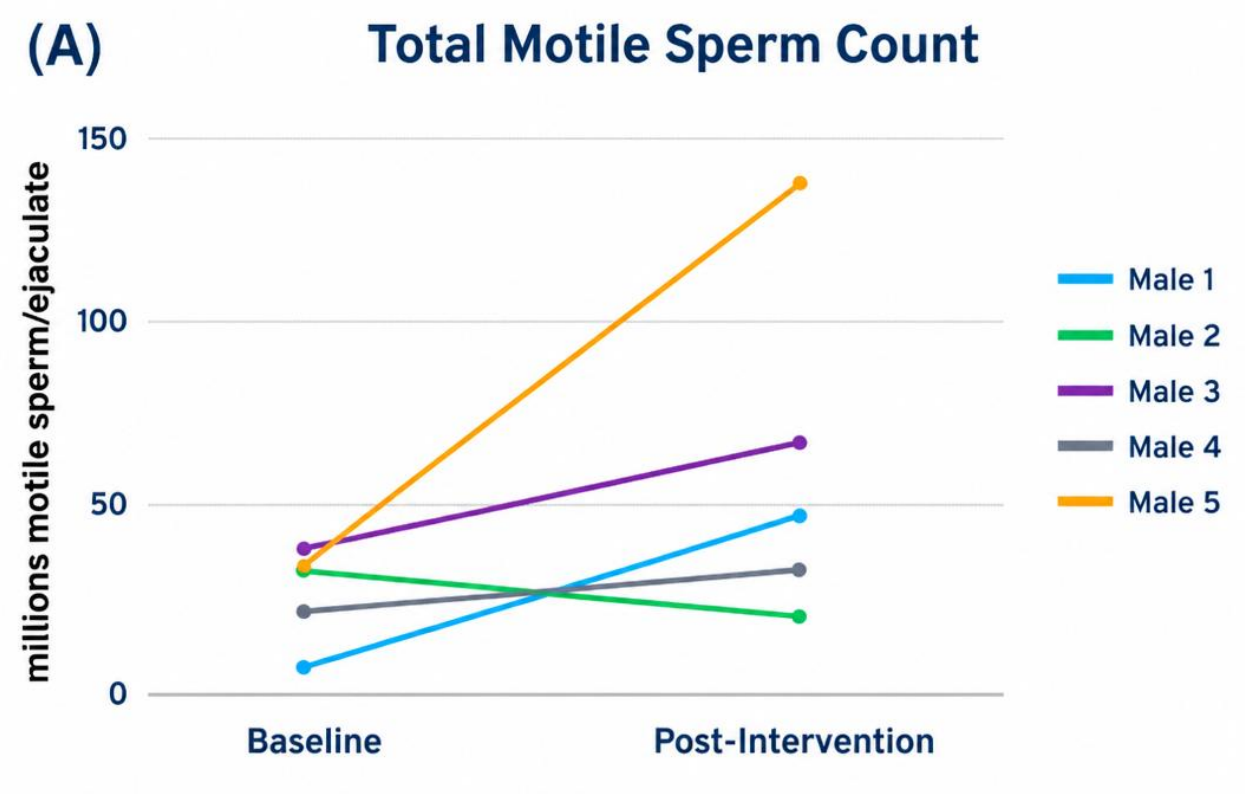


Abbreviations
PS – polystyrene
MPs – microplastics
PMMA - polymethyl methacrylate
NPs- nanoplastics

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Francis, et al. (2026), Liu, et al. (2025)

“The Plastic Detox” Shows Real-Life Benefits



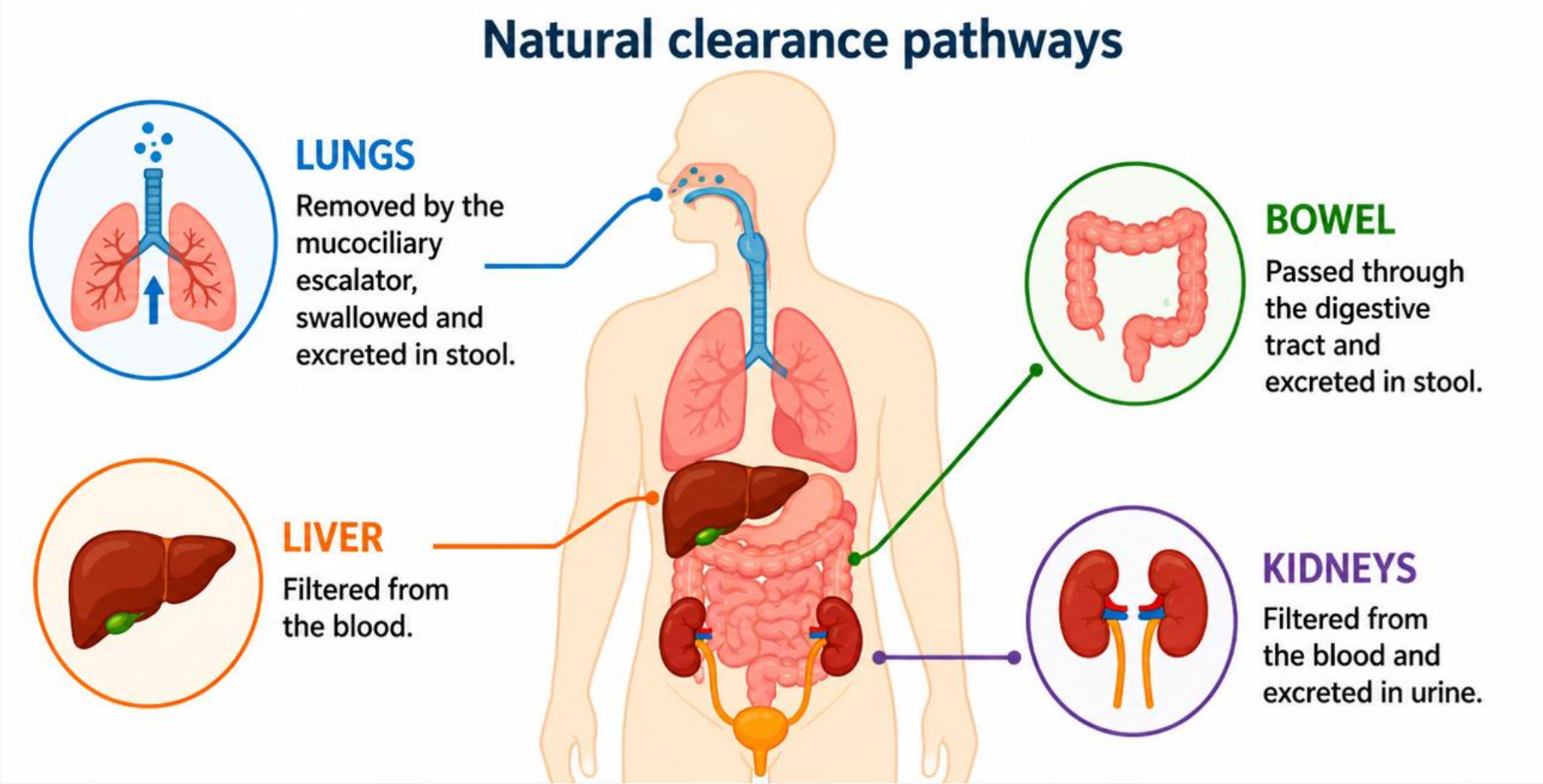
- Six couples over 12 weeks
- All TTC for >12 months
- One couple TTC for >10 years
- Mailed plastic free products for use in their homes – storage containers, wraps, straws etc.
- BPA and monobenzyl phthalate declined significantly

Four of the five couples achieved pregnancy and live birth following the 12-week intervention; one couple is expecting their second child

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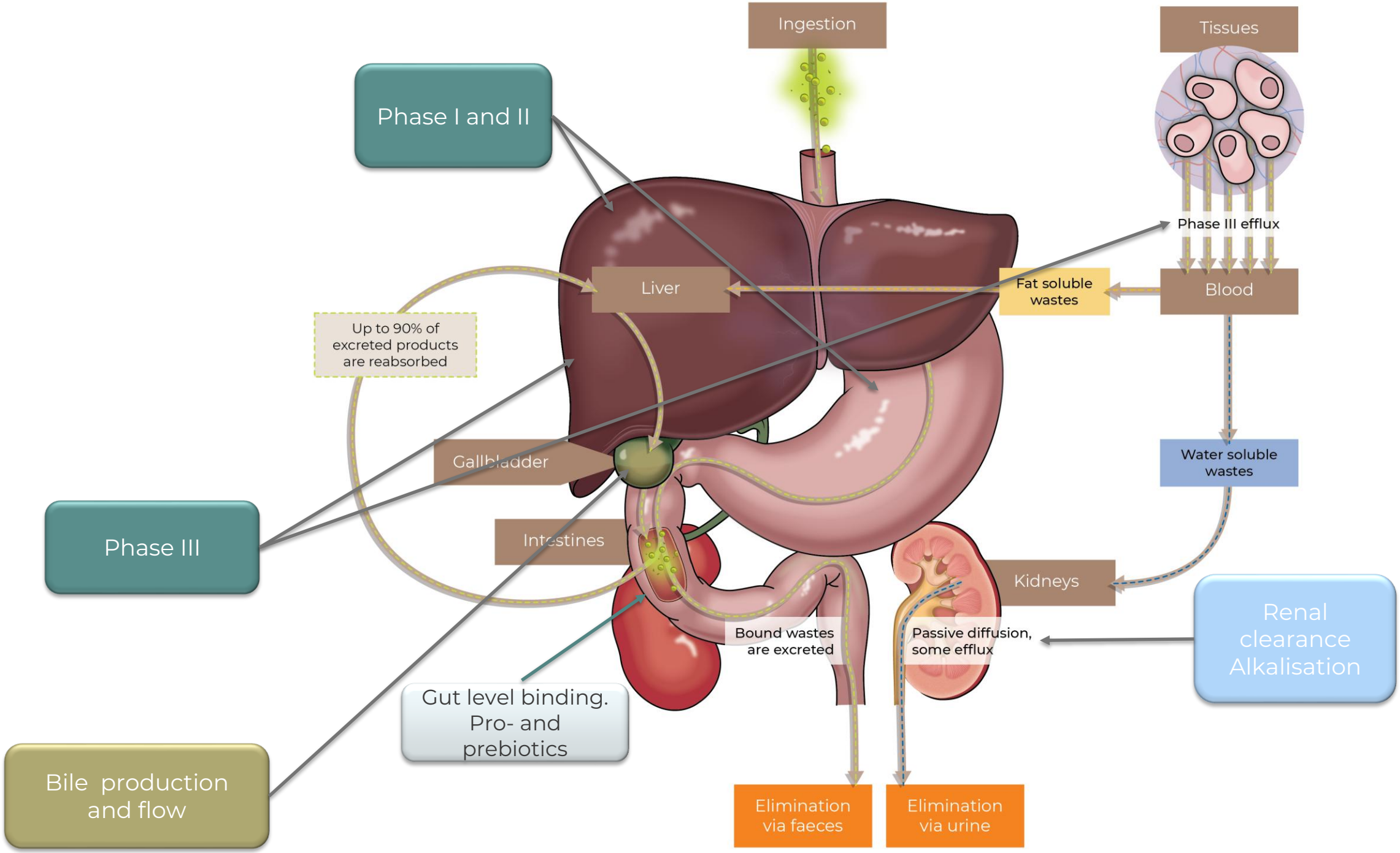
Hua, et al. (2026)

Number 2: Support Elimination Pathways



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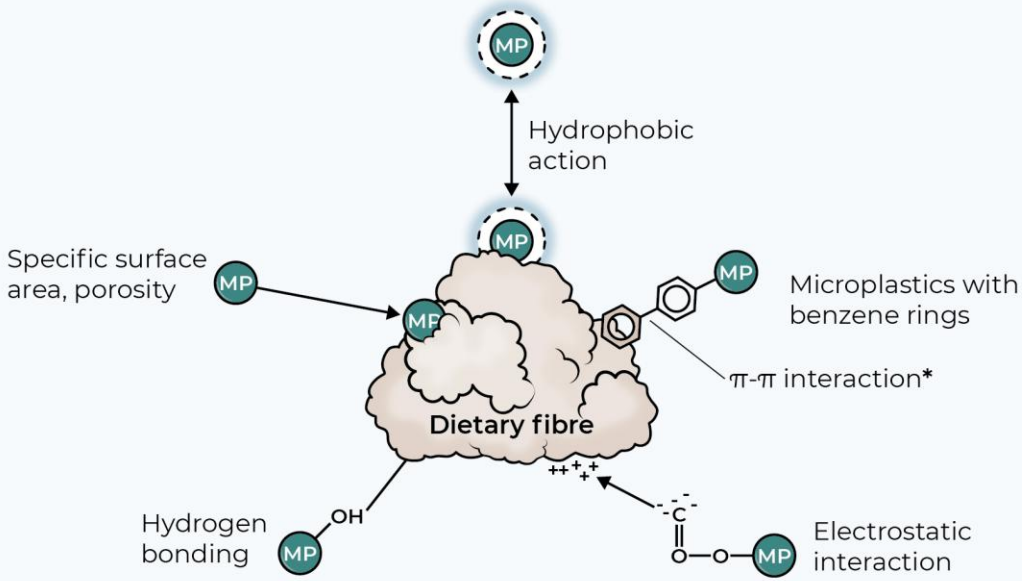
Hong, et al. (2025)


Ingestion
Tissues
Phase I and II
Phase III efflux
Liver
Fat soluble wastes
Blood
Up to 90% of excreted products are reabsorbed
Gallbladder
Water soluble wastes
Phase III
Intestines
Kidneys
Bound wastes are excreted
Passive diffusion, some efflux
Renal clearance Alkalisation
Gut level binding. Pro- and prebiotics
Bile production and flow
Elimination via faeces
Elimination via urine

Fibre Adsorbs Microplastics

Adsorption:

- The ability to attract and bind n
- Traps the toxin in the gut so it is excreted



Dietary fibre reduces the residence time of MPs in the GIT and facilitates their rapid removal

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Wang et al. (2024)

Fabulous Fibre

HOW FIBRE LOWERS TOXIN LOAD

1. Increases 24-hour gastrointestinal excretion of PFOA, PFOS and PFNA
2. Higher dietary quality — and diets richer in fruit and fibre — lowers serum PFAS concentrations
3. Decreases mercury in the brain, blood and small intestine, and increases its excretion in faeces and urine

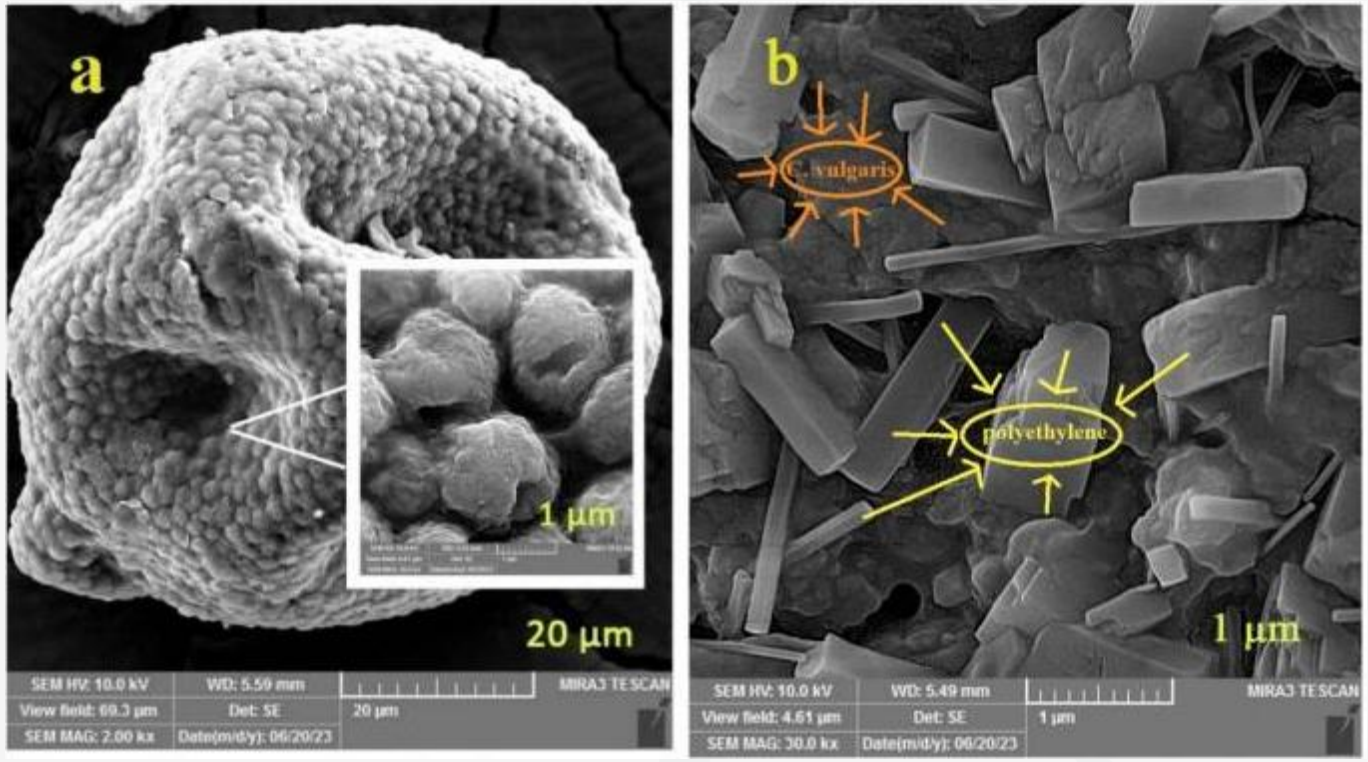
FIBRE ALSO ADSORBS

- Bile salts
- Cholesterol
- Aflatoxin
- Nitrites
- Heterocyclic amines
- Polycyclic aromatic hydrocarbons
- Acrylamides

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Dzierlenga et al. (2021), Sultan et al. (2023), Guo et al. (2021) Wang et al. (2024), Rodríguez-Viso et al. (2023)

Chlorella Creates a Microplastic Floc



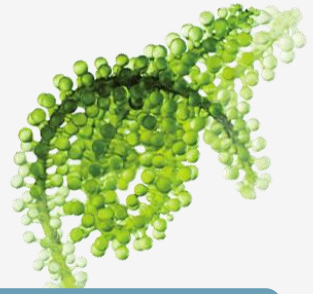
- A **floc** is a loose clump or cluster of fine particles that form together
- **Cell wall** passes through the GI tract unabsorbed
- Theoretically, chlorella will bind GI microplastics in a similar way that it binds in aquatic environments

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Esmaeili Nasrabadi, et al. (2023)

Chlorella

Single-celled green freshwater microalgae



Binds and Removes Toxins

- Chelates heavy metals – mercury, strontium, caesium, thallium
- Removes microplastics from aquatic environments
- Reduces PFAS levels in contaminated water
- Chlorophyll traps HCAs and PAHs; reduces HCAs in humans

Protective and Metabolic Effects

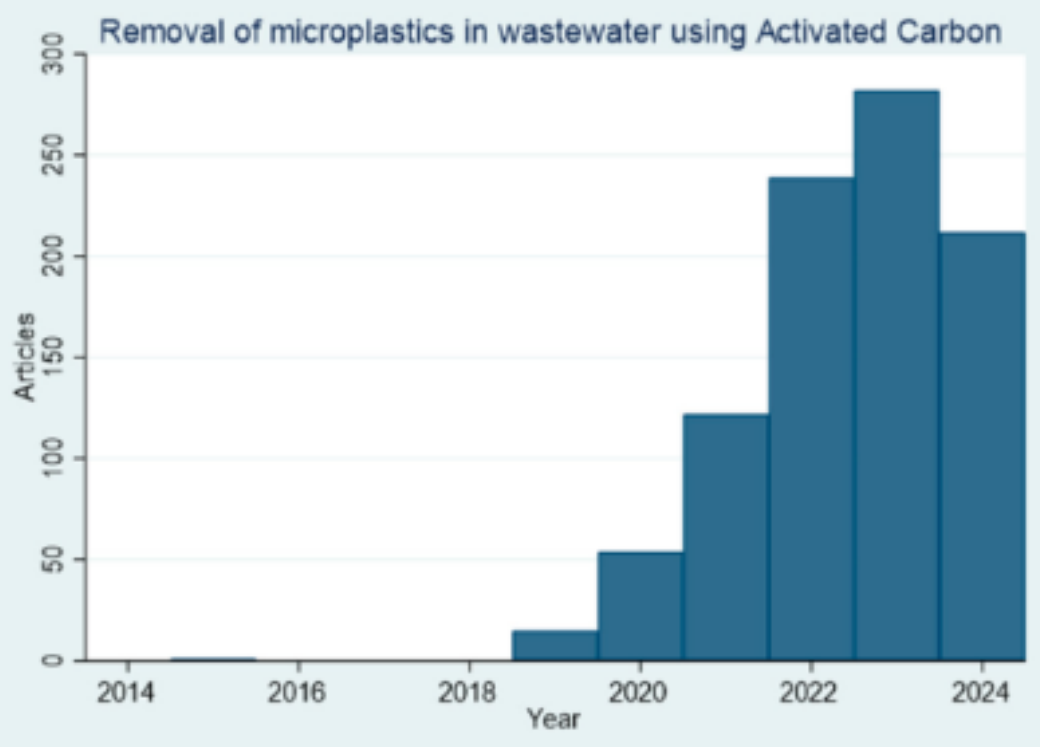
- Counteracts acrylamide-induced thyroid disturbance
- Antioxidant
- Lowers LDL-cholesterol
- Prevents histamine release (inhibits mast-cell degranulation via Th1 immune response)

Dosage: 200–1800 mg/day for 4–6 weeks, up to 3–10 g

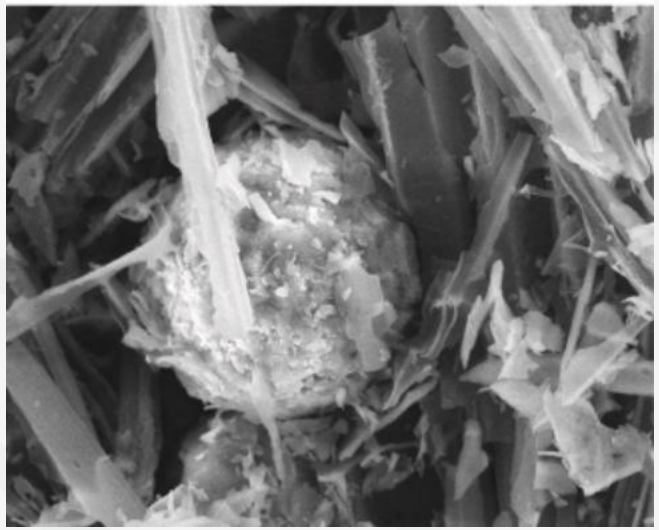
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Yadav et al. (2022), Merino et al. (2019), Nasrabadi et al. (2023), Bah (2022), Natural Medicines Comprehensive Database (2026), Lee et al. (2015), Alabbadi et al. (2022), Sherafi et al. (2022), Bae et al. (2013)

Activated Charcoal is Hitting the Research Bigtime



- Activated carbon and activated charcoal are chemically the same
- Large surface area and porous structures provide several active sites that can trap MPs



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Anuwa-Amarh, et al. (2024), Alom, et al. (2024)

Activated Charcoal – Microplastics and Other Toxins



WHAT IT IS

Coconut-derived and processed into a micro-porous structure with a very high surface area

HOW IT WORKS

Binds toxins in the GI lumen, reducing their absorption, reabsorption and systemic toxicity

DOSING

Single doses up to 100 g for acute poisoning; lower doses used for up to three years

WHAT IT BINDS and REMOVES

- **Drugs and poisons**
- **Heavy metals**
- **Cholesterol and bile salts**
- **Acrolein (with dietary fibre)**
- **Microplastics — water and gut**
- **PFAS, acrylamides, phthalates and PAHs**

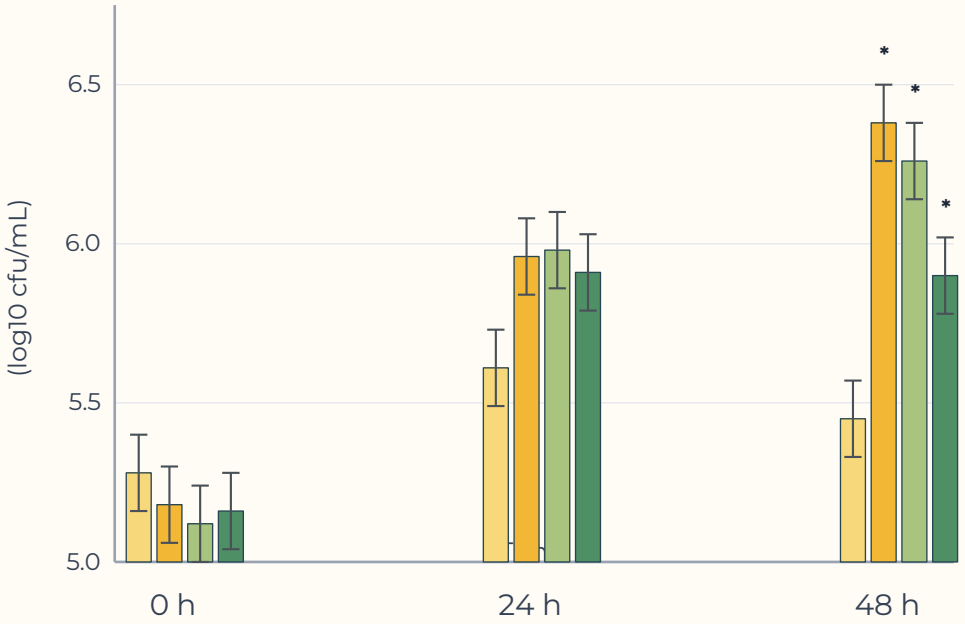
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Jrayed et al. (2024), Silberman et al. (2023), Neuvonen et al. (1989), Alom et al. (2024), Patrick and Pizzorno (2024), Cantoni et al. (2021), Australian Drinking Water Guidelines (1996), Yebra-Pimentel et al. (2014), Liu et al. (2024), Lamichhane et al. (2016), NMD 2026

Gold Kiwifruit Supports the Microbiome and So Much More

Gut microbiota response

Bifidobacterium spp increased over 24 to 48 hours



+

Clinical Trial Outcomes

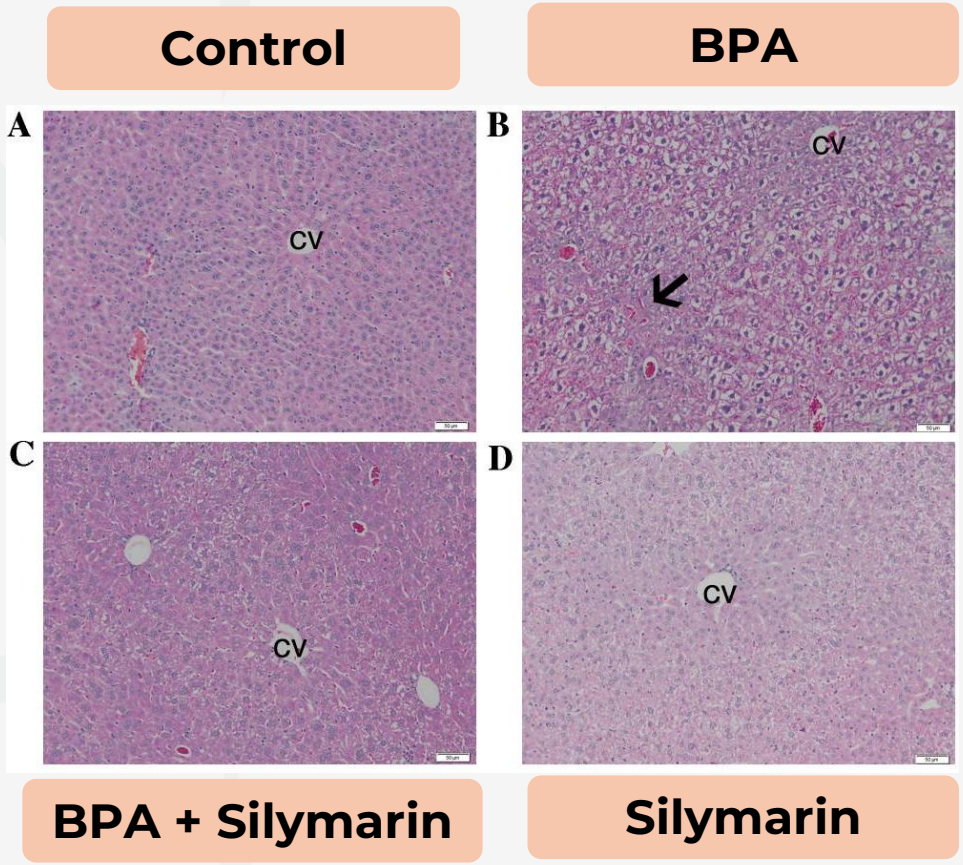
- **Severity and duration of cold symptoms**
- **Total wellbeing**
- **Constipation**
- **Post-prandial blood glucose**
- **Iron & vitamin C status**

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Parkar, et al. (2012), Billows, et al. (2025), Bayer, et al. (2022), Inoue, et al. (2021), Beck et al. (2011), Hunter, et al. (2012)

Smart Silybum Combats Fatty Liver and BPA

- Silybum rescues hepatic inflammation and histopathology due to BPA
- Improves liver enzymes and histology in MAFLD
- Protects against glutathione depletion
- Anti-inflammatory – reduces IL-6 and TNF-α
- Antioxidant



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Zaulet, et al. (2017), Wah-Kheong, et al. (2017), Zhong, et al. (2017), Wadhwa, et al. (2022)

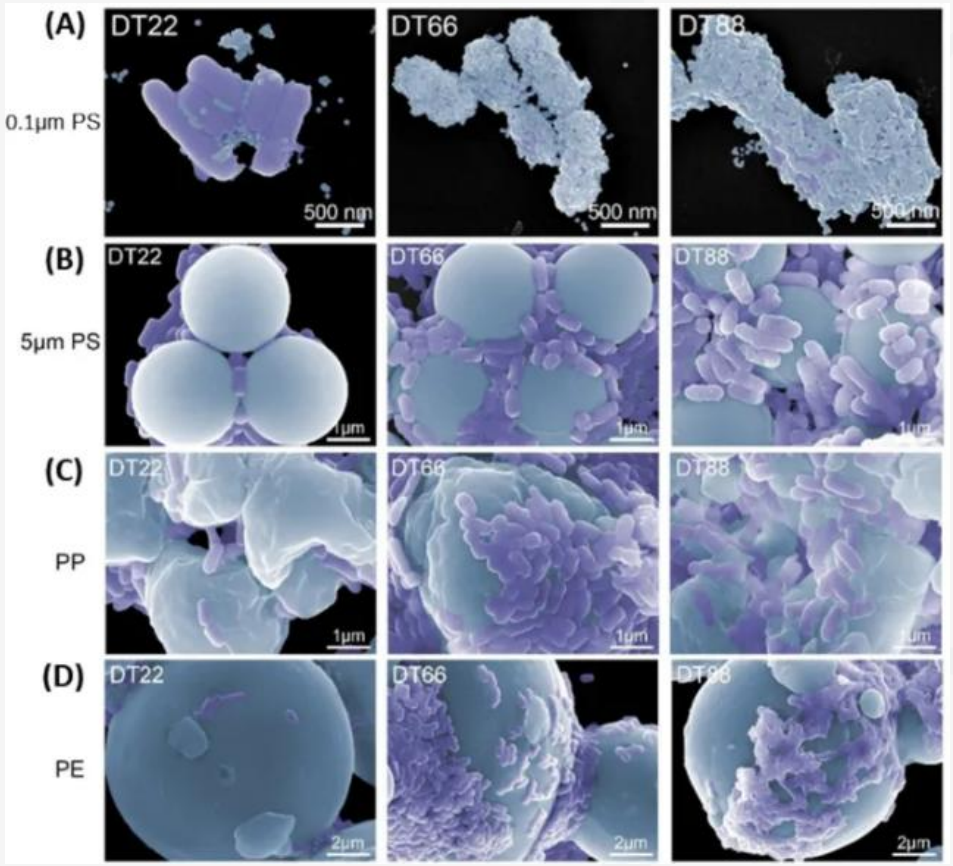
Alkalising Minerals Support Kidney Detox

- Alkalisation is the standard medical approach to poisoning from:
  - Organophosphate pesticides (OPs)
  - Salicylates
  - Methanol and ethylene glycol
  - Methotrexate
  - Phenobarbital
  - Chlorpropamide
  - Fluoride
- And has been shown to improve ochratoxin elimination

- Metabolic acidosis causes **mitochondrial stress** in the renal tubules which alkalisation reverses
- Alkalising therapy increases urinary pH which supports the excretion of weak bases

Roberts & Buckley. (2005), Mirrakhimov, et al. (2017), Silva (2022)

Polystyrene ‘Flocs’ to Probiotics



Research into probiotics and microplastics (and other chemicals) is **nascent**

This study specifically looked at **polystyrene** and fermented food derived ***Lacticaseibacillus paracasei*** **DT66, DT88 and DT22** (animal study)

Adsorption ratios were **71,4%, 79.8% and 6.2%** (respectively)

What we can infer from this research: adsorption is **strain and likely chemical specific**

Probiotics and fermented foods offer **potential benefit** – but **research is lacking** – watch this space!

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Teng, et al. (2025)

Implementation in Clinical Practice



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Week One and Two: Preparation and Support

Phase I, II & III Detoxification Support	Prepare and protect the liver, gallbladder and kidneys Antioxidant support	**St. Mary's thistle** to prepare & protect the liver, **cleavers** for renal protection, **dandelion** and **choline** for bile production **Broccoli sprout, schisandra** and **St. Mary's thistle** for antioxidant protection
Probiotic Blend for Digestive Comfort	Support gut barrier and microbial balance Detoxify heavy metals and toxins	***Lactiplantibacillus plantarum* Lpla33 (DSM 34428)** improves barrier function and protects the liver against toxicity ***Bifidobacterium longum* CECT 7347 (HT-ES1)** increases butyrate-producing species, supporting liver and kidney function
Alkalising Minerals	Replenish minerals Alkalise urine	**Mineral citrates and carbonates** replenish minerals for enzyme function and optimise kidney function

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Week Three and Four: Mobilise and Bind

Phase I, II & III Detoxification Support	Mobilise and excrete toxins Antioxidant support	**Schisandra and quercetin** promote phase I **Broccoli sprout, schisandra, choline** and **moringa** promote phase II **Broccoli sprout** and **quercetin** promote phase III **Broccoli sprout, schisandra, barley grass, moringa** and **St. Mary's thistle** for antioxidant protection
Probiotic Blend for Digestive Comfort	Support gut barrier and microbial balance Detoxify heavy metals and toxins	***L. plantarum* Lpla33 (DSM 34428)** improves barrier function and binds heavy metals in the gut ***B. longum* CECT 7347 (HT-ES1)** increases butyrate-producing species, supporting liver and kidney function
Alkalising Minerals	Replenish minerals Alkalise urine	**Mineral citrates and carbonates** support renal clearance of toxins and protect the kidneys
Gut Level Toxin Binder	Bind toxins for excretion Prevent enterohepatic recycling Inhibit ß glucuronidase	**Konjac** inhibits ß glucuronidase **Activated charcoal** binds toxins and protects the kidneys **Chlorella** binds heavy metals and toxins **Kiwifruit** provides fibre for toxin excretion **Globe artichoke** protects the liver and promotes bile flow

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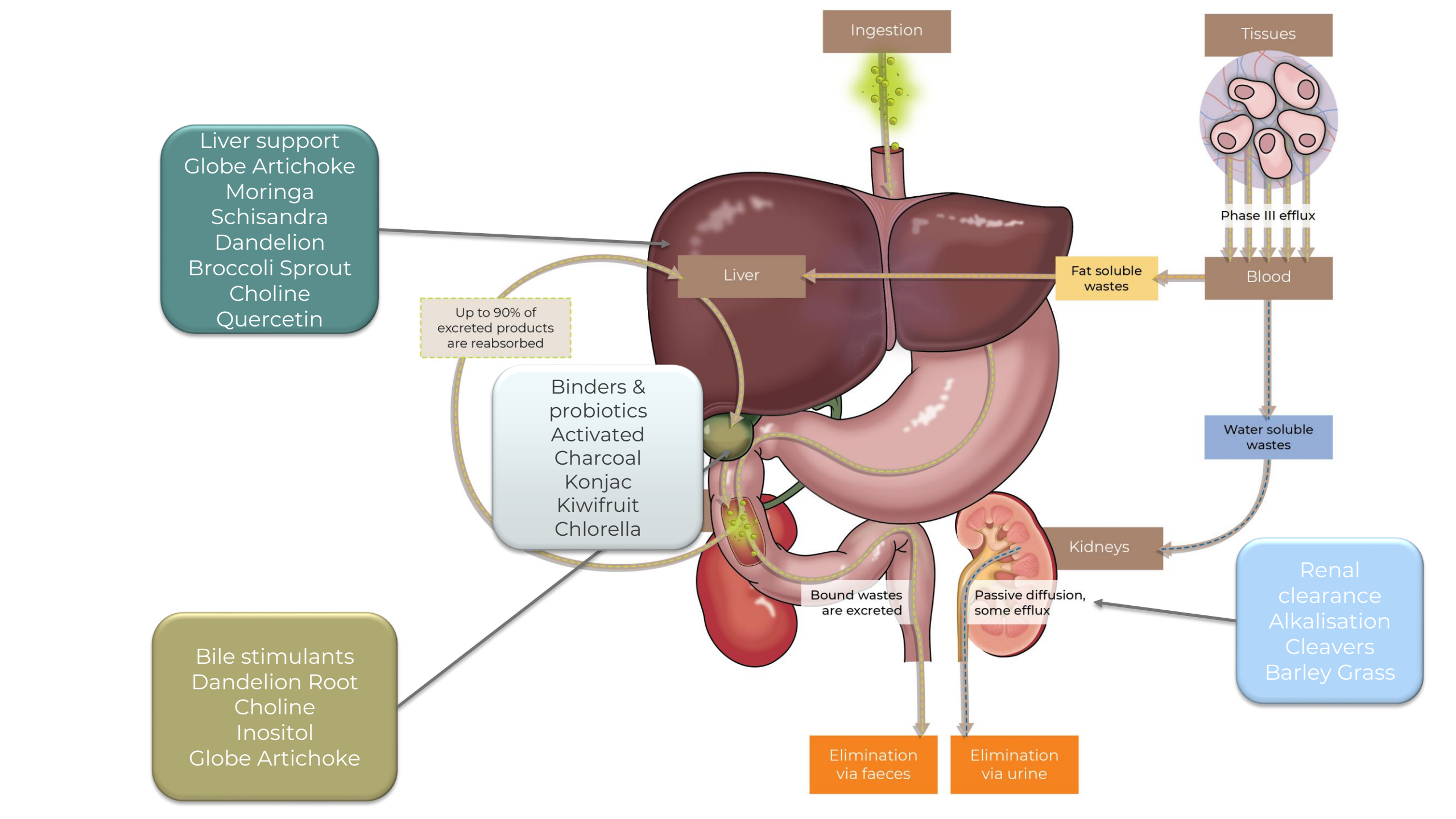
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Post-Detox: Replenish Minerals and Microbiome

Probiotic Blend for Microbiome Restoration	Restore the microbiome	***B. longum* CECT 7347 (HT-ES1)** increases butyrate=producing species ***Lactobacillus rhamnosus* GG** restores microbial stability ***Saccharomyces boulardii*** binds pathogens, modulates the immune system and has trophic effects
Alkalising Minerals	Replenish minerals Restore pH	**Mineral citrates and carbonates** replenish minerals and support whole body pH

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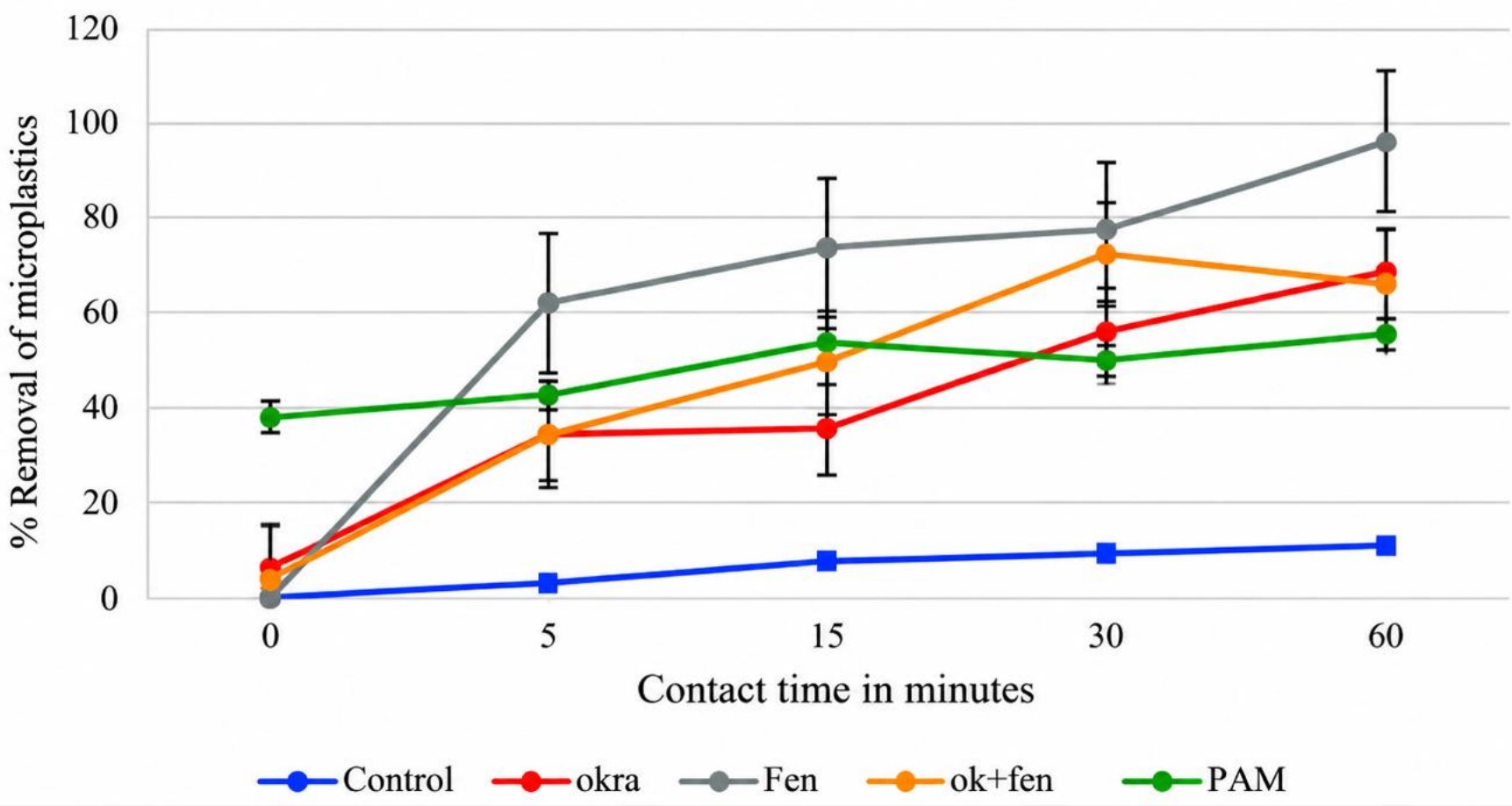

Liver support
Globe Artichoke
Moringa
Schisandra
Dandelion
Broccoli Sprout
Choline
Quercetin
Ingestion
Tissues
Phase III efflux
Liver
Fat soluble wastes
Blood
Up to 90% of excreted products are reabsorbed
Binders & probiotics
Activated Charcoal
Konjac
Kiwifruit
Chlorella
Water soluble wastes
Kidneys
Bound wastes are excreted
Passive diffusion, some efflux
Renal clearance
Alkalisation
Cleavers
Barley Grass
Bile stimulants
Dandelion Root
Choline
Inositol
Globe Artichoke
Elimination via faeces
Elimination via urine

Food-Based Interventions for Plastic Detox

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Fenugreek and Okra: An Anti-plastic Curry Recipe

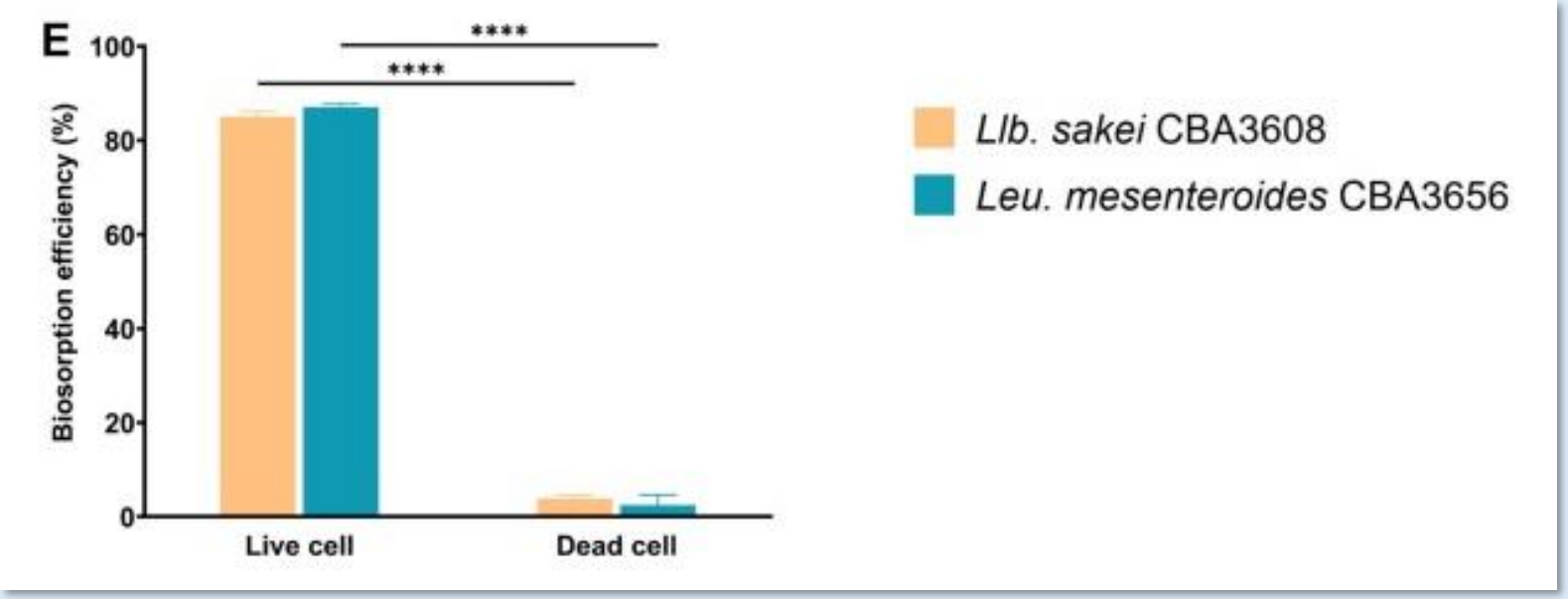


- % removal of **polystyrene** in simulated water samples
- **Okra + fenugreek** most efficient for **freshwater** samples with an ~77% microplastic removal.
- For the **ocean** water, **okra** showed the best removal efficiency of ~80%

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Srinivasan, et al. (2025)

My Oh My it’s Kimchi!





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Lee, et al. (2026)

Research from the World Institute of Kimchi

Antioxidants Minimise Harm



MICROPLASTICS =
Oxidative stress

01	**Vitamin C**	Co-treatment significantly reduced oxidative stress markers in microplastic-exposed human lung fibroblasts.
02	**Quercetin**	Treatment significantly decreased oxidative stress in microplastic-exposed human intestinal cells.
03	**Curcumin**	Scavenged ROS and enhanced the expression of antioxidant enzymes in exposed cell models.
04	**Resveratrol**	Decreased ROS levels and increased antioxidant enzyme activity across various exposed cell models.

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Wang, et al. (2025)

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Vitamin E to the PFAS Rescue

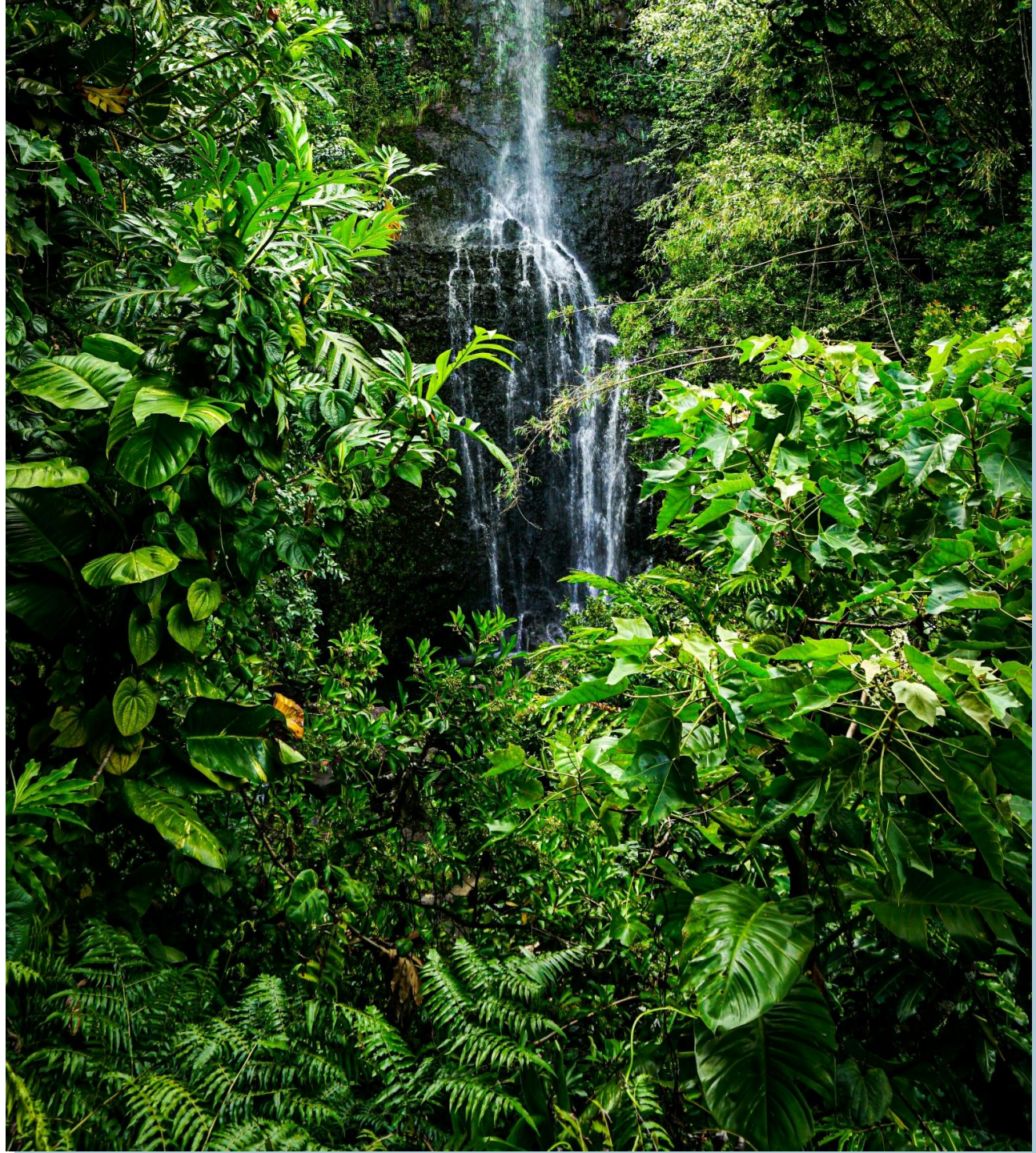
- PFAS exposure increases the risk of diabetes
  - Males and older individuals with higher PFAS levels had an increased risk of diabetes
  - Vitamin E (specifically alpha-tocopherol) exhibited significant interaction effects with PFAS, modulating blood glucose levels



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Chang et al. (2025)

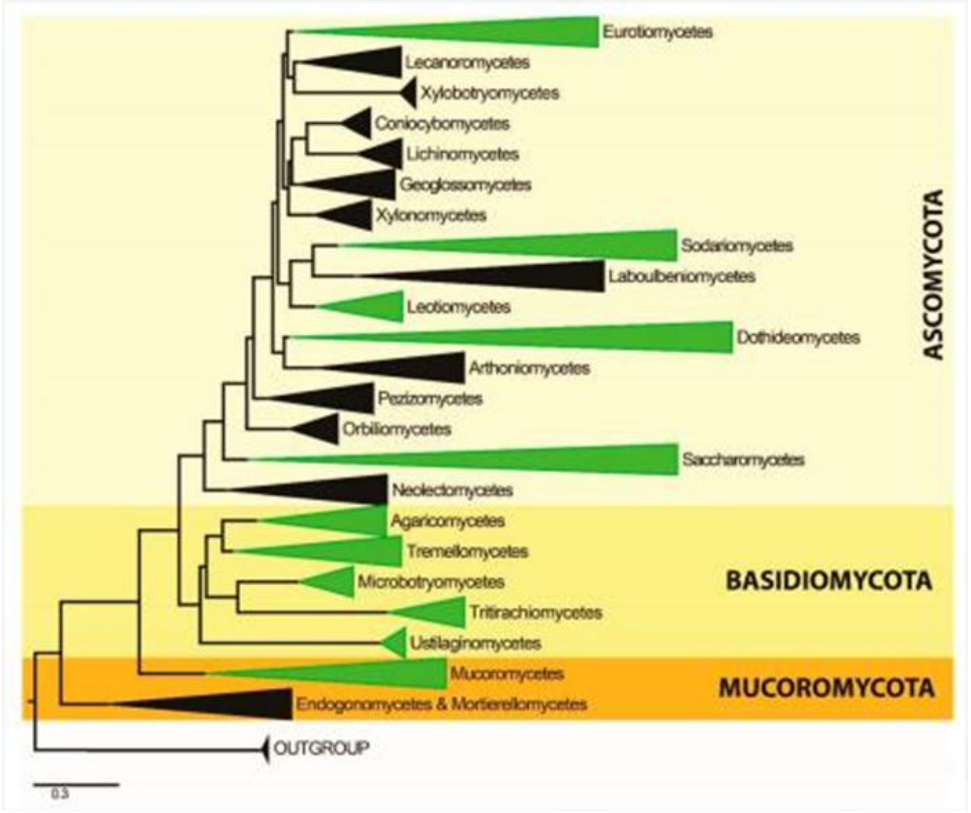
Hope for the Future



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Fungi: Nature's Plastic Degraders

Plastic-degrading fungi across major fungal groups



Phylogenetic overview

01

Unique plastic-degrading enzymes

Certain fungi produce enzymes capable of attacking both macroplastics and microplastics.

02

Eurotiomycetes lead the way

Eurotiomycetes contain the greatest diversity of identified plastic-degrading fungi.

Potential for natural bioremediation

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Adapted from Ekanayaka et al. (2022)

Review

Plastic mulching in agriculture. Trading short-term agronomic benefits for long-term soil degradation?

Zacharias Steinmetz [a], Claudia Wollmann [a], Miriam Schaefer [a], Christian Buchmann [a], Jan David [a], Josephine Tröger [b,c], Katherine Muñoz [a,c], Oliver Frör [d], Gabriele Ellen Schaumann [a,*]



CSIRO's plastic mulch alternative boosts water productivity by 30%

CSIRO's latest invention, TranspiratiONal, a spray-on polymer membrane will help farmers increase crop yield and save water, but with fewer inputs and less environmental impact.

Questions



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Thank You

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