Centrum environmentálního výzkumu:
Odpadové a oběhové hospodářství a environmentální bezpečnost

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INSTITUTE OF CHEMICAL PROCESS FUNDAMENTALS OF THE ASCR

VŠB TECHNICKÁ UNIVERZITA OSTRAVA

VYSOKÁ ŠKOLA CHEMICKO-TECHNOLOGICKÁ V PRAZE

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

VÚV TGM

WP 1.B NOVÉ DRUHY ODPADŮ A TECHNOLOGIÍ
WP 2.B KONTAMINACE HORNINOVÉHO PROSTŘEDÍ

konference
Životní prostředí – Prostředí pro život
2. – 3. 11. 2023, NTK Praha

T A
Č R

Tento projekt je spolufinancován se státní podporou Technologické agentury ČR a Ministerstva životního prostředí v rámci **Programu Prostředí pro život.**

www.tacr.cz www.mzp.cz

Negativní vliv mikroplastů na životní prostředí

Tomáš Cajthaml

Ústav pro Životní prostředí, Přírodovědecká fakulta

Univerzita Karlova, Benátská 2, 128 01 Praha 2

Původ mikroplastů

PRIMÁRNÍ MIKROPLASTY

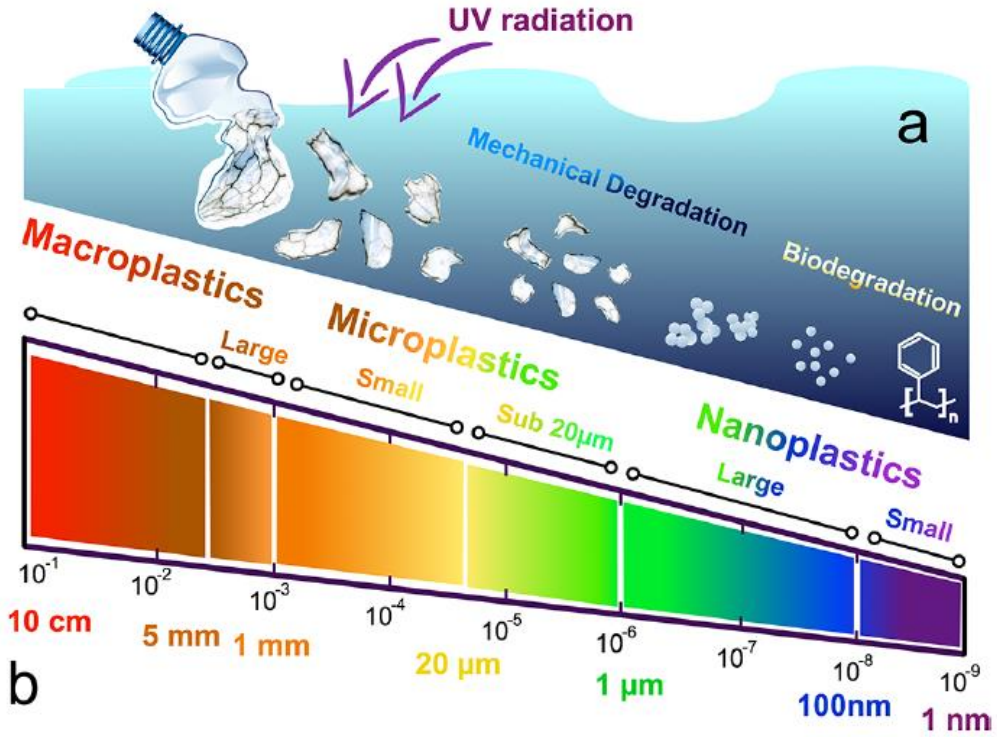
do životního prostředí vstupují v podobě mikročástic

X

SEKUNDÁRNÍ MIKROPLASTY

vznikají z životním prostředí rozpadem větších plastových předmětů

Proces degradace plastů a dělení částic dle velikosti



Gillibert, R. *et al.* (2019) 'Raman tweezers for small microplastics and nanoplastics identification in seawater', *Environmental Science and Technology*, 53(15), pp. 9003–9013. doi: 10.1021/acs.est.9b03105.

Celosvětová produkce plastů

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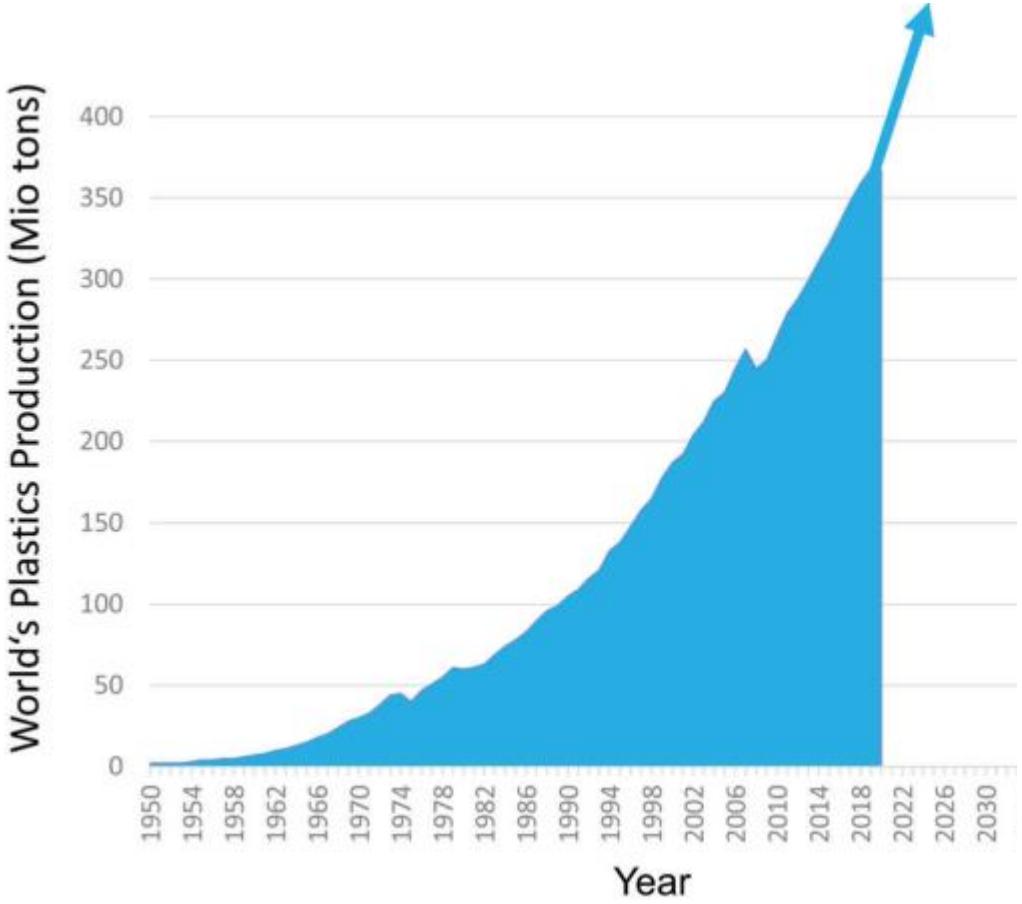
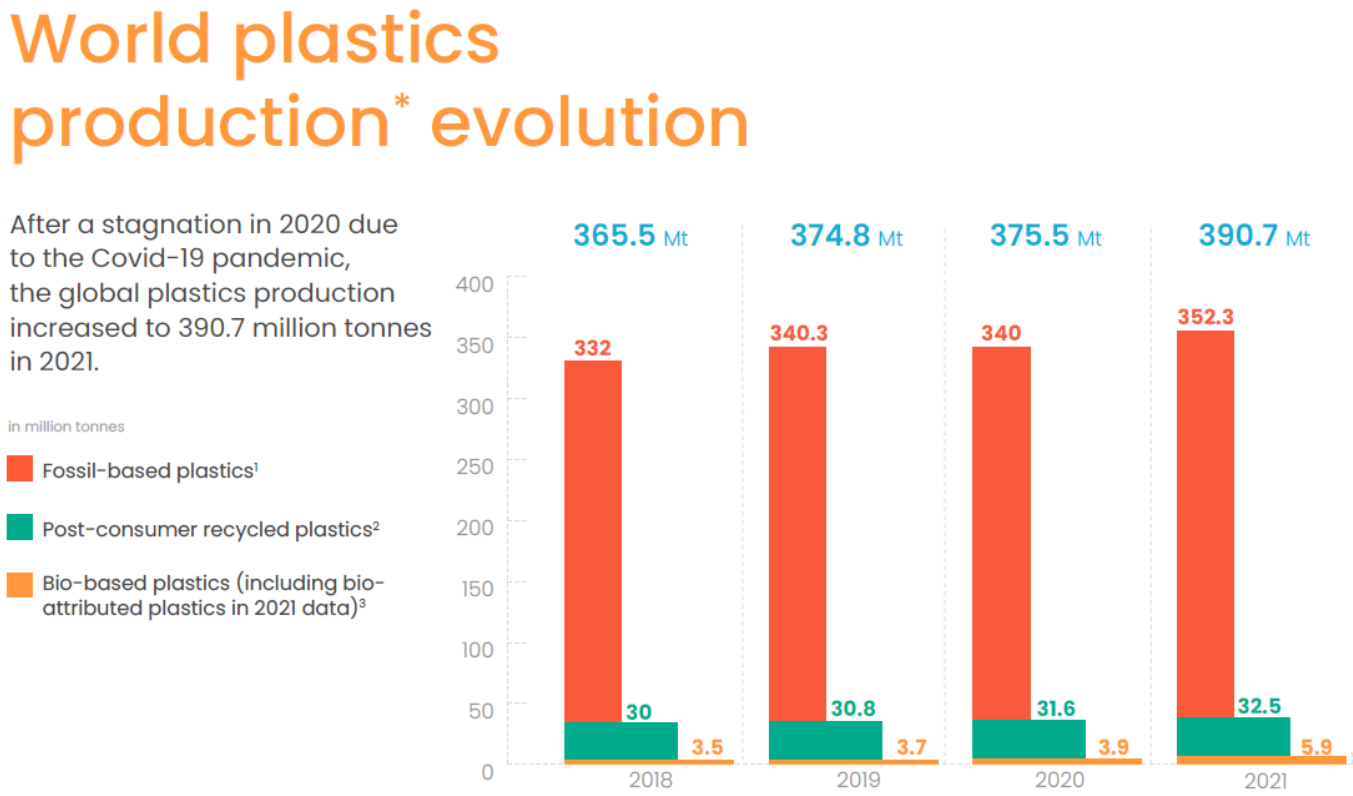
Od počátků



Closing the Carbon Loop in the Circular Plastics Economy, Carl G. Schirmeister and Rolf Mülhaupt*, Macromol. Rapid Commun. 2022, 2200247

V posledních letech



PlasticsEurope (2022) Plastics – the Facts 2022

Využití plastů x čas jejich rozkladu

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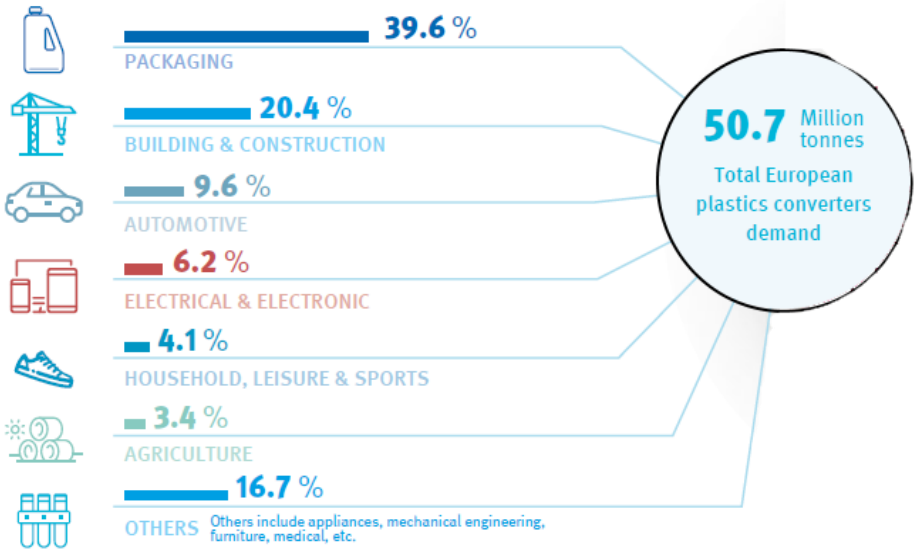
PLASTICS DEMAND BY SEGMENT 2019

Distribution of European (EU28+NO/CH) plastics converters demand by segment in 2019. Packaging and building & construction by far represent the largest end-use markets. The third biggest end-use market is the automotive industry.

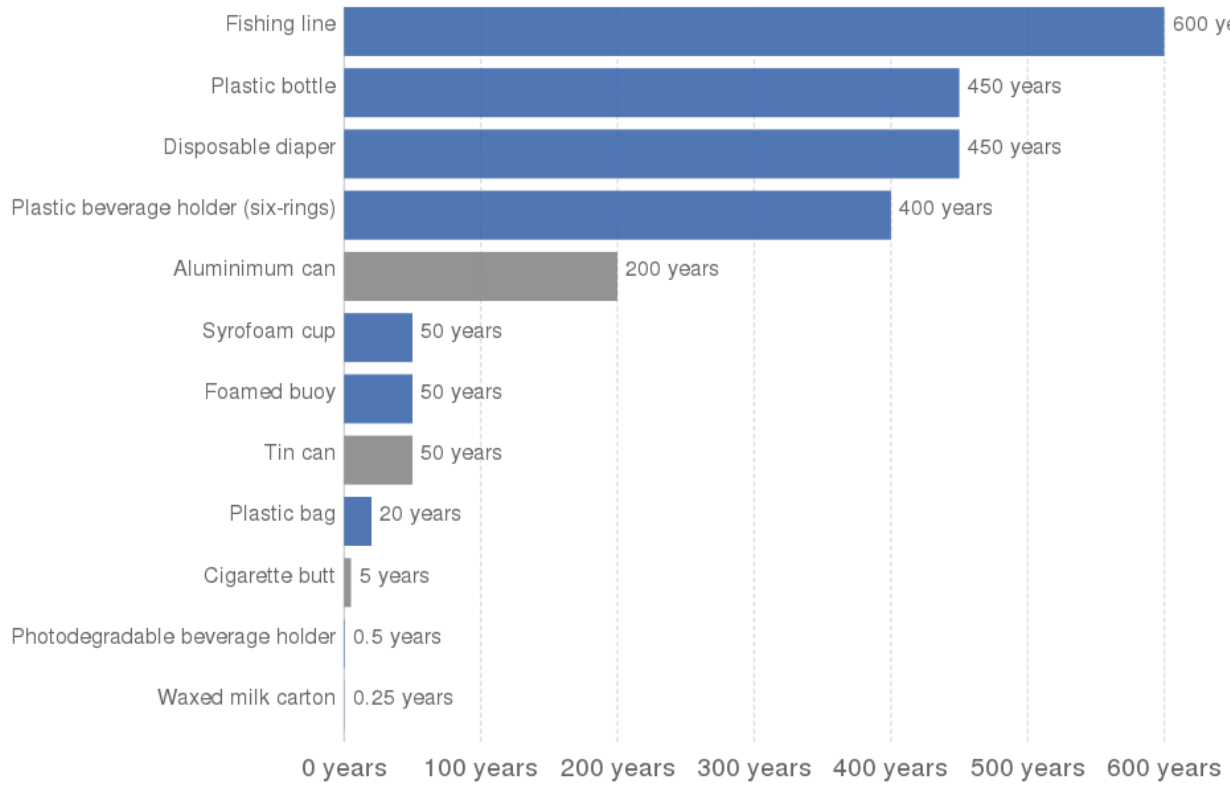
SOURCE: PlasticsEurope Market Research Group (PEMRG) and Conversio Market & Strategy GmbH



PlasticsEurope (2019) Plastics – the Facts 2019 An analysis of European plastics production, demand and waste data.

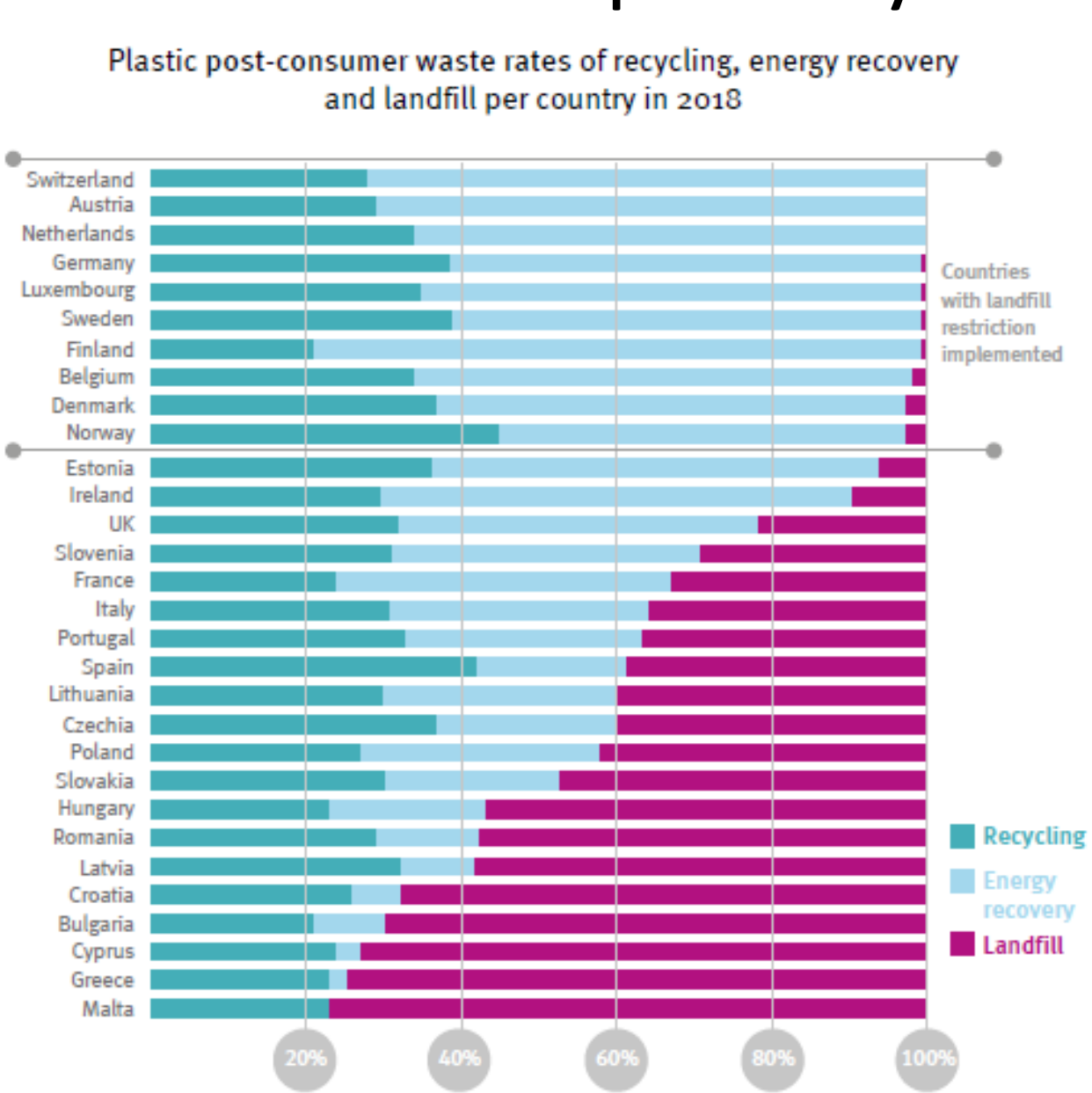
Decomposition rates of marine debris items

Average estimated decomposition times of typical marine debris items. Plastic items are shown in blue.



Source: U.S. National Park Service; Mote Marine Lab; National Oceanic and Atmospheric Administration Marine Debris Program

Nakládání s plastovým odpadem



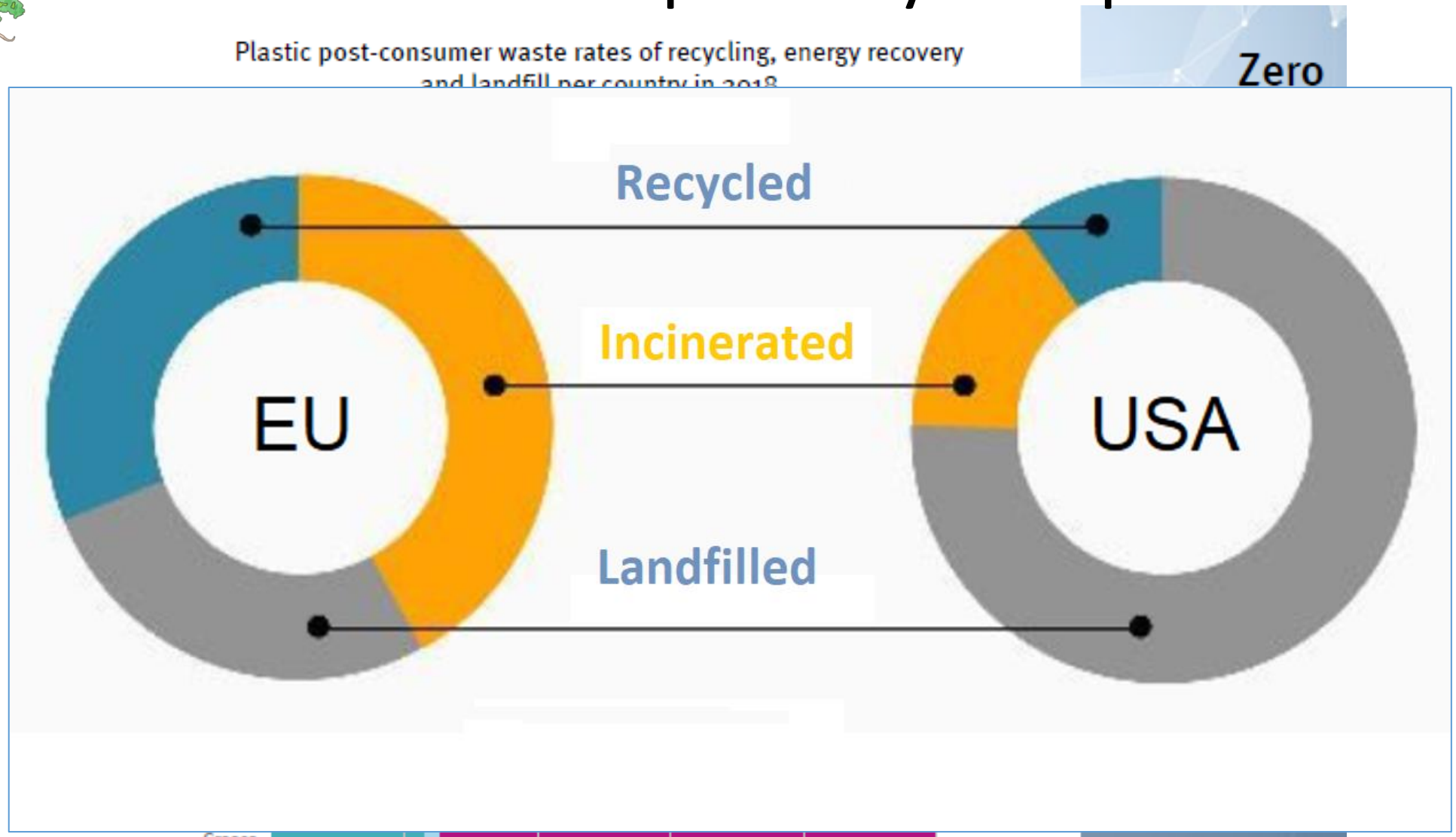
Zero landfilling is needed to achieve the circular economy of plastics

Countries with landfill restrictions of recyclable and recoverable waste have, on average, higher recycling rates of plastic post-consumer waste.

SOURCE: Conversio Market & Strategy GmbH

PlasticsEurope (2020) *Plastics – the Facts 2019 An analysis of European plastics production, demand and waste data*, *PlasticsEurope*.

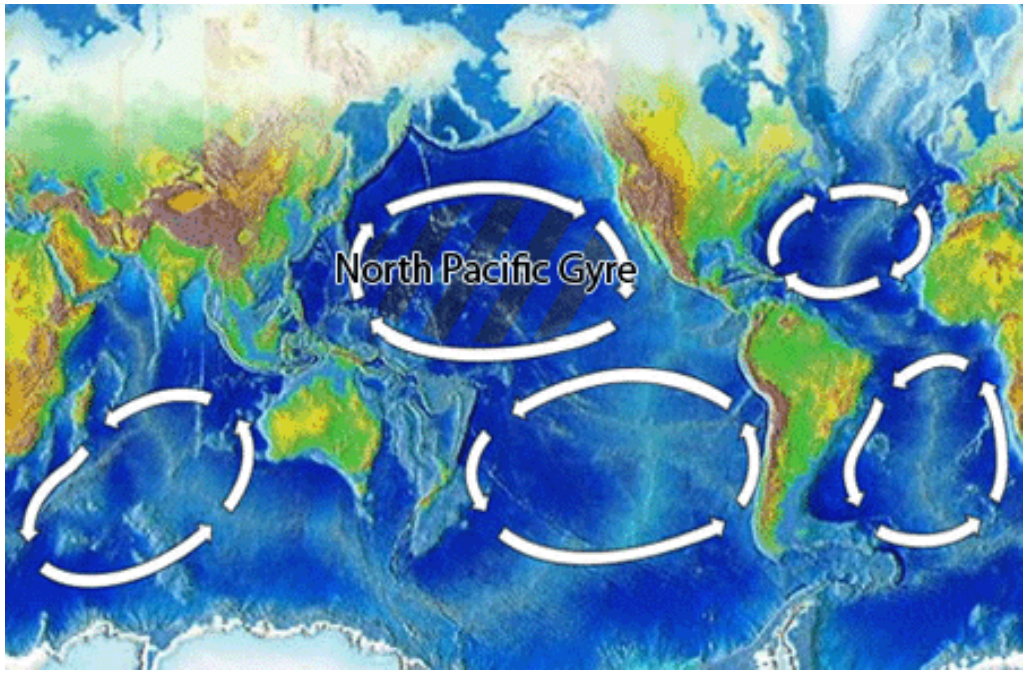
Nakládání s plastovým odpadem



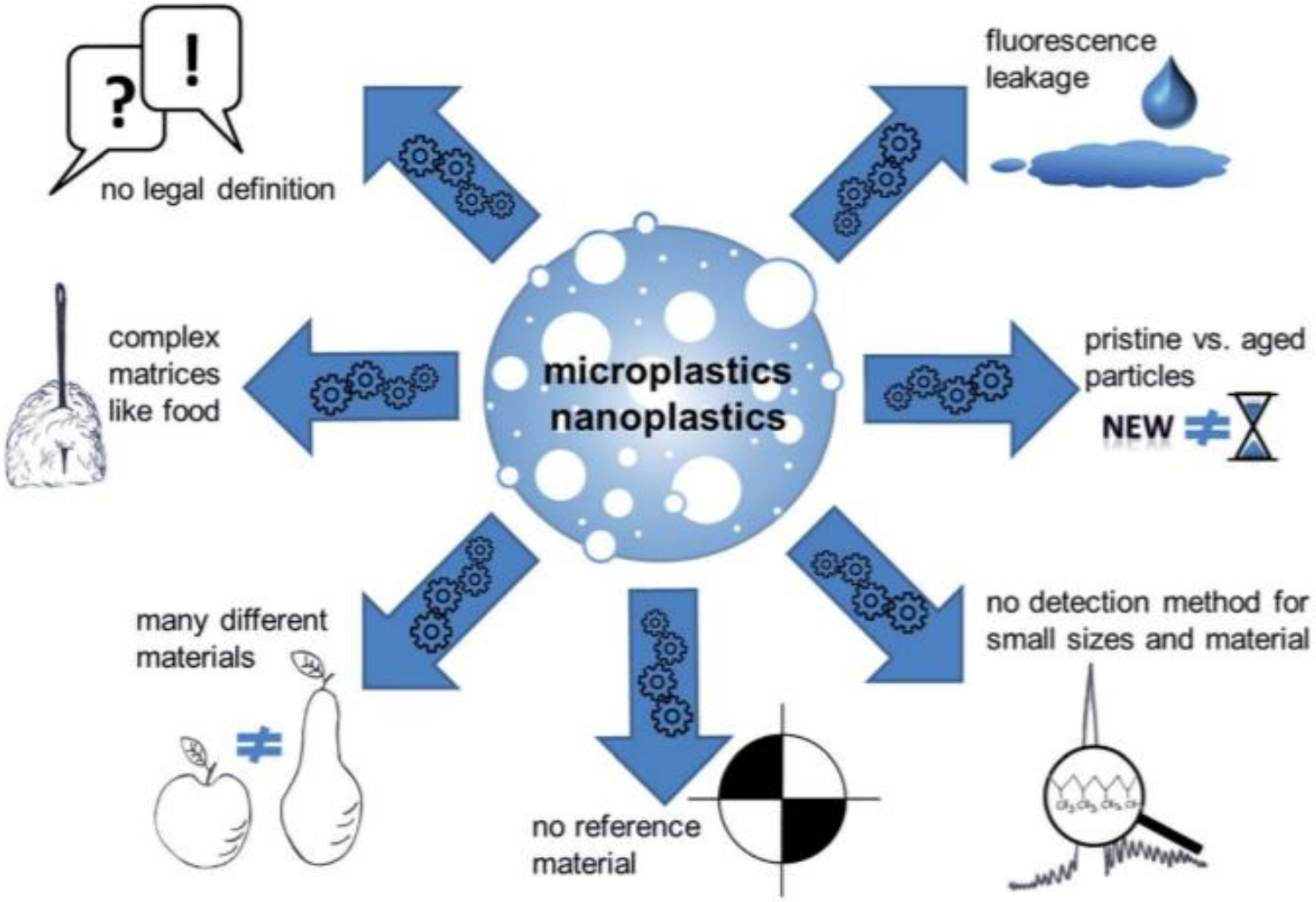
PlasticsEurope (2020) *Plastics – the Facts 2019 An analysis of European plastics production, demand and waste data*, *PlasticsEurope*.

Nakládání s plastovým odpadem

Velká tichomořská odpadková skvrna (4x rozloha Německa)



Výzvy a nástrahy výzkumu mikro- a nanoplastů



Paul, M. B. *et al.* (2020) 'Micro- And nanoplastics-current state of knowledge with the focus on oral uptake and toxicity', *Nanoscale Advances*. Royal Society of Chemistry, pp. 4350–4367. doi: 10.1039/d0na00539h.

Nástrahy výzkumu mikroplastů: tvar a materiál

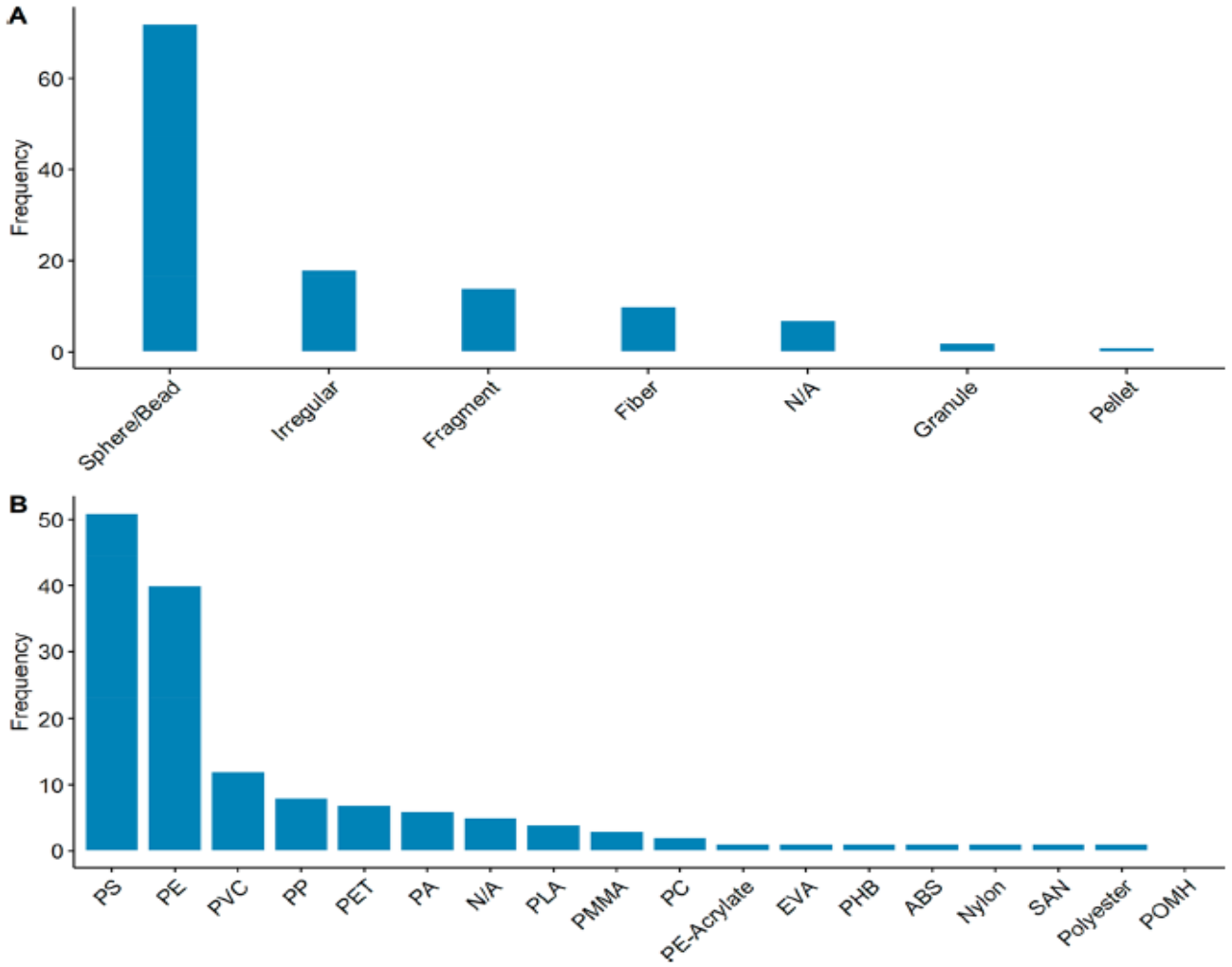
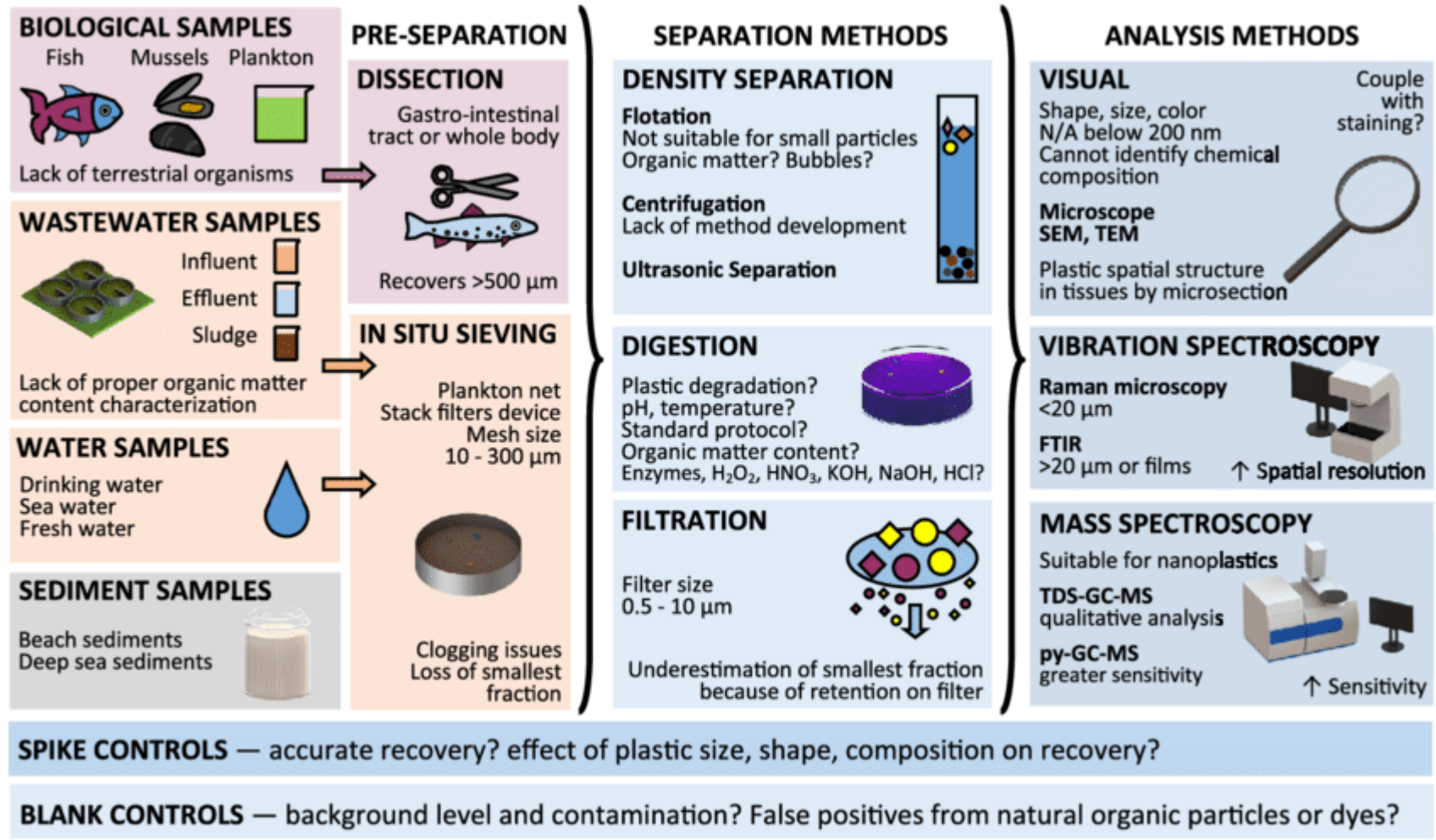


Figure 2. Number of studies reporting a particular shape (A) or polymer type (B) for the microplastics used in the exposure tests (from a total of 124 records for shapes and 145 records for polymer types). PS = polystyrene, PE = polyethylene, PVC = polyvinyl chloride, PP = polypropylene, PET = terephthalate, PA = polyamide, N/A = not analyzed, PLA = polylactic acid, PMMA = poly(methyl methacrylate), PC = polycarbonate, PE-Acrylate = polyethylene-Acrylate, EVA = ethylene-vinyl acetate, PHB = polyhydroxybutyrate, ABS = acrylonitrile butadiene styrene, SAN = styrene acrylonitrile resin, and POMH = polyoxymethylene-homopolymer.

De Ruijter, V. N. *et al.* (2020) 'Quality Criteria for Microplastic Effect Studies in the Context of Risk Assessment: A Critical Review', *Cite This: Environ. Sci. Technol*, 54, pp. 11692–11705. doi: 10.1021/acs.est.0c03057

Metody detekce mikroplastů



Overview of microplastics and nanoplastics separation and analysis methods in simple and complex matrices

Nguyen, B. et al. (2019) 'Separation and Analysis of Microplastics and Nanoplastics in Complex Environmental Samples'. doi: 10.1021/acs.accounts.8b00602.

Kde byly mikroplasty nalezeny?

(Liebezeit and Liebezeit al., 2013, 2014)

(Schymanski et al., 2018)

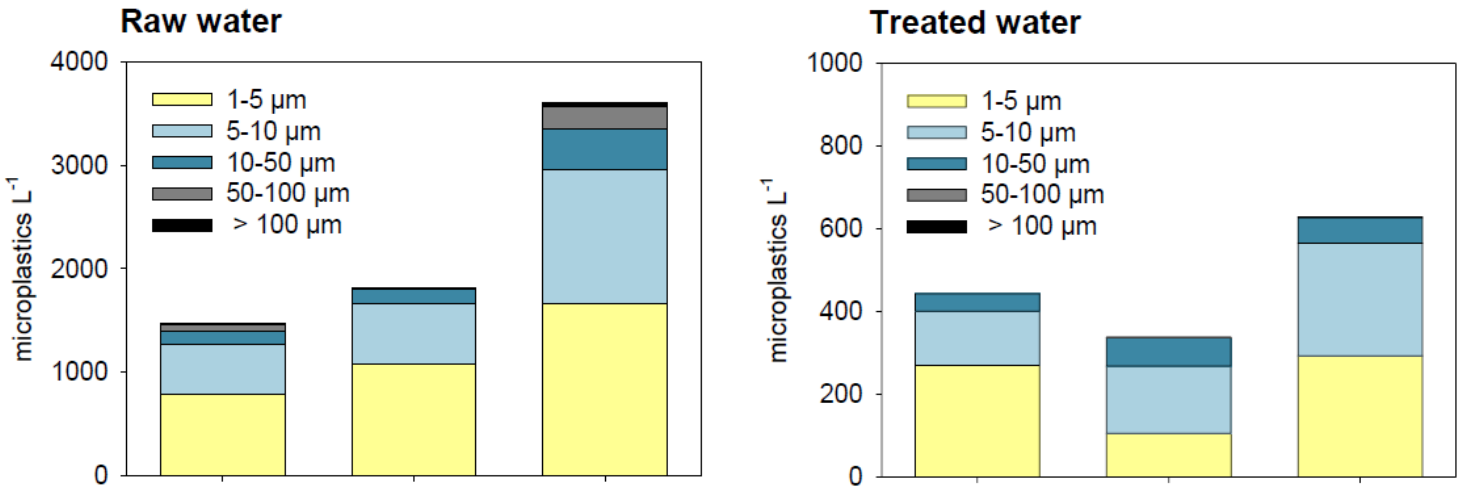
(Li et al., 2015)

(Hernandez et al., 2019)

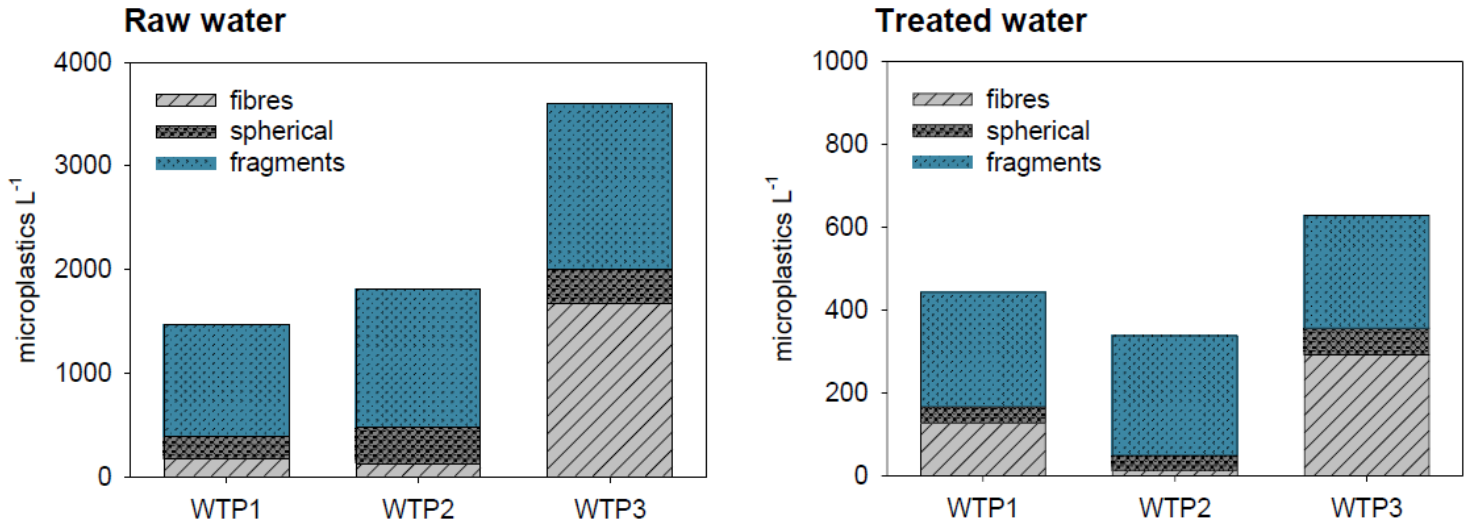
(Yang et al., 2015)

Mikroplasty v pitných vodách v České republice

Velikostní distribuce

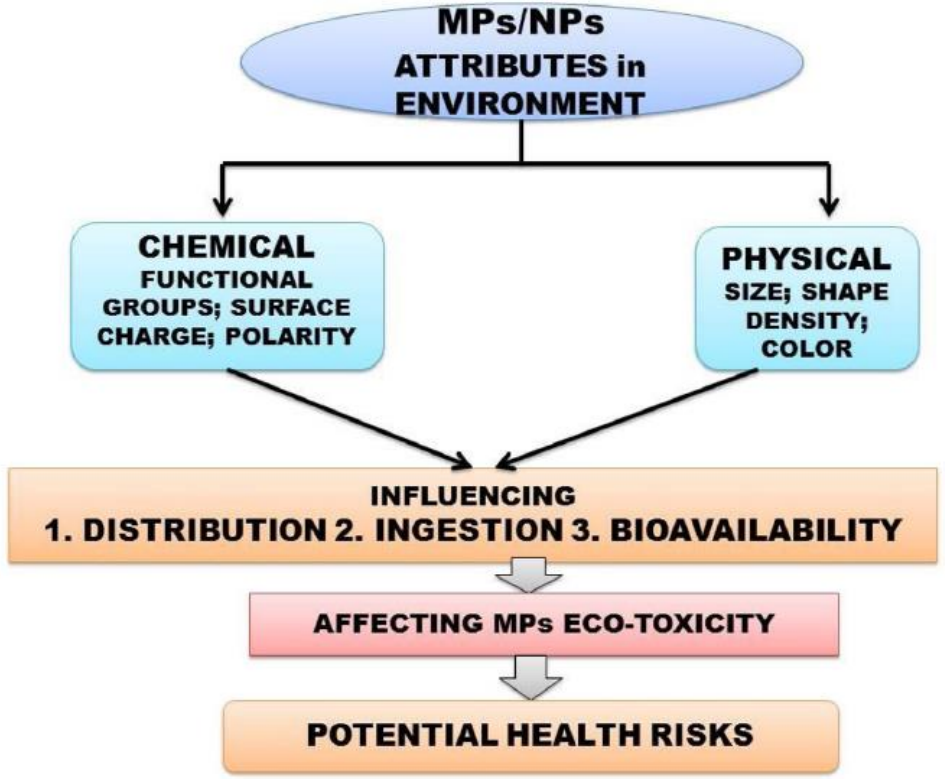


Tvarová distribuce

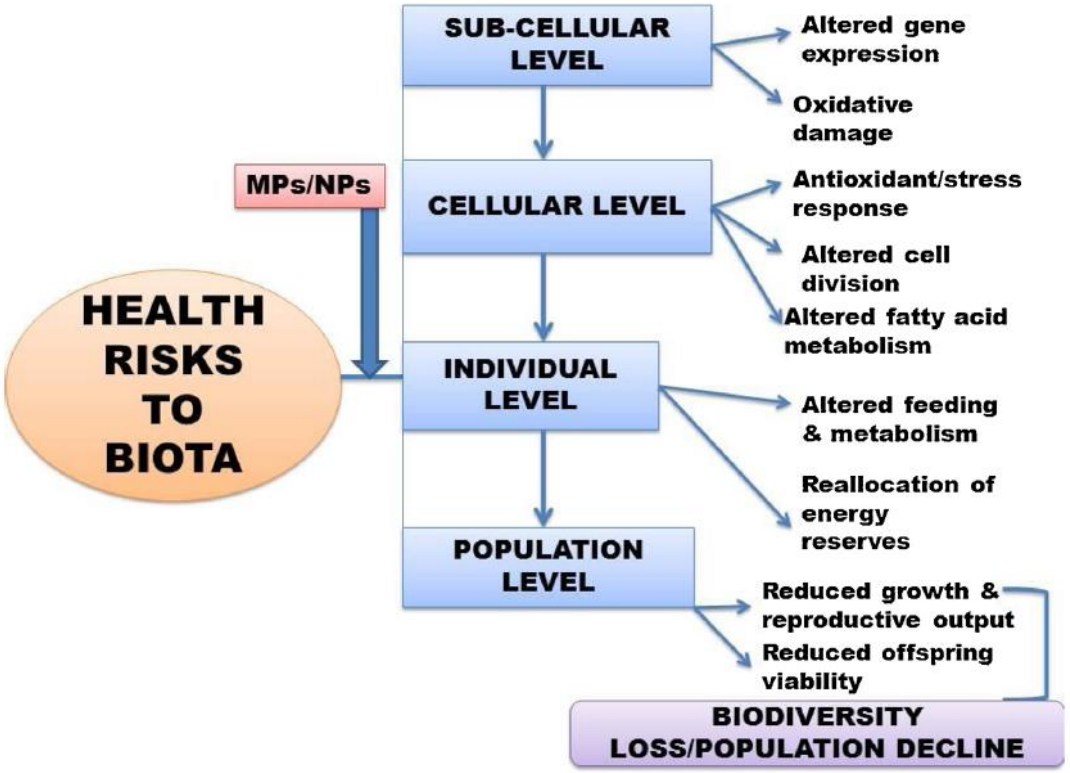


Pivokonsky M. et al. 2018. Occurrence of microplastics in raw and treated drinking water. Science of the Total Environment 643, 1644-1651. .

Toxicita mikroplastů



Fyzikálně chemické vlastnosti plastových částic ovlivňující jejich chování, ekotoxicitu, osud a transport v životním prostředí



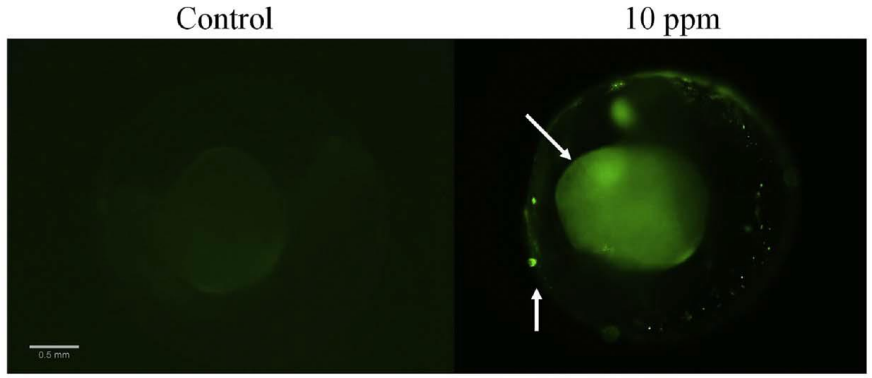
Zdravotní rizika expozice mikroplastům a nanoplastům: od molekulární po ekosystémovou úroveň

Rai, P. K. *et al.* (2021) 'Environmental fate, ecotoxicity biomarkers, and potential health effects of micro- and nano-scale plastic contamination', *Journal of Hazardous Materials*. Elsevier B.V., 403, p. 123910. doi: 10.1016/j.jhazmat.2020.123910.

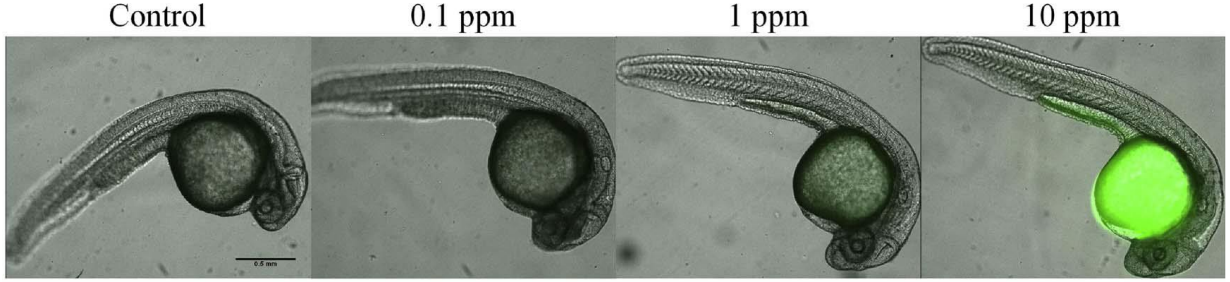
Toxicita mikroplastů – biodostupnost

PS 51 nm

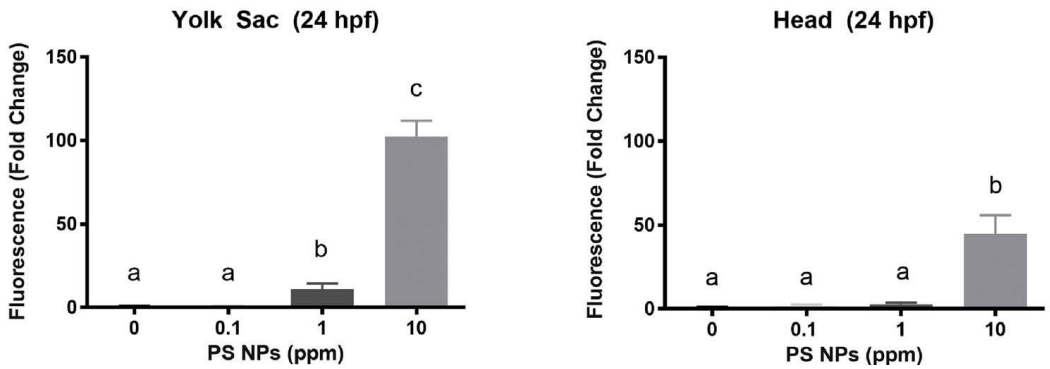
A



B

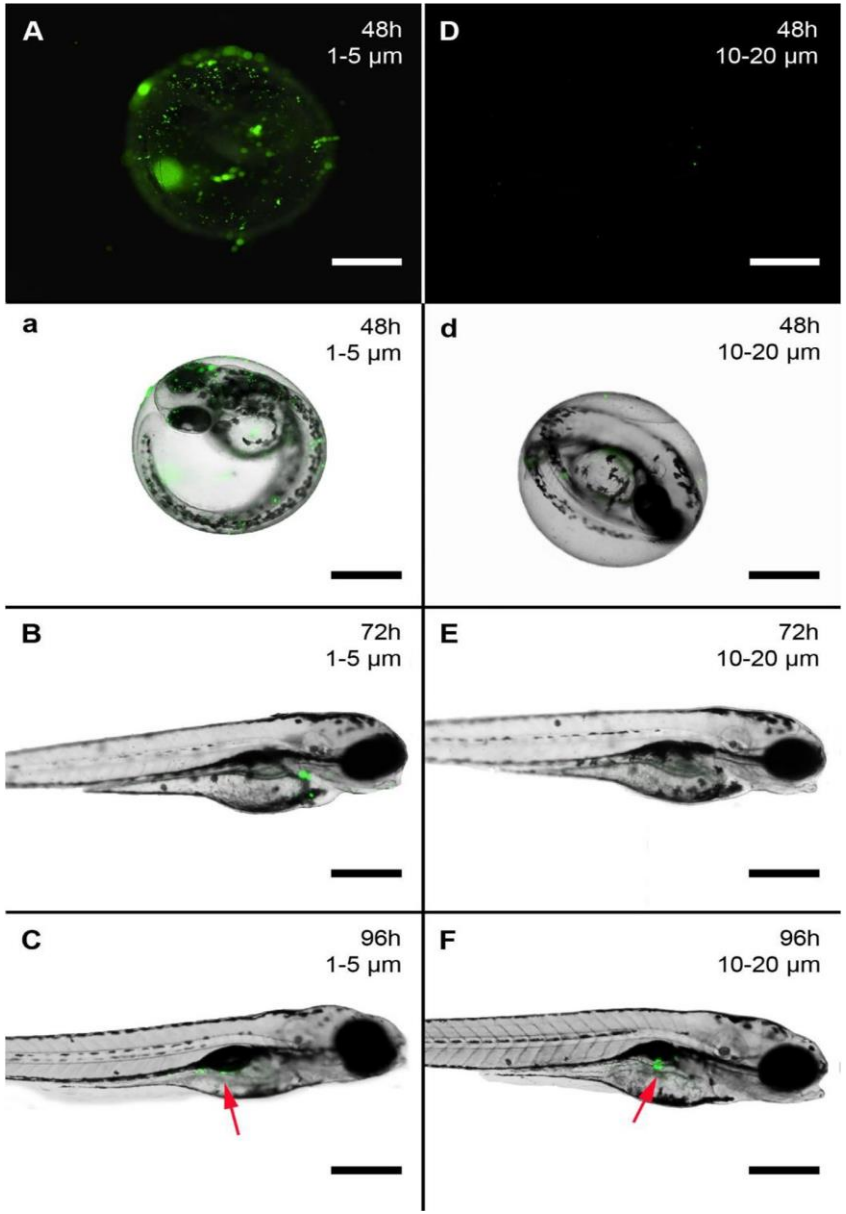


C



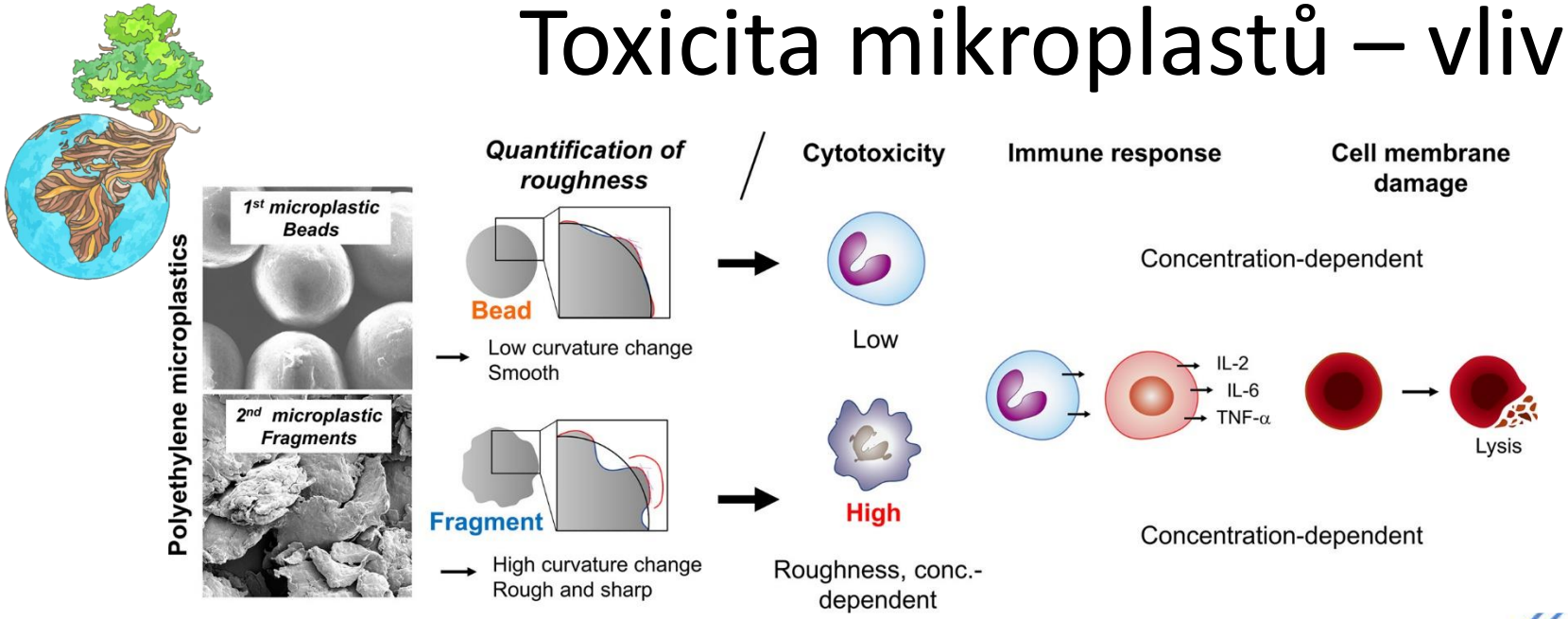
Aquatic Toxicology 194 (2018) 185–194

PE

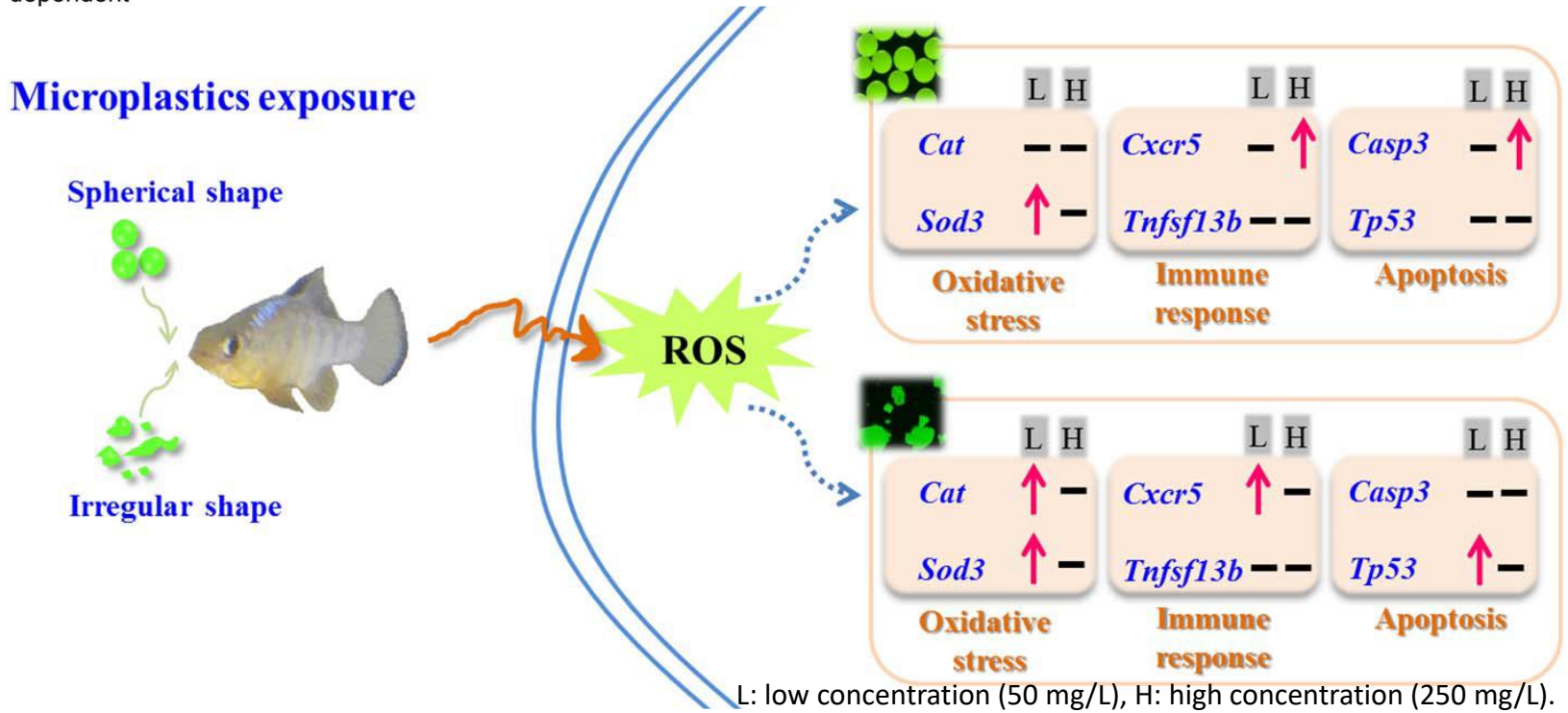


Environmental Pollution 235 (2018) 918-930

Toxicita mikroplastů – vliv tvaru



Choi, D. *et al.* (2021) 'In vitro toxicity from a physical perspective of polyethylene microplastics based on statistical curvature change analysis', *Science of the Total Environment*. Elsevier B.V., 752, p. 142242. doi: 10.1016/j.scitotenv.2020.142242.

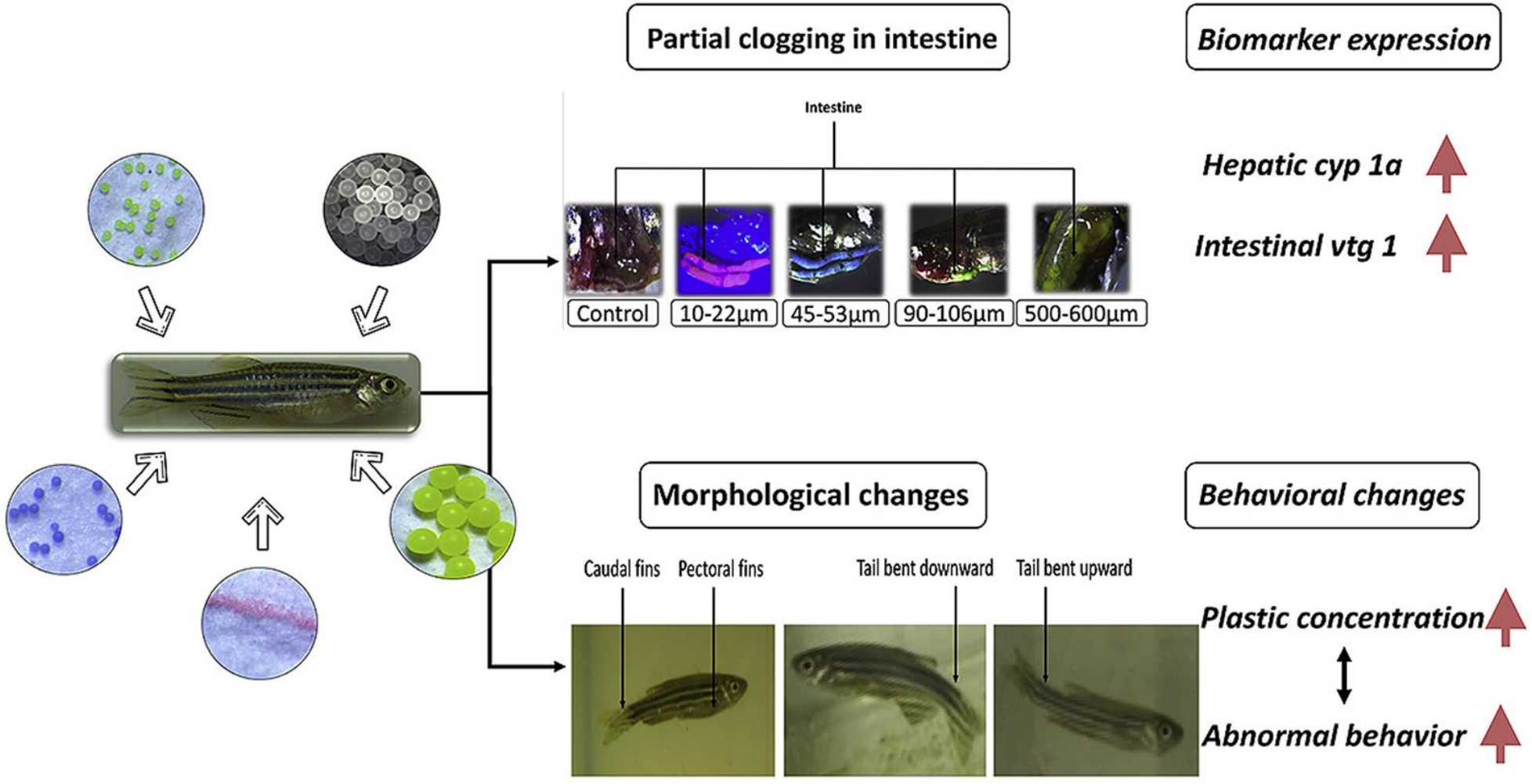


Choi, J. S. *et al.* (2018) 'Toxicological effects of irregularly shaped and spherical microplastics in a marine teleost, the sheepshead minnow (Cyprinodon variegatus)', *Marine Pollution Bulletin*. Elsevier Ltd, 129(1), pp. 231–240. doi: 10.1016/j.marpolbul.2018.02.039.

L: low concentration (50 mg/L), H: high concentration (250 mg/L).

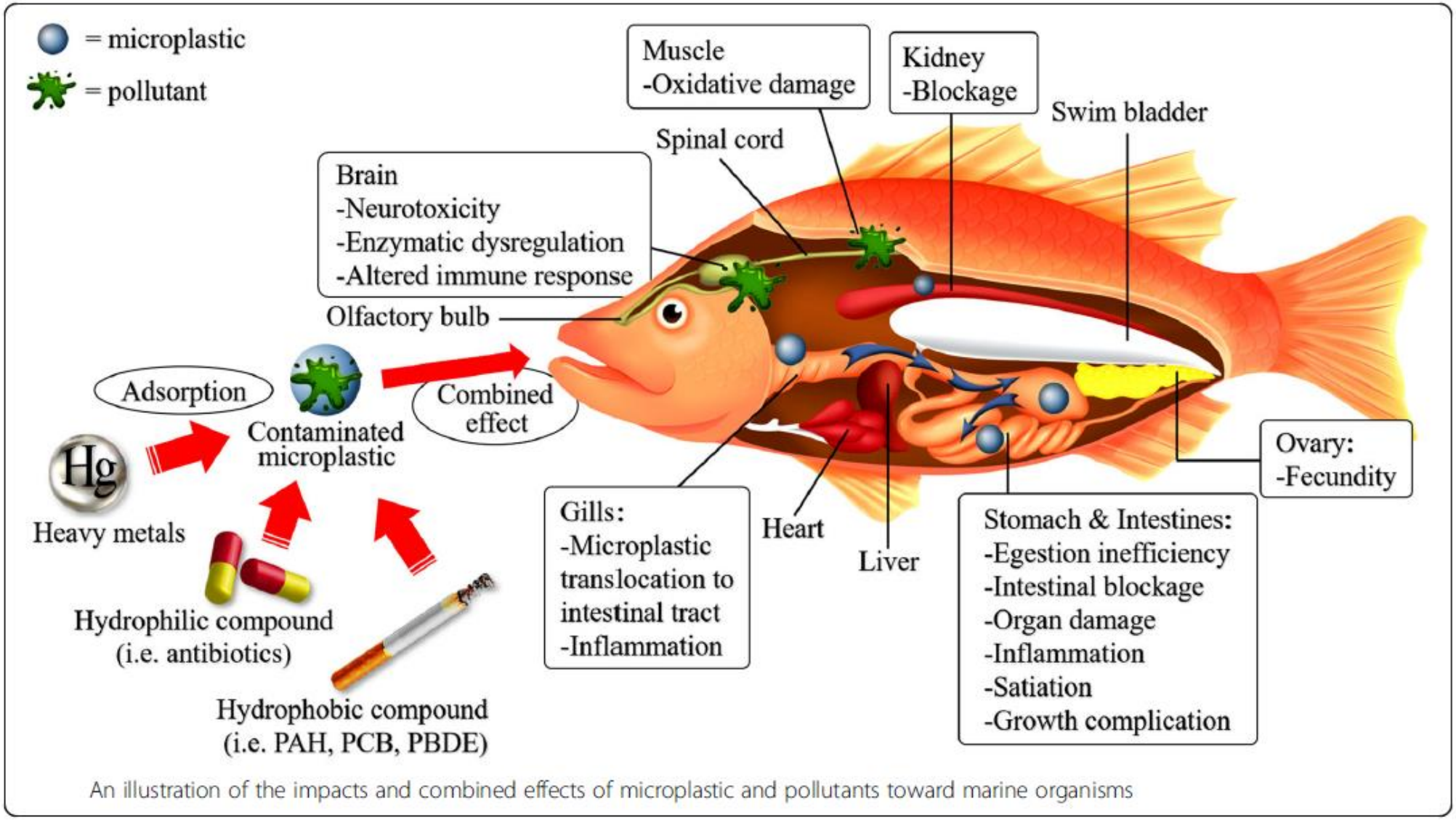
Toxicita mikroplastů – *in vivo*

Toxický efekt mikročástic polyethylenu na dospělé *Danio rerio*



Mak, C. W., Ching-Fong Yeung, K. and Chan, K. M. (2019) 'Acute toxic effects of polyethylene microplastic on adult zebrafish', *Ecotoxicology and Environmental Safety*, 182, p. 109442. doi: 10.1016/j.ecoenv.2019.109442.

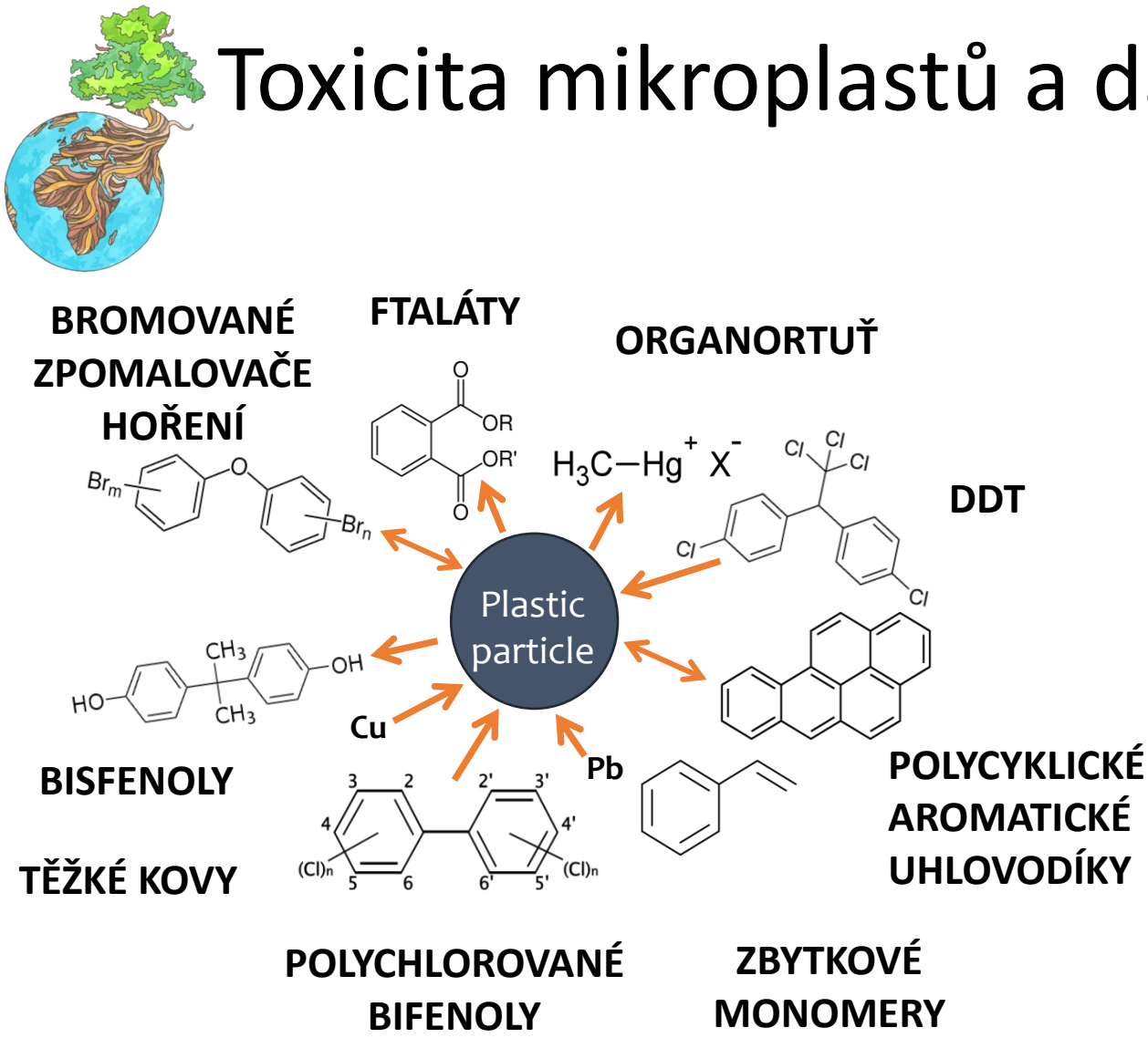
Toxicita mikroplastů



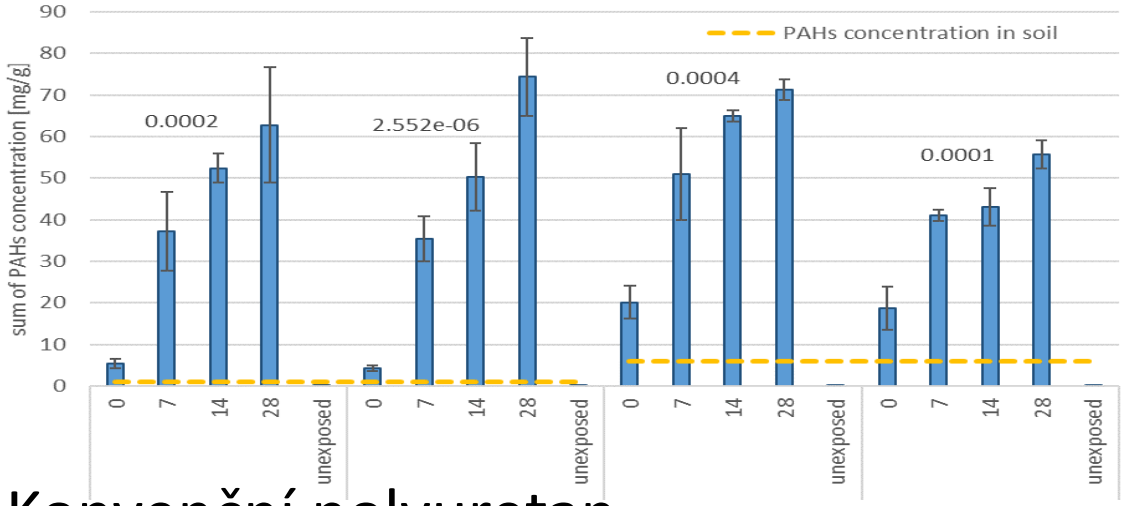
An illustration of the impacts and combined effects of microplastic and pollutants toward marine organisms

Amelia, T. S. M. *et al.* (2021) 'Marine microplastics as vectors of major ocean pollutants and its hazards to the marine ecosystem and humans', *Progress in Earth and Planetary Science*. Progress in Earth and Planetary Science, 8(1). doi: 10.1186/s40645-020-00405-4.

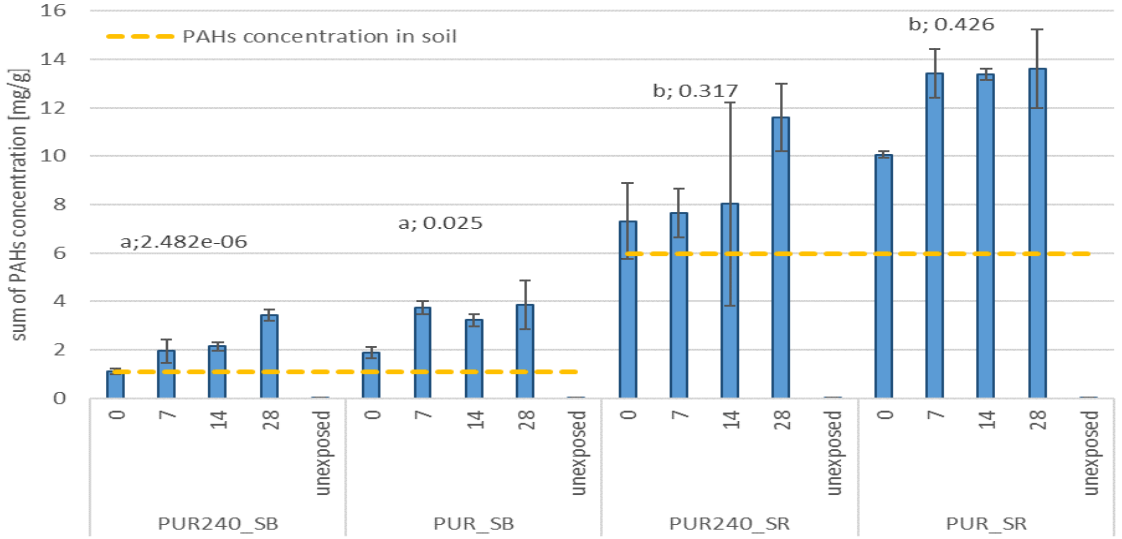
Toxicita mikroplastů a dalších polutantů - akumulace



Biodegradabilní polyuretan



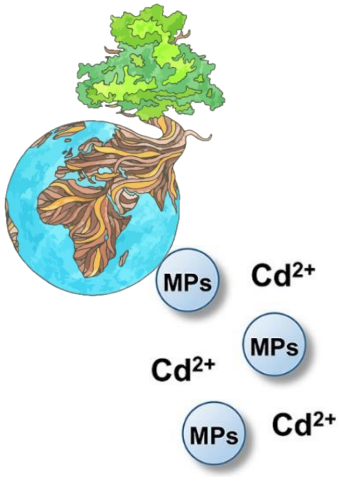
Konvenční polyuretan

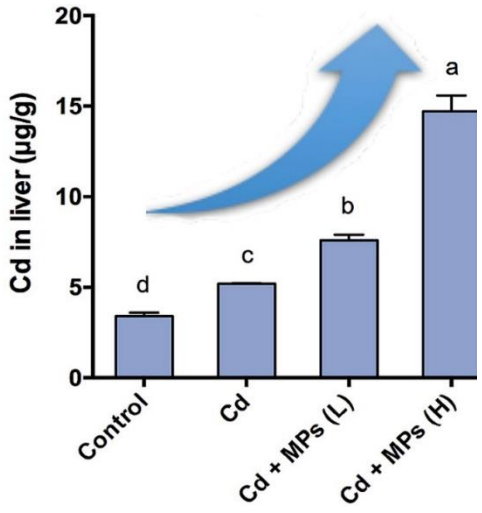


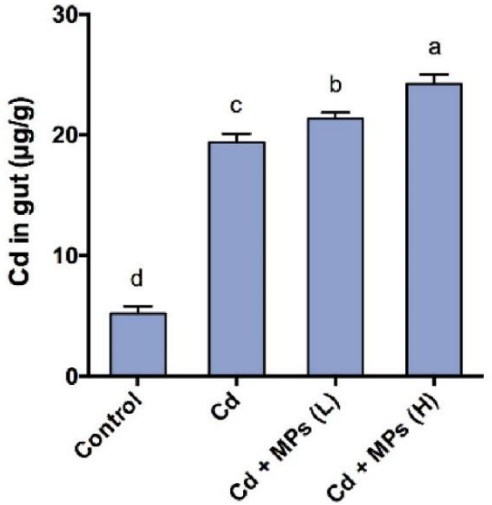
Accumulation of polycyclic aromatic hydrocarbon in microplastics

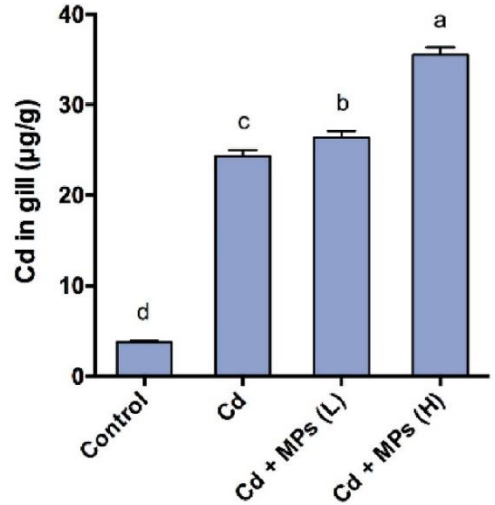
Cerna T. et al., 2021. Polycyclic aromatic hydrocarbon accumulation in aged and unaged polyurethane microplastics in contaminated soil. Science of the Total Environment 770, 14525

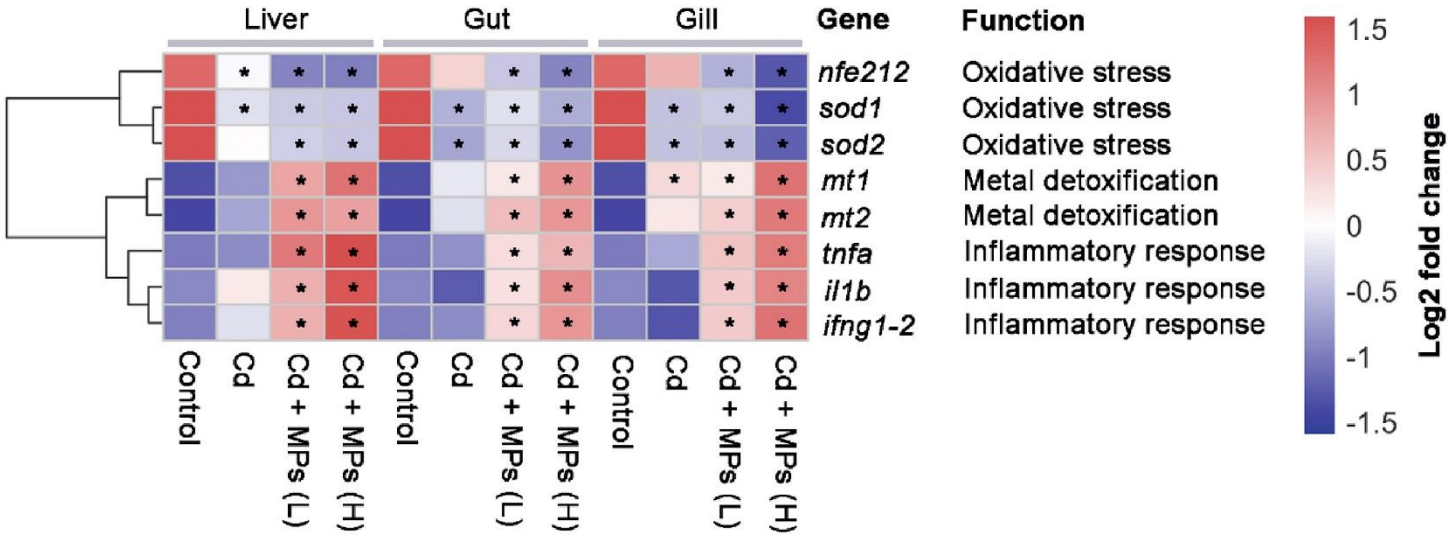
Akumulace polutantů – zvýšení toxicity







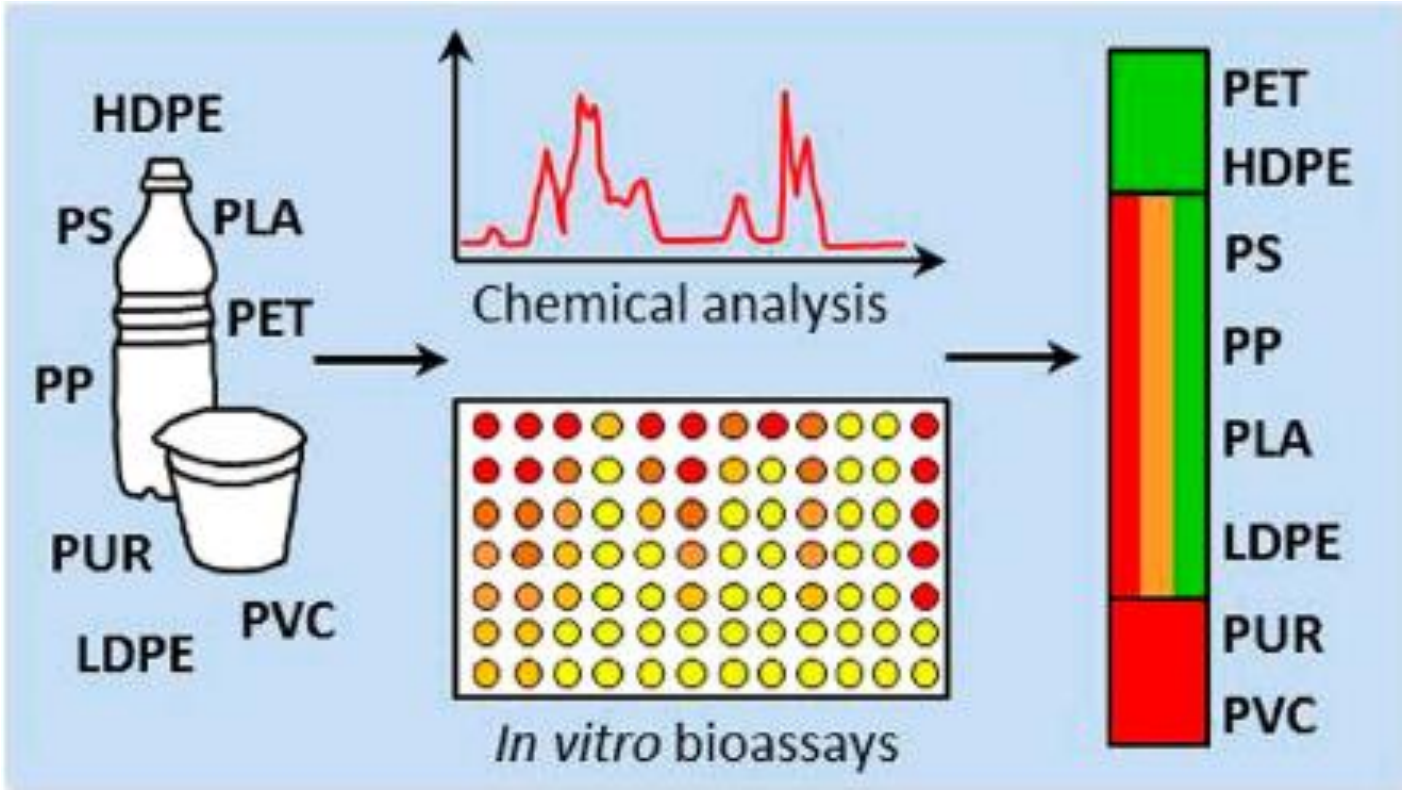




Differential expression of functional genes in different tissues determined by qRT-PCR according to the 2DDCtcomparative method (n¼5). Gene differential expression wereidentified based absolute log2fold change 1.2 and p<0.05 versus control group (marked with *).

Lu, K. *et al.* (2018) 'Influence of microplastics on the accumulation and chronic toxic effects of cadmium in zebrafish (Danio rerio)', *Chemosphere*, 202, pp. 514–520. doi: 10.1016/j.chemosphere.2018.03.145.

Plasty a uvolňování toxických aditiv



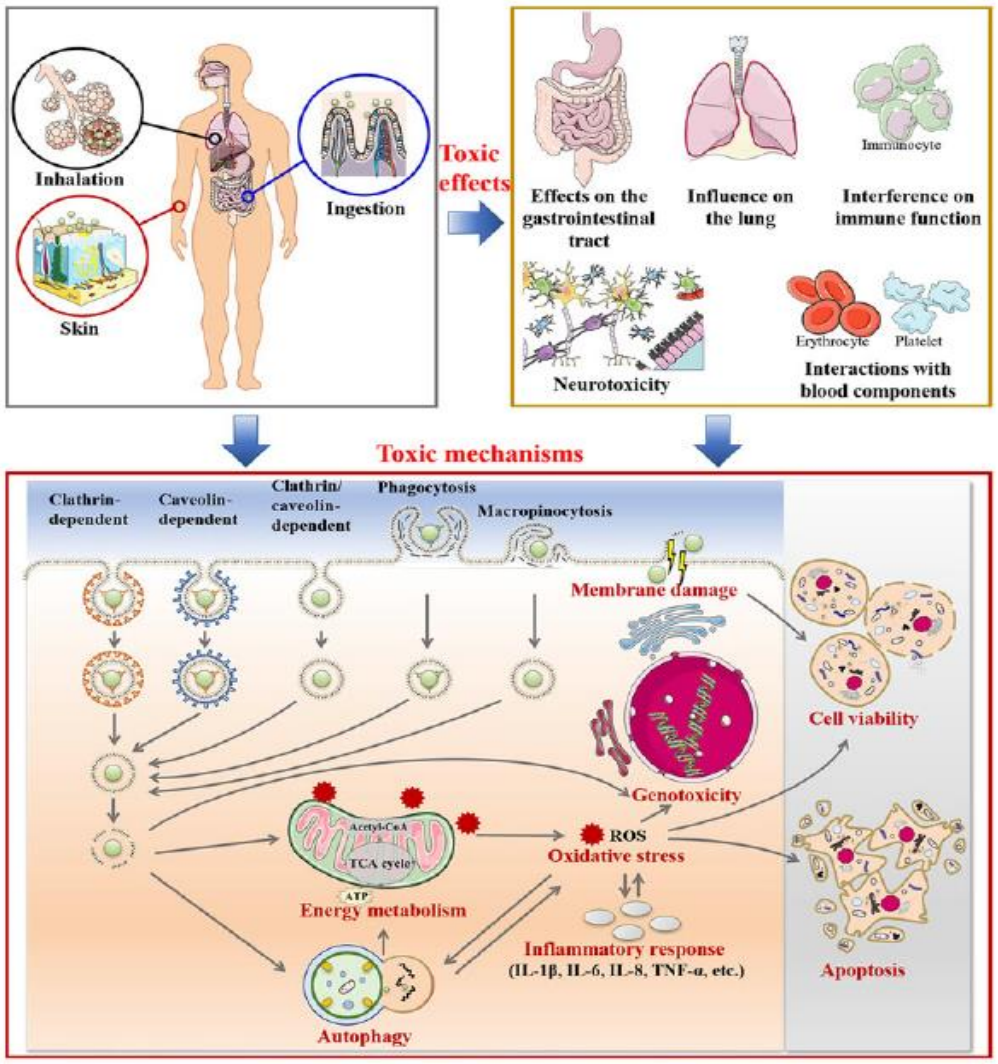
Skupiny potenciálně nebezpečných látek s endokrinně disruptivním efektem spojované s plastovým materiálem:

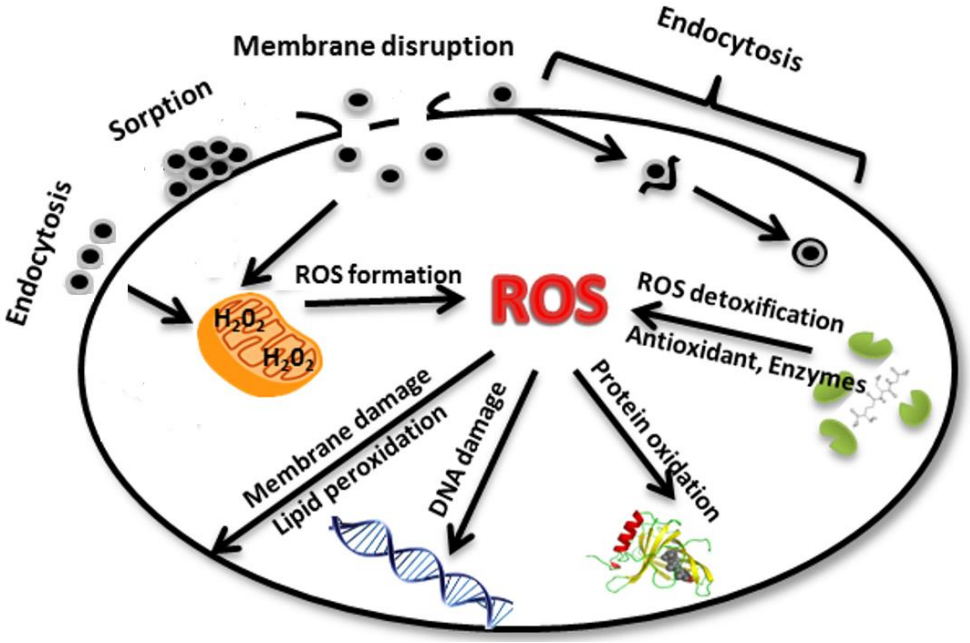
BISFENOLY
PARABENY
FTALÁTY
BENZOFENONY
PESTICIDY
FUNGICIDY
ORGANOCÍNY

Zimmermann, L. et al. (2019) 'Benchmarking the in Vitro Toxicity and Chemical Composition of Plastic Consumer Products - Supplementary', Environmental Science and Technology, 53(19), pp. 1–40. doi: 10.1021/acs.est.9b02293.

Rai, P. K. *et al.* (2021) 'Environmental fate, ecotoxicity biomarkers, and potential health effects of micro- and nano-scale plastic contamination', *Journal of Hazardous Materials*. Elsevier B.V., 403, p. 123910. doi: 10.1016/j.jhazmat.2020.123910.

Vliv mikroplastů na lidské zdraví

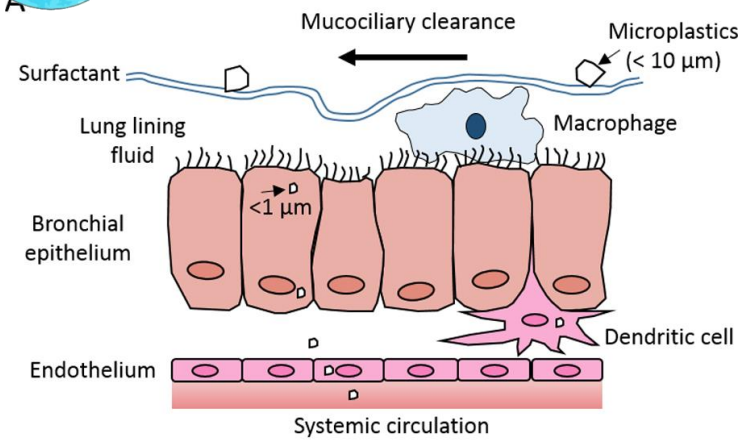


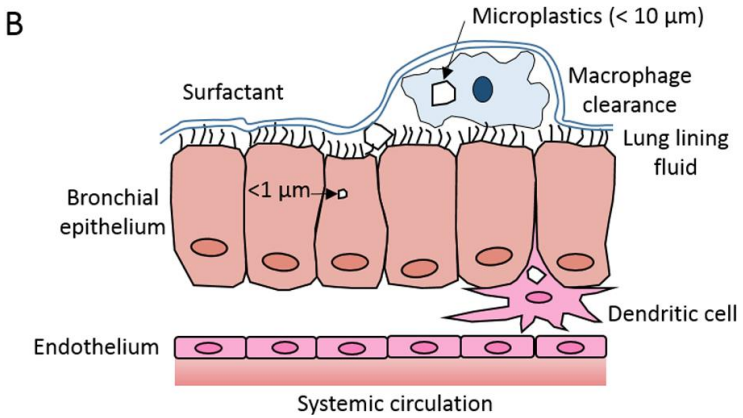


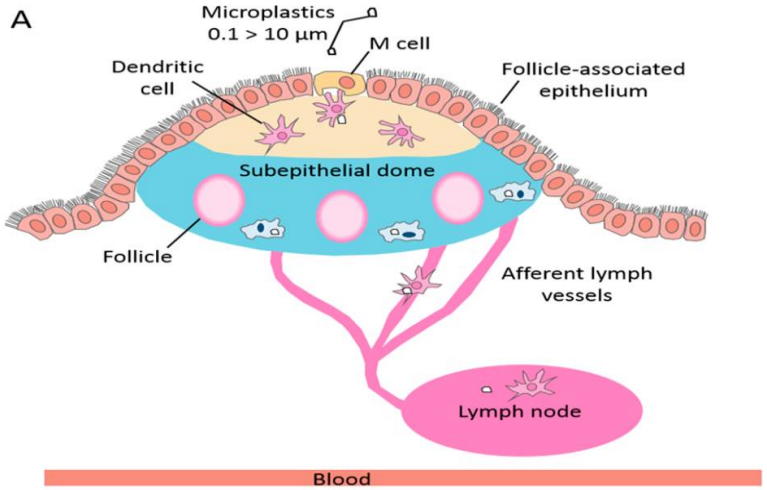
Appl Microbiol Biotechnol
(2016) 100:9809–9819

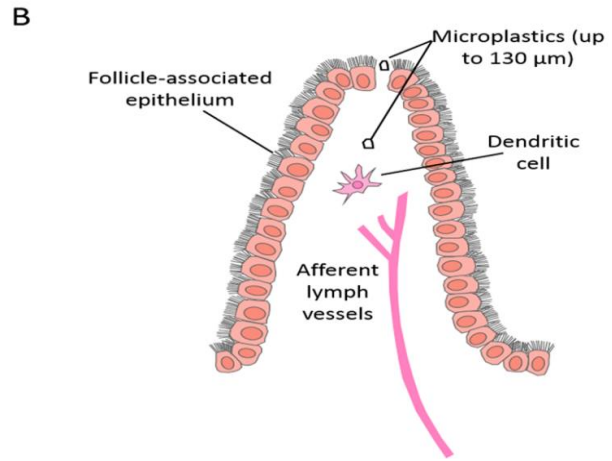
Shi, Q. *et al.* (2021) 'Toxicity in vitro reveals potential impacts of microplastics and nanoplastics on human health: A review', *Critical Reviews in Environmental Science and Technology*. Taylor & Francis, 0(0), pp. 1–33. doi: 10.1080/10643389.2021.1951528.

Možnosti vstupu mikroplastů do organismu … a výsledky

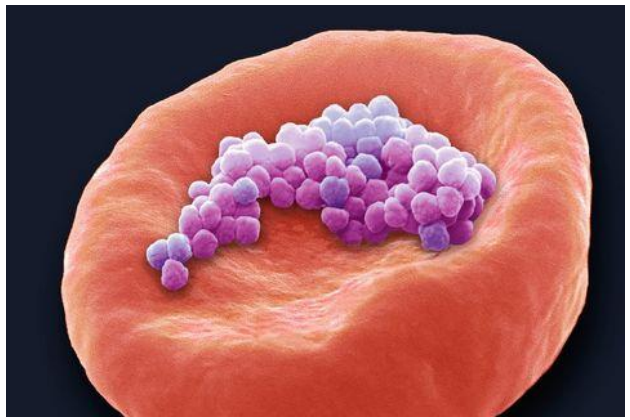








Environ. Sci. Technol. 2017, 51, 6634−6647



Snímek z elektronového mikroskopu (Steve Gschmeissner)

Lidské keratinocyty obsahující červené polystyrenové částice (0.25 ± 0.06 µm). Jádra buněk jsou obarvena modře pomocí Hoechst 33342.

Děti a expozice mikroplastům

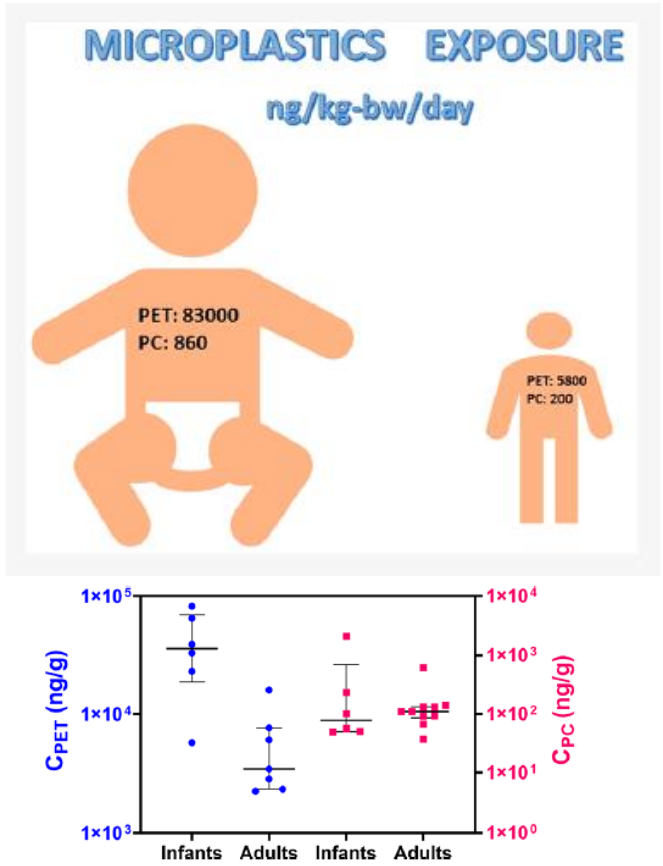


Figure 1. Concentrations (dry weight) of polyethylene terephthalate (PET) and polycarbonate (PC) microplastics in infant (n = 6) and adult feces (n = 10). Dots represent individual samples. Upper and lower lines represent interquartile ranges. Middle lines represents median values.

Zhang, J. *et al.* (2021) 'Occurrence of Polyethylene Terephthalate and Polycarbonate Microplastics in Infant and Adult Feces', *Environmental Science & Technology Letters*. doi: 10.1021/acs.estlett.1c00559.

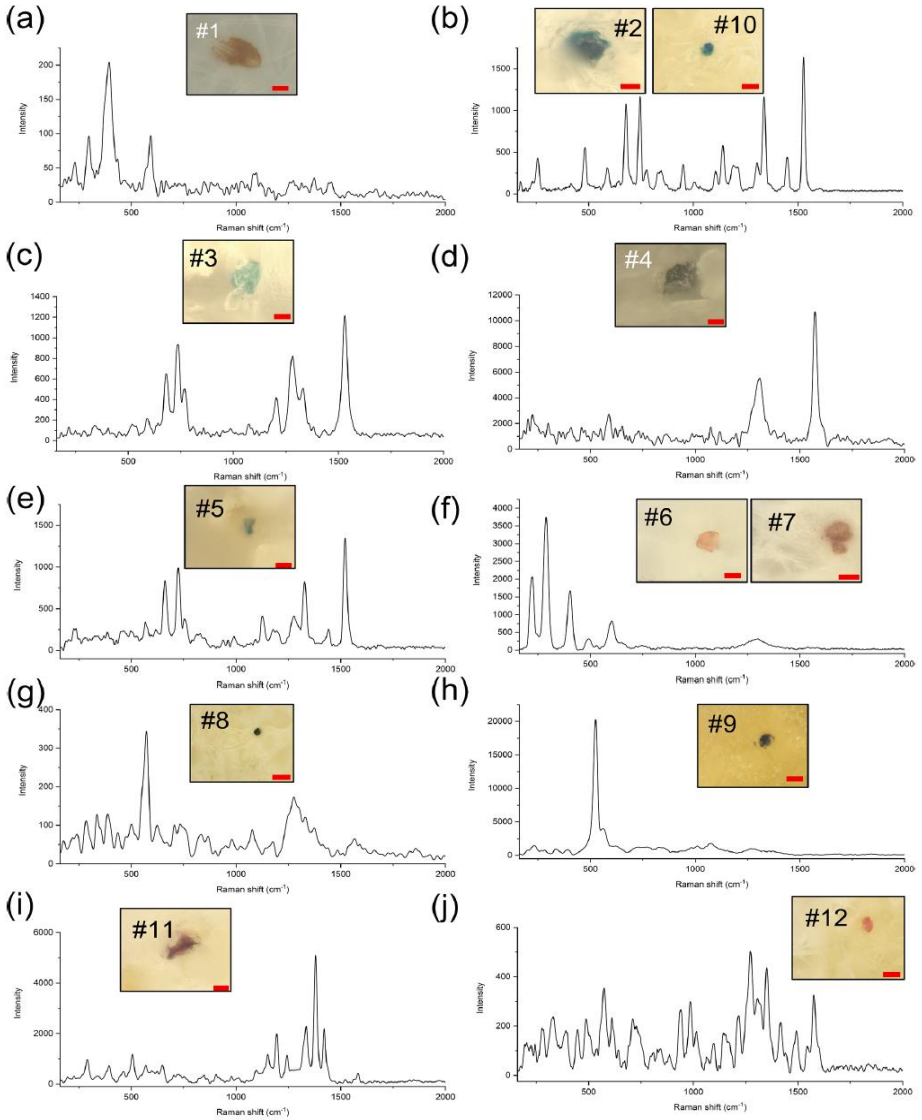


Fig. 2. Microphotographs and Raman spectra of the microplastics found in human placenta: (a) Particle #1 (scale bar 5 μm); (b) Particles #2 and #10 (scale bar 5 μm for #2 and 10 μm for #10); (c) Particle #3 (scale bar 5 μm); (d) Particle #4 (scale bar 5 μm); (e) Particle #5 (scale bar 5 μm); (f) Particles #6 and #7 (scale bar 10 μm for #6 and 5 μm for #7); (g) Particle #8 (scale bar 10 μm); (h) Particle #9 (scale bar 10 μm); (i) Particle #11 (scale bar 5 μm), and (l) Particle #12 (scale bar 10 μm).

Ragusa, A. *et al.* (2021) 'Plasticenta: First evidence of microplastics in human placenta', *Environment International*. Elsevier Ltd, 146, p. 106274. doi: 10.1016/j.envint.2020.106274.

Děkuji Vám za pozornost!