

Xenobiotics from Water to the Gut: Monitoring Environmental BPA and Assessing Its Gut Bacterial Tolerance for Health Risk and Biodegradation



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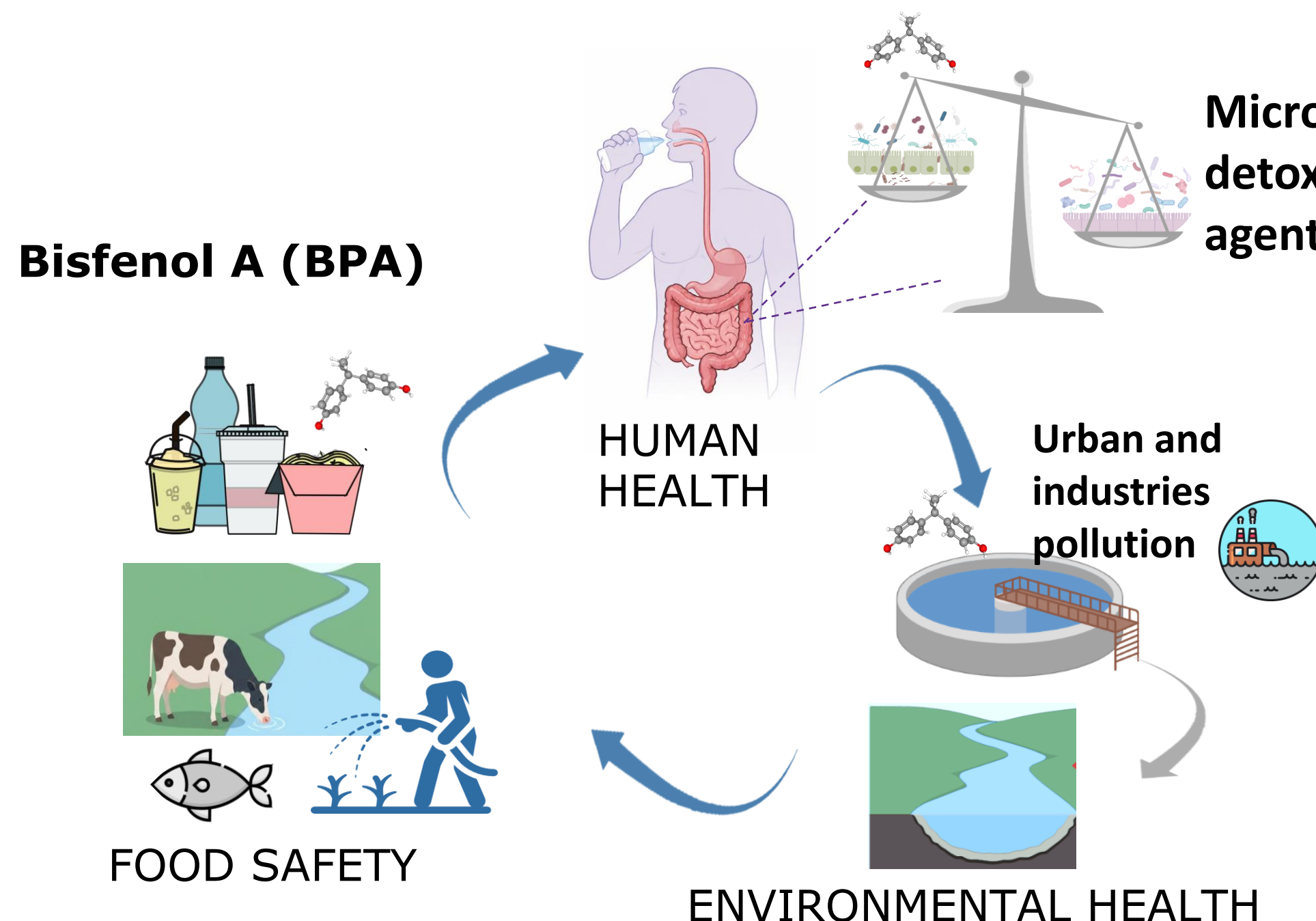
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INTRODUCTION

Bisphenol is used to manufacture packaging, polycarbonate plastics, and epoxy resins. Driven by high plastic pollution, it filters into the environment, threatening global health. Within a **One Health** context, this pollutant from urban and industrial sources cycles through water and soil, accumulating in plants and animals before reaching humans by ingestion. Therefore, **monitoring this compound** starting directly at the water source is critical to understanding and mitigating its entry into the **food chain**.



Once ingested, this compound reaches the gut, altering the **microbiota** and its essential role in maintaining health.

Our previous *in vitro* studies revealed a clear alteration marked by groups of BPA-sensitive and BPA-resistant bacteria, which were isolated by UGR group in a collection as a potential biological detoxification tool. Therefore, measure their degrading BPA capacities is the next step to **unlocking their potential for targeted biological detoxification**.

AIM: To quantify BPA concentrations in Krakow's waters as source of dietary exposure and evaluate the potential biodegradation capacities of gut microbiota species from the UGR bacteria isolated collection.

METHODOLOGY

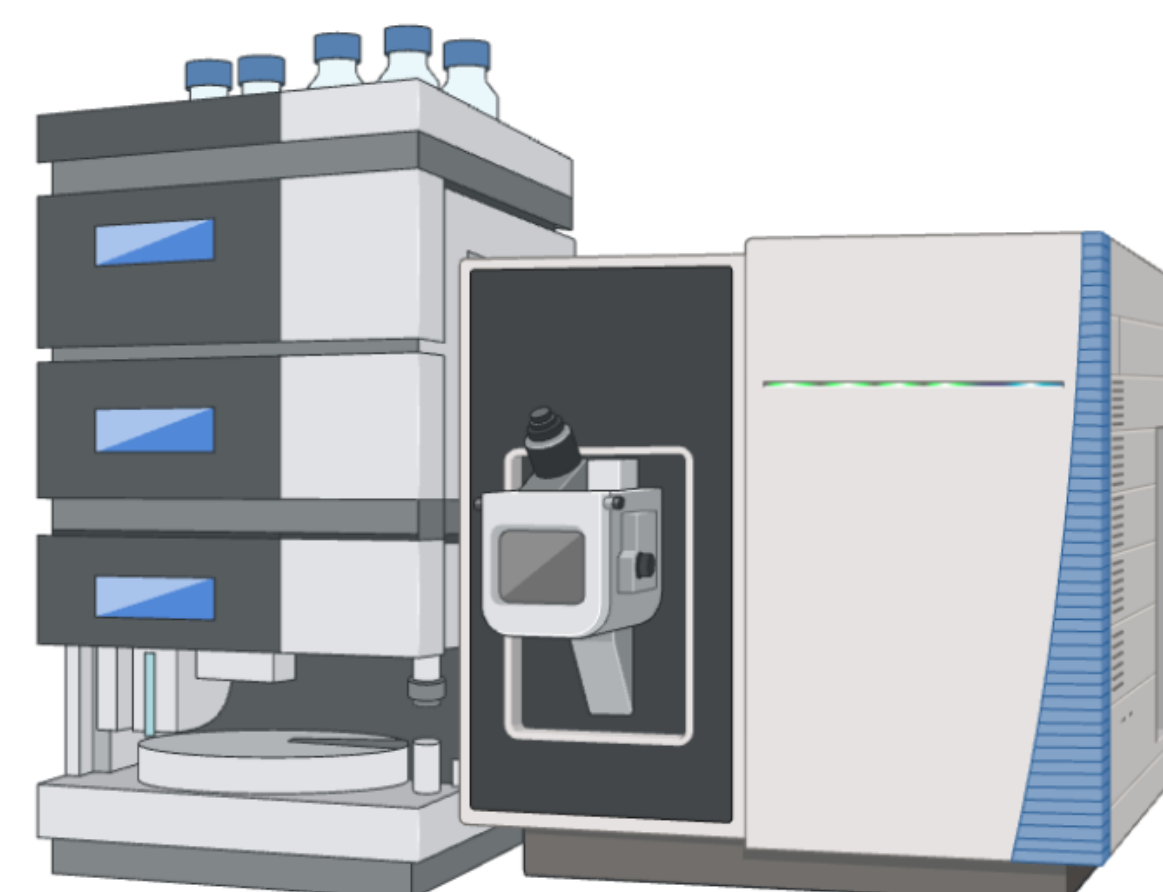
Environmental samples

(water samples from Krakow, AGH)



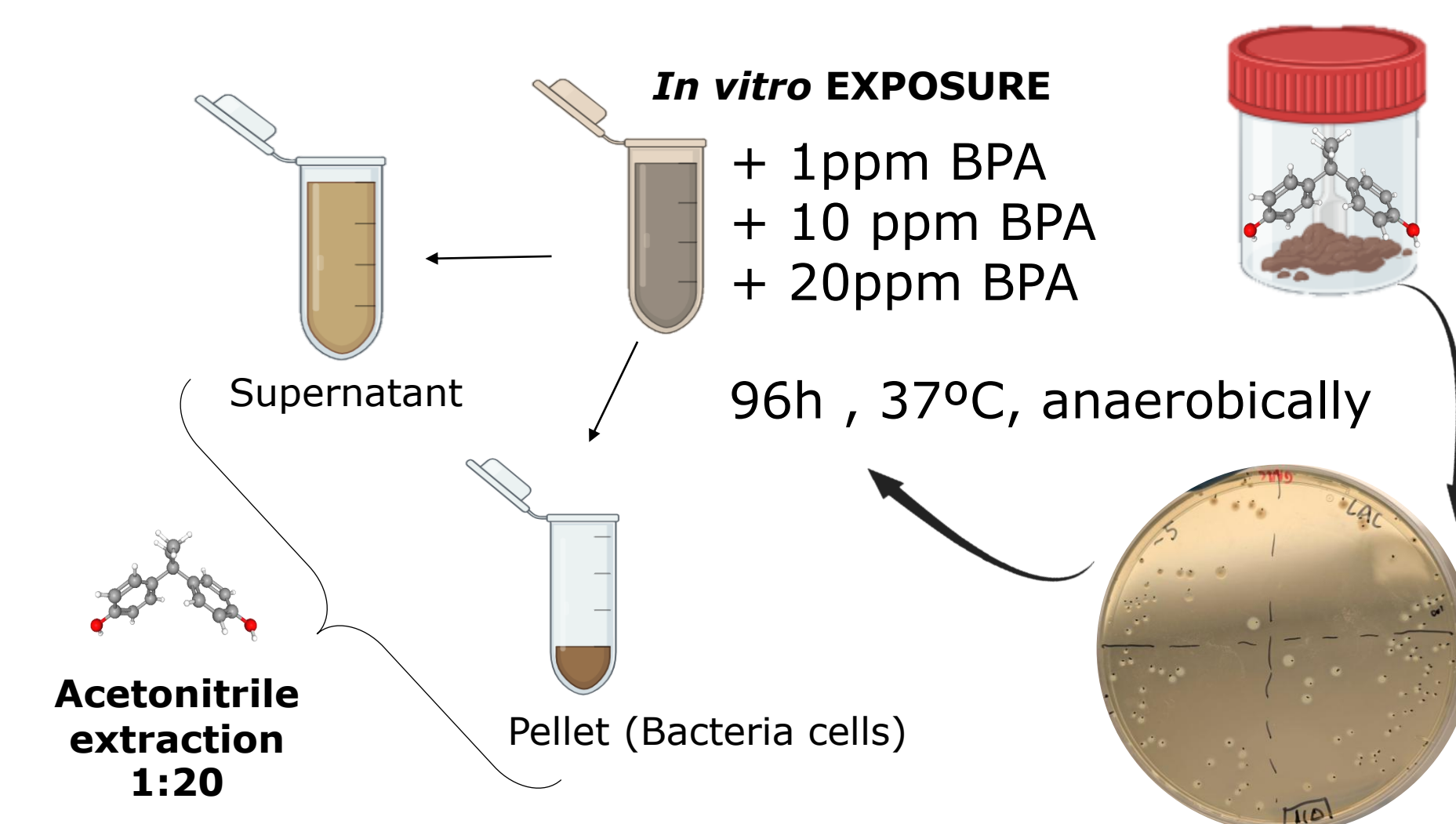
River water samples were pre-concentrated and purified solid-phase extraction (SPE) cartridges followed by methanol elution

UHPLC-MS/MS



Biological samples

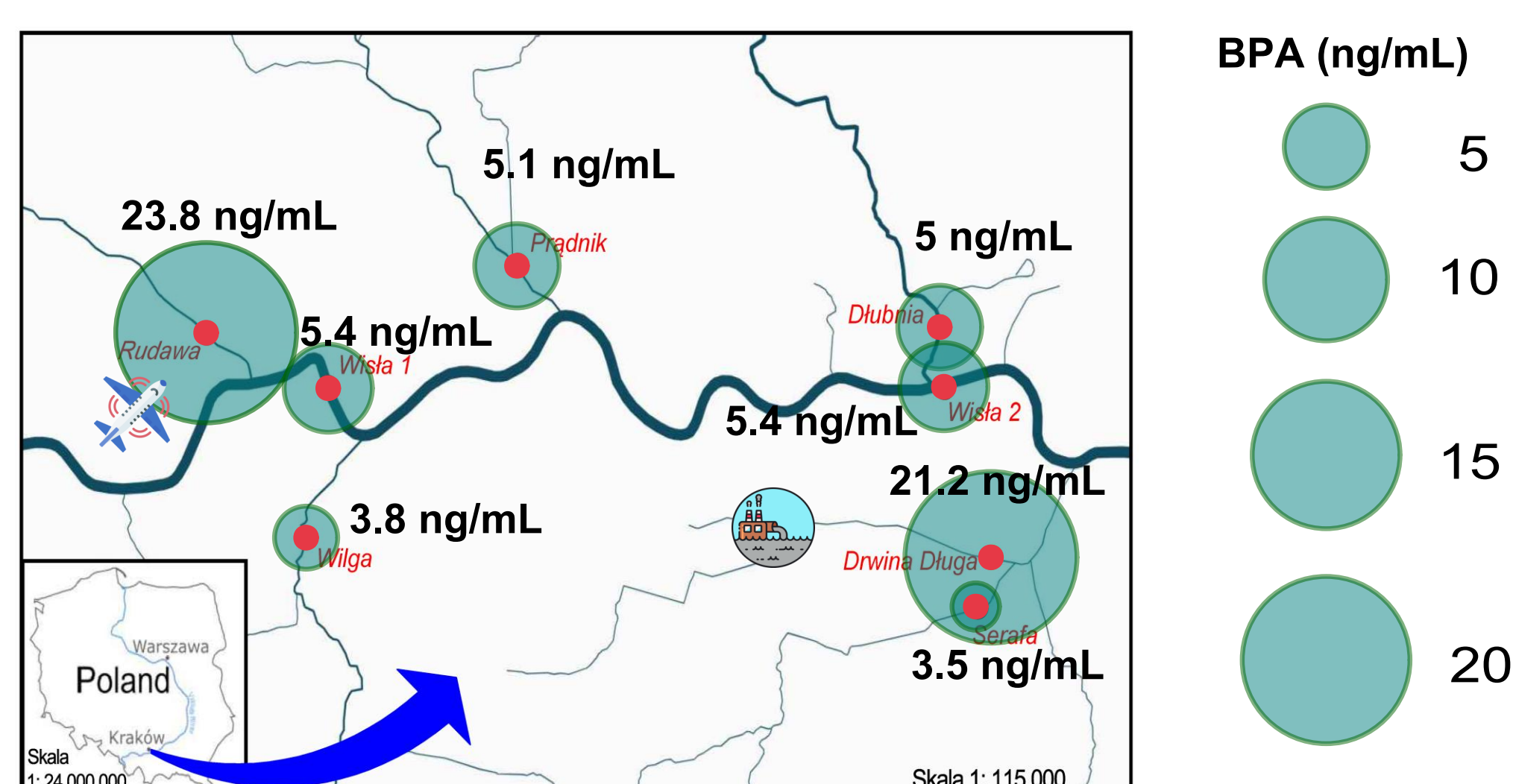
(bacteria collection from UGR)



RESULTS

Environmental monitoring

Vistula river and tributaries

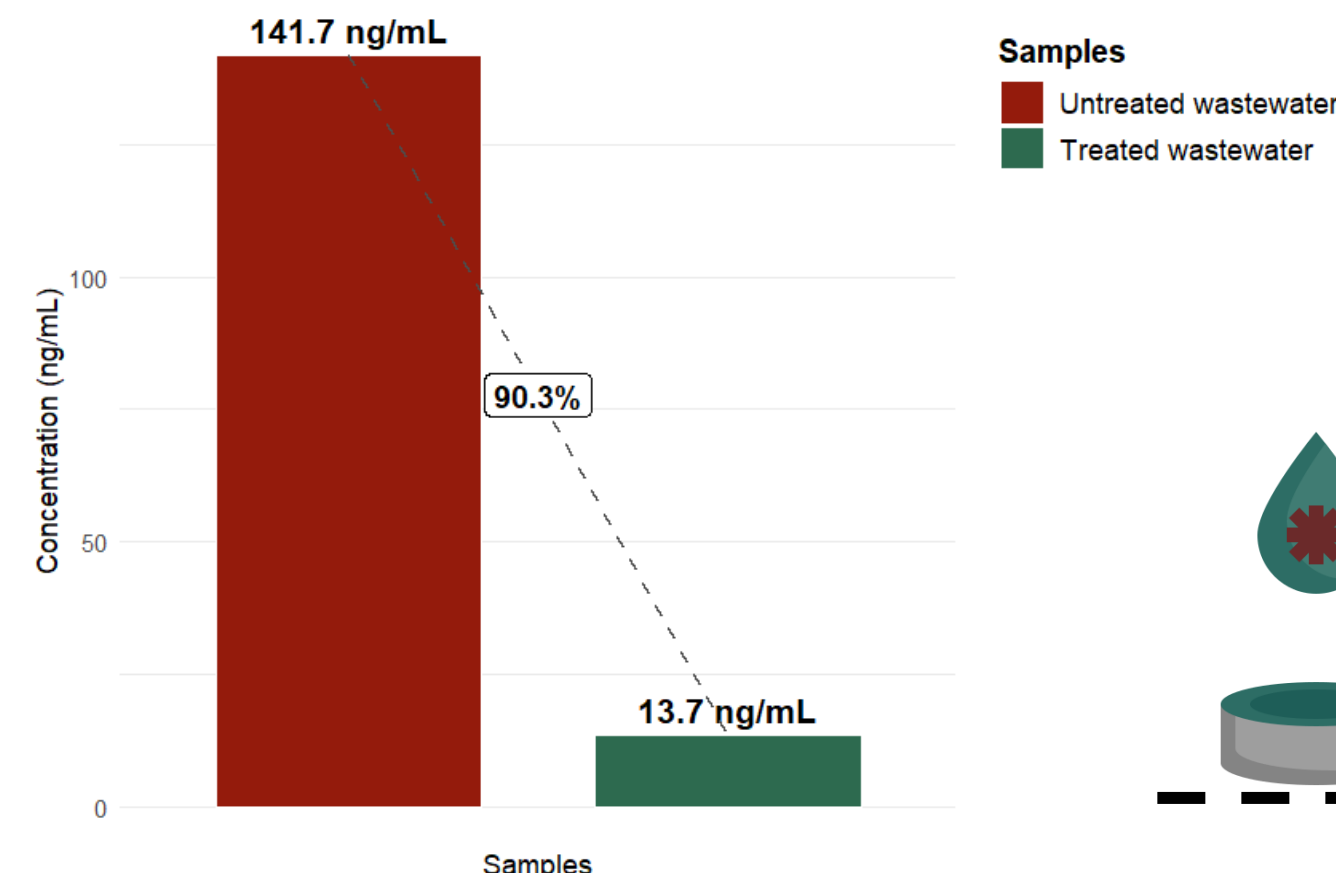


Tap Water

BPA < LOD (0.005ng/mL)
Drinking Water Directive standard (<2.5 ng/mL)

Potential point sources:
Drwina Długa → wastewater treatment plant
Rudawa → airport

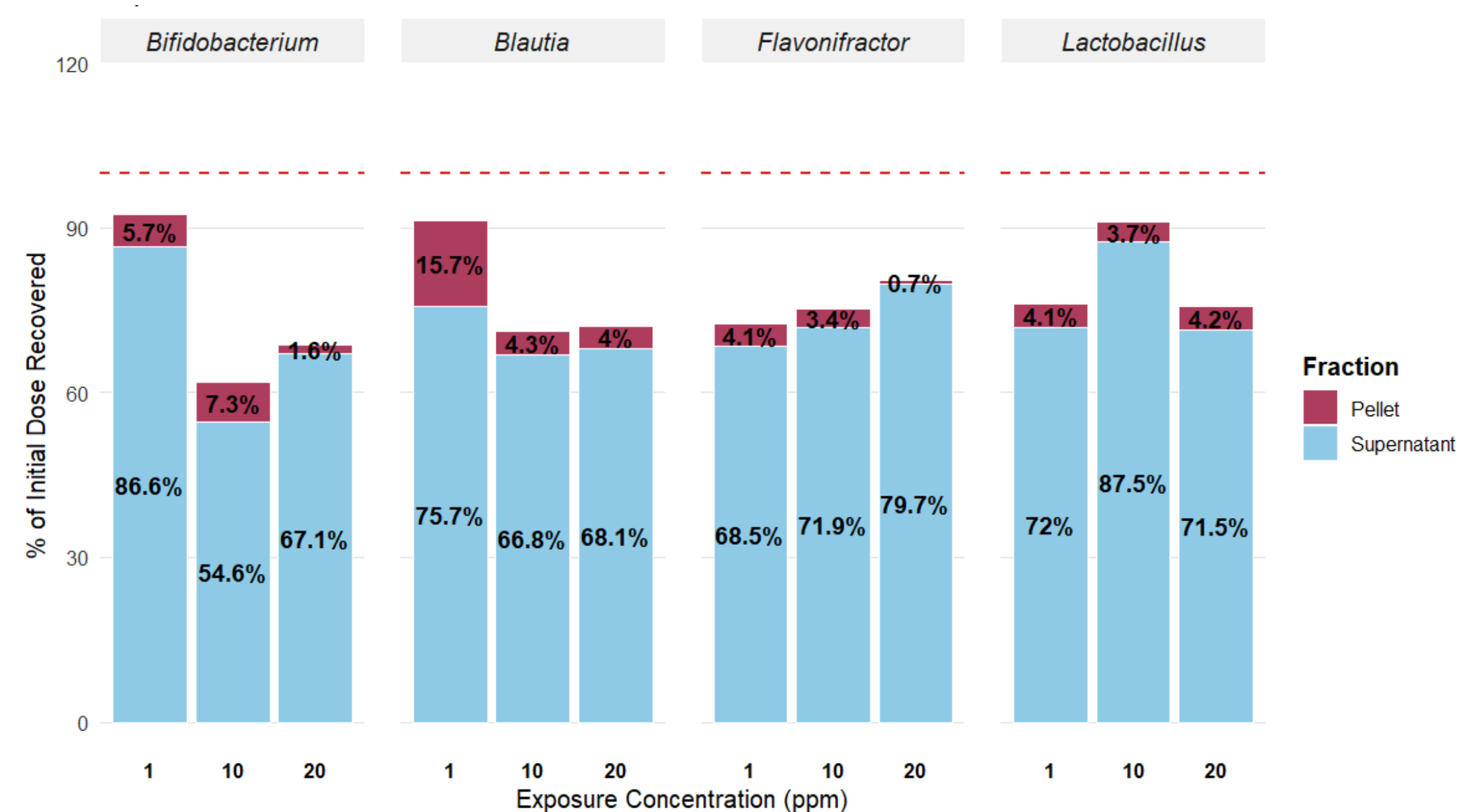
Wastewater treatment efficiency



Mechanical / Biological wastewater treatment:
90% of efficiency reducing the BPA

Around **14ng/mL** are still present and **incorporated to the environment**

Gut bacteria degradation capacities

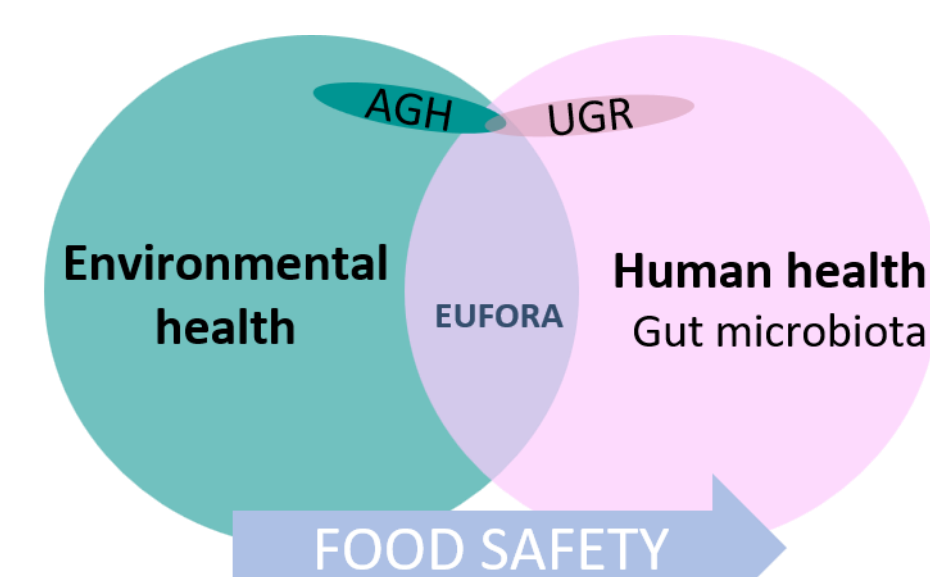


Remaining BPA (%) in bacterial cultures after 96 h
Bioaccumulation = pellet → 5% (mean)
BPA removed in the supernatant → 26% (mean)

A significant amount of BPA remained in the culture, indicating that its reduction by these genera was minimal, even though their growth was barely affected by this concentration.
Consequently, the persisting BPA is free to affect more sensitive bacteria within the community.

FUTURE PERSPECTIVES

- Tracking BPA flow from the environment to humans via food chain
- Characterizing environmental reservoirs (soil)
- Potential degrading gut bacteria



CONCLUSION

Environmental monitoring of BPA in rivers near large cities, such as Krakow, demonstrates the active persistence of BPA in the environment, which increase crop, animal and human exposures. Therefore, a One Health approach is key to jointly assess xenobiotic environmental and post-exposures by preventive strategies. This study has tested a validated microbiota-based approach to effectively control the impact on the bioavailability of the xenobiotic compound.

References:

Koziarska, M., Strzebońska, M. & Szalińska, E. Development and validation of a green/blue UHPLC-MS/MS method for trace pharmaceutical monitoring. *Sci Rep* 15, 30902 (2025). <https://doi.org/10.1038/s41598-025-15614-z>
Luque, G., Ortiz, P., Torres-Sánchez, A., Ruiz-Rodríguez, A., López-Moreno, A., & Aguilera, M. (2025). Impact of Ex Vivo Bisphenol A Exposure on Gut Microbiota Dysbiosis and Its Association with Childhood Obesity. *Journal of Xenobiotics*, 15(1), 14. <https://doi.org/10.3390/jox15010014>