



PLASTIC' 2024

**3as JORNADAS SOBRE CONTAMINACIÓN
POR PLÁSTICOS**

15 Y 16 DE OCTUBRE 2024

CaixaForum Macaya

Paseig de Sant Joan, 108 Barcelona

LIBRO DE ABSTRACTS

PRESENTACIONES ORALES

Martes 15 de Octubre

16h00-16h10 Bienvenida

Chairman: Maria Vittoria Barbieri, Lara Cioni

16h10-16h30 **ORAL 1: Microplastics: a reflection on the lack of human exposure regulations.**
Giuseppina Zuri (IDAEA-CSIC)

16h30-16h50 **ORAL 2: Plastic fate and transport in rivers: where do we find the plastics?**
David Mennekes (ETH Zurich)

16h50-17h10 **ORAL 3: Linking marine litter land sources and its spatial distribution on fishing grounds in the NW Mediterranean Sea.**
Marta Blanco (ICM-CSIC)

17h10-17h30 **ORAL 4: Las gaviotas como biovectores de la dispersión de plásticos desde vertederos a humedales.**
Manuel Serrano (EBD-CSIC)

17h30-17h50 **ORAL 5: "Plastic Pirates – Go Europe!" in Spain: Citizen Science as a powerful approach to monitor plastic pollution in fluvial ecosystems.**
Meritxell Abril (BETA Technological Center)

17h50-18h10 **ORAL 6: Liberación de microplásticos en lavandería industrial.**
Manuel Barbero (EEBE-UPC)

18h10-18h30 **ORAL 7: Biodegradación de microplásticos en lodos de depuradora sometidos a condiciones de compostaje.**
Isabel Marín (CCMAR-University of Algarve)

ORAL 1 - Microplastics: a reflection on the lack of human exposure regulations

G. Zuri⁽¹⁾, M. Zuri⁽²⁾

⁽¹⁾ *Department of chemometrics, IDAEA-CSIC, Carrer de Jordi Girona 18-26, 08034 Barcelona, Spain*

⁽²⁾ *Freelance writer, Specialist in Foreign Languages and Literatures for Cultural Mediation, Alghero, Italy*

giuseppina.zuri@idaea.csic.es, Tel: +39-3665931433

Human civilization has been defined by our ability to discover and create new tools to overcome novel challenges. Crafting and manufacturing have come a long way since the Stone Age, when the use of rock, animal bones, and wood led to methods to extract and manipulate metals such as iron copper and tin; and eventually build the objects that are part of our everyday life. Each of these breakthroughs kickstarted the beginning of a new era, but few have been as revolutionary as plastic. It could be argued that the second half of the 20th century marked the beginning of the plastic age.

Within only a few decades, its virtually unlimited capacity to be shaped into a variety of items made it possible to build new tools, and significantly reduce the cost of others.

For the first time in human history a material that was both extremely cheap to produce, highly malleable, and remarkably resistant became widely available. Ironically, this resistance is, in fact, the reason why plastic is also becoming increasingly problematic. Once disposed in landfills or (un)intentionally in the environment, plastic stays there for years. In 2004, Professor Richard Thompson, found microscopic plastic particles in beach sediments and estuarine around Plymouth in the United Kingdom[1]. From this discovery, he coined the term “microplastics” (MP) to define any plastic particle smaller than 5 millimetres[2]. Little did he know that just 20 years later, these MP would become a major global environmental crisis, and that they would be found virtually everywhere on the surface of Earth, from oceans, and ice caps, to fishes, shrimps, beer, wine or the roots of vegetables, and even floating in the air. Their global presence means that humans have been extensively exposed to them throughout decades. And we have proof of it, since scientists have now found MP in urine[3], faeces[4], blood[5], lung tissue[6], placenta[7], semen[8], and even breastmilk[9].

Luckily, our bodies have ways to clear harmful substances, but some MP can still sidestep them and pose health risks. Over the past five years, over 200 studies have been published exploring how MP affect animals, and describing their links with chronic inflammation, oxidative stress, and DNA damage. In turn, all these processes are factors associated with the development of cardiovascular and respiratory disease, reproductive issues, and cancer. Despite this, the real effect MP have on human health is difficult to estimate[10], mostly due to inter-species differences. Moreover, many studies have focused on materials significantly different from those found in the environment. Since the negative impact of MP on our health are not yet fully understood, European authorities cannot establish precise policies regarding MP exposure, or plans to attenuate their impact for public health. While there are important arguments to move against MP, policymakers require well-established exposure thresholds to determine the point at which MP become a serious threat to health.

We, as citizens, can also have a positive impact on the amount of microplastics present in the environment by making conscious choices such as finding alternatives to single use plastic items and prepackaged food, resisting the fast-fashion trend and purchase clothes that are durable and made of natural fibres, instead. Although these actions won't solve the current issue, they will certainly help containing it and prevent further worsening.

Acknowledgements – G. Zuri would like to thank “la Caixa” Foundation [ID 100010434; code LCF/BQ/DI21/11860062] for the PhD fellowship.

- [1] Thompson, R. C., Olsen, Y., Mitchell, R. P., Davis, A., Rowland, S. J., John, A. W. G.. 2004. *Science*, 304.
- [2] Arthur, C., Baker, J., Bamford, H.. 2009. NOAA Marine Debris Program.
- [3] Pironti, C., Notarstefano, V., Ricciardi, M., Motta, O., Giorgini, E., Montano, L.. 2022. *Toxics*, 11, 40.
- [4] Schwabl, P., Köppel, S., Königshofer, P., Bucsics, T., Trauner, M., Reiberger, T., Liebmann, B.. 2019. *Ann Intern Med*, 171.
- [5] Leslie, H. A., van Velzen, M. J. M., Brandsma, S. H., Vethaak, A. D., Garcia-Vallejo, J. J., Lamoree, M. H. 2022. *Environment International*, 163, 107199.
- [6] Jenner, L. C., Rotchell, J. M., Bennett, R. T., Cowen, M., Tentzeris, V., Sadofsky, L. R.. 2022. *Science of The Total Environment*, 831, 154907.
- [7] Braun, T., Ehrlich, L., Henrich, W., Koeppel, S., Lomako, I., Schwabl, P. and Liebmann, B.. 2021. *Pharmaceutics*, 13, 921.
- [8] Zhao, Q., Zhu, L., Weng, J., Jin, Z., Cao, Y., Jiang, H., Zhang, Z.. 2023. *Science of The Total Environment*, 877, 162713.
- [9] Ragusa, A., Notarstefano, V., Svelato, A., Belloni, A., Gioacchini, G., Blondeel, C., Zucchelli, E., De Luca, C., D'Avino, S., Gulotta, A., Carnevali, O., Giorgini, E.. 2022. *Polymers*, 14, 2700.
- [10] Zuri, G., Karanasiou, A., Lacorte, S.. 2023. *Environmental Research*, 237, 116966.

ORAL 2 - Plastic fate and transport in rivers: where do we find the plastics?

D. Mennekes

ETH Zurich, Department of Environmental Systems Science, Universitätstrasse 16, 8092 Zürich, Switzerland

@: david.mennekes@usys.ethz.ch

Over the last years micro-and macroplastic (or plastic debris) have been increasingly monitored providing a more and more detailed grid of sampling data. However, sampling data only provides spot information while the general information where plastics will accumulate in the environment remains difficult to obtain.

Here, we present a modelling and experimental approach to understand micro-and macroplastic fate in rivers and lakes on a country-scale. On the one hand, we will show how we obtain microplastic sedimentation data in small-scaled flume experiments. We observed sedimentation velocities of different polymers and particle sizes in different simulated river environments. Our set-up observed each particle individually with a camera from the injection point until the moment of settlement. On the other hand, we used modelling approaches to predict concentrations of micro-and macroplastics throughout a whole country. The model was first implemented for Switzerland, to compare dominating processes for micro-and macroplastic fate to increase our process understanding and derive exposure maps. On a large scale, we found that fate and transport are different for both size classes. On a catchment scale (e. g. the Rhine catchment in Switzerland) we observed about 45% and 98% retention for microplastic and macroplastics respectively. Moreover, we estimated that the accumulation of microplastics might be concentrated in lakes, while macroplastic accumulation, i. e. through beaching at river banks, is widely spread throughout the catchment. Also, macroplastic pollution in rivers and at river banks was found to be highly related to emission sites due to fast retention processes (i.e. beaching). In contrast, microplastic pollution was predicted to be spread over longer distances through water bodies. On the laboratory scale, we confirmed that particle sizes also matter within the microplastic size range. Additionally, sediment bed influenced the transport distance for different particle sizes.

Finally, understanding the fate and transport will help to decide on mitigation strategies in order to decrease plastic pollution and the potential risk to flora and fauna. Moreover, using the presented processes understanding can be applied to estimate emission data based on plastic concentration measurements in rivers. Future work would further integrate laboratory studies, like the one presented, in a large scale modelling approach.

ORAL 3 - Linking marine litter land sources and its spatial distribution on fishing grounds in the NW Mediterranean Sea

Marta Blanco^(1,2), Marc Balcells^(1,2), Víctor Martín-Vélez⁽¹⁾, Joan Sala-Coromina^(1,2), Jordi Ribera-Altirir^(1,2), Ferran Bustos^(1,2), Joan B. Company^(1, 2), Eve Galimany^(1,2)

⁽¹⁾ *Department of Marine Renewable Resources, Institut de Ciències del Mar (ICM-CSIC), Passeig Marítim de la Barceloneta 37–49, 08003 Barcelona, Catalonia, Spain*

⁽²⁾ *Institut Català de Recerca per a la Governança del Mar (ICATMAR), , Passeig Marítim de la Barceloneta 37–49, 08003 Barcelona, Catalonia, Spain*

mblanco@icm.csic.es, Tel: +34-932 30 95 00

Marine litter (ML) comes mainly from land but most of it accumulates on the seabed, where the bottom trawling fleet regularly operates and can accidentally catch it. This study aims to characterize the benthic ML in NW Mediterranean fishing grounds and study the effect of land sources on its spatial distribution. For this study, ML was collected from onboard commercial bottom trawlers from nine different ports along the Catalan margin in three different depths (40-800m), where 420 hauls were performed between 2019 and 2022. The ML caught in the nets was classified as metal, plastic, rubber, textile, wood, and other waste. Plastics were the fraction with more abundance, up to 63% of the total weight of ML. The fishing effort had no effects on ML distribution. However, the main land sources that explained its spatial distribution on the seafloor were sampling area, distance to the river mouths and distance to a waste water treatment plant (WWTP) submarine outfall. The ML showed higher values in front of

Barcelona, where some hauls reached up to 201.94 kg km⁻², whereas the lowest quantities were observed in the northern and southern limits of the study area. This study highlights the importance to improve waste management on land in order to prevent the accumulation of marine litter on the fishing grounds.

Acknowledgements – this work was supported by the Catalan Institute for Ocean Governance Research (ICATMAR), trawl surveys were financed by European Maritime and Fisheries Fund (EMFF) and the Catalan General Directorate of Marine Policy and Sustainable Fisheries by projects PESCAT (ARP029/18/00003) and CGCAT (ARP140/20/000006). We thank all ICATMAR personnel who helped with the data collection. We are very thankful to all fishers for their support throughout the project.

ORAL 4 - Las gaviotas como biovectores de la dispersión de plásticos desde vertederos a humedales

Manuel Serrano, Julián Cano, Belén Cañuelo, María Caminero, Lars Ursen, Isabel Afán, Andy J. Green, Manuela G. Forero, Marta I. Sánchez

Biología de la Conservación y Cambio Global, Estación Biológica de Doñana CSIC, Américo Vespucio 26, Sevilla, España

manuel.serrano@ebd.csic.es, Tel: +34 622162704

La acumulación de plásticos en los ecosistemas es un problema que afecta a los diferentes integrantes de los mismos a nivel global. Hasta el momento, los ecosistemas marinos son los más investigados en cuanto a acumulación y efectos de estos contaminantes (1), frente a humedales y salinas escasamente estudiados, pese a estar expuestos a la acumulación de plásticos y tóxicos derivados (2,3). En este estudio evaluamos el papel de dos especies de láridos, la gaviota patiamarilla (*Larus michahellis*) y la gaviota sombría (*Larus fuscus*) como vectores de movilización y dispersión de plásticos entre los vertederos donde potencialmente se alimentan hacia las salinas localizadas en el estuario de los ríos Tinto y Odiel. Datos previos a este estudio (4) han revelado que estas especies utilizan basureros de la zona para alimentarse. Posteriormente, depositan las egagrópilas y heces con restos no digeridos, plásticos y otra basura, en las zonas donde se reproducen y descansan, produciendo hotspots de contaminación (4). En este trabajo estimaremos la ocurrencia y abundancia de plástico en las excretas de las aves y se determinará el tipo de plástico transportado. Finalmente, realizamos una estima del flujo anual de plástico a las salinas utilizando por un lado los datos mensuales de efectivos poblacionales de ambas especies, y por otro, datos de movimiento entre zonas de alimentación y descanso a partir de la información generada por los dispositivos GPS que portan los individuos.

[1] Provencher, J. F., Borrelle, S. B., Bond, A. L., Lavers, J. L., Van Franeker, J. A., Kühn, S., Hammer, S., Avery-Gomm, S., & Mallory, M. L. (2019). Recommended best practices for plastic and litter ingestion studies in marine birds: Collection, processing, and reporting. *FACETS*, 4(1), 111-130. <https://doi.org/10.1139/facets-2018-0043>

[2] Cano-Povedano, J., López-Calderón, C., Sánchez, M. I., Hortas, F., Cañuelo-Jurado, B., Martín-Vélez, V., Ros, M., Cózar, A., & Green, A. J. (2023). Biovectoring of plastic by white storks from a landfill to a complex of salt ponds and marshes. *Marine Pollution Bulletin*, 197, 115773. <https://doi.org/10.1016/j.marpolbul.2023.115773>

[3] Martín-Vélez, V., Cano-Povedano, J., Cañuelo-Jurado, B., López-Calderón, C., Céspedes, V., Ros, M., Sánchez, M. I., Shamoun-Baranes, J., Müller, W., Thaxter, C. B., Camphuysen, C. J., Cózar, A., & Green, A. J. (2024). Leakage of plastics and other debris from landfills to a highly protected lake by wintering gulls. *Waste Management*, 177, 13-23. <https://doi.org/10.1016/j.wasman.2024.01.034>

[4] Navarro J, Grémillet D, Afán I, Ramírez F, Bouten W, et al. (2016) Feathered Detectives: Real-Time GPS Tracking of Scavenging Gulls Pinpoints Illegal Waste Dumping. *PLOS ONE* 11(7): e0159974. <https://doi.org/10.1371/journal.pone.0159974>

ORAL 5 - "Plastic Pirates – Go Europe!" in Spain: Citizen Science as a powerful approach to monitor plastic pollution in fluvial ecosystems.

M. Abril⁽¹⁾, P. De La Fuente⁽²⁾, A.J. Canepa⁽³⁾, F. Gignac⁽¹⁾, L. Proia⁽¹⁾, M. Farré⁽⁴⁾, M. Llorca⁽⁴⁾, J.C. López-Doval⁽¹⁾

⁽¹⁾ *BETA Technological Center, University of Vic - Central University of Catalonia, Carretera de Roda 70, 08500, Vic, Barcelona, Spain*

⁽²⁾ *International Research Center in Critical Raw Materials for Advanced Industrial Technologies (ICCRAM). University of Burgos, I+D+I. Plaza Misael Bañuelos s/n. 09001 Burgos, Spain*

⁽³⁾ *Universidad de Burgos, C/ Villadiego s/n, 09001, Burgos, Spain.*

⁽⁴⁾ *Institute of Environmental Assessment and Water Research, C. Jordi Girona 18-26, 08034, Barcelona, Spain.*

meritxell.abril@uvic.cat, Tel: +34- 93 881 61 68

Although plastic pollution is one of the major environmental challenges of our time, there is still an important knowledge gap in relation with the real sources, fluxes and impacts of plastics in freshwater ecosystems. Citizen science can be a powerful approach to address this gap by obtaining data over large spatial and temporal scales, while also increasing awareness of plastic pollution in freshwaters that can result in positive behavioural changes to face this problem. In addition, citizen science can play an outstanding role in school science and environmental education as it engages young citizens directly with these environmental problems at local level while gives them an understanding of the scientific process. The EU-funded project "Plastic Pirates - Go Europe!" empowers school classes and young people across Europe to collect data about plastic pollution in freshwater ecosystems. To obtain high quality scientific data, this project uses standardized methods to quantify and characterize plastic and microplastic litter in rivers and to identify possible plastic sources along European rivers and streams. The collected data in these sampling campaigns is then entered in the database of the project and analysed by scientists and researchers. In this way, young European citizens are making an important contribution to researching the state of European rivers and the extent and pollution caused by plastic waste. In Spain, the Plastic Pirates initiative started in autumn 2022, when around 800 participants collected samples across 39 river reaches and found 3081 plastic items, 85% single-use plastics. In autumn 2023 and spring 2024, 51 river reaches have been monitored, expanding a database that will increase understanding of drivers of plastic pollution in fluvial ecosystems. Results from this project provides evidence on the prevalence, sources, and distribution of plastic waste in European rivers, both macro and microplastic, and the power of citizen science to understand and tackle plastic pollution.

Acknowledgements – Plastic Pirates has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 10108882 and its Europeanization is coordinated by the German Aerospace Center - Project Management Agency. In Spain, it is coordinated by the BETA Technological Center (University of Vic-Central University of Catalonia), together with the University of Burgos and Fundación Oxígeno. It has also received support from the Spanish Foundation for Science and Technology (FECYT) of the Ministry of Science, Innovation and Universities.

ORAL 6 - Liberación de microplásticos en lavandería industrial

M. Barbero⁽¹⁾⁽²⁾, S. Casas⁽³⁾, J. De Pablo⁽⁴⁾

⁽¹⁾ *Departament, d'Enginyeria Química, EEBE and Barcelona Research Center in Multiscale Science and Engineering, UPC, Eduard Maristany, 10-14, 08019, Barcelona*

⁽²⁾ *Girbau S.A., Crta Manlleu km.1, 08500 Vic, Barcelona,*

⁽³⁾ *Eurecat, Centro Tecnológico de Catalunya, Plaça de la Ciència, 2, 08242 Manresa, Barcelona*

⁽⁴⁾ *Departament, d'Enginyeria Química, EEBE and Barcelona Research Center in Multiscale Science and Engineering, UPC, Eduard Maristany, 10-14, 08019, Barcelona*

manuel.barbero@upc.edu, Tel: +34 696301244

En este trabajo, se caracteriza la liberación de microfibras (MF) de prendas de poliéster a lo largo de su ciclo de vida durante el lavado y en las distintas fases de este. Para ello se aplicaron técnicas de determinación gravimétrica y microscopía óptica.

La liberación total de MF a lo largo de los 30 ciclos de lavado, se cifró en 2229,74 mg/kg de ropa y 89,19 mg/prenda. El 25% de la masa total de MF, se libera en el primer lavado, cifra que alcanza un 44% hasta el lavado número 5.

Los análisis específicos para conocer la liberación de MF en cada una de las fases del proceso de lavado, determinaron que el 51 +/- 7% lo hacen en la fase de lavado. La comparación entre la liberación de MF en los tres aclarados restantes, permitió determinar la escasa influencia del suavizante y la relación positiva y directa entre el tiempo de acción mecánica y liberación de microplásticos donde una reducción del 80% del tiempo de acción mecánica, se traduce en una reducción de un 80 +/- 6% en la liberación de microplásticos.

En la caracterización microscópica, se excluyeron las partículas inferiores a 50 µm para evitar errores de medición. Se determinó que el 36% de los microplásticos detectados se encuentran en longitudes de entre 50 y 200 µm seguido por un 22% entre 200 y 400 µm. Con esto, se ha asimilado la morfología del microplástico a una forma cilíndrica, con un diámetro y longitud promedio de 24,6 y 421 µm respectivamente.

Cruzando lo anterior con los datos obtenidos mediante la determinación gravimétrica, se estableció la relación entre masa y número de microfibras en 3569 MF/mg y sirvió para obtener el número total de MF superiores a 50 µm liberadas a lo largo del ciclo de vida, 7.957.942 MF/kg y 318.317 MF/prenda. Las microfibras por debajo de 50 µm representan solamente el 11% del total de la masa, pero debido a su tamaño podrían rondar en torno al 68% de las partículas presentes en este tipo de efluentes.

ORAL 7 - Biodegradación de microplásticos en lodos de depuradora sometidos a condiciones de compostaje

Adriana González Alcívar, Jorge Dias Carlier, Maria Clara Costa, Isabel Marín Beltrán

*Centre of Marine Sciences (CCMAR), University of Algarve, Gambelas Campus, building 7,
8005-139 Faro, Portugal*

imbeltran@ualg.pt, Tel: +351-913148074

El uso de lodos de depuradora en suelos agrícolas es una buena iniciativa para reducir los residuos, y al mismo tiempo fertilizar los suelos. En base a la Directiva Europea 86/278/CEE, estos lodos deben ser tratados antes de su aplicación en los suelos, y no deben exceder los límites de toxicidad reportados para 7 metales pesados. Sin embargo, esta normativa no considera la concentración de microplásticos (plásticos con una longitud menor a 5 mm [1]) y otros contaminantes emergentes, antes de su utilización en terrenos agrícolas. Se ha determinado que, en las plantas de tratamiento de aguas, entre el 70 y el 99% de los microplásticos (MP) eliminados de las aguas pasan a la fase sólida [2,3], con posibles efectos adversos en las propiedades del suelo [4].

En el presente estudio se simuló un proceso de compostaje, para evaluar la posible biodegradación de MP producidos a través de plásticos convencionales (botella de tereftalato de polietileno, PET) y de una bolsa etiquetada como compostable – cuyo análisis químico reveló una composición a base de polietileno de baja densidad, adicionados a fangos de una depuradora. Así mismo, se evaluó el efecto de los MP en las condiciones físico-químicas del compost (pH, contenido en materia orgánica, y ratio C:N). El diseño experimental consistía en 7 tratamientos: 40 partículas de cada tipo de plástico adicionadas a 25 g de fangos; los mismos tratamientos con lodos bioaumentados con una cepa bacteriana del género *Bacillus*; un control positivo (fangos sin microplásticos) y dos controles negativos, uno para cada tipo de plástico (40 partículas adicionadas a 25 ml de agua destilada). Las muestras se mantuvieron en una estufa (50°C), cubiertas ligeramente con papel de aluminio.

Los resultados mostraron que, después de 60 días, ambos tipos de MP permanecieron en los lodos, aunque se observaron algunos cambios en sus grupos funcionales (determinados mediante espectroscopia FTIR), y en la superficie de las partículas (determinados por microscopía electrónica). Los MP no afectaron significativamente al proceso de compostaje, pero sí lo hizo la adición de *Bacillus*, que estimuló el proceso de remineralización de la materia orgánica, disminuyendo el porcentaje de materia orgánica y el C:N en estos tratamientos. Estos resultados ponen en alerta la necesidad de controlar el contenido en MP de los lodos de las depuradoras antes de su aplicación en los suelos, así como evaluar su impacto en la matriz de destino.

Agradecimientos – Este trabajo fue financiado por fondos nacionales portugueses a través de la Fundação para a Ciências e Tecnologia (FCT) en el ámbito del proyecto PTDC/CTA-AMB/7782/2020, y a través de los proyectos UIDB/04326/2020, UIDP/04326/2020 y LA/P/0101/2020. Isabel Marín Beltrán recibió financiación postdoctoral de la Convocatoria Estímulo al Empleo Científico, Apoyo Individual 2017 (CEEIND/03072/2017).

[1] Arthur, C., Baker, J. & Bamford, H. 2009. Proceedings of the International Research Workshop on the Occurrence, Effects, and Fate of Microplastic Marine Debris. NOAA Technical Memorandum NOS-OR&R-30.

[2] Carr, S. A., Liu, J., & Tesoro, A. G. 2016. *Water Research* 91, 174–182.

[3] Murphy, F., Ewins, C., Carbonnier, F., & Quinn, B. 2016. *Environmental Science & Technology* 50(11), 5800–5808.

[4] Anderson Abel de Souza Machado, Chung Wai Lau, Jennifer Till, Werner Kloas, Anika Lehmann, Roland Becker, and Matthias C. Rillig. 2018. *Environmental Science & Technology* 52 (17), 9656-9665.

PRESENTACIONES ORALES

Miércoles 16 de octubre

- 9h00-9h05 Bienvenida
Ethel Eljarrat (Organizadora de PLASTIC'2022)
- 9h05-9h40 CONFERENCIA PLENARIA: Los bioplásticos y el medio ambiente: ¿aliados o enemigos?
Luis Cabedo (Catedrático de Ciencia de los Materiales de la Universitat Jaume I y Director de la Cátedra UBE de Plásticos Sostenibles)
- Chairman:* *Lara Cioni, Maria Vila*
- 9h40-10h00 **ORAL 8: Bioplastics: trick-or-treat for freshwater ecosystems in the context of global change.**
Berta Bonet (CEAB-CSIC)
- 10h00-10h20 **ORAL 9: Effects of micro-bioplastics on the microbiome-brain cross talk and cognition in the aquatic invertebrate *Daphnia magna*.**
Paula Carrillo (IDAEA-CSIC)
- 10h20-10h40 **ORAL 10: Comparison of the effects of bioplastic products on marine bacterial communities in a microcosm experiment.**
Clara Serrano (IDAEA-CSIC)
- 10h40-11h00 **ORAL 11: Interaction of nanoplastics and phenantrene: evaluation of ecotoxic effects on in vivo and in vitro fish models (*Danio rerio*).**
Marlid García (Universidad Complutense de Madrid)
- 11h00-12h00 Pausa café – **Sesión de Pósters**
- Chairman:* *Marta Llorca, Maria Vittoria Barbieri*
- 12h00-12h20 **ORAL 12: Human exposure to plastic additives through menstrual products use.**
Lara Cioni (IDAEA-CSIC)
- 12h20-12h40 **ORAL 13: Tracking Tire-related chemicals in the Llobregat Delta area, Barcelona (Spain).**
Nicola Montemurro (IDAEA-CSIC)
- 12h40-13h00 **ORAL 14: Analysis of plasticizers in potentially inhalable particles (PIP) from recycled rubber flooring in playgrounds and sport facilities.**
Daniel Rozúa (IDAEA-CSIC)

- 13h00-13h20 **ORAL 15: Effect of depuration time on microplastics levels in edible mollusks.**
Nora Expósito (Universitat Rovira i Virgili)
- 13h20-13h40 **ORAL 16: Presencia de microplásticos en agua, refrescos y otras bebidas.**
Andrea Barrientos (Universitat Rovira i Virgili)
- 13h40-14h00 **ORAL 17: Flame retardants and plasticizers in Portuguese homes and schools.**
Judith Desmet (IDAEA-CSIC)
- 14h00-14h20 **ORAL 18: Study of micro- and nanoplastics in stool samples: analytical development.**
David Alcaide (IDAEA-CSIC)
- 14h20-14h30 Clausura
Ethel Eljarrat (Organizadora de PLASTIC'2022)

PLENARIA - "Los bioplásticos y el medio ambiente:

¿aliados o enemigos?"

Luis Cabedo Mas

*Grupo de Polímeros y Materiales Avanzados (PIMA) UNIVERSITAT JAUME I
Avda. Vicent Sos Baynat, s/n, 12071 Castelló de la Plana (España)*

lcabedo@uji.es, Tel: +34-964728193

El impacto medioambiental asociado al uso masivo de plásticos es una de las mayores preocupaciones globales. Desde la década de 1950, la producción mundial de plásticos ha crecido exponencialmente, superando los 400 millones de toneladas anuales en la actualidad, y se espera que para 2050 se duplique. Cada año, más de 8 millones de toneladas de plásticos terminan en los océanos, y se estima que en 30 años podría haber más plásticos que peces en el mar, en términos de masa. El coste económico de la gestión de estos residuos es igualmente alarmante: el Programa de las Naciones Unidas para el Medio Ambiente (PNUMA) estima que los daños medioambientales y sociales provocados por los plásticos alcanzan los 75 mil millones de dólares anuales.

Para mitigar el creciente problema de los residuos plásticos, la economía circular se presenta como la única solución sostenible. En este enfoque, los materiales deben mantenerse en uso el mayor tiempo posible mediante su reciclaje y reutilización. Sin embargo, existen situaciones en las que el reciclaje es impracticable o ineficaz. En muchas regiones y países, la falta de infraestructuras eficientes para la gestión de residuos impide el correcto reciclaje. Además, productos plásticos pequeños, muy sucios o complejos, como los materiales multicapa utilizados en envasado, son prácticamente imposibles de reciclar. También existen aplicaciones en entornos abiertos, como la agricultura, la pesca y la silvicultura, donde la recuperación de los plásticos usados no es viable.

En estos casos, los polímeros biodegradables se presentan como una posible solución. Estos materiales pueden descomponerse en determinadas condiciones, ofreciendo una alternativa más adecuada para aplicaciones donde el reciclaje no es factible. Aunque aún presentan limitaciones técnicas y su coste sigue siendo elevado, su potencial para reducir los residuos plásticos en sectores críticos es significativo.

Es importante destacar que existe un considerable desconocimiento y mal uso de los términos "biodegradable" y "bioplástico", lo que puede llevar a una falsa sensación de seguridad sobre su impacto medioambiental. No todos los bioplásticos son biodegradables, y la biodegradabilidad depende de condiciones específicas que a menudo no se cumplen en los entornos naturales o en los sistemas de gestión de residuos actuales. En esta conferencia, se analizará el significado real de estos conceptos y se explorará el reciclaje orgánico como una herramienta dentro de la economía circular. Asimismo, se presentarán las limitaciones y las oportunidades que ofrece el conocimiento y control del proceso de biodegradación, mostrando su potencial en la reducción del impacto medioambiental asociado al uso de plásticos.

ORAL 8 - Bioplastics: trick-or-treat for freshwater ecosystems in the context of global change

Bonet, Berta⁽¹⁾, Giménez, Lorena⁽¹⁾, Ribot, Miquel⁽¹⁾, Castelar, Sara⁽¹⁾, Torremorell, Ana María⁽²⁾

⁽¹⁾ *1 Integrative Freshwater Ecology Group, Centre for Advanced Studies of Blanes (CEAB-CSIC), Blanes, Catalonia, Spain*

⁽²⁾ *Programa Ecología de Protistas y Hongos (PEPHON), Instituto de Ecología y Desarrollo Sustentable-INEDES- (CONICET-UNLu). Departamento de Ciencias Básicas-Universidad Nacional de Luján, Argentina*

berta.bonet@ceab.csic.esm, Tel: +34-639011151

Plastics are present in our daily life, but their high persistence and degradation into microplastics make them a worldwide environmental threat. Alternatively, bioplastics (BioP) have been developed. BioP are biodegradable at the end of their life due to their chemical composition? and/or produced from renewable sources. They have become an alternative since they can degrade into water and carbon dioxide. In fluvial ecosystems, the inherent microbial communities could potentially decompose BioP due to their great capacity for recycling and decomposition of nutrients such as carbon. However, it is still unknown how the degradation of BioP will affect in-stream carbon and nutrient cycling, and consequently, their potential effects on essential ecosystem services such as water purification. In addition, global change, especially rising temperatures, may further accelerate their degradation. Thus, this study aims to explore and provide new knowledge on the decomposition of BioP on freshwater ecosystems and their related effects under different water temperatures using microbial communities as a bioindicators.

Results from a microcosm study measurements of BioP decomposition and effects on functional and structural biofilm performance under different temperatures will be presented. To achieve this aim, a microcosm study is being performed at 20°C and 30°C using a BioP (Mater-Bi) with and without biofilm. Water and biofilms samples have been taken before bioplastic addition (T0), and after 1, 3, 7, 14 and 21 days. Water physicochemical parameters, nutrients, DOC, CDOM, as well as functional and structural biofilm changes using several endpoints: total biomass, algal and bacterial biomass, enzyme activities, photosynthetic activity, metabolic activity (Raz/Rru system), main algal groups. SEM observations of BioP and biofilm community have also been evaluated.

The results will serve to evaluate the effects of BioP on fluvial ecosystems and on water quality. Moreover, results will provide evidence of the effects of BioP as a potential source of anthropogenic organic matter, especially nutrients and their potential effects on carbon cycling.

Keywords: Bioplastics, biofilm, global change, freshwater ecosystems

Acknowledgements –. This project is supported by a scholarship from the ComFuturo program of the General CSIC Foundation that has received funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No. 101034263 and external scholarship for young researchers RESOL-2023-1547-APN-DIR#CONICET . Moreover, thanks to the work placement agreement between the CEAB and the UPC, allowing the participation of LG in this study.

ORAL 9 - Effects of –micro-bioplastics on the microbiome-brain cross talk and cognition in the aquatic invertebrate *Daphnia magna*

María Paula Carrillo, Maria Vila-Costa, Carlos Barata

Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, Spain

mapqam@cid.csic.es, Tel: +34 654825102

The effects of plastics on aquatic ecosystems, especially microplastics, have been extensively studied. While bioplastics are seen as more sustainable, they could have toxic effects to aquatic organisms [1]. Understanding the impact of microplastics on the gut microbiome is crucial, as alterations can lead to various health conditions [2], but their effects on gut microbiome-neurological defects in invertebrates remain unknown. The aim of this study is to assess the effect of bioplastic particles (MPLs), specifically poly(lactic acid) (PLA) and poly(hydroxybutyrate) (PHB), in the feeding and behavioural responses, gut microbiome and cephalic transcription in *D. magna*. *Daphnia* juveniles were exposed for 72 h to microparticles of two bioplastics, PHB and PLA, at two concentrations (high: 150 mg/L, low: 1.5 mg/L), along with kaolin and control groups, and under starvation conditions. Exposure to high concentrations of PLA and PHB microparticles significantly inhibited feeding and impacted various behavioral responses in *D. magna*, resembling effects observed under starvation. Microbiome analysis revealed notable shifts in taxonomic composition and functional profiles. Specifically, PLA and PHB microparticle treatments reduced key bacteria like *Limnochabacter* and increased relative abundance of *Enterobacteriales* (*Aeromonas*) and *Pseudomonadales* (*Pseudomonas* and *Acinetobacter*) in gut microbiome. Transcriptomic analysis revealed that both PLA microparticles and starvation enhanced catabolic processes related to energy acquisition from sources other than food, while microplastics up-regulated neurological pathways, cell turnover, and differentiation. In contrast, starvation down-regulated these pathways. These transcriptomic responses are likely associated to functional changes in the gut microbiome. Exposure to microplastics resulted in decreased biosynthesis of short-chain fatty acids in the gut, altered neurological pathways in the brain and disrupted behavioural responses, altogether supporting the role of the microbiota-gut-brain crosstalk on neurological disorders.

Acknowledgements – This work has been supported by the Spanish Ministry of Science and Innovation (MCIN) through projects CogniTox (PID2020-113371RB-C21) and MIQAS (PID2021-128084OB-I00). Maria Paula Carrillo was supported by the Spanish Ministry of Universities fellowship FPU20/03595.

[1] Savva, K., Farré, M., Barata, C., 2023. Sublethal effects of bio-plastic microparticles and their components on the behaviour of *Daphnia magna*. *Environmental Research*, 236, 116775.

[2] Li, W., Chen, X., Li, M., Cai, Z., Gong, H., Yan, M., 2022. Microplastics as an aquatic pollutant affect gut microbiota within aquatic animals. *Journal of Hazardous Materials*, 423, 127094.

ORAL 10 - Comparison of the effects of bioplastic products on marine bacterial communities in a microcosm experiment

C. Serrano-Lorigados, K. Savva, M. Fernández-Altimira, M. Farré, J. Dachs, M. Vila-Costa & M. Llorca

Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, Spain

clara.serrano@cid.csic.es, Tel: +34-692665429

Biodegradable biobased bioplastics are promising alternatives to non-degradable fuel-based plastics, but they use to contain more chemical additives for conferring them similar properties than fuel-based plastics that could leach in seawater [1]. Due to the recent transition to biomaterials, their effects on the marine environments and ecosystems are not fully understood. To evaluate the influence of bioplastics on coastal surface marine bacterial communities, a microcosm experiment was conducted during two months using seawater amended with non-aged biobased pellets of polylactic acid (PLA), poly-hydroxybutyrate (PHB) and biodegradable commercial products made of PLA (Knife) or biodegradable PLA&PHB (Bag).

Throughout the experiment, leaching compounds were tentatively identified at level 2 of confidence by liquid chromatography coupled to high resolution mass spectrometry for all the amendments, with 64 chemicals leaching only in presence of bacteria, including PLA degradation products and plastic additives. The bacterial community was analysed considering three different fractions: free-living (FL), particle-attached (PA) and bioplastic-attached (BioPIA) bacteria. After two months, the study revealed that the taxonomic composition of the bacterial community was primarily determined by the living strategy and secondarily by the type of bioplastic product and detected leachates. Commercial products and pellets modulated the FL bacterial community differently. Leachates in commercial product-amended microcosms were plastic-related compounds, whereas those in pellet-amended microcosms were detected only in incubation with bacteria, including PLA degradation products and metabolites. The PA bacterial community was modulated differently only in Bag-amended microcosms, due to plastic-related entities not related to bacterial activities. PLA amendment promoted bacterial production in this fraction, with PLA degradation products and degradation metabolites identified as key determinants of community composition. Bioplastic-attached bacterial taxa differed for each amendment, but shared high relative abundances of the orders Phycisphaerales, OM190 and Pseudomonadales, suggesting a potential role in PLA biodegradation. This study provides further insights into the influence of bioplastics and their leachates on marine microbial communities, contributing to our understanding of bioplastics' effects on the global oceans.

Acknowledgements – This work was supported by BIOPLASTICMENT (20228CNS101) from the Spanish Ministry of Science and Innovation, and partially by SGR01150 from Generalitat de Catalunya. C.SL gives thanks her grant from the Spanish Ministry of Science and Innovation and the European Social Fund (ESF+) (PRE2021-098386).

[1] Akoueson, F., Paul-Pont, I., Tallec, K., Huvet, A., Doyen, P., Dehaut, A. and Duflos, G. 2023. *Sci Tot Env* 875(2): 159318

ORAL 11 - Interaction of nanoplastics and phenanthrene: evaluation of ecotoxic effects on in vivo and in vitro fish models (Danio rerio)

P. De Oro-Carretero⁽¹⁾, M. García-Ordoñez⁽²⁾, N. Roher^{(2),(3)}, J. Sanz-Landaluze⁽¹⁾

⁽¹⁾ *Department of Analytical Chemistry, Faculty of Chemical Science, Complutense University of Madrid, 28040 Madrid, Spain*

⁽²⁾ *Institute of Biotechnology and Biomedicine (IBB), Universitat Autònoma de Barcelona, 08193 Barcelona, Spain*

⁽³⁾ *Department of Cell Biology, Animal Physiology and Immunology, Universitat Autònoma de Barcelona, 08193 Barcelona, Spain*

Marlid.Garcia@uab.cat

Plastic pollution has become one of the most relevant environmental issues, every year 19-23 million tonnes of plastic waste leaks into aquatic ecosystems¹. Plastic degradation can give rise to nanoplastics (NPs), small enough to be bioavailable. NPs are susceptible to accumulate or adsorb on the surface persistent organic pollutants (POPs), which can potentially increase their toxicity. The interaction between NPs and POPs, such as phenanthrene (PHE), is a growing concern due to their potential impact on living organisms². This study explores how polystyrene nanoplastics (PS-NPs) interact with PHE and the effects on biological systems, using the zebrafish liver cell line (ZFL) and zebrafish larvae as a model³.

Zebrafish larvae (3 dpf) were exposed to 5 mg/L PS-NPs or co-exposed with 0.05 mg/L PHE for 48 hours and imaged by fluorescence microscopy. This concentration of PS-NPs alone or in combination with PHE did not result in any mortality. In contrast, the presence of PS-NPs was observed to alter the toxicity profile of PHE in cells, as evidenced by cytotoxicity (MTT) and oxidative stress (ROS generation) assays. Further analysis using miniaturised ultrasound-assisted extraction and GC-MS revealed that PS-NPs affected the bioaccumulation and metabolism of PHE and its metabolites (OH-PHEs). Flow cytometry with PS-NPs labelled with a green fluorophore (dragon green) demonstrated that PHE enhanced the cellular uptake of PS-NPs.

These findings indicate that the interaction between nanoplastics and phenanthrene can significantly modify toxicity and metabolic pathways in in vitro models, posing a combined threat that may be more severe than their individual effects. In addition, this study provides clear evidence that PS-NPs can be accumulated in zebrafish larvae after exposure alone or in combination with phenanthrene.

Acknowledgements – Financial support from the Ministry of Science and Innovation [PID 2020 114714 RB 100] [PID2021-126710OB-C21]. Paloma de Oro is grateful for her predoctoral contract [PRE2021/097956]. Marlid García is grateful for her predoctoral contract [PRE2022-103797].

[1] Environment UN. Plastic pollution [Internet]. UNEP - 2022 [citado el 6 de julio de 2024].

[2] Xu, K., Ai, W. et al. 2022. Gondwana Res. 108:127–32.

[3] Brandts, I., García-Ordoñez, M. et al. 2020. Environ Sci Nano 7:2410–2.

ORAL 12 - Human Exposure to Plastic Additives through Menstrual Products Use

L. Cioni, J. Calvo Salvador, E. Eljarrat

Environmental and Water Chemistry for Human Health (ONHEALTH) Research Group, Institute of Environmental Assessment and Water Research (IDAEA)-CSIC, Jordi Girona 19-26, Barcelona 08034, Spain

lara.cioni@idaea.csic.es, Tel: +34-932557598

Menstrual products have been shown to contain chemicals with potential toxic effects, like phthalates (PAEs) and per- and polyfluoroalkyl substances [1]. Since the vulvar tissue in contact with these products has high chemical absorption capacity, the use of these products might contribute significantly to human exposure [1]. However, the studies investigating this exposure pathway for plastic additives are limited only to PAEs. The goal of our study was to analyze menstrual products for 3 groups of plastic additives: PAEs, organophosphate esters (OPEs) and alternative non-phthalate plasticizers (NPPs). Obtained data will be used to evaluate exposure to these compounds through the use of menstrual products and their potential health risks.

A total of 10 sanitary pads, 4 panty liners and 9 tampons were analyzed with a protocol adapted from the literature [2,3]. Human exposure through dermal contact with menstrual products was quantified by calculating the estimated daily intake (EDIdermal). To assess the potential carcinogenic and non-carcinogenic risks for human health the EDIdermal values were compared with reference values established by the US EPA [4].

A total of 7 PAEs, 16 OPEs, and 8 NPPs were detected in the menstrual products analyzed. Sanitary pads had the highest Σ plastic additives concentrations (median: 9901 ng/g), followed by panty liners (median: 1935 ng/g) and tampons (median: 123 ng/g). While tampons had the lowest concentrations for all classes of plastic additives, panty liners showed the highest Σ PAEs and Σ OPEs concentrations and sanitary pads showed the highest Σ NPPs concentrations. To give an idea of the contribution of menstrual products use to plastic additives exposure, the EDIdermal values for Σ OPEs for panty liners (median: 1.16 ng/kg bw/day) were well below the EDIs calculated by other studies for OPEs exposure through dietary intake (62-103 ng/kg bw/day [5]), particulate matter inhalation (3.97 ng/kg bw/day [6]), but comparable with EDIs reported for dust ingestion (1.75 ng/kg bw/day [6]). This EDI comparison example highlights the relevance of considering consumer products as a potential exposure route. Still, risk assessment calculations showed no potential health risks from the sole exposure to plastic additives through menstrual products. However, it is important to note that the use of these products adds up to exposure from other pathways and might contribute to exceed the exposure thresholds for adverse health effects.

Acknowledgements – This project was supported by the SINERGIA 2024 project framework within IDAEA-CSIC (Spanish Ministry of Science and Innovation, Severo Ochoa Project CEX2018-000794-S) and through a collaboration agreement between IDAEA and Rezero.

[1] Upson, K., Shearston J.A., Kioumourtzoglou M.A. . 2022. Curr Environ Health Rep 9: 38–52.

[2] Fernández-Arribas, J., Moreno T., Bartrolí R., Eljarrat E. 2021. Environ Int 154: 106654.

[3] Gao C.J., Wang F., Shen H.M., Kannan K., Guo Y. 2020. Environ Sci Technol 54, 2: 930–937.

[4] US EPA. 2019. Regional Screening Levels (RSLs).

[5] Fernández-Arribas, J., Moreno T., Eljarrat E. 2023. Environ Int 175: 107936.

[6] Balasch A., Moreno T., Eljarrat E. 2023. Environ Sci Technol 57, 49: 20669-20677.

ORAL 13 - Tracking Tire-related chemicals in the Llobregat Delta area, Barcelona (Spain)

N. Montemurro⁽¹⁾, F. de Angelis⁽¹⁾, G. Gkotsis⁽²⁾, K. Diamanti⁽²⁾, E. de Roa⁽³⁾, N. Thomaidis⁽²⁾, M. Garí⁽¹⁾

⁽¹⁾ IIDAEA-CSIC, c/Jordi Girona 18-26, 08034 Barcelona, Catalonia, Spain

⁽²⁾ Laboratory of Analytical Chemistry, Department of Chemistry, University of Athens
Panepistimiopolis Zografou 157 71 Athens, Greece

⁽³⁾ Consorci del Delta Av. Onze de setembre, 73-75, 08820 El Prat de Llobregat

nmoqam@cid.csic.es, Tel: +34-932557683

Tire-related chemicals (TRCs), are receiving considerable attention as potential contaminants in the environment. TRCs include many compounds, including over 200 rubber additives such as antiozonants, vulcanizing or crosslinking agents. These chemical agents are introduced into the environment through tire wear particles (TWPs) generated while driving and can migrate from the road surface into receiving waters during precipitation events.

The Llobregat Delta (Barcelona) surrounded by various natural spaces, including some coastal wetlands, where there are some brackish water lagoons as well as the Barcelona-El Prat airport, was chosen to study the distribution of the TRCs present in the water and evaluate their effects on the environment.

To monitor the water quality in the Llobregat Delta, 3 samplings were conducted in January (without rain events), February (light rains), and March (heavy rain) 2024.

A total of 75 grab samples of road runoff and surface water were collected from the Llobregat river close to the Barcelona-El Prat airport (Parking T1/T2), the C-32 road, and the C-31 road, from the extensive network of open canals used for irrigation of Baix Llobregat, and from Illa, la Ricarda, la Roberta, and las Filipinas-Remolar ponds.

To estimate the occurrence of TRCs, the samples were extracted using solid phase extraction and analyzed by liquid chromatography coupled to quadrupole-time-of-flight mass spectrometry (LC-QTOF-MS), by applying sophisticated wide-scope target screening workflows by using the Bruker timsTOF Pro2 platform, powered by the latest parallel accumulation serial fragmentation (PASEF®) technology, with its proven robustness, high sensitivity and fast MS/MS acquisition. Over 3000 different pollutants including 80 TRCs were screened in the samples.

This environmental screening demonstrated that most of TRCs can enter the water cycle during rainfall. For most TRCs (i.e., 1,3-diphenylguanidine, dicyclohexylamine, and 6PPD-quinone), it is clearly evident that after intense rainfall the concentrations tend to increase, especially in the sampling points near the highway bridges, the Llobregat river, the open canals, and the Parking T1/T2.

Acknowledgements – The authors acknowledge the support of the Economy and Knowledge Department of the Catalan Government through Consolidated Research Group (SGR01150 and SGR00986). This work falls under the TRANSIT national project (PID2022-138623OA-100) funded by the Spanish Ministry of Science and Innovation.

ORAL 14 - ANALYSIS OF PLASTICIZERS IN POTENTIALLY INHALABLE PARTICLES (PIP) FROM RECYCLED RUBBER FLOORING IN PLAYGROUNDS AND SPORT FACILITIES

D. Rozúa, I. González, T. Moreno, E. Eljarrat

Dept. of Environmental Chemistry, IDAEA-CSIC, Jordi Girona, 18-26, E-08034, Barcelona, Spain

@: daniel.rozua@idaea.csic.es Tel: +34-934006100 (ext.: 437786)

In recent years, the recycling of rubber materials has emerged as a significant contributor to circular economy and sustainable development. Despite this, rubber contains large amounts of various polymers and additives, many of which are individually recognized as toxic to the environment[1]. The release of these substances could potentially increase at the last stages of the useful life of rubber products, raising additional concerns regarding recycled rubber[2]. The degradation of these materials can form small, inhalable particles of size PM_{2.5} and PM₁₀ which, although not airborne, can be suspended by wind or human activity, and as such are considered potentially inhalable particles (PIP).

One of the most well-known applications of recycled rubber is the production of artificial flooring, typically used in children's playgrounds and running tracks. These floor tiles are made by crumbing used rubber and binding the granules back in the desired shape with the use of a polymeric resin. Both recycled rubber and resin can contain plasticizers, like organophosphate esters (OPEs), phthalates and phthalate substitutes, benzothiazoles (BTHs), benzotriazoles (BTRs), and bisphenols (BPs). All of these families are known to pose a significant threat to human health due to their ability to bioaccumulate, making exposition to them dangerous even at low concentrations [3][4].

PIP cannot be collected with regular air sampling methods, so alternative techniques are needed. In this study, PIP of size PM_{2.5} and PM₁₀ were sampled using field resuspending chamber patented by IDAEA-CSIC [5]. The rubber flooring of 8 parks and tracks from Barcelona was sampled, and their PIP extracted from air filters by a simple ultrasound extraction and analysis with liquid chromatography coupled to mass spectrometry (LC-MS) for the detection and quantitation of the previously mentioned plasticizer families. Results show a remarkable efficiency for monitoring these compounds in PIP deposited on the ground.

Acknowledgements –This work is funded by the Spanish Ministerio de Ciencia, Innovación y Universidades (Project EDGE, PID2022-140801OB-I00 and Grant CEX2018-000794-S funded by MCIN/AEI/10.13039/501100011033), and by the Catalan Generalitat de Catalunya (Consolidated Research Group Environmental and Water Chemistry for Human Health 2021 SGR 01150, and Environmental Geochemistry and Atmospheric Studies 2021 SGR 00447).

[1] Avagyan et al., *Environ Sci Pollut Res* 21 (2014), 11580-11586.

[2] Marsili et al., *J Environ Anal Toxicol* 5(2) (2014), 265.

[3] Llompart et al., *Chemosphere* 90 (2013), 423-431.

[4] Grynkiewicz et al., *Sci Rep* 12 (2022), 6683.

[5] Amato et al., *Atmos Environ* 43 (2009), 1650-1659.

ORAL 15 - Effect of depuration time on microplastics levels in edible mollusks

Nora Expósito⁽¹⁾, Andrea Barrientos-Riosalido^(1,2), Saul Santini⁽³⁾, Alessandra Cincinelli⁽³⁾, Laura Alcalde-Sanz⁽⁴⁾, Victòria Castell⁽⁴⁾, Martí Nadal^(1,2), Jordi Sierra⁽⁵⁾, Joaquim Rovira^{(1,2)*}

⁽¹⁾ *Universitat Rovira i Virgili, School of Medicine, Laboratory of Toxicology and Environmental Health, 43201, Reus, Catalonia, Spain.*

⁽²⁾ *Institut d'Investigació Sanitària Pere Virgili (IISPV), 43204, Reus, Catalonia, Spain.*

⁽³⁾ *Department of Chemistry "Ugo Schiff", University of Florence, Via della Lastruccia 3-13, 50019-Sesto Fiorentino, Italy.*

⁽⁴⁾ *Catalan Food Safety Agency, Department of Health, Generalitat de Catalunya, Roc Boronat 81-95, 08005 Barcelona, Catalonia, Spain.*

⁽⁵⁾ *Laboratory of Soil Science, Faculty of Pharmacy and Food Sciences, Universitat de Barcelona, Av. Joan XXIII s/n, 08028 Barcelona, Catalonia, Spain.*

nora.exposito@fundacio.urv.cat, Tel: +34-671153053

Microplastics (MPs) are emerging pollutants found worldwide, not only in environmental matrices but also in the food web. Due to their filter-feeding behavior and integral consumption mollusks represent one of the main human exposure pathways for humans to pollutants. The present study aimed to establish optimal removal rates of MPs in cultivated or harvested edible bivalves currently on the market. The effect of the depuration time, one of the easiest parameters to control, on MPs removal rates was also investigated. Samples of three species (mussels, oysters and wedge clams) were directly collected from a producer at three different depuration times (non-depurated, standard depuration -24 hours for mussels, 2 hours for wedge clams and 72 hours for oysters- and extended depuration -48 hours for mussels, 5 hours for wedge clams and 96 hours for oysters). The most abundant detected morphology corresponded to fibers, being >90% of the total MPs regardless of the species and depuration time. Standard depuration rates were linked to a 50%, 26% and 26% reduction of MPs in mussels, oysters and wedge clams, respectively. In turn, extending the depuration treatment did not significantly improve the depuration rate, as overall depuration rates reached only 46%, 43% and 32% in mussels, oysters and wedge clams, respectively. The total ingestion of MPs through the consumption of these species was estimated for the adult population. Exposure values were calculated in a range between 2,508 (P95: 6,184) and 4,692 (P95: 12,121), depending on the depuration stage. In terms of fibers length, this means a yearly mean accumulated consumption of 4.5, 2.4, and 2.7 m of fibers for non-depurated, standard depurated and extended depurated mollusks, respectively.

Acknowledgements: This study was financially supported by the Catalan Food Safety Agency (Department of Health, Generalitat de Catalunya, Barcelona) as well as project grant PID2022-140866OB-I00 (MP-DiGuLi project) funded by MICIU/AEI and by the "European Union".

1.-ACSA (Agència Catalana de Seguretat Alimentària) Guia de pràctiques correctes d'higiene per als centres de depuració de mol·luscs [In Catalan] (2022) Departament de Salut, Generalitat de Catalunya. Available from: https://acsa.gencat.cat/web/.content/_Publicacions/Guies_i_documents_de_bones_practiques/Guies_de_Practiques_Correctes_dHigiene_reconegudes_oficialment/Depuracio-molluscs/DepuradoresCAT_30maig.pdf Last accessed May 2024.

- 2.-Auguet T., Bertran L., Barrientos-Riosalido A., Fabregat B., Villar B., Aguilar C., Sabench F. Are Ingested or Inhaled Microplastics Involved in Nonalcoholic Fatty Liver Disease? (2022) *International Journal of Environmental Research and Public Health*, 19 (20), art. no. 13495.
- 3.-Can Tunçelli I., Erkan N. Microplastic pollution in wild and aquacultured Mediterranean mussels from the Sea of Marmara: Abundance, characteristics, and health risk estimations (2024) *Environmental Research*, 242, art. no. 117787
- 4.-Expósito, N., Rovira, J., Sierra, J., Gimenez, G., Domingo, J.L., Schuhmacher, M. Levels of microplastics and their characteristics in molluscs from North-West Mediterranean Sea: Humanintake (2022) *Marine Pollution Bulletin*, 181, art. no. 113843

ORAL 16 - Presencia de microplásticos en agua, refrescos y otras bebidas

A. Barrientos-Riosalido^(1,2), J. Rovira^(1,2), N. Expósito⁽¹⁾, J. Sierra⁽³⁾

⁽¹⁾ *Universitat Rovira i Virgili, Facultat de Medicina, Laboratori de Toxicologia y Salud Ambiental, Reus, Catalunya, España*

⁽²⁾ *Institut d'Investigació Sanitària Pere Virgili (IISPV), Catalunya, Reus, 43204, España*

⁽³⁾ *Laboratorio de Ciencias del Suelo, Facultad de Farmacia y Ciencias de la Alimentación, Universitat de Barcelona, Av. Joan XXIII s/n, 08028 Barcelona, Catalunya, España*

andrea.barrientos@urv.cat, Tel: +34-601603041

Los microplásticos (MPs) son partículas poliméricas sintéticas o semisintéticas, de tamaño entre 1 μm y 5 mm, insolubles en agua y persistentes en el medio ambiente 1. Los MPs de menor tamaño pueden absorberse sistemáticamente 2, lo que provoca graves problemas de salud, especialmente a nivel hepático e intestinal 3–5.

El estudio tiene como objetivo determinar los niveles de MP en bebidas, considerando el envase para poder calcular la ingesta total de MP a través de la dieta.

Se han analizado diferentes muestras de agua del grifo procedente de Plantas Potabilizadoras y de casas particulares (n=5, 1000L), agua embotellada de diferentes localizaciones (n=3, 30L) y refrescos de cola (n=3, 4L), de limón (n=3, 4L), cerveza (n=2, 4L) y vino (n=3, 4L) procedentes de diferentes envases. En primer lugar, se realizó una etapa de digestión para eliminar la materia orgánica. Esto implicó una combinación de hidrólisis alcalina con hidróxido de sodio (KOH, 2 M) con agitación durante 2 días a 40 °C. En segundo lugar, se realizó una hidrólisis enzimática con celulasa durante 72 horas, seguida de oxidación con peróxido de hidrógeno (H₂O₂, 33-35%) a 40 °C y agitación suave durante 24 horas.

Posteriormente, se aislaron los MPs utilizando un sistema de filtración al vacío, con un filtro de politetrafluoroetileno de 47mm y un tamaño de poro de 10 μm . Una vez aislados, se observaron mediante un microscopio estereoscópico (LEICA MZ10) acoplado a una cámara (FLEXACAM C1), registrando su tamaño, forma (partícula, film, pellet, fibra,...) y color.

A continuación, fueron identificados mediante espectroscopía infrarroja por transformada de Fourier (FTIR) o, para tamaños más pequeños, espectroscopía RAMAN. Finalmente, utilizando el software Omnic Picta, los espectros resultantes se compararon utilizando bibliotecas internas y disponibles comercialmente (HR Nicolet Sampler Library, Hummel Polymer Sample Library, Polymer Laminate Films y Wizard Library).

Algunos de los resultados preliminares obtenidos muestran que:

- Todas las bebidas analizadas presentan contaminación por MPs. Aunque se encuentran concentraciones más altas en los refrescos. Esta contaminación parece provenir no sólo del embalaje sino también del proceso de fabricación. Además, el agua del grifo contiene una concentración muy baja de MPs en comparación con el agua embotellada.
- La diversidad en el color y morfología de las partículas encontradas (fragmentos, películas y fibras) indica múltiples fuentes de contaminación.

- Estos resultados subrayan la necesidad de continuar con los estudios para comprender mejor la magnitud y las fuentes de contaminación por MPs en productos de consumo.

Agradecimientos – Subvención del proyecto PID2022-140866OB-I00 (proyecto MP-DiGuLi) financiado por MICIU/AEI y por la “Unión Europea”.

- [1] Frias, J. P. G. L.; Nash, R. Microplastics: Finding a Consensus on the Definition. *Mar. Pollut. Bull.* 2019, 138, 145–147. <https://doi.org/10.1016/j.marpolbul.2018.11.022>.
- [2] Lehner, R.; Weder, C.; Petri-Fink, A.; Rothen-Rutishauser, B. Emergence of Nanoplastic in the Environment and Possible Impact on Human Health. *Environ. Sci. Technol.* 2019, 53 (4), 1748–1765. <https://doi.org/10.1021/acs.est.8b05512>.
- [3] Wang, K.; Zhu, L.; Rao, L.; Zhao, L.; Wang, Y.; Wu, X.; Zheng, H.; Liao, X. Nano- and Micro-Polystyrene Plastics Disturb Gut Microbiota and Intestinal Immune System in Honeybee. *Sci. Total Environ.* 2022, 842, 156819. <https://doi.org/10.1016/j.scitotenv.2022.156819>.
- [4] Rahman, A.; Sarkar, A.; Yadav, O. P.; Achari, G.; Slobodnik, J. Potential Human Health Risks Due to Environmental Exposure to Nano- and Microplastics and Knowledge Gaps: A Scoping Review. *Sci. Total Environ.* 2021, 757, 143872. <https://doi.org/10.1016/j.scitotenv.2020.143872>.
- [5] Lu, L.; Wan, Z.; Luo, T.; Fu, Z.; Jin, Y. Polystyrene Microplastics Induce Gut Microbiota Dysbiosis and Hepatic Lipid Metabolism Disorder in Mice. *Sci. Total Environ.* 2018, 631–632, 449–458. <https://doi.org/10.1016/j.scitotenv.2018.03.051>.

ORAL 17 - Flame retardants and plasticizers in Portuguese homes and schools

J. Desmet^(1,2), R. Pimenta⁽³⁾, K. Oliveira⁽³⁾, S.M. Almeida⁽³⁾, M. Viana⁽¹⁾, E. Eljarrat⁽¹⁾

⁽¹⁾ *Department of Environmental Chemistry – ONHEALTH Research Group, IDAEA-CSIC, 18 26, Carrer de Jordi Girona, 18-26, 08038 Barcelona, España*

⁽²⁾ *"Programa de doctorat de Química analítica i medi ambient", Universidad de Barcelona, Spain*

⁽³⁾ *Centro de Ciências e Tecnologias Nucleares, Instituto Superior Técnico, Estrada Nacional 10, km 139.7, 2695-066 Bobadela-LRS, Portugal*

judith.desmet@idaea.csic.es, Tel: +34 93 255 75 98 (ext. 437786)

Children spend most of their day in indoor environments. The European InChildHealth project aims to identify determinants for indoor air quality (IAQ) and evaluate their health impacts. Plasticizers and flame retardants (FRs), constituting organophosphate esters (OPEs) and phthalate esters (PEs), are typically found in indoor air. They are extensively used as functional additives in plastics, textiles, electronic equipment, furniture, and building materials and are therefore ubiquitous in the indoor environment [1]. Studies have shown their adverse health effects associated with exposure, which led to the legal restriction of some of these components and the production of alternative plasticizers (APs) [2]. The aim of this study was to determine the concentrations of the compounds to which children are exposed through inhalation in homes and schools.

Sampling time was carried out to cover the occupational time of children in schools at daytime (6 locations; 8 h/day) and in houses at evening/night-time (5 locations; 15 h/day) during a week, using an adapted protocol from the literature [3].

A total of 8 OPEs, 5 PEs and 6 APs were detected in the sampling locations. The indoor concentration of Σ analysed compounds was higher (median: 284 ng/m³) than the outdoor concentrations (median: 84 ng/m³). For all sampling locations Σ PEs had the highest relative contribution (>70%), in indoor environments the relative contribution of Σ OPEs and Σ APs was higher (median OPEs: 2.18% - median APs: 15.0%) than in outdoor environments (median OPEs: 1.82% - median APs: 1.93%). The most abundant compounds were diethyl phthalate (6.35-371 ng/m³) and dimethyl phthalate (2.45-72.6 ng/m³). Both compounds are used in cosmetics as fragrance ingredients. Compounds were detected within the range of previous studies [3,6]. This study shows the abundance of flame retardants and plasticizers, especially in indoor environments. The detection of recently emerged APs shows their relevance in indoor air monitoring and the need for research on their potential health impacts.

Acknowledgements – This work is part of the InChildHealth project, funded by the European Union's Horizon 2021 research and innovation program under the call HORIZON-HLTH-2021-ENVHLTH-02-02 and grant agreement no. 101056883. The study was also funded by the Generalitat de Catalunya (Consolidated Research Group 2021SGR01150). IDAEA-CSIC is a Centre of Excellence Severo Ochoa (Spanish Ministry of Science and Innovation, Project CEX 2018-000794-S). IST authors acknowledge the FCT support through the UIDB/04349/2020 project.

[1] Cao, D., Lv, K., Gao, W., Fu, J., Wu, J., Fu, J., Wang, Y., & Jiang, G. (2019). *Ecotoxicology and Environmental Safety*, 169, 383–391.

[2] Christia, C., Poma, G., Harrad, S., de Wit, C. A., Sjoström, Y., Leonards, P., Lamoree, M., & Covaci, A. (2019). *Environmental Research*, 171, 204–212.

- [3] Esplugas, R., Rovira, J., Mari, M., Fernández-Arribas, J., Eljarrat, E., Domingo, J. L., & Schuhmacher, M. (2022). Science of the Total Environment, 806(150494), 1–13.
- [4] Chemicals Evaluation and Research Institute. (2007). Hazard Assessment Report. June.
- [5] Scientific committee on cosmetic products and non-food products intended for consumers. (2006). Opinion concerning Diethyl phthalate. Cancer, June.
- [6] Huo, C. Y., Li, W. L., Liu, L. Y., Sun, Y., Guo, J. Q., Wang, L., Hung, H., & Li, Y. F. (2023). Science of The Total Environment, 863, 160852.

ORAL 18 - Study of micro- and nanoplastics in stool samples: analytical development

D. Alcaide-Benavides^(1,2), X. Borrell⁽¹⁾, R. Mazigh⁽¹⁾, C.M. Villanueva⁽³⁾, E. Calikanzaros⁽³⁾, M. Llorca⁽¹⁾, M. Farré⁽¹⁾

⁽¹⁾ ON HEALTH Research Group, Environmental Chemistry Department, IDAEA-CSIC, Barcelona, Spain

⁽²⁾ Doctoral Program in Analytical Chemistry and Environmental Science, Dep. Of Chemical Engineering and Analytical Chemistry, University of Barcelona, Barcelona, Spain

⁽³⁾ ISGlobal, Barcelona, Spain

dabqsh@cid.csic.es , Tel: 934 00 61 00 (ext. 437903)

Humans are exposed to micro- and nanoplastics (MNPLs) basically through dermal, respiratory and ingestion routes, generating for example ROS effect at cytotoxicological level in alveolar basal epithelial cells [1]. In this study we aimed to develop a robust analytical methodology to evaluate the presence of MNPLs in complex human matrices to further study human excretion routes after MNPLs exposure.

Different protocols have been tested using lyophilized human stool samples, including i) toluene extraction; ii) soft and strong basic followed by acid attacks; iii) hydrogen peroxide treatment for organic material reduction followed by basic and acidic attacks; and iv) Fenton reactive consisting on a combination of hydrogen peroxide with Iron catalyst for organic material reduction followed by strong acid attacks. The final supernatant was filtered by 0.7 µm glass fiber filters and then extracted by ultrasonic bath by means of toluene and analyzed by size exclusion liquid chromatography coupled to high resolution mass spectrometry equipped with an atmospheric-pressure photoionization source as described elsewhere [2].

The main results showed that the best extraction methodology was (iv) involving the digestion of 0.5-2 g lyophilized sample with Fenton reactive followed by centrifugation and filtration of the supernatant. Afterwards, the filters are digested with strong nitric acid attack. After, the mixture is eluted from the filter and cleaned with HPLC water followed by ethanol. Then the filters are dried overnight and extracted by toluene in an ultrasonic bath followed by evaporation under nitrogen stream. The final analysis is carried out by suspect screening acquisition protocol with SEC-APPI-HRMS working in full scan (500 – 3,000 Da) at 15,000 FWHM of resolution under isocratic conditions [2]. The main quality parameters for target polymers (polyethylene, polypropylene and polystyrene) were ranging from 40-55% of recovery rates with a reproducibility below 28% (expressed in %RSD) and method limits of quantification up to 0.5 ng/g in dry sample.

The analysis of 10 volunteer samples denoted the presence of PE and PP at low quantification levels as well as the presence of polysiloxanes.

Acknowledgements – This work was supported by ANSES project (ref. 2021/1/077. Characterizing oral exposure to micro- and nanoplastics and their translocation into human gastro-intestinal barriers EXMINA)

[1] Savva, K., Borrell, X., Moreno, T., Pérez-Pomeda, I., Barata, C., Llorca, M., & Farré, M. (2023). Cytotoxicity assessment and suspected screening of plastic additives in bioplastics of single-use household items. *Chemosphere*, 313, 137494.

[2] Llorca, M., Vega-Herrera, A., Schirizzi, G., Savva, K., Abad, E., & Farré, M. (2021). Screening of suspected micro (nano) plastics in the Ebro Delta (Mediterranean Sea). *Journal of hazardous materials*, 404, 124022.

PRESENTACIONES en formato PÓSTER

Miércoles 16 de Octubre

11h-12h Pausa café – **Sesión de Pósters**

Póster 1 **Black microplastics outside the Raman niche: a particle-laser-beam interaction case-study.**

Giuseppina Zuri (IDAEA-CSIC)

Póster 2 **Comprehensive characterization techniques for identification of microplastics by ATR-FTIR, electron and optical microscopy.**

Juan Muñoz-Arnanz (IQOG-CSIC)

Póster 3 **Estudios de laboratorio centrados en la adsorción de metales en microplásticos.**

Mary Isabel Villacis (Universitat de Girona)

Póster 4 **Cuantificación de microplásticos en lagos de Aragón: resultados preliminares.**

Inés de la Parra (IPE-CSIC)

Póster 5 **Tracing trash: Unveiling the dynamic microplastic landscape of Valencia's Mediterranean tourist beaches.**

V. Soursou (Universidad de Valencia, CIDE-CSIC)

Póster 6 **Contribution of mountain tourism to transport and storage of plastic pollution in riparian-stream ecosystems.**

Delfina Cornejo (CEAB-CSIC)

Póster 7 **Emerging contaminants in urban stormwater from Barcelona.**

Filippo Chierchini (IDAEA-CSIC)

Póster 8 **Tire rubber additives and their transformation products: Environmental assessment.**

Francesca de Angelis (IDAEA-CSIC)

Póster 9 **Eliminación de nanoplásticos del agua mediante ozonización catalítica.**

Julia Nieto (Dep. de Ingeniería Química y Química Analítica, Universitat de Barcelona)

Póster 10 **Evaluation of elimination processes for bioplastics in wastewater treatment plants.**

David Alcaide (IDAEA-CSIC)

Póster 11 **Suelos restaurados con biosólidos: contaminación por microplásticos después de 27 años.**

Jordi Sierra (Fac. Farmàcia, Universitat de Barcelona)

- Póster 12 **Assessing the uptake and impact of plastic additives on plants grown in a hydroponic system under a reclaimed water scenario.**
Maria Pau García (ICRA-CERCA, Universitat de Girona)
- Póster 13 **Diversity of marine bacteria growing on leachates from virgin and weathered plastic: Insights into potential degraders.**
Cristina Romera (ICM-CSIC)
- Póster 14 **Impact of plastic leaching on marine phytoplankton metabolism.**
Marina Briones (ICM-CSIC)
- Póster 15 **Exploring plastic additive leaching in seawater: The role of biofilm on colonized surfaces.**
Berta Sala (ICM-CSIC)
- Póster 16 **Degradation and organic compound leaching assessment of antifouling polymer-based paints.**
David Alcaide (IDAEA-CSIC)
- Póster 17 **Plastic additives: Flame retardants and BPA derivates interact *in vitro* with B-esterase enzymes in marine zooplankton.**
Paula Aguilera (ICM-CSIC)
- Póster 18 **Impact of organophosphate flame retardants on lung health: Phenotypic and lipidomic study using an *in vitro* cell model.**
Maryam Pyambri (IDAEA-CSIC)
- Póster 19 **Valor pronóstico del hábito tabáquico, la composición corporal y marcadores de inflamación sistémica en pacientes con carcinoma renal no metastásico y oncocitoma renal.**
Darío Gracia-Rojo (Dep. de Urología, Parc Taulí Hospital Universitari, Universitat Autònoma de Barcelona)
- Póster 20 **Plastificantes en huevos de aves del Parque Nacional de Doñana.**
Maria Vittoria Barbieri (IDAEA-CSIC)
- Póster 21 **Occurrence of halogenated flame retardants in edible fish samples from the Mediterranean Spanish FAO zone (FAO 37.1.1).**
Valentina Araya (IDAEA-CSIC)
- Póster 22 **Preliminary assessment of microplastics in indoor air from different microenvironments of Barcelona, Spain.**
Aleix Balasch (IDAEA-CSIC)
- Póster 23 **Toxicological evaluation of biodegradable and conventional plastics: Impact of photodegradation and composting on environmental safety.**
Cinta Porte (IDAEA-CSIC)

- Póster 24 **Poly(dimethyl)siloxane (PDMS) as a tool to assess dermal exposure to plastic additives from textile materials.**
Sandra Callejas (IDAEA-CSIC)
- Póster 25 **Exposure to plasticizers in children from Val d'Aran.**
Julio Fernández Arribas (IDAEA-CSIC)

PÓSTER 1 - Black microplastics outside the Raman niche: a particle-laser-beam interaction case-study

G. Zuri^(1,2), T. M. Seifried⁽²⁾, M. D. Kowal⁽²⁾, H. Joulaei⁽²⁾, E. Grant⁽²⁾

⁽¹⁾ *Department of chemometrics, IDAEA-CSIC, Carrer de Jordi Girona 18-26, 08034 Barcelona, Spain*

⁽²⁾ *Department of Chemistry, University of British Columbia, Vancouver, BC V6T 1Z1, Canada*

giuseppina.zuri@idaea.csic.es, Tel: +39-3665931433

Raman spectroscopy enables a study of the interaction of light from a monochromatic laser source with the molecules present in a sample [1]. Advantages of Raman include little need for sample preparation and a natural spatial resolution as sharp as 1 μm . It therefore offers one of the most powerful spectroscopic techniques to identify microplastics (MP) in an environmental sample [2]. However, many microplastics are black and strongly absorb light of all wavelengths typically used in Raman spectroscopy. This can result in reduced or complete attenuation of the signal intensity. The thermal effect may alter the sample's chemical structure or even destroy the sample, thus losing one of the main advantages the Raman technique offers. This has aimed to develop a method to expose black particles to a laser beam without causing sample destruction with the hypothesis that cooling prevents sample destruction and allows the use of higher laser power, resulting in improved signal recording. Here, we tested a total of nine plastic items of polypropylene (PP), polyethylene (PE), polystyrene (PS), three different items of polyethylene terephthalate (PET), acrylonitrile butadiene styrene (ABS), and two different samples of tire wear particulates. We analysed these samples with a Wasatch Photonic WP 785XM semi-integrated Raman Spectrometer (Wasatch Photonic, WP, Morrisville, USA), equipped with a 785 nm diode laser, a spectral resolution across the fingerprint range 400-2100 cm^{-1} and a resolution of 8 cm^{-1} . We collected spectra using different combinations of laser power and exposure time to obtain a good compromise between spectra quality and time needed for the measurements. The laser power was typically in the range of 45 to 450 mW, and integration time between 100 and 400 ms. We acquired the spectra using ENLIGHTEN™ 3.2.36 spectroscopy software (Wasatch Photonic, WP, Morrisville, USA) and identified plastic polymers by comparing the spectra with those of an in-house built library. We tested two cooling systems to prevent burning: 1. A CP-040HT Peltier-Thermoelectric Cold-Plate Cooler (TE® Technology Inc, Traverse City, MI) at a temperature of -4.6 ± 0.2 °C; 2. Adding a drop of deionised water on top of the particles.

MP made of PE, PS, and ABS resisted laser power up to 135 mW before smoke or burning was observed. In contrast, microplastics made of PET were far more resistant. The use of the cooling system enhanced the resistance of the test materials to the laser power; however, it did not prevent surface damage. In general, the addition of a drop of water on the sample allowed us to increase both the laser power and the sample exposure time to the beam, preventing both smoke formation and surface damage. The addition of a water drop worked better for fragments since fibres tend to float on top of the water surface. This work affords an inexpensive and easily applicable solution to overcome the issue of black particle analysis.

Acknowledgements – Giuseppina Zuri acknowledges “la Caixa” Foundation [ID 100010434; code LCF/BQ/DI21/11860062] and the financial support from “Santander Mobility Scholarship” to carry out the research stay at the University of British Columbia.

[1] Zoubir, A.. 2012. Raman Imaging: Techniques and Applications, 168.

[2] Anger, P. M., von der Esch, E., Baumann, T., Elsner, M., Niessner, R., & Ivleva, N. P.. 2018. TrAC Trends in Analytical Chemistry, 109, 214–226.

PÓSTER 2 - Comprehensive characterization techniques for identification of microplastics by ATR-FTIR, electron and optical microscopy

Dulce L. Soliz Rojas⁽¹⁾, Juan Muñoz-Arnanz⁽²⁾, Begoña Jiménez⁽²⁾, Gema Paniagua-González⁽¹⁾, Juan Carlos Bravo-Yagüe⁽¹⁾, Rosa M^a Garcinuño Martínez⁽¹⁾, Pilar Fernández-Hernando⁽¹⁾

⁽¹⁾ *Departamento de Ciencias Analíticas, Facultad de Ciencias, Universidad Nacional de Educación a Distancia (UNED) Avda. Esparta s/n, Ctra. de Las Rozas-Madrid (M-505) Km. 5, 28232, Las Rozas Madrid, Spain.*

⁽²⁾ *Departamento de Análisis Instrumental y Química Ambiental, Instituto de Química Orgánica General, CSIC, Juan de la Cierva, 3, 28006, Madrid, Spain.*

juan.ma@iqog.csic.es, Tel: +34-915622900

The knowledge of the polymeric composition of microplastics (MPs) is crucial as it provides useful information on the resistance, durability, and degradability of these materials, thereby aiding in the control of this contamination^{1,2}. However, there is currently a lack of reliable standardized methods for the identification and characterization of MPs. This study employs different techniques in a complementary manner to identify and characterize MPs commonly found in the environment.

A total of 10 types of plastics were collected: polystyrene (PS), polyethylene terephthalate (PETE), polyethylene (PE), high- and low-density polyethylene (HDPE and LDPE, respectively), polyvinyl chloride (PVC), polypropylene (PP), polytetrafluoroethylene (PTFE), polyamide (PA, Nylon 6,6), and polycarbonate (PC). Their chemical identification was analyzed using Fourier-transform infrared spectroscopy with attenuated total reflectance (FTIR-ATR). Additionally, the samples were observed using light microscopy and scanning electron microscopy (SEM). Staining with 12 different dyes was performed to improve the identification of microplastics. This study confirms the effectiveness of the FTIR technique in identifying different polymers based on the unique vibrational modes in the resulting spectra. SEM images revealed that PETE, PE, PVC, PS, HDPE, and LDPE exhibited smooth, non-porous surfaces, while PP, PC, PTFE, and PA (Nylon 6,6) showed roughness and porosity. These results were consistent with optical microscopy studies using different dyes, which showed that plastics with higher porosity (PP, PA (Nylon 6,6), and PTFE) were more prone to staining (using thorin, bromocresol green, lucifer yellow, alizarin, amide black, and phenol red). Nile Red produced marked staining in PVC, PP, PTFE, and PA (Nylon 6,6), and to a lesser extent in PC.

This research demonstrates the significant potential of combining these three techniques for the more accurate identification of MPs.

Acknowledgements – This study was supported by the Spanish Ministry of Science and Innovation (Project EXPOPLAS (PID2019-110576RB-I00), Grants CEX2018-000794-S and PRE2020-093018 funded by MCIN/AEI/10.13039/501100011033 and by “ESF Investing in your future”).

[1] A. Sridhar, D. Kannan, et al., 2022. Chemosphere, 286, <https://doi.org/10.1016/j.chemosphere.2021.131653>.

[2] A.K. Amponsah, E.A. Afrifa, et al., 2024. Heliyon, 10, e25608, <https://doi.org/10.1016/j.heliyon.2024.e25608>.

PÓSTER 3 - Estudios de laboratorio centrados en la adsorción de metales en microplásticos

Mary Isabel Villacis⁽¹⁾, Mònica Iglesias⁽¹⁾, Laura Torrent⁽¹⁾, Ignasi Queral⁽²⁾, Manuela Hidalgo⁽¹⁾, Eva Marguí⁽¹⁾

⁽¹⁾ *Departamento de Química, Universidad de Girona, C/ M. Aurèlia Capmany, 69, 17003 Girona, España*

⁽²⁾ *Departamento de Ciencias de la Tierra, Instituto de Diagnóstico Ambiental y Estudios del Agua (IDAEA-CSIC), C. Jordi Girona, 18-26, 08034, Barcelona, España*

maryisabel.villacis@udg.edu, Tel: +34-661462655

La contaminación por microplásticos en el agua es un problema creciente que afecta a los ecosistemas acuáticos y a la salud humana. Estos diminutos fragmentos de plástico pueden permanecer en el medio ambiente durante cientos de años y, además, estudios recientes han mostrado su capacidad para liberar metales contenidos en su estructura o adsorberlos en su superficie actuando como potenciales vectores de contaminación. Por tanto, es necesario el desarrollo de nuevos tratamientos de aguas residuales que permitan la eliminación de este tipo de contaminantes particulados. En este sentido, y en línea con los objetivos de desarrollo sostenible, se están estudiando tratamientos alternativos de aguas residuales basados en la naturaleza. En estudios previos de nuestro grupo de investigación se ha demostrado el potencial de un sistema de tratamiento de aguas terciario basado en la capacidad filtradora de la *Daphnia magna* (crustáceo planctónico del orden Cladocera) para la eliminación de partículas < 30µm, bacterias, nutrientes y algunos microcontaminantes [1].

En el presente estudio, mediante experimentos controlados de laboratorio, se ha investigado la adsorción de metales (Pb y Zn) en micro plásticos comerciales (MPs) de diversos tamaños (10-20µm y 53-63µm) y composiciones (polietileno (PE) y poliestireno (PS)). Los resultados obtenidos indicaron que los MPs de PE y PS pueden adsorber cantidades significativas de metales y que el porcentaje adsorbido depende de factores como el tipo de metal, la concentración de este y el tamaño de partícula del MP. Adicionalmente, se estudió también el efecto de la presencia de los mismos microplásticos en la capacidad de filtración y eliminación de metales por parte de la *Daphnia magna*. En este sentido, se verificó la capacidad de *Daphnia magna* para acumular MPs en su tracto digestivo y el efecto de la presencia de MPs en la eliminación de otros contaminantes (metales) por parte de las *Daphnias*.

Acknowledgements - Esta investigación se lleva a cabo en el marco del proyecto de investigación PID 2021-127326OB-I00 financiado por MCIN/AEI/10,13039/501100011033. También se agradece el apoyo financiero del Departamento de Investigación y Universidades de la Generalitat de Catalunya, a través de la Beca Joan Oró para la contratación de investigadores predoctorales en formación (2023).

[1] Salvadó, V., Hidalgo, M., Pous, N., Serra, T., Colomer, J. 2021. Innovative Wastewater Treatment Technologies, 192.

PÓSTER 4 - Cuantificación de microplásticos en lagos de Aragón: resultados preliminares

I. de la Parra Muñoz⁽¹⁾, J. Pey Betrán⁽¹⁾, B.L. Valero Garcés⁽¹⁾, I. Marín Beltrán⁽²⁾

⁽¹⁾ *Dpto. Procesos Geoambientales, IPE-CSIC, Avda. Montañana 1005, 50059, Zaragoza, España*

⁽²⁾ *Ecology and restoration of riverine, estuarine and coastal habitats, Centro de Ciências do Mar do Algarve, Universidade do Algarve Campus de Gambelas Edifício 7, 8005 - 139, Faro, Portugal*

inesdelaparra@ipe.csic.es, Tel: +34-876243761 ext 430535

La identificación y caracterización de microplásticos (en adelante, MPs) en entornos continentales es un campo de estudio relativamente reciente y cada vez más demandado^[1]. El presente trabajo pretende cuantificar y caracterizar los MPs presentes en 5 lagos aragoneses ubicados en el Pirineo (Acherito, Estanés, Marboré), el Valle del Ebro (Chiprana) y el Sistema Ibérico (Navajo de la Pardina), y así evaluar la situación actual relativa a MPs a escala regional, considerando un gradiente altitudinal, latitudinal y de impacto antrópico. Los lagos seleccionados se sitúan en Espacios Naturales Protegidos y son elementos icónicos del paisaje y del patrimonio natural.

Durante el verano y otoño de 2023 se tomaron 2 réplicas de 1 litro de agua superficial y de 2 litros a máxima profundidad usando una botella Niskin. Las muestras se filtraron en filtros de polietersulfona de 0.45µm y se realizó una digestión con H₂O₂ al 15% durante 48h (50°C). Después se filtraron en un nuevo filtro y se exploraron en lupa estereoscópica. La cuantificación, composición y caracterización de las partículas según la forma (fibra, fragmento, pellet), tamaño y color concluyó con el análisis de al menos el 25% de cada filtro mediante microscopía de Transformada de Fourier (µFTIR).

Los resultados preliminares muestran concentraciones de hasta 4 MPs/litro, con el máximo de concentración observado en el Navajo de la Pardina. Estos resultados iniciales sugieren, a priori, que las diferencias pueden responder a la carga de actividad humana que soportan los sistemas lacustres. Así, los ibones pirenaicos de Marboré y Estanés, con mayor altitud y dificultad de acceso, presentan concentraciones en el rango inferior de este estudio, mientras que el Navajo de la Pardina, que recibe constantes visitas por su atractivo ecológico y recreativo, y la Salada de Chiprana, próxima a actividad industrial, agrícola y urbana, muestran concentraciones más elevadas.

No obstante, conviene considerar estas concentraciones con cautela, puesto que todas las partículas confirmadas como plásticos son fragmentos y pellets > 40µm, mientras que alrededor del 35% de las partículas analizadas fueron fibras, con una anchura < 30µm. Esto podría revelar la limitación de la técnica de análisis hacia las partículas de menor tamaño y suponer una subestimación de la concentración de MPs. En definitiva, la concentración de MPs puede servir como indicador antrópico sobre un sistema natural continental. Por ello, es necesario invertir más esfuerzos en estandarizar los protocolos de extracción y análisis de MPs.

Este trabajo ha sido financiado gracias a los proyectos POSAHPI-2 (PID2022-143146OB-I00) y ASAH-AS (OAPN 2021, ref 2799/2021). Isabel Marín Beltrán recibió financiación de la Fundação para a Ciência e a Tecnologia (FCT) - Convocatoria Estímulo al Empleo Científico, Apoyo Individual 2017 (CEECIND/03072/2017).

[1] Nava, V., Chandra, S., *et al.* 2023. Nature 619, 317-322.

PÓSTER 5 - Tracing Trash: Unveiling the Dynamic Microplastic Landscape of Valencia's Mediterranean Tourist Beaches

V. Soursou, J. Campo, Y. Picó

*Environmental and Food Safety Research group, University of Valencia (SAMA-UV),
Desertification Research Centre CIDE (CSIC-UV-GV), Road CV-315 Km 10.7, 46113 Moncada,
Valencia, Spain*

julian.campo@uv.es, Tel: +34-687797021

The Mediterranean region annually attracts approximately one-third of global coastal tourism, a significant contributor to plastic pollution. This study examined the presence of microplastics (MPs) sized between 10 μm and 5 mm in sand from seven tourist beaches along the Valencia province coastline in Eastern Spain, which are regularly cleaned. Sampling campaigns were performed in the winter and in the summer 2022 to evaluate the impact of high tourist activity. The methodology employs density separation with a Sediment Microplastic Isolation (SMI) Unit, conventional visual inspection and ATR-FTIR analysis [1]. Additionally, automatic quantification and identification of the smallest polymer particles was done by μFTIR using silicon filters transparent to the IR. All beaches were polluted with MPs. Results showed significantly higher average MP concentrations in summer (339 ± 92 MP kg⁻¹ by stereomicroscopy and 339 ± 189 MP kg⁻¹ by μFTIR) compared to winter (71 ± 92 MP kg⁻¹ and 143 ± 85 MP kg⁻¹) ($p < 0.05$). Fiber forms of MPs predominated, with polyethylene (PE) and halogenated polystyrene (Cl-PS and Br-PS) being the most prevalent polymers, sourced likely from food packaging, swimming equipment, and fishing nets. Ecological risk assessment, conducted using the Pollution Load Index (PLI), Hazardous Index (HI), and Risk Quotient (RQ), indicated a potential moderate to high risk depending on the applied approach. In general, while PLI values point to a low pollution load of MPs in the samples; the chemical toxicity, as evidenced by the HI values and the resulting ecological risk cannot be overlooked. Additionally, RQ results from the summer campaigns suggest a potential risk to the environment in Malvarossa and Gandía beaches. This underscores the impact of their proximity to large urban areas on the MP pollution of the coast. These findings provide a comprehensive insight into MPs in beach sand and highlight the need for more effective pollution management strategies.

Acknowledgements – This study forms part of the ThinkInAzul programme and was supported by MCIN with funding from the European Union Next Generation EU (PRTR-C17.I1) and the Generalitat Valenciana. V. Soursou also acknowledges her pre-doctoral contract by the Grant ACIF/2021/408, funded by the Generalitat Valenciana.

[1] Soursou, V., Campo, J, Picó, Y. 2023. Trac 166, 117190.

PÓSTER 6 - Contribution of mountain tourism to transport and storage of plastic pollution in riparian-stream ecosystems

Delfina Cornejo⁽¹⁾, Eugenia Martí⁽¹⁾, Henar Margenat⁽¹⁾, Joaquim Serra⁽³⁾, Mònica Martínez⁽³⁾,
Helena Guasch⁽¹⁾

⁽¹⁾ *Integrative Freshwater Ecology Group, Center for Advanced Studies of Blanes (CEAB-CSIC),
Spain*

⁽²⁾ *Laboratoire écologie fonctionnelle et environnement, Université de Toulouse, CNRS,
Toulouse, France*

⁽³⁾ *Department of Materials Science and Physical Chemistry. Faculty of Chemistry. Universitat de
Barcelona*

dcornejo@ceab.csic.es, Tel: +34-673490641

High-mountain freshwater environments are commonly considered pristine areas where anthropogenic impact is low¹. However, the intensification of human tourist activities in these regions has led to the spread of plastic pollution^{2,3,4}. Our study explores and quantifies the influence of mountain tourism on plastic transport and storage in riparian headwater stream ecosystems as they are the sources to downstream ecosystem exports. The study areas are located in the Pyrenees of Andorra and Catalonia, which show different levels of human pressure, associated with presence of touristic villages, ski resorts and hiking areas, and encompass different pollution management strategies. To approach the objective, we developed survey protocols for plastic quantification and identification in the riparian area, stream water column, streambed sediments and epilithic biofilms⁵. We will present the results of macro- (> 5 cm) and mesoplastic (50 – 5 mm) presence in riparian areas, which are indicative of the link between tourism activities and stream plastic pollution. Results indicate that riparian areas act as transient storage zones of larger plastics, with higher values around the influence area of ski resorts (531 MacP ha⁻¹ ± 209) than around urban areas (328 MacP ha⁻¹ ± 249) in both countries. In contrast, the chemical composition of plastics did not reflect differences among the different tourism pressure. The holistic approach of this study demonstrates how mountain tourism can contribute to plastic pollution and confirms that fluvial ecosystems, even those located in headwaters at high elevations, are remarkable sources of plastic pollution that eventually will be transported downstream.

[1] Price, M.F., 2015. Mountains: A Very Short Introduction. Oxford University Press.

[2] Allen, S., Allen, D., Phoenix, V.R., Le Roux, G., Dur´antez Jim´enez, P., Simonneau, A., Binet, S., Galop, D., (2019). Atmospheric transport and deposition of microplastics in a remote mountain catchment. Nat. Geosci. 12 (5), 339–344. <https://doi.org/10.1038/s41561-019-0335-5>.

[3] Parolini, M., Antonioli, D., Borgogno, F., Gibellino, M.C., Fresta, J., Albonico, C., De Felice, B., Canuto, S., Concedi, D., Romani, A., Rosio, E., Gianotti, V., Laus, M., Ambrosini, R., Cavallo, R., (2021). Microplastic contamination in snow from western Italian alps. Int. J. Environ. Res. Publ. Health 18 (2), 768. <https://doi.org/10.3390/IJERPH18020768>, 2021, Vol. 18, Page 768.

[4] Margenat, H., Guasch, H., le Roux, G., Vila-Gispert, A., Cornejo, D., Chouache, L., Martí, E., Sonke, J. E., el Zrelli, R. B., Laffont, L., & Hansson, S. v. (2024). Distinct dynamics in mountain watersheds: Exploring mercury and microplastic pollution—Unraveling the influence of atmospheric deposition, human activities, and hydrology. Environmental Research, 242. <https://doi.org/10.1016/j.envres.2023.117760>

[5] Margenat et al. (2021). Guidelines of field-tested procedures and methods for monitoring plastic litter in Mountain riverine Systems (PLASTICØPYR project). DOI: <http://dx.doi.org/10.20350/digitalCSIC/13880>

PÓSTER 7 - Emerging Contaminants in Urban Stormwater from Barcelona

F. Chierchini⁽¹⁾, S. Santana-Viera^(1,2), F. Labad⁽¹⁾, M. Teixido⁽³⁾, S. Perez⁽¹⁾

⁽¹⁾ ONHEALTH, IDAEA-CSIC, c/Jordi Girona 18-26, 08034, Barcelona, Spain

⁽²⁾ Instituto Universitario de Estudios Ambientales y Recursos Naturales (i-UNAT), Universidad de Las Palmas de Gran Canaria, 35017 Las Palmas de Gran Canaria, Spain

⁽³⁾ GROUNDWATER AND HYDROGEOCHEMISTRY, IDAEA-CSIC, c/Jordi Girona 18-26, 08034, Barcelona, Spain

filippo.chierchini@idaea.csic.es, Tel: +34 93 400 61 00

Challenges posed by rapid urbanization, climate change, and the increased frequency of extreme weather events are forcing cities to adapt a new urban water management. Stormwater harvesting represents a prospective local resource, particularly in densely populated arid regions marked by severe water scarcity. Among these, deployment of stormwater blue-green infrastructure (BGI) is a promising practice to mitigate flood risk, while recharging aquifer and reducing combined sewer overflows [1]. However, urban stormwater, significantly impacted by anthropogenic contaminants from sources such as consumer product degradation, buildings and construction materials, automotive wear, littering, and road infrastructure, can be carrier of hazardous substances into the environment. Despite the detection of legacy and (un)regulated contaminants (e.g., pesticides, PPCPs, anti-corrosion agents, plastic and rubber additives) in various water sources, there remains a lack of scientific knowledge on the source, transport, and fate of new chemicals of concern due to insufficient monitoring in the urban water cycle [2]. For instance, blue-green infrastructure may fail to effectively remove persistent, mobile, and toxic (PMT) organic compounds, allowing them to enter surface and ground waters. This study focuses on urban stormwater “first flushes” from various sites across three districts in Barcelona, collected from March to April 2022. The sampling design included conventional and pedestrian street runoff, rainwater and BGI effluents. Grab samples were analyzed using an evaporative enrichment methodology. 34 contaminants of urban interest, were quantified using a targeted LC-HRMS method. All targets were detected in at least one sample, with benzenesulfonamide, 1,3 diphenylalanine, di-n-butyl phosphate, tolyltriazole, and TCPB being the most abundant and ubiquitous, with median concentrations exceeding 100 ng L⁻¹. BGI effluents showed lower load contamination load compared to influent runoff waters, although various substances are eluding removal capacity of these stormwater treatment.

Eventually, HRMS/MS data measured via data-independent acquisition mode were retrospectively analysed crossing an internal library of compounds related to Tire Wear Particles (TWPs) reported in literature. Several of the latter were identified in street runoff samples.

Monitoring urban stormwater quality is crucial to prevent risks for receiving surface and ground waters and to ensure the safe use of enlarged water supplies.

Acknowledgements – The authors thank the project URBANWAT (WaterJPI-JC-2018_16) for the foundation of the current work. This study was supported by the “Agencia Estatal de Investigación” from the Spanish Ministry of Science and Innovation and the IDAEA-CSIC, a Centre of Excellence Severo Ochoa (CEX2018-000794-S), through its program SYNERGY Projects financed with Severo Ochoa funds. This work was also supported by the Spanish Ministry of Science and Innovation through the project WATERPOLLUT (PID2022-138556OB-C21) and the Agència de Gestió d'Ajuts Universitaris i de Recerca (Beatriu de Pinós 2020 (grant no. BP 00280)).

[1] Spahr et al., Environmental Science: Water Research and Technology 6 15–44.

[2] Mutzner et al., Environmental Science: Water Research and Technology 9 (2023) 3094-3102.

PÓSTER 8 - Tire Rubber Additives and their Transformation Products: Environmental Assessment.

Francesca De Angelis^(1,2), Antonia Merola⁽¹⁾, Mercè Garí⁽¹⁾, Nicola Montemurro⁽¹⁾

⁽¹⁾ *Institute of Environmental Assessment and Water Research (IDAEA-CSIC), c/Jordi Girona 18-26, 08034 Barcelona, Catalonia, Spain*

⁽²⁾ *Faculty of Chemistry. University of Barcelona. Barcelona, Catalonia, Spain*

fdaqsh@cid.csic.es Tel: +34 643517824

Tire-Road Wear Particles (TRWPs) generated from the abrasion caused by the interaction between vehicle tires and road surfaces are a major source of microplastics. Their accumulation on road surfaces and the consequent transport into water sources after rain events cause water contamination and can affect the biota. Moreover, additives used during manufacturing can leach into the environment and further react and transform, which raises ecological and health concerns [1].

This study aims to assess Tire Rubber Additives (TRAs) and their transformation products (TPs) in water sources. Specifically, the area chosen is that of the Llobregat River Delta (Catalonia, Spain) comprising the second-biggest Spanish airport surrounded by urban, agricultural, industrial, and natural protected spaces. Sampling campaigns were conducted before and after rain events to monitor the effect of road runoff on TRAs and TPs concentrations.

Instrumental analysis was conducted with the latest Bruker timsTOF Pro2 platform, powered by parallel accumulation serial fragmentation (PASEF®) technology, with its proven robustness, high sensitivity and fast MS/MS acquisition. A wide-scope target and suspect screening method for common TRAs was implemented and included N,N'-substituted p-phenylenediamines (PPDs), benzothiazoles, benzotriazoles, and cyclic amines, and TPs. Sample preparation was optimized for the studied matrix and involved concentration and clean-up of the samples through solid phase extraction with Oasis HLB cartridges.

Preliminary results on the study areas showed an increase in these compounds in river water samples after a rain event at concentrations ranging from few ng/L (6PPD-quinone) to 1 µg/L (1,3-Diphenylguanidine).

The potential environmental impacts of TRWPs are still unknown, mainly due to the lack of reliable data, the limited number of samples studied, the diversity of compounds, and the methodological challenges. This method will allow the monitoring of TRAs and TPs in environmental matrices and give tools for risk assessment.

Acknowledgments – The authors acknowledge the support of the Economy and Knowledge Department of the Catalan Government through Consolidated Research Group (SGR01150 and SGR00986). This work falls under the TRANSIT national project (PID2022-138623OA-100) funded by the Spanish Ministry of Science and Innovation.

[1] Tian Z. et al., 2020. Science 371, 185-189.

PÓSTER 9 - Eliminación de nanoplásticos del agua mediante ozonización catalítica.

J. Nieto-Sandoval⁽¹⁾, R. Ammar⁽¹⁾, R. P. Cavalcante^(1,2), C. Sans⁽¹⁾

⁽¹⁾ *Departamento de Ingeniería Química y Química Analítica, Grupo Ingeniería de Procesos de Oxidación Avanzada, Universitat de Barcelona, Barcelona, España*

⁽²⁾ *Universidade Estadual de Campinas, Faculdade de Tecnologia, Brazil*

julia.nietosandoval@ub.edu, Tel: +34 934021307

El problema de la contaminación plástica representa un importante desafío para la comunidad científica, especialmente debido a su persistencia en el medioambiente y, en particular, en los distintos cursos del agua. La fragmentación genera partículas cada vez más pequeñas, alcanzando tamaños menores a 1 μm , conocidas como nanoplásticos (NPs). Las tecnologías convencionales empleadas en las Estaciones Depuradoras de Aguas Residuales (EDARs) y Estaciones de Tratamiento de Agua Potables (ETAPs) no logran eliminarlos completamente, detectándolos incluso en el agua potable [1]. En este contexto, resulta fundamental desarrollar tecnologías eficaces que aseguren su completa eliminación. Los procesos de oxidación avanzada resultan prometedores para la eliminación de contaminantes orgánicos recalcitrantes. Este estudio se centra en la evaluación de la eficiencia del proceso de ozonización catalítica en la degradación de NPs. Las reacciones se realizaron en un sistema semicontinuo en un reactor de vidrio tipo tanque agitado a 20°C, utilizando nanoplásticos de poliestireno (PS) como contaminante modelo (20 mg L⁻¹), con un tamaño promedio de partícula de 0,140 μm . Se examinó tanto la ozonización simple, sin catalizadores, como en presencia de catalizadores homogéneos y heterogéneos. La ozonización simple, empleada habitualmente como etapa de desinfección, dio lugar a una reducción del peso molecular de los NPs, pero no es efectiva para su mineralización por lo que puede resultar en un problema adicional. Con la adición de iones metálicos como catalizadores se logró una disminución de la turbidez de hasta un 65% y una mineralización del 70% con una dosis de 1 mM de Co²⁺ y de ozono de 5 mg min⁻¹. A partir de estos resultados, se desarrollaron catalizadores heterogéneos basados en cobalto para evitar la contaminación secundaria y permitir la recuperación y reutilización de los catalizadores. Para ello, se exploró el desarrollo y aplicación de catalizadores estructurados debido a las limitaciones asociadas con los catalizadores en polvo. En conclusión, la ozonización catalítica se presenta como una alternativa prometedora para la eliminación de NPs del agua.

Agradecimientos – Este trabajo ha sido financiado por el Ministerio de Ciencia e Innovación de España a través del proyecto PID2020-112674RB-I00.

[1] Li, Y., Wang, Z., Guan, B. 2022 Environmental Research, 204, 112134.

PÓSTER 10 - Evaluation of elimination processes for bioplastics in wastewater treatment plants

D. Alcaide-Benavides^(1,2), E.Torres⁽¹⁾, V.Lopez⁽¹⁾, M. Farré⁽¹⁾ M. Llorca⁽¹⁾

⁽¹⁾ *ON HEALTH Research Group, Environmental Chemistry Department, IDAEA-CSIC, Barcelona, Spain*

⁽²⁾ *Doctoral Program in Analytical Chemistry and Environmental Science, Dep. Of Chemical Engineering and Analytical Chemistry, University of Barcelona, Barcelona, Spain*

dabqsh@cid.csic.es , Tel: 934 00 61 00 (ext. 437903)

The use of plastics is a global concern problem due to their persistence and accumulation in the environment, resulting in the contamination of oceans, soils, and harm to the wildlife. A promising solution to this crisis is bioplastics, produced from renewable sources such as starch or corn, that can be biodegraded under different conditions¹. However, for bioplastics to be a sustainable alternative, it is crucial to determine whether the organisms present in conventional activated sludge (CAS) in wastewater treatment plants (WWTPs) can efficiently degrade or reduce them.

In this context, we evaluated under laboratory conditions the elimination of different (bio)microplastics, possible leaching of plastic additives and related compounds facilitated by CAS organisms during an exposure time of 15 days. With this aim we exposed two commercial garbage bags made of polylactic acid (PLA) and polyethylene (PE) fragmented to microsize and PLA micropellets. The analysis of fuel-based (bio)microplastics was carried out by size exclusion chromatography coupled to high resolution mass spectrometry equipped with an atmospheric photoionization source (SEC-APPI-HRMS) while PLA analyses were done using pyrolysis-gas chromatography coupled to HRMS. In the case of plastic additives, the analysis was done by means of reverse phase liquid chromatography coupled to HRMS equipped with an electrospray ionization source².

The results show that both PLA bag and PLA micropellet have high percentages of biodegradation reaching up to 90% of degradation ratio by the microorganisms present in CAS, whereas the PE shows a negligible. In the case of plastic additives, the results of the biodegradation experiment in the spiked samples showed that, after fifteen days of exposure, approximately 80% of the additives studied were degraded up to 65% in some cases. Finally, the leaching of some plastic additives during microbial treatment was confirmed during the whole experiment.

Acknowledgements – This work was supported by BIOPLASTICMENT project (ref. CNS2022-135615) from the Spanish Ministry of Science and Innovation.

[1] I. Muhammad Shamsuddin, Bioplastics as Better Alternative to Petroplastics and Their Role in National Sustainability: A Review, *Advances in Bioscience and Bioengineering*, vol. 5, no. 4, p. 63, 2017.

[2] Vega-Herrera A, Llorca M, Savva K, León VM, Abad E and Farré M. Screening and Quantification of Micro(Nano)Plastics and Plastic Additives in the Seawater of Mar Menor Lagoon. *Front. Mar. Sci.* 2021, 8:697424.

PÓSTER 11 - Suelos restaurados con biosólidos: contaminación por microplásticos después de 27 años

J. Sierra⁽¹⁾, E. Martí⁽¹⁾, V. Carabassa⁽²⁾, M. Pons⁽²⁾, N. Exposito⁽³⁾, J. Rovira⁽³⁾, X. Domene⁽²⁾

⁽¹⁾ *Secció de Sanitat Ambiental i Edafologia. Fac. Farmàcia, Universitat de Barcelona,*

⁽²⁾ *Centre de Recerca Ecològica i Aplicacions Forestals CREAF Universitat Autònoma de Barcelona. Cerdanyola del Vallès.*

⁽³⁾ *Environmental Engineering Laboratory. Departament d'Enginyeria Química. Universitat Rovira i Virgili. Tarragona.*

sierra@ub.edu Tel: +93 4024494

En Catalunya desde el año 1981 (Llei 12, 1981, Generalitat de Catalunya) es obligatoria la restauración de los espacios afectados por las actividades mineras. Ésta comprende 3 fases principales: el modelaje de la morfología final del terreno, la reposición del suelo y la recuperación de la vegetación y la fauna. Para la restauración del suelo a menudo se construyen los llamados tecnosoles, “suelos técnicos a la carta”, con materiales minerales de rechazo mezclados con enmiendas orgánicas, tales como los biosólidos [1]. Éstos ayudan a la colonización biológica de estos materiales inertes al aportar materia orgánica y nutrientes. Sin embargo, los lodos de depuradora también llevan asociados productos indeseables tales como metales, contaminantes orgánicos y microplásticos (MPs). En el presente trabajo se han muestreado (año 2023) los suelos restaurados en 1996 de la cantera Dos Maries de Alcover (Tarragona). Para ello se han analizado los MPs de los distintos horizontes de tecnosoles contruidos con y sin biosólidos, y del suelo con el bosque original. Para la construcción de los tecnosoles enmendados se aportó una dosis única de lodo de depuradora urbana a razón de 50 t de lodo seco/ha. Los resultados indican que tanto el suelo original como los tecnosoles sin lodo contienen entre 100 y 200 MPs por kg. Sin embargo, los suelos que recibieron lodos hace 27 años contienen en el horizonte superficial entre 1600 y 2500 MPs por kg. Las fibras y filamentos son la morfología más abundante (90%) y los análisis mediante IR indican que el poliéster es el polímero más abundante, seguido de polipropileno, acrílico y polietileno. Las partículas están formadas principalmente por ftalato de polietileno, polietileno, polipropileno y poliuretano. La contaminación por microplásticos no parece movilizarse hacia horizontes inferiores, y se correlaciona con las concentraciones de Pb y Zn.

Agradecimientos – Proyecto ECOFARMERS. Ministerio de ciencia e innovación. PID2020-114334RB-100

[1] Carabassa, V. 2020. Valorització de residus orgànics en tecnosols i avaluació de la restauració d'espais degradats. Tesis Doctoral. Universitat Autònoma de Barcelona-CREAF.

PÓSTER 12 - Assessing the uptake and impact of plastic additives on plants grown in a hydroponic system under a reclaimed water scenario

M.P. Garcia-Moll^(1,2), H. Beral^(1,2), L. Alonso^(1,2), L.H.M.L.M. Santos^(1,2), G. Buttiglieri^(1,2), S. Rodriguez-Mozaz^(1,2)

⁽¹⁾ *Catalan Institute for Water Research (ICRA-CERCA), C/ Emili Grahit 101, 17003 Girona, Spain*

⁽²⁾ *University of Girona, Girona, Spain*

mpgarcia@icra.cat, Tel: +34-685526586

Increasing population and climate change-driven droughts have heightened demands for quality freshwater. In the Mediterranean Area, 20% of the population face constant water stress, increasing to over 50% affected in summer. Consequently, water reclamation strategies are urgent, including for crops production. Despite related regulations (e.g., EU 2020/741), irrigation with reclaimed water still faces technical, economical, and social barriers. However, food safety is paramount to prevent health risks. Reclaimed water may contain a wide variety of organic micropollutants, including plastic additives, that may not be entirely removed during treatment, posing risks of entering the food chain.

This study examines the uptake and bioaccumulation of selected plastic additives as well as the generation of transformation products (TPs) in a hydroponic system with Carex (*Carex praegracilis*) and lettuce (*Lactuca sativa*) grown for phytoremediation purposes and for crops production, respectively. Seven additives, which are related to textile, packaging, and tire wear particles, were spiked in the irrigation water, namely: benzotriazole-1H (BTR), bisphenol S (BPS), 1,3-dio-tolylguanidine (DTG), hexamethoxymethylmelamine (HMMM), benzothiazole (BTZ), tris(2-chloroethyl) phosphate (TCEP), and benzophenone-3 (BzP). Target analysis of the additives was performed both in water and plants using UHPLC-MS/MS to evaluate their uptake and bioaccumulation, while suspect screening for the determination of TPs was conducted with LC-HRMS.

This research aims to enhance our understanding of plastic additives fate in water reclamation scenarios, ensuring efficient phytoremediation and/or safer agricultural practices to protect public health.

Acknowledgements – The authors acknowledge the research funded by the Spanish State Research Agency of the Spanish Ministry of Science and Innovation with the project code: PID2020-115456RB-I00/MCIN/AEI/10.13039/501100011033; ReUseMP3. The Acquity UPLC-MS QTRAP 5500, Waters-SCIEX facility and Orbitrap Exploris 120 UPLC-MS, Thermo Fisher Scientific facility received support from the CERCA Institute through the CERCAGINYS program, funded by the Spanish Ministry of Science and Innovation. The authors are grateful for the support from the Economy and Knowledge Department of the Catalan Government through a Consolidated Research Group (ICRA-TECH – 2021 SGR 01283 and ICRA-ENV - 2021 SGR 01282). M.P. Garcia-Moll acknowledges funding from predoctoral Joan Oró Program of Secretariat of Universities and Research from Department of Research and Universities of the Government of Catalonia and European Social Fund for his FI fellowship 2023 FI-1 00226).

PÓSTER 13 - Diversity of marine bacteria growing on leachates from virgin and weathered plastic: Insights into potential degraders

Romera-Castillo, Cristina; Birnstiel, Stéphanie; Sebastián, Marta

Institut de Ciències del Mar-CSIC, Passeig Maritim de la Barceloneta 37-49, 08003, Barcelona, Spain

crisrc@icm.csic.es, Tel: +93-230 95 55

Plastic debris in the ocean releases chemical compounds that can be toxic to marine fauna. It was recently found that some marine bacteria can degrade such leachates, but information on the diversity of these bacteria is mostly lacking. In this study, we analysed the bacterial diversity growing on leachates from new low-density polyethylene (LDPE) and a mix of naturally weathered plastic, collected from beach sand. We used a combination of Catalysed Reporter Deposition-Fluorescence In Situ Hybridization (CARD-FISH), BioOrthogonal Non-Canonical Amino acid Tagging (BONCAT), and 16S rRNA gene amplicon sequencing to analyse bacterioplankton-groups specific activity responses and the identity of the responsive taxa to plastic leachates produced under irradiated and non-irradiated conditions. We found that some generalist taxa responded to all leachates, most of them belonging to the Alteromonadales, Oceanospirillales, Nitrosococcales, Rhodobacterales, and Sphingomonadales orders. However, there were also non-generalist taxa responding to specific irradiated and non-irradiated leachates. Our results provide information about bacterial taxa that could be potentially used to degrade the chemicals released during plastic degradation into seawater contributing to its bioremediation [1].

Acknowledgements –This work and C.R.-C. involvement was supported by a project with reference PID2019-109889RJ-I00 funded by MCIN/AEI 10.13039/501100011033 and a ComFuturo grant by FGCSIC. We acknowledge the “Severo Ochoa Centre of Excellence” accreditation (CEX2019-000928-S) and the Thematic Network of Micro- and Nanoplastics in the Environment (RED2018-102345-T, EnviroPlaNet). We also thank Vanessa Balaguer for assistance with the DNA extraction.

[1] Romera-Castillo, C., Birnstiel, S., Sebastián, M. Diversity of marine bacteria growing on leachates from virgin and weathered plastic: Insights into potential degraders. *Environmental Microbiology Reports* 2024, 16(3), e13305. <https://doi.org/10.1111/1758-2229.13305>

PÓSTER 14 - Impact of plastic leaching on marine phytoplankton metabolism

M. Briones-Rizo, C. Romera-Castillo, N. Sampedro

*Institut de Ciències del Mar (ICM), CSIC, Passeig Marítim de la Barceloneta, 37-49 08003
Barcelona (Spain)*

briones@icm.csic.es , Tel: +34-662912004, EXT 445783

Plastic floating in the ocean has reached up to 250,000 tons with consequences for marine organisms which may become entangled or ingest it [1]. Plastic also presents a large amount of chemical additives which are added during its manufacture. In fact, up to 60%–70% of plastic can be additives [2, 3]. These compounds, together with degradation products of the plastic polymer, are referred to as plastic leachates and are released into the water during plastic degradation. Several studies have demonstrated that plastic leachates can affect some marine species [4, 5].

In the ocean, friction and, mostly, ultraviolet light promote the degradation of plastic, triggering the release of plastic leachates that become part of the dissolved organic carbon (DOC) pool. All that dissolved organic matter (DOM) released by plastic can alter the biogeochemistry of the seawater, such as decreasing its pH [6] or changing the composition of the DOM already present [5]. Plastic leachates have been also found to stimulate microbial activity in the ocean, fueling marine bacterial metabolism [5, 7]. But it can also reduce phytoplankton photosynthetic activity and oxygen production [4]. Phytoplankton play a crucial role in the carbon cycle and is at the base of the marine trophic food chain. Due to its significance in ocean ecology and climate regulation, changes in phytoplankton productivity can profoundly impact biodiversity, fisheries, the human food supply, and global warming rates [8, 9, 10]. Therefore, it is important to understand how plastic pollution affect these microorganisms.

This study examines the effect of plastic on ten phytoplankton species present in the Mediterranean Sea, aiming to establish a link between plastic-induced threats to phytoplankton development and its production of dissolved organic matter. Plastic leachates were generated in seawater under simulated conditions occurring at the surface ocean. Then, ten phytoplankton species were cultured in these plastic leachates and their growth, performance (including cell size and biomass), and production of DOM were followed. The results offer new insights into how plastic pollution affects the growth and development of marine phytoplankton and the impact on the DOM biogeochemistry.

Acknowledgements –This work and C.R.-C. involvement was supported by a project with reference PID2019-109889RJ-I00 funded by MCIN/AEI 10.13039/501100011033 and a ComFuturo grant by FGCSIC. M. B.-R. was supported by JAE-Intro 2020 and a doctoral scholarship FPU 2022, both funded by MCIN/AEI. This work acknowledges the ‘Severo Ochoa Centre of Excellence’ accreditation (CEX2019-000928-S).

[1] Eriksen, M., Lebreton, L. C., Carson, H. S., Thiel, M., Moore, C. J., Borerro, J. C., ... & Reisser, J. (2014). Plastic pollution in the world's oceans: more than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. *PLoS one*, 9(12), e111913.

[2] Hahladakis, J. N., Velis, C. A., Weber, R., Iacovidou, E., & Purnell, P. (2018). An overview of chemical additives present in plastics: Migration, release, fate and environmental impact during their use, disposal and recycling. *Journal of hazardous materials*, 344, 179-199.

[3] Hermabessiere, L., Dehaut, A., Paul-Pont, I., Lacroix, C., Jezequel, R., Soudant, P., & Duflos, G. (2017). Occurrence and effects of plastic additives on marine environments and organisms: a review. *Chemosphere*, 182, 781-793.

- [4] Tetu, S. G., Sarker, I., Schrameyer, V., Pickford, R., Elbourne, L. D., Moore, L. R., & Paulsen, I. T. (2019). Plastic leachates impair growth and oxygen production in *Prochlorococcus*, the ocean's most abundant photosynthetic bacteria. *Communications biology*, 2(1), 184.
- [5] Romera-Castillo, C., Pinto, M., Langer, T. M., Álvarez-Salgado, X. A., & Herndl, G. J. (2018). Dissolved organic carbon leaching from plastics stimulates microbial activity in the ocean. *Nature communications*, 9(1), 1430.
- [6] Romera-Castillo, C., Lucas, A., Mallenco-Fornies, R., Briones-Rizo, M., Calvo, E., & Pelejero, C. (2023). Abiotic plastic leaching contributes to ocean acidification. *Science of The Total Environment*, 854, 158683.
- [7] Romera-Castillo, C., Birnstiel, S., & Sebastián, M. (2024). Diversity of marine bacteria growing on leachates from virgin and weathered plastic: Insights into potential degraders. *Environmental Microbiology Reports*, 16(3), e13305.
- [8] Gregg, W. (2003). Ocean primary production and climate: Global decadal changes. *Geophysical Research Letters*, 30(15).
- [9] Hallegraeff, G. M. (2010). Ocean Climate Change, Phytoplankton Community Responses, And Harmful Algal Blooms: A Formidable Predictive Challenge. *Journal of Phycology*, 46(2), 220-235.
- [10] Shen, M., Ye, S., Zeng, G., Zhang, Y., Xing, L., Tang, W., ... & Liu, S. (2020). Can microplastics pose a threat to ocean carbon sequestration?. *Marine pollution bulletin*, 150, 110712.

PÓSTER 15 - Exploring plastic additive leaching in seawater: The role of biofilm on colonized surfaces

Berta Sala⁽¹⁾, Rebeca Mallenco-Fornies⁽¹⁾, Núria Trilla-Prieto⁽²⁾, Naiara Berrojalbiz⁽²⁾, Alex Campillo⁽¹⁾, Maria Vila-Costa⁽²⁾, Jordi Dachs⁽²⁾, Cristina Romera-Castillo⁽¹⁾

⁽¹⁾ *Institute of Marine Science (ICM-CSIC), Passeig Marítim de la Barceloneta 27-49, 08003 Barcelona, Spain*

⁽²⁾ *Global Change and Genomic Biogeochemistry, Dep. of Environmental Chemistry, Institute of Environmental Assessment and Water Research (IDAEA-CSIC); Jordi Girona 18-26, 08034 Barcelona (Spain)*

bsala@icm.csic.es, Tel: +34-636289482

In seawater, plastic releases chemical compounds with implications for marine fauna and seawater biogeochemistry. These compounds can be additives or polymer degradation products, and their release process is enhanced by sunlight radiation. The presence of microorganisms in seawater also leads to rapid formation of a complex biological layer on plastic surfaces known as 'biofilm'. This biofilm is composed of a mixture of microorganisms, extracellular compounds, and organic matter adhering to the plastic surface, fundamentally altering its properties and interactions in the environment. All studies analyzing plastic leaching in seawater have used new virgin plastic, ignoring the role of biofilm in this process. This study explores this phenomenon to understand whether biofilm presence on plastic enhances or inhibits the leaching process in seawater.

Two experiments were conducted to study plastic additive leaching in seawater: one with low-density polyethylene (LDPE) colonized by biofilm and another, as a control, with new LDPE without biofilm. Plastic pieces were incubated in sterilized seawater under artificial UV and visible radiation. In the experiment with non-colonized plastic, dark treatments were also performed to study the effect of radiation on leaching. Samples from water, plastic, and biofilm were meticulously collected at specific intervals. Organophosphates (OPEs) released by plastic into seawater were analyzed using an Agilent 7890A gas chromatograph coupled to an Agilent 7000B triple quadrupole mass spectrometer.

The experiment with non-colonized plastic revealed substantial concentrations of OPEs, indicating their potential for leaching under diverse light and darkness conditions. A notable observation was the distinct response among various OPEs to UV exposure. These results will be compared with those obtained from the experiment with colonized plastic. Findings from this study are expected to offer critical perspectives in comprehending the complex dynamics of chemical leaching associated with plastics in marine environments.

PÓSTER 16 - DEGRADATION AND ORGANIC COMPOUND LEACHING ASSESSMENT OF ANTIFOULING POLYMER-BASED PAINTS

D. Alcaide-Benavides^(1,2), X. Borrell-Díaz⁽¹⁾, N. Gimeno⁽³⁾, M. Llorca⁽¹⁾, M. Farré⁽¹⁾

⁽¹⁾ *ON HEALTH Research Group, Environmental Chemistry Department, IDAEA-CSIC, Barcelona, Spain*

⁽²⁾ *Doctoral Program in Analytical Chemistry and Environmental Science, Dep. Of Chemical Engineering and Analytical Chemistry, University of Barcelona, Barcelona, Spain*

⁽³⁾ *Pinturas Hempel, S.A.U, Barcelona, Spain*

dabqsh@cid.csic.es, Tel: +934 00 61 00 (ext. 437903)

The maritime industry is crucial in global trade and transportation but also significantly contributes to marine pollution. One of these sources of pollution is plastic ship paints, which can deliver micro/nanoplastics (MNPLs), plastic additives, and compounds used because of their antifouling properties to the ocean. These substances are known to have adverse effects on marine ecosystems. In response to the growing environmental concerns, companies are developing biodegradable ship paints. These innovative coatings aim to provide the necessary protective functions while significantly reducing environmental impact.

This study examines four different types of antifouling paints based on biodegradable and nonbiodegradable bases. These paints were exposed to marine conditions in marine mesocosm for two months. Samples consisting of 2L water at time 0 and after 2 months were taken to evaluate the presence of MNPLs in waters coming from the antifouling paints, while 100 mL water was taken at time 0 and every week to evaluate the leaching of any related plastic additive. For the study of MNPLs, the samples were filtered and the filter extracted using ultrasonic-assisted extraction with toluene followed by the suspect screening analysis by size exclusion chromatography coupled to high-resolution mass spectrometry equipped with an atmospheric photoionization source (SEC-APPI-HRMS) for based-foil polymers and pyrolysis coupled to gas chromatography (GC) HRMS for biodegradable polymers¹. Plastic additives were extracted and pre-concentrated by solid phase extraction (SPE) and subsequently analyzed using a suspect screening by reverse phase chromatography coupled to HRMS equipped with an electrospray ionization source. Finally, the raw data from the suspect screening of plastic additives was further processed by Compound Discoverer 3.0 software to identify any possible related plastic additives.

The main results showed the presence of polydimethylsiloxane in all the mesocosms and polypropylene in two of them coming either from the exposed paints or from the panels. In the case of plastic additives, the suspect screening analysis and following different confidence' criteria levels², showed more than 30 plastic additives at level 1 and 2 of confidence that could be leached either from paints or from the panels.

Acknowledgements – This work was supported by the Nautilus PROJECT (CPP2021-008466) from the Spanish Ministry of Science and Innovation and Generalitat de Catalunya through SGR01150.

[1] Vega-Herrera A, Llorca M, Savva K, León VM, Abad E and Farré M. Screening and Quantification of Micro(Nano)Plastics and Plastic Additives in the Seawater of Mar Menor Lagoon. *Front. Mar. Sci.* 2021, 8:697424.

[2] Schymanski, E. L., Jeon, J., Gulde, R., Fenner, K., Ruff, M., Singer, H. P., & Hollender, J. Identifying small molecules via high resolution mass spectrometry: communicating confidence. *Environ. Sci. Technol.* 2014, 48, 4, 2097–2098.

PÓSTER 17 - Plastic additives: flame retardants and BPA derivatives interact *in vitro* with B-esterase enzymes in marine zooplankton

Paula Aguilera, Sergi Omedes, Enric Saiz, Montserrat Solé

Institut de Ciències del Mar, CSIC, Pg. Marítim de la Barceloneta 37-49, Barcelona 08003, Spain

paguilera@icm.csic.es, Tel: +34 616 794 399

Zooplankton are key components of the marine pelagic realm, serving as the primary link between primary producers and higher trophic biota¹. Among zooplankton components, copepods are one of the most abundant and diverse groups, inhabiting nearly all marine environments. They play a crucial role in marine food webs and global biogeochemical cycles, making them particularly relevant for research in the context of the increasing threat of plastic pollution in also a warmer ocean.

Recent studies have highlighted the Mediterranean Sea as a highly polluted marine environment in terms of plastic debris². Plastic waste enters aquatic ecosystems through multiple pathways where it can potentially persist from decades to centuries³. Besides the potential physical effects of plastic particles on zooplankton, it is known that plastic additives can be released during their degradation and affect marine biota. In the case of copepods, however, little is known on the impact of plastic additives in their physiological performance.

In this study we have investigated the *in vitro* interaction of selected flame retardant organophosphate esters and plasticizers such as bisphenol A and its derivatives in relevant enzymatic systems of three copepod species that can be found in the Mediterranean Sea: the calanoids *Paracartia grani* and *Centropages typicus*, and the cyclopoid *Oithona davisae*. We chose for the assay relevant B-esterase enzymes since previous studies in marine species have demonstrated that some plastic additives can have significant interaction with them. Therefore, we evaluated the *in vitro* inhibition of the carboxylesterase (CE) and acetylcholinesterase (AChE) enzymes of the target copepod species after exposure to different additives at a single 50 µM concentration for 15 min and afterwards measured the residual activity. B-esterases are commonly adopted biomarkers of organophosphate pesticide exposure (mainly AChE), and additionally CE are involved in the metabolism of xenobiotics as well as endogenous molecules⁴.

Our results revealed that most flame retardant organophosphate esters and bisphenol A derivatives inhibited CE activity, making it a suitable biomarker for assessing exposure in zooplankton. By contrast, AChE activity was only inhibited by few compounds such as bisphenol A diglycidyl ether and Bisphenol AF, which could alter feeding and motility activity of zooplankton.

Acknowledgements – This research was supported by grants PID2020-118645RB-I00 and PID2021-122592NB-I00 funded by MCIN/AEI/10.13039/501100011033 and by European Union Next GenerationEU/ PRTR, and also with funding from the Spanish government through the 'Severo Ochoa Centre of Excellence' accreditation (CEX2019-000928-S). P.A. was supported by grant PRE2022-102491 funded by MCIN/AEI/10.13039/501100011033 MICIU/AEI/10.13039/501100011033 and by FSE+.

[1] Turner, J. T. (2004). The importance of small planktonic copepods and their roles in pelagic marine food webs. *Zool. Stud.*, 43(2), 255-266.

[2] Balcells, M., Blanco, M., Colmenero, A. I., Barría, C., Santos-Bethencourt, R., Nos, D., ... & Galimany, E. (2023). Fishing for litter, accidental catch in bottom trawl nets along the Catalan coast, Northwestern Mediterranean. *Waste Management*, 166, 360-367.

[3] Gambardella, C., Miroglio, R., Costa, E., Cachot, J., Morin, B., Clérandeau, C., ... & Garaventa, F. (2024). New insights into the impact of leachates from in-field collected plastics on aquatic invertebrates and vertebrates. *Environmental Pollution*, 124233.

[4] Omedes, S., Andrade, M., Escolar, O., Villanueva, R., Freitas, R., & Solé, M. (2022). B-esterases characterisation in the digestive tract of the common octopus and the European cuttlefish and their in vitro responses to contaminants of environmental concern. *Environmental Research*, 210, 112961.

PÓSTER 18 - Impact of Organophosphate Flame Retardants on Lung Health: Phenotypic and Lipidomic study using an In Vitro Cell Model

Maryam Pyambri, Athina Pavlidou, Sílvia Lacorte, Joaquim Jaumot, Carmen Bedia

Environmental Chemistry Department. Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, Spain

maryam.pramani@idaea.csic.es, Tel: +34 934006100

Organophosphate flame retardants (OPFRs) are widely used in many industries because they help reduce flammability. They are commonly found in plastic products, where they improve fire safety without affecting the material's performance. These applications are seen in various consumer goods and industrial products, including electronics, building materials, furnishings, and textiles. However, the extensive use of OPFRs in plastics has raised significant concerns about their potential environmental and health impacts [1].

This study aims to explore the potential hazardous impact of OPFR exposure on lung health. The research utilized two and three-dimensional (3D) cell cultures of the A549 lung cancer cell line to study the phenotypic effects and lipidomic alterations caused by seven OPFRs, including tris(2-butoxyethyl) phosphate (TBOEP), triphenyl phosphate (TPhP), 2-ethylhexyl diphenyl phosphate (EHDPHP), tris(1,3-dichloro-2-propyl) phosphate (TDCPP), tris(2-ethylhexyl) phosphate (TEHP), tricresyl phosphate (TCP), and tris(2-chloroethyl) phosphate (TCEP).

The study evaluated cell viability, reactive oxygen species (ROS), and release of interleukin 8 (IL-8), finding that TPhP, TDCPP, and EHDPHP were the most toxic OPFRs, as they increased ROS levels and IL-8 production. Lipidomic profiling revealed significant alterations, with specific OPFRs impacting lipid species associated with energy metabolism, cell death, and survival. These changes may potentially be linked to the development of diseases such as asthma, pulmonary fibrosis, or acute respiratory distress syndrome. This research elucidates the relationship between OPFR exposure and its effects on human lung health.

Acknowledgements – This research was funded by MCIN/AEI/10.13039/501100011033 (Severo Ochoa Project CEX2018- 000794-S, and PID2022-137766NB-I00)

[1] J. Yang, Y. Zhao, M. Li, M. Du, X. Li, and Y. Li, "A review of a class of emerging contaminants: The classification, distribution, intensity of consumption, synthesis routes, environmental effects and expectation of pollution abatement to organophosphate flame retardants (OPFRs)," International Journal of Molecular Sciences, vol. 20, no. 12. 2019. DOI: 10.3390/ijms20122874.

PÓSTER 19 - Valor pronóstico del hábito tabáquico, la composición corporal y marcadores de inflamación sistémica en pacientes con carcinoma renal no metastásico y oncocitoma renal.

Darío Gracia-Rojo⁽¹⁾, Jesús Muñoz-Rodríguez⁽¹⁾, Antoni Malet-Munté⁽²⁾, Diana Fuertes⁽³⁾, Marta Capdevila⁽¹⁾, Angel Prera⁽¹⁾, Eduardo Vicente⁽¹⁾, José Luis Gonzalez-Sala⁽¹⁾, Naim Hannaoui⁽¹⁾, Arturo Dominguez-Garcia⁽¹⁾, Clara Centeno⁽¹⁾, Leticia de Verdonces⁽¹⁾, Olga Mayordomo⁽¹⁾, Carmina Pla⁽¹⁾, Anna Ferran⁽¹⁾, Paula Azuara⁽¹⁾, Silvia Cuadrench⁽¹⁾, Maria Eugenia Zegri⁽¹⁾, Anna Gavalda⁽¹⁾, Nuria Masip⁽¹⁾ Carlos Abad⁽¹⁾.

⁽¹⁾ *Departamento de Urología, Parc Taulí Hospital Universitari. Universitat Autònoma de Barcelona, Parc Taulí SN 08208, Sabadell. España.*

⁽²⁾ *Departamento de Diagnóstico por la Imagen. UDIAT, Parc Taulí Hospital Universitari. Universitat Autònoma de Barcelona, Parc Taulí SN 08208, Sabadell. España.*

⁽³⁾ *Unitat de Suport a la Recerca, Institut d'Investigació i Innovació Parc Taulí (I3PT). Universitat Autònoma de Barcelona. Plaça de la Torre de l'Aigua, s/n 08208 Sabadell. España.*

dgcastor72@gmail.com, Tel: +34-661179045

Introducción:

Los cambios anormales en la composición corporal y la respuesta a la inflamación sistémica se han asociado con una mala supervivencia de los pacientes con diferentes tipos de cáncer. En pacientes con cáncer renal localizado no hay un consenso establecido, ya que hay estudios que no muestran peor pronóstico con los mencionados factores. Las personas fumadoras tienen un riesgo superior de padecer un cáncer renal (30% más que los no fumadores) [1-5].

Después del establecimiento de una relación causal entre el consumo de tabaco y el cáncer en la década de 1950, se introdujeron filtros de acetato de celulosa con la afirmación de reducir el impacto adverso para la salud de los cigarrillos sin filtro. Los filtros, que a menudo se perciben como más agradables y saludables, fomentan el consumo de tabaco. Sin embargo, los cigarrillos con filtro se inhalan más profundamente para obtener la misma demanda de nicotina, mientras que la combustión alterada libera más nitrosaminas específicas del tabaco. El uso cada vez mayor de ventilación con filtro de cigarrillo se asocia con un fuerte aumento de adenocarcinomas de pulmón en las últimas décadas. Si bien no previene los efectos adversos para la salud, se ha creado un problema ambiental global debido a la basura filtrante no biodegradable, que causa efectos ecotoxicológicos y la propagación de microplásticos [2].

Existen estudios que han mostrado una caracterización integral de la metilación coordinada del ADN y los marcadores de expresión genética del tabaquismo en el tejido adiposo y brindan información para comprender las consecuencias generalizadas para la salud del tabaquismo fuera del pulmón [3].

Nuestro estudio tuvo como objetivo explorar el valor pronóstico de la asociación entre el consumo de tabaco, los indicadores de composición corporal y los marcadores de inflamación sistémica entre pacientes con cáncer de células renales (CCR) no metastásico u oncocitoma renal sometidos a nefrectomía parcial o radical.

Métodos:

Revisamos retrospectivamente, de una base prospectiva, los registros médicos de pacientes afectados de CCR u oncocitomas renales no metastásicos, tratados mediante nefrectomía parcial o radical, entre enero de 2005 y diciembre de 2015. Se analizaron la proporción de pacientes que eran fumadores activos. El seguimiento final se realizó hasta abril de 2024, pérdida de seguimiento o muerte por tumor u otra causa. El tejido adiposo subcutáneo (TAS), el tejido adiposo visceral (TAV), la grasa perirrenal, la sarcopenia y la obesidad sarcopénica se determinaron de la tomografía computarizada (TC) realizada previa a la intervención quirúrgica. Como marcadores de inflamación sistémica se valoró la relación neutrófilos linfocitos (RNL) y la relación linfocitos monocitos (RLM), determinados en analítica previa a la intervención quirúrgica. Las características de los datos iniciales se presentaron con valores de medianas, desviación estándar (DE) y frecuencias. La asociación entre los factores clínicos y la composición corporal se analizó mediante regresión logística binaria. Se aplicó el método de Kaplan-Meier para estimar las tasas de supervivencia. Se utilizó la prueba de Log Rank para comparar las diferencias entre grupos. Se realizaron análisis univariados y multivariados utilizando el modelo de riesgos proporcionales de Cox para identificar los posibles factores de riesgo. Una p bilateral $< 0,05$ se definió como estadísticamente significativa. El análisis estadístico se realizó utilizando SPSS.

Resultados: Se incluyeron 270 pacientes no metastásicos, tratados quirúrgicamente por CCR (251) u oncocitomas (19). Media de seguimiento 124,6 meses (0.23-230,1). Del total, 139 pacientes (51.9%) eran fumadores, todos con filtro de celulosa.

Impacto pronóstico de la composición corporal y los marcadores de inflamación:

Los análisis multivariantes de Cox mostraron que el ser fumador ($HR=5,4$ $p=0.027$) y la afectación ganglionar ($HR=1,8$; $p=0.008$) fueron factores de riesgo significativos para una menor supervivencia libre de progresión. Únicamente el estadio III ($HR=1,4$; $p=0.002$) fue factor de riesgo significativo para una menor supervivencia cáncer específica. El padecer hipertensión arterial ($HR=5,502$ $p=0.033$), el ser fumador ($HR=4,199$; $p=0.015$), el estadio II ($HR=325,857$; $p=0.046$), el estadio III ($HR=42,165$; $p=0.001$), la presencia de afectación ganglionar ($HR=61,62,3$; $p=0.009$) y una cifra elevada de la RNL ($HR=0,791$; $p=0.047$) fueron factores de riesgo significativos para una menor supervivencia global.

Para explorar el impacto pronóstico de la composición corporal combinada con marcadores de inflamación, utilizamos curvas de Kaplan-Meier para mostrar las diferencias entre cada grupo. Los pacientes con obesidad sarcopénica elevada tenían una menor supervivencia global ($p=0.00068$). Los enfermos con una RNL elevada tenían una menor supervivencia global ($p=0.022$), los pacientes con una RLM baja tenían menor supervivencia global ($p=0.0051$), los enfermos que presentaban una RNL elevada y obesidad sarcopénica elevada tenían una menor supervivencia global

($p=0.00031$); y los pacientes con una RLM baja y una obesidad sarcopénica elevada tenían una menor supervivencia global ($p<0.0001$). Pacientes con RNL alta y TAV alta, menor supervivencia global ($p=0.015$). Pacientes con RLM baja y TAV alta menor supervivencia global ($p=0.0021$). Pacientes con RLM baja y sarcopenia menor supervivencia global ($p=0.011$). Paradójicamente los pacientes con RLM alta y TAS alta mostraron una menor supervivencia global ($p=0.01$).

Conclusión: Hemos observado que la mala composición corporal (sarcopenia, TAS, TAV y obesidad sarcopénica elevadas), medidos mediante TC abdominal, junto con alteraciones en los marcadores de inflamación sistémicos (RNL y RLM) se asoció con menor supervivencia global de los pacientes con CCR y oncocitomas no metastásicos sometidos a tratamiento quirúrgico. Los

pacientes fumadores con filtros de celulosa presentan un mayor riesgo de progresión y mortalidad global. Se necesitan estudios futuros para dilucidar aún más la relación biológica entre la composición corporal y la inflamación en pacientes con CCR y oncocitoma renal no metastásico.

[1] Seray Gizem Gur Ozcan SG, Deniz Barali D, Erkan. 2024. *Curr Med Imaging*. 2024;20(1):e15734056301569. doi: 10.2174/0115734056301569240322083100. The Association of Body Composition Parameters Measured by

Computed Tomography with Cancer Stage, Prognosis, and Survival in Patients with Renal Cell Carcinoma

[2] Everaert S, Schoeters G, Lardon F, Janssens A, Van Larebeke N, Raquez JM, Bervoets L, Spanoghe P. Protecting public health and the environment: towards a general ban on cellulose acetate cigarette filters in the European Union. 2023. *Front Public Health*. 2023 Oct 31;11:1282655. doi: 10.3389/fpubh.2023.1282655. eCollection 2023.

[3] Tsai PC, Glastonbury CA, Eliot MN, Bollepalli S, Yet I, Castillo-Fernandez JE, Carnero-Montoro E, Hardiman T, Martin TC, Vickers A, Mangino M, Ward K, Pietiläinen KH, Deloukas P, Spector TD, Viñuela A, Loucks EB, Ollikainen M, Kelsey KT, Small KS, Bell JT. Smoking induces coordinated DNA methylation and gene expression changes in adipose tissue with consequences for metabolic health. 2018. *Clin Epigenetics*. 2018 Oct 20;10(1):126. doi: 10.1186/s13148-018-0558-0.

[4] Furberg H, Bradshaw PT, Knezevic A, Olsson L, Petruzella S, Stein E, Paris M, Scott J, Akin O, Hakimi AA, Russo P, Sanchez A, Caan B, Mourtzakis M. Skeletal muscle and visceral adipose radiodensities are pre-surgical, non-invasive markers of aggressive kidney cancer. 2024. *J Cachexia Sarcopenia Muscle*. 2024 Apr;15(2):726-734. doi: 10.1002/jcsm.13429. Epub 2024 Jan 24. PMID: 38263932; PMCID: PMC10995262.

[5] Khan AI, Psutka SP, Patil DH, Hong G, Williams MA, Bilen MA, Sekhar A, Kissick HT, Narayan VM, Joshi SS, Ogan K, Master VA. Sarcopenia and systemic inflammation are associated with decreased survival after cytoreductive nephrectomy for metastatic renal cell carcinoma. *Cancer*. 2022 Jun 1;128(11):2073-2084. doi: 10.1002/cncr.34174. Epub 2022 Mar 14. PMID: 35285950.

PÓSTER 20 - Plastificantes en huevos de aves del Parque Nacional de Doñana

M.V. Barbieri⁽¹⁾, S. Ortiz Lisbona⁽¹⁾, V. Araya Piqué⁽¹⁾, F. Sergio⁽²⁾, E. Eljarrat⁽¹⁾

⁽¹⁾ *ONHEALTH group, Department of Environmental Chemistry, Institute of Environmental Assessment and Water Research (IDAEA-CSIC), C/ Jordi Girona 18-26, 08034, Barcelona, Spain*

⁽²⁾ *Department of Conservation Biology, Doñana Biological Station (EBD-CSIC), C/Américo Vespucio s/n, 41092 Sevilla, Spain*

mariavittoria.barbieri@idaea.csic.es, Tel: +34 934 00 61 00

Los contaminantes asociados al plástico incluyen numerosos aditivos químicos que proporcionan propiedades específicas a los plásticos y que actualmente, se usan en una amplia gama de aplicaciones en distintos sectores. Los plastificantes pueden liberarse fácilmente en el medio ambiente, ya que no están químicamente unidos al material plástico y, en consecuencia, la población, la flora y la fauna están expuestas a ellos.

Muchos de estos compuestos se consideran sustancias de preocupación emergente, ya que presentan un cierto grado de toxicidad y algunos estudios han relacionado su presencia con efectos adversos para la salud como la neurotoxicidad, el cáncer y la toxicidad reproductiva, entre otros [1].

Este trabajo se centra en el análisis de diferentes familias de plastificantes, e incluye 20 ésteres organofosforados (OPE), 10 ftalatos (PAE) y 4 plastificantes alternativos a los ftalatos (NPP) en muestras de huevos de aves del Parque Nacional de Doñana en España. Se analizaron 55 muestras de huevos infértiles de tres especies diferentes: Águila Calzada (*Hieraaetus Pennatus*), Milano Negro (*Milvus Migrans*) y Milano Real (*Milvus Milvus*), recolectadas entre los años 2013 y 2021.

El método analítico empleado para la detección y cuantificación de estos compuestos se basa en la cromatografía de flujo turbulento (TFC) combinada con la cromatografía de líquidos de alta resolución (HPLC) acoplada a la espectrometría de masas en tándem (MS-MS). La extracción de las muestras se realizó en fase líquida mediante ultrasonido, mientras que la purificación se realizó con el sistema TFC [2].

Se detectaron un total de 8 OPE, 10 PAE y 4 NPP en 42 de las 55 muestras de huevos de aves analizadas, en un rango de concentraciones de 0.20 a 14582 ng/g peso lipídico (lw) demostrando así la presencia de plastificantes en el medio ambiente y su bioacumulación en la biota de una zona protegida como el Parque Nacional de Doñana. Los mayores niveles de contaminación se encontraron en las muestras de águila calzada. Este resultado es comparable con otro estudio [3] en el que se analizaron retardantes de llamas, donde el águila calzada fue la especie más contaminada. Este resultado puede deberse a los hábitos de alimentación y al comportamiento migratorio de esta ave, más propensa a bioacumular contaminantes de otras fuentes externas, mientras que los milanos son aves dispersivas y residentes.

Acknowledgements – This study was funded by the Generalitat de Catalunya (Consolidated Research Group 2021SGR01150). IDAEA-CSIC is a Centre of Excellence Severo Ochoa (Spanish Ministry of Science and Innovation, Project CEX 2018-000794-S).

- [1] Du J, Li H, Xu S, Zhou Q, Jin M, Tang J. 2019. A review of organophosphorus flame retardants (OPFRs): occurrence, bioaccumulation, toxicity, and organism exposure. *Environmental Science and Pollution Research*; 26:22126-22136 <https://doi.org/10.1007/s11356-019-05669-y>.
- [2] Giulivo M, Capri E, Eljarrat E, Barceló D. 2016. Analysis of organophosphorus flame retardants in environmental and biotic matrices using on-line turbulent flow chromatography-liquid chromatography-tandem mass spectrometry. *J Chromatogr A*, 1474:71–78 <https://doi.org/10.1016/j.chroma.2016.10.042>.
- [3] Barón E, Máñez M, Andreu AC, Sergio F, Hiraldo F, Eljarrat E, et al. 2014. Bioaccumulation and biomagnification of emerging and classical flame retardants in bird eggs of 14 species from Doñana Natural Space and surrounding areas (South-western Spain). *Environ Int*; 68:118–126 <https://doi.org/10.1016/j.envint.2014.03.013>.

PÓSTER 21 - Occurrence of halogenated flame retardants in edible fish samples from the Mediterranean Spanish FAO zone (FAO 37.1.1)

V. Araya, M.V. Barbieri, E. Eljarrat

ONHEALTH, Environmental Chemistry, Institute of Environmental Assessment and Water Research (IDAEA-CSIC), c/Jordi Girona 18-26, Barcelona, Spain

valentina.araya@idaea.csic.es, Tel: +34-618239364

Flame retardants are commonly used as plastic additives to reduce flammability. Numerous organic flame retardants have been found to pose toxicity concerns. For example, PBDEs exhibit endocrine disruption, developmental neurotoxicity, and reproductive disorders [1]. Due to that, novel brominated flame retardants (NBFRs) have been commercialized; however, these also exhibit toxic behaviors. The goal of this study is to provide an overview of the distribution of different flame retardants (PBDEs, NBFRs, Dechloranes, and SCCPs) along the Catalan Mediterranean coast and among the most consumed species in Spain. Samples were purchased from local fishing spots in Roses, Sant Carles de la Ràpita, and Vilanova. The species chosen were determined by the fishing season and the most consumed fish in Spain. These consisted on European seabass (*Dicentrarchus labrax*), European hake (*Merluccius merluccius*), Gilt-head bream (*Sparus aurata*), Longfin tuna (*Thunnus alalunga*), Common sole (*Solea solea*), European common cuttlefish (*Sepia officinalis*) and European squid (*Loligo vulgaris*). Samples were extracted based on preexistent methods ([2], [3]) using a selective pressurized liquid extraction (SPLE) with an automated Accelerated Solvent Extraction system (Dionex, Sunnyvale, CA, USA). A subsample of 1-1.5 g of every specimen was extracted with hexane:dichloromethane (1:1). Fat was determined gravimetrically. After the extraction, samples were treated with sulphuric acid to get rid of any impurities; moreover, after the acid treatment, a solid-phase extraction was performed using neutral alumina cartridges, and the target compounds were eluted with hexane:dichloromethane (1:2). The sample was then reconstituted to toluene. Finally, the samples were analyzed by GC-MS/MS (EI) for PBDEs and GC-MS/MS (NCI) for Dechloranes. SCCPs were analyzed by GC/MS (NICI). The results were compared between sites, to give an overview of the state of the coast, and between species, to determine which species might pose the highest risk when consumed.

Acknowledgements – This study has been funded by the European Union – NextGeneration EU – as part of the MITECO program for the Spanish Recovery, Transformation and Resilience Plan (Recovery and Resilience Facility of the European Union established by the Regulation (EU) 2020/2094), and was entrusted to CSIC, AZTI, SOCIB, and the universities of Vigo and Cadiz. This study has been also funded by the Generalitat de Catalunya (Consolidated Research Group 2021 SGR01150).

[1] Z. Wu et al., "Exposure pathways, levels and toxicity of polybrominated diphenyl ethers in humans: A review," *Environ. Res.*, vol. 187, no. February, p. 109531, 2020, doi: 10.1016/j.envres.2020.109531.

[2] A. Labandeira, E. Eljarrat, and D. Barceló, "Congener distribution of polybrominated diphenyl ethers in feral carp (*Cyprinus carpio*) from the Llobregat River, Spain," *Environ. Pollut.*, vol. 146, no. 1, pp. 188–195, 2007, doi: 10.1016/j.envpol.2006.04.037.

[3] A. De La Cal, E. Eljarrat, and D. Barceló, "Determination of 39 polybrominated diphenyl ether congeners in sediment samples using fast selective pressurized liquid extraction and purification," *J. Chromatogr. A*, vol. 1021, no. 1–2, pp. 165–173, 2003, doi: 10.1016/j.chroma.2003.09.023.

PÓSTER 22 - Preliminary assessment of microplastics in indoor air from different microenvironments of Barcelona, Spain

A. Balasch ⁽¹⁾, J. M. Levermore ⁽²⁾, S. L. Wright ⁽²⁾, T. Moreno ⁽¹⁾, E. Eljarrat ⁽¹⁾

⁽¹⁾ *Instituto de Diagnostico Ambiental y Estudios del Agua (IDAEA), CSIC, 18-26 Jordi Girona, Barcelona 08034*

⁽²⁾ *MRC Centre for Environment and Health, Imperial College London, White City Campus, 80–92 Wood Lane, London W12 0BZ, UK*

abagam@cid.csic.es, Tel: +34 93 255 75 98 (ext. 437786)

Microplastic (MPs) pollution has emerged as a global issue due to the extensive use and improper disposal of plastic products. While early research primarily examined MP effects on aquatic and terrestrial ecosystems, recent studies have also detected MPs in the air, raising concerns about their impact on air quality and their potential to reach remote environments. This study aims to assess the concentration levels of three types of microplastic (polyethylene terephthalate (PET), polystyrene (PS), and polyvinyl chloride (PVC)) in indoor air across various microenvironments which account for over 80% of daily time spent.

Samples were collected in the metropolitan area of Barcelona using quartz microfiber filters with a personal environmental monitor (PEM, SKC) fitted with a PM10 inlet and connected to a Leland Legacy Pump (SKC) at a flow rate of 10 L/min. Sampling sites included different rooms from 10 houses, means of transportation, and workplaces. Each filter was divided into three strips to perform triplicates, ensuring consistency in the detection of MPs across different filter sections. The MPs were analysed using Pyrolysis-(GC)xGC-TOFMS (Pegasus BT 4D, LECO), with calibration curves ranging between 0.05 and 10 µg for quantification.

In total, 46 filters were analyzed. For PET, its quantifying ion was detected in 91% of the samples, but only 54% were within the calibration curve, while the rest were below it. PET concentrations ranged from 0.12 to 23 µg/m³, with a median of 0.48 µg/m³. PS was detected in 62% of the samples; however, only 4% were within the calibration curve, with concentrations ranging from 0.02 to 22 µg/m³ and a median of 0.28 µg/m³. Finally, PVC was detected in 90% of the samples and quantified in 74%, with concentrations ranging from 0.03 to 8.4 µg/m³ and a median of 0.41 µg/m³. The highest levels for every MP were mainly detected in workplaces such as a sewing shop, motorbike workshop and hair salon, as well as inside cars. In the case of PVC, there high concentrations were also found in one of the kitchens, which might be associated with coatings used in the kitchen. These preliminary results allow for an initial assessment of daily exposure to MPs through inhalation in indoor microenvironments, which account for over 80% of daily time spent.

Acknowledgements – This study was supported by the Spanish Ministry of Science and Innovation (Project EXPOPLAS PID 2019-110576RB-I0), by the Severo Ochoa Programme Grant CEX 2018-000794-S funded by MCIN/AEI/10.13039/501100011033, and by the Generalitat de Catalunya (Consolidated Research Groups 2021 SGR01150, SGR00447). A. Balasch thanks his fellowship PRE 2020-091979. The authors would like to thank the volunteers that helped during the sampling campaign and the workers that accepted sampling the workplaces.

[1] John, K. I., Omorogie, M. O., Adeleye, A. T., Bayode, A. A., & Helmreich, B. (2023). Environmental Microplastics Distribution, Impact, and Determination Methods: a Review. In *Journal of Analytical Chemistry* (Vol. 78, Issue 9, pp. 1199–1212). Pleiades Publishing. <https://doi.org/10.1134/S106193482309006X>

[2] Sridharan, S., Kumar, M., Singh, L., Bolan, N. S., & Saha, M. (2021). Microplastics as an emerging source of particulate air pollution: A critical review. In *Journal of Hazardous Materials* (Vol. 418). Elsevier B.V. <https://doi.org/10.1016/j.jhazmat.2021.126245>

PÓSTER 23 - Toxicological evaluation of biodegradable and conventional plastics: Impact of photodegradation and composting on environmental safety

T. Wang, M. Hosseinzadeh, C. Porte

Departamento Química Ambiental, IDAEA -CSIC-, C/ Jordi Girona 18-26, Barcelona

cinta.porte@idaea.csic.es, Tel: +34-934006175

In recent years, biodegradable/compostable plastic (BPs) have been promoted as eco-friendly alternatives to traditional plastics for addressing environmental concerns. However, the potential toxic effects resulting from leachable chemicals in these plastics have been relatively overlooked. This study evaluates the toxicity of methanolic extracts of BPs compare to conventional plastics (both virgin and recycled), and explores the potential impact of plastic photodegradation and composting on toxic responses, employing a battery of in vitro assays conducted in PLHC-1 cells. The results reveal a noteworthy decrease in cell viability (<70%) in PLHC-1 cells after a 24-hour exposure to extracts from compostable plastics, but not those of conventional plastics. Toxicity was enhanced by photodegradation and partial composting of BPs. Extracts of conventional plastics, and particularly those of recycled plastics, induced 7-ethoxyresorufin-O-deethylase (EROD) activity and micronucleus formation in exposed cells, indicating the presence of significant amounts of CYP1A inducers and genotoxic compounds in the extracts, which was enhanced by photodegradation. These findings underscore (a) the importance of investigating the impact of degradation mechanisms, such as sunlight exposure and composting, on the toxicity of plastics, and (b) the need to investigate the composition of newly formulated compostable plastics, as they could potentially Childhood exposure to contaminants related to plastic is a significant concern due to the potential unknown consequences in their adult health. There are multiple exposure pathways, including beverages consumption, were tap water daily intake is estimated in 1.33 L/person/day [1]. Organophosphate esters (OPEs) are a group of compounds whose long-term toxic effects are currently under scrutiny. Moreover, the presence of metabolites of OPEs and other plasticizers in urine, such as phthalates (mPAEs), may serve as indicators for monitoring the degree of exposure to plastic.

PÓSTER 24 - Poly(dimethyl)siloxane (PDMS) as a tool to assess dermal exposure to plastic additives from textile materials

Sandra Callejas-Martos, Lara Cioni, Ethel Eljarrat

Environmental and Water Chemistry for Human Health (ONHEALTH), Institute of Environmental Assessment and Water Research (IDAEA CSIC), Barcelona (Spain)

scmqam@cid.csic.es, Tel: +34-646030663

Plasticizers are extensively used in consumer products due to their versatility and effectiveness in enhancing the properties and performance of a wide range of materials. These compounds can be released into the environment during the process of production, usage, and dismantling by leaching, volatilization, and abrasion since they are additive-type without chemical bonding. These additives enter the human body primarily through inhalation, ingestion, and dermal contact. Despite being the least studied pathway, dermal exposure is significant as plasticizers can migrate from products and be absorbed through the epidermis. Accurate migration rate measurements are crucial for assessing exposure but are often uncertain. To reduce these uncertainties, this study developed an analytical methodology to estimate the easily releasable fraction (ERF) of plastic additives—sixteen OPEs, sixteen phthalates, and four alternative plasticizers (two adipates, one citrate, and DINCH)—from textile materials via dermal contact.

For the migration experiments, clean poly(dimethyl)siloxane (PDMS) sheets (1x1 cm²) were used as a passive sampler. The PDMS sheets were placed on top of the textile material and covered with a glass petri dish. Factors affecting migration [1], such as contact time, pressure, and temperature, were meticulously controlled. Moreover, the human skin surface is generally coated with a thin film of liquid-phase sebaceous lipids. This surface lipid film contributes to the properties of the skin and can affect the migration rate of these compounds. To better simulate dermal migration [2], artificial sebum and sweat were introduced between the PDMS and textile samples.

Following the migration experiments, the PDMS sheets underwent ultrasonic liquid extraction with acetonitrile as the solvent. The extracts were analyzed using liquid chromatography-mass spectrometry (LC-QqQ). This methodology enabled the estimation of daily exposure doses of plasticizers from clothing, providing valuable data for assessing dermal exposure risks. Differences in ERF values were analyzed based on the compounds' physical and chemical properties. Obtained ERF values for a wide range of plastic additives can contribute significantly to understanding and mitigating the risks associated with dermal exposure to plasticizers.

Acknowledgements – This research work was funded by the European Commission NextGenerationEU (Regulation EU 2020/2094), through CSIC's Global Health Platform (PTI Salud Global), and by the Generalitat de Catalunya (Consolidated Research Group 2021SGR01150).

[1] D. Y. Kim, S. Sochichiu, and J. H. Kwon, "Effects of time, temperature, and sebum layer on migration rate of plasticizers in polyvinyl chloride products," *Chemosphere*, vol. 308, Dec. 2022, doi: 10.1016/j.chemosphere.2022.136478

[2] O. Ragnarsdóttir, M. A. E. Abdallah, and S. Harrad, "Dermal bioaccessibility of perfluoroalkyl substances from household dust; influence of topically applied cosmetics," *Environ Res*, vol. 238, Dec. 2023, doi: 10.1016/j.envres..

PÓSTER 25 - Exposure to plasticizers in children from Val d'Aran

J. Fernández-Arribas⁽¹⁾, S. Callejas-Martos⁽¹⁾, P. S. Ventura Wichner^{(2) (3)}, E. Eljarrat⁽¹⁾

⁽¹⁾ IDAEA, CSIC, Jordi Girona, 18-26, Barcelona, España

⁽²⁾ IGTP, Ctra de Can Ruti, Camí de les Escoles s/n, Badalona (Barcelona), España

⁽³⁾ Servicio de Pediatría, Hospital Universitari Arnau de Vilanova, Av. Alcalde Rovira Roure, 80, Lleida, España

jfaqam@cid.csic.es, Tel: +34-932557598

Childhood exposure to contaminants related to plastic is a significant concern due to the potential unknown consequences in their adult health. There are multiple exposure pathways, including beverages consumption, where tap water daily intake is estimated in 1.33 L/person/day [1]. Organophosphate esters (OPEs) are a group of compounds whose long-term toxic effects are currently under scrutiny. Moreover, the presence of metabolites of OPEs and other plasticizers in urine, such as phthalates (mPAEs), may serve as indicators for monitoring the degree of exposure to plastic.

The main purpose of the study is to assess the occurrence of OPEs in tap water from eighteen houses in the Val d'Aran region (Lleida). These households were home to different children, specifically including 10 boys and 10 girls aged between 3 and 10 years. Urine samples were collected from each volunteer to evaluate the presence of plasticizer metabolites, including mOPEs and mPAEs. Extraction methodology for water samples have been carried out by liquid chromatography tandem mass spectrometry (LC-MS/MS), based on a previously method [1]. Urine samples were analyzed by techniques based on high resolution mass spectrometry (UHPLC-qTOF).

The total concentration of OPEs in water samples ranged from 3.47 to 41.7 ng/L, while mOPEs in urine ranged from 0.70 to 94.6 µg/g of creatinine. Additionally, mPAEs ranged from 1.48 to 27.6 µg/g of creatinine. These values are comparable to those reported in other studies [2, 3].

Based on the available data, there is no significant correlation between the concentrations of contaminants in water and urine. Nevertheless, a significant negative correlation ($p = 0.027$) was observed between the levels of mOPEs and mPAEs in urine samples. This discrepancy can be attributed to the presence of additional exposure pathways, such as diet, dermal contact, and inhalation, which should be considered.

Acknowledgements – This study was supported by the Spanish Ministry of Science and Innovation (Project EXPOPLAS (PID2019-110576RB-I00), Grants CEX2018-000794-S and PRE2020-093018 funded by MCIN/AEI/10.13039/501100011033 and by “ESF Investing in your future”), and by the Generalitat de Catalunya (Consolidated Research Group 2021 SGR01150). The authors acknowledge the volunteers for their willingness to participate in the study.

[1] Fernández-Arribas, J., Moreno, T., & Eljarrat, E. (2023). Human exposure to organophosphate esters in water and packed beverages. *Environment International*, 175, 107936.

[2] Huang, J., Li, J., Meng, W. & Su, G. (2024). A critical review on organophosphate esters in drinking water: Analysis, occurrence, sources, and human health risk assessment. *Science of The Total Environment*, 913, 169663.

[3] Yin, S., den Ouden, F., Cleys, P., Klimowska, A., Bombeke, J., Poma, G. & Covaci, A. (2024). Personal environmental exposure to plasticizers and organophosphate flame retardants using silicone wristbands and urine: Patterns, comparisons, and correlations. *Science of The Total Environment*, 927, 172187.

