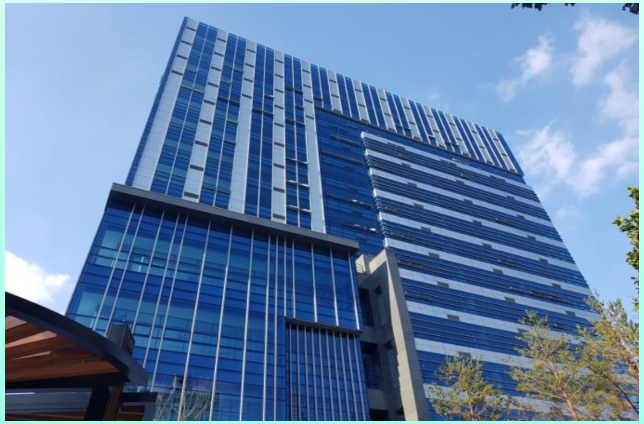
Introduction to KIAST

Korea Institute of Analytical Science and Technology

KIAST
한국분석과학연구소
Korea Institute of Analytical Science and Technology

Since 2018



■ KIAST is in Seoul Korea

Collaboration Network

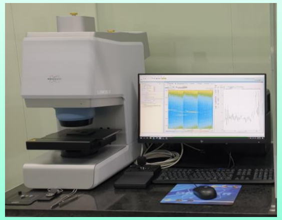
- Advisory Board Member of **EU IMPTOX** project
- Advisory Board Member of **EU PlasticsTrace** project
- Member of **US NSF DWTU Micro/Nanoplastics** Task Group

IEC · ISO · Joint Research Centre JRC · IMPTOX · PlasticTrace · Umwelt Bundesamt · BfR · BAM · ASTM International · NSF · NIST · Fraunhofer · UL · DIN · VDE Institute · Technical University of Munich · SGS · TÜV SÜD · Bruker · HORIBA · Bureau Veritas · Ghent University · iis · smart membranes · CHIRON · intertek · PHILIPS · eurofins · APPLiA · CONTROLUNION

■ Lab. of Microplastics Analysis

TED-GC-MS
(TGA & 2TDS & GC-MS)

Py-GC-MS
(Py-3030D & GC-MS)



µFTIR-FPA
(LUMOS 2, Bruker Optics)

µRaman
(XploRA+, Horiba)

Sample pretreatment room
(**Clean room**, ULPA filter)

Analysis zone for Spectroscopy
(**Clean booth**, HEPA filter)

ISO & IEC Standards activities

“Hazardous substances” Halogen, PAHs, BPA, SCCP/MCCP (IEC/TC 111)

- 2025 — IEC/TC 111/WG 3 (PFAS Task @ E&E) IEC/TR Proposed
  IEC/PFAS TR NWIP Approved (2025.09)
- 2023 — IEC 62321-10 (PAHs by GC-MS) ED2 project started
- 2022 — IEC 62321-14 (SCCP/MCCP by GC-NCI-MS) NWIP passed
- 2021 — KEIT Funding project “International standardization for SCCP/MCCP & *BPA* (2021~2025)”
- KS C IEC 62321-10 (PAHs by GC-MS) published
- 2020 — KS C IEC 62321-3-2 (F, Cl, Br, (I) by C-IC) published (2nd ED)
- IEC 62321-10 (PAHs by GC-MS) IS published
- IEC 62321-3-2 (F, Cl, Br, (I) by C-IC) IS published (2nd ED)
- 2019 — IEC 62321-13 (BPA by LC, LC-MS) Project NWIP proposed
- 2018 — IEC/TC 111/WG 3 & JWG 14 Co-Convenor started
- 2017 — KS M 9721 (PAHs by GC-MS) published
- 2015 — IEC 62321-10 (PAHs by GC-MS) Project leader started
- IEC 62321-3-2 (Halogen by C-IC) revision started
- 2013 — IEC 62321-3-2 (Br by C-IC) IS published
- 2009 — IEC 62321-3-2 (Br by C-IC) Project leader started
- KS M 0180 (Halogen by C-IC) published
- 2008 — IEC/TC 111/WG 3 Halogen test method PWI proposed

IEC ISO

“Microplastics” (TC 61/SC 14, TC 38, TC 147/SC 2&SC 6, IEC/SC 59D)

- 2025 — ISO/TC 61 NWIP Proposed (BPs in recycled plastics by LC-MS/MS) (@2025 ISO/TC 61/SC 5 & SC 14 Plenary) (2025.11)
- 2024 — Korea Research Foundation Project “Prospective Cohort Study on Microplastics on Perinatal Outcomes of Pregnant Women/Fetuses” (2024-2029) – Joint Research with Seoul National University Bundang Hospital
- Member of US NSF DWTU Micro/Nanoplastics Task Group
- 2021 — ISO/TC 147(water quality)/SC 6(sampling)/WG 16 (microplastics) & IEC/TC 59/SC 59D(Laundry machine)/AG 17 (microplastics) Korean Delegate
- MOTIE funding project “Development of microplastic sensor in living environment”(2021-2023)
- 2020 — ISO/TC 147(water quality)/SC 2/JWG 1 (microplastics) Korean Delegate
- ISO/TC38(Textiles)/WG 34 (microplastics) Korean Delegate
- MFDS funding project “Microplastics in foods” (2020~2021)
- MoE funding project “Development of a pyrolysis-based quantitative analysis method for microplastics (<5 μm)”
- 2019 — NIER funding project “Research on preparing a Korean Industrial Standard (KS) test method for microplastics in water”
- 2018 — ISO/TC 61(plastics)/SC 14/WG 4 (microplastics) Korean Delegate
- 2018 — “Development of microplastic analysis method in cosmetics” for MFDS official test methods

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Microplastics Lab. (Clean Room)

TED-GC/MS

Py-GC/MS

μ-FTIR

μ-Raman

Inorganic (Heavy metal) **Lab.**

ICP-MS

ICP-OES

UV-VIS

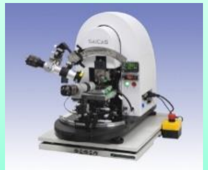
ED-XRF

Halogen & Organic Lab.

Combustion-IC

HS-GC/MS

LC-MS/MS



Surface Analysis SAICAS

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International Organization for Standardization Activities

Standard Organization	Technical Committee	Working Group / Project	Leadership	Period
IEC	TC 111 (Environmental standardization for electronic products and systems)	**WG 3** (Test methods of certain substances)	**Convener**	2018~
		JWG 14 (Test methods of certain substances in plastics) Joint between TC 111 & ISO/TC 61/SC 5	**Convener**	2018~
		IEC 62321-3-2 (Halogen_F, Cl, Br, (I) by C-IC) ED2	**Project leader**	2009~
		IEC 62321-10 (PAHs by GC-MS) ED2		2014~
		IEC 62321-13 (BPA by LC, LC-MS, LC-MS/MS)		2019~
		IEC 62321-14 (SCCP/MCCP by GC-NCI-MS)		2021~
		PFAS Task		2025~
	SC 59D (Home laundry appliances)	AG Group 17 & WG 18 (**Microplastics**)	**Korean Delegate**	2021~
ISO	TC 61 (Plastic)/SC 14 (Environment)/WG4	**Microplastics** test method (Environmental)		2018~
	TC 147 (Water quality)/SC 2 (Methods)/JWG 1	**Microplastics** test method (Water)		2020~
	147 (Water quality)/SC 6 (Sampling)/WG 16	Sampling (general methods) for **microplastics**		2021~
	TC 38 (Textiles)/WG 34	**Microplastics** test method (Textiles)		2020~

International/National Standards Establishment Performance

Standard	Standardization Organization	Number	Role	Year of publish
Determination of certain substances in electrotechnical products –Part 3-2: Screening – **Fluorine, chlorine and bromine** in polymers and electronics by combustion-ion chromatography (C-IC)	IEC/TC 111	**IEC 62321-3-2:2020**	Project leader	2020
Determination of certain substances in electrotechnical products – Part 10: **Polycyclic aromatic hydrocarbons (PAHs)** in polymers and electronics by gas chromatography-mass spectrometry (GC-MS)	IEC/TC 111	**IEC 62321-10:2020**	Project leader	2020
Determination of certain substances in electrotechnical products - Part 3-2: Screening - **Fluorine, bromine and chlorine** in polymer and electronics by combustion-ion chromatography (C-IC)	IEC/TC 111 KATS	KS C IEC 62321-3-2: 2020	Project leader	2020
Determination of certain substances in electrotechnical products - Part 10: **Polycyclic aromatic hydrocarbons (PAHs)** in polymers and electronics by gas chromatography-mass spectrometry (GC-MS)	IEC/TC 111 KATS	KS C IEC 62321-10: 2020	Project leader	2021

IEC/TC 111/WG 3 & JWG 14 Current activity (2026.01)

For RoHS/ELV/REACH SVHCs compliance

IEC 62321-series standards

- WG 3 Co-Convenors: Miyuki TAKENAKA (Japan) & Jaehak JUNG (Koea)
- JWG 14 Co-Convenors: Hairong ZHANG (China) & Jaehak JUNG (Koea)

▣ Metal & Halogen
- Pb, Cd, Hg, Cr
- Cr(VI)
- F, Cl, Br, I

(To-be) Au, Ag, Pd, Pt, Al, Fe, Cu, Sn, Co, Ni, Sb, Si and P

▣ Organics
- PBBs/PBDEs
- Phthalates
- HBCDD
- PAHs
- TCEP
- Bisphenol-A
- SCCP/MCCP
- TBBPA
- UV

Specification	Part name (Substances)	Project Leader	Instrument (N: Normative)	NWIP	IS Pub.	Now
IEC 62321-1	**General** requirement	Richard (Intertek, UK)	-	2009	2013	IS Published
IEC 62321-2 (Revision)	Disjointment including Mechanical **Sampling**	Youjiang Chen (USA)	-	2009	2013	IS Published
				2018	2021	IS Published
IEC 62321-3-1	**Screening by XRF** (**Pb, Cd, Cr, Hg, Br**) → Add (**Cl, P, Sb, Sn**)	Dirk Wissmann (Germany)	XRF	2009	2013	IS Published
				2019	2025	IIS
IEC 62321-3-2 ED2	**Screening by C-IC** (N : **F, Cl, Br**, Annex: **I**)	**Jaehak Jung (Korea)**	Combustion-IC (N)	2009	2013 (1.0)	IS Published
			Oxygen Bomb-IC, flask-IC (Annex)	2015	2020 (2.0)	IS Published
IEC 62321-3-3	**Screening by Py/TD-GC-MS** (**Phthlate, PBB.PBDE**)	Jaewoo Kim (Korea) Nakagawa (Japan)	Py(TD)-GC-MS	2015	2021	IS Published
IEC 62321-3-4	**Screening by HPLC-UV, TD-MS, TLC** (**Phthalate**)	Chunyang Lu (China)	HPLC-UV, TD-MS, TLC (N) FT-IR (Annex)	2018	2023	IS Published
IEC 62321-4 AMD	**Hg**	Miyuki (Japan)	ICP-OES, ICP-MS, CV-AAS, AFS, DMA	2009	2013	IS Published
					2017	AMD Published
IEC 62321-5	**Pb, Cd, Cr → added metals (Sb, As, Be, Co, Cu, Fe, Mn, Ni, Sn, Zn)**	Miyuki (Japan)	ICP-OES, ICP-MS, AAS, AFS		2013	IS Published
IEC 62321-5 (revision)		Jinsook Lee (Korea)			2029 (2.0)	WD
IEC 62321-6	**PBBs/PBDEs**	Scott (USA)	GC-MS (N) HPLC, IAMS (Annex)		2015	IS Published
IEC 62321-7-1	**Cr(VI) in metal coatings**	Sophia (USA)	UV-VIS		2015	IS Published
IEC 62321-7-2	**Cr(VI) in polymers**	Claudia (Germany)	UV-VIS		2017	IS Published
IEC 62321-8 ED2	**Phthalate**	Jaewoo Kim (Korea) K.Obayashi (Japan)	GC-MS, Py-GC-MS (N)	2012	2017 (1.0)	IS Published
			LC-MS, IAMS (Annex)	2021	2026 (2.0)	CDV
IEC 62321-9	**HBCDD**	Inseok Choi, Hyundoc Choi (Korea)	LC-MS and GC-MS	2015	2021	IS Published
IEC 62321-10 ED2	**PAHs**	**Jaehak Jung (Korea)**	GC-MS	2015	2020 (1.0)	IS Published
		Jaehak Jung (Korea) Kerstin Scharrer (Germany)		2022	2026 (2.0)	CDV
IEC 62321-11★	**TCEP**	Jinsook Lee (Korea)	GC-MS, LC-MS	2017	2024	IS Published
IEC 62321-12	**PBB/PBDE/Phthalate**	Qiuxin Huang (China)	GC-MS (N)	2018	2023	IS Published
IEC 62321-13	**Bisphenol-A**	Gunyoung Ryu, Jaehak Jung (Korea)	LC-DAD, LC-MS, LC-MS/MS	2020	2026	FDIS
IEC 62321-14	**SCCP/MCCP**	**Juyang Kim (Korea),** Xing Weibing (China)	GC-NCI-MS	2022	2026	FDIS
IEC 62321-15	**TBBPA**	Hyundoc Kim (Korea)	GC-MS, LC-MS	2022	2026	CDV
PWI-UV	**Benzotriazole UV absorbers**	Songsong Xiong (China), **Jaehak Jung (Korea)**	GC-MS	2026	2029	PWI

(NWIP 2009 spans IEC 62321-4 AMD through IEC 62321-7-2.)

Introduction to KIAST

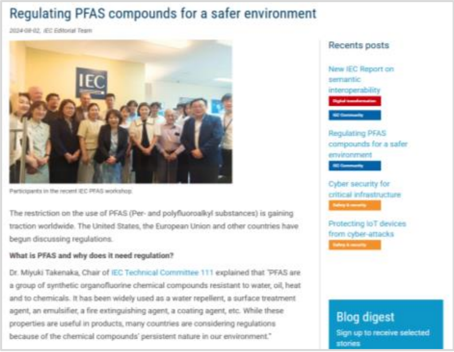
International Standardization Experts & Global Microplastics Advisor Activities

RoHS/REACH Test method Standard

(2019 **IEC/TC 111/WG 3** meeting @ Shanghai, China)

▶ **IEC/TC 111/WG 3 & JWG 14 Convenor** (2022.11, Delft NL)

▶ **ISO/TC 61/SC 5 & SC 14 Experts** (2025_Bangkok TH)

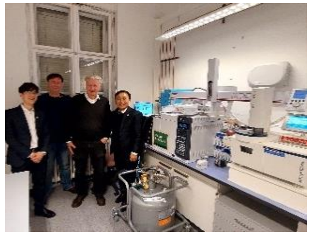


▶ IEC **PFAS** Workshop @IEC APRC in Singapore, 2024.05.29)

Microplastics ISO & IEC Standardization Delegate Activities

&

Global Microplastics Advisor Activities



UBA Germany

BAM Germany

BfR Germany

Microplastic test and analysis method standard development cooperation activities

(2022.11, Berlin, Germany)

(EU **MPs** Scientific Advisory Board member, 2022)

- Microplastics in soils Symposium (UBA in Germany) 2022.10.19
- VAMAS workshop 2022.10.19

(**SETAC2025 Special Event**, **PlasticTrace**)

(2025.05.12)

(2023 **EU** 3rd **Imptox** Public Workshop, 2023.03.10-12)

These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 964827 (AURORA), No. 965173 (IMPTOX), No. 965196 (Plasticheal), No. 965367 (PlasticsFatE), and No. 964766 (POLYRISK).

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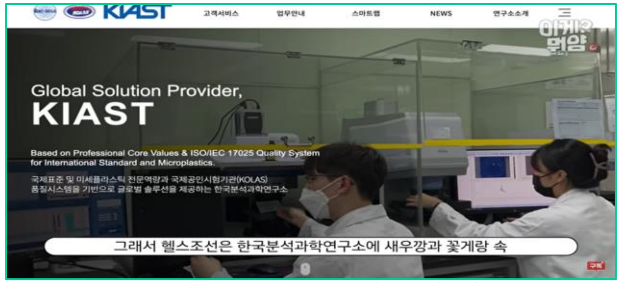
Introduced in Newspaper and Broadcasts (KIAST)



https://www.youtube.com/watch?v=OqF5MxtbI6w

https://www.youtube.com/watch?v=kYwZR2YF0Lc&t=1994s

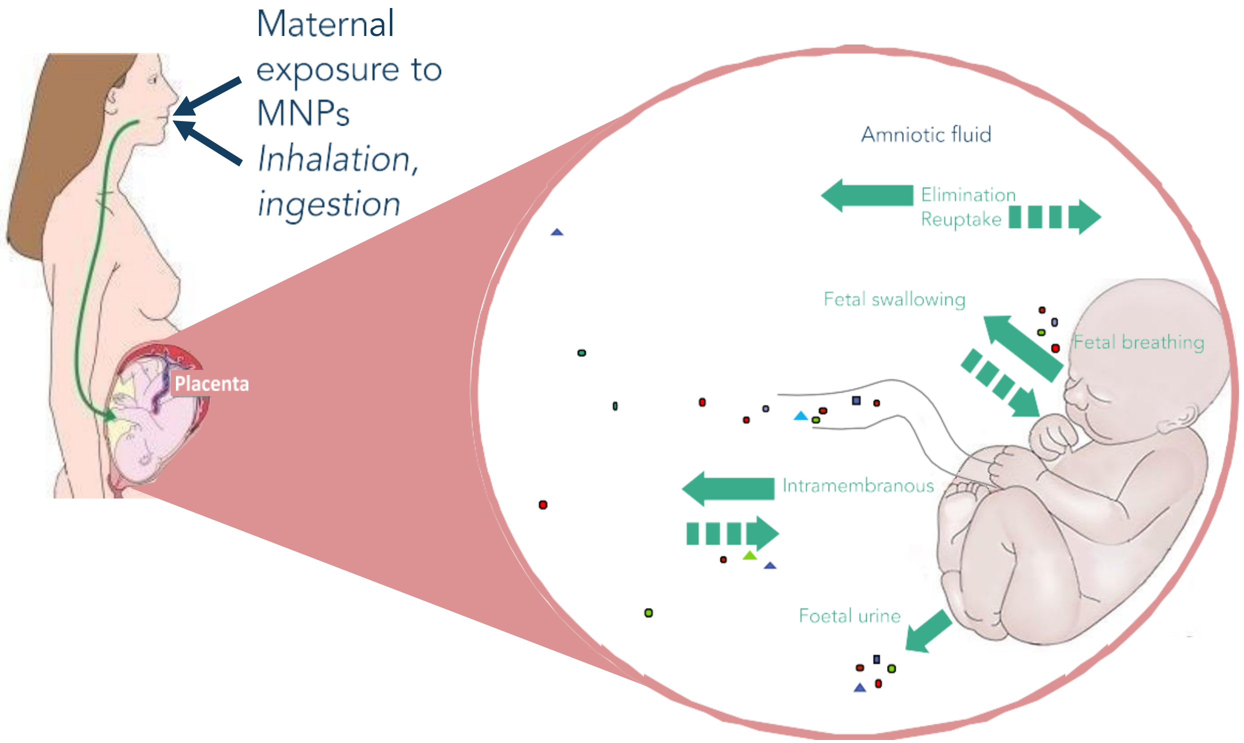
- **[KBS]** Synthetic Fiber Clothing Threatens the Sea - **Detection of microplastics in laundry wastewater** (2018.12.25)
- **[tvN]** Comparative Analysis of Bottled Water and Tap Water (2019.02.13)
- **[SBS] The uncoated golf ball becomes microplastic for our table** (2021.6.22)
- **[SBS] Water is life. Acrylic scrubbers and microplastics** (2021. 8.14)
- **[SBS] First detection of MPs in meat blood absorption pads** (2021.10.20)
- **[SBS] (Morning Wide) "When you dip a tea bag, does 'this' come out!"** (2022.02.28)
- **[JTBC] Documentary Plus "Plastic Free City"** (2022.02.27)
- [MK] **Microplastics in paper cups "Plastics Pandemic"** (2022.04.20)
- **[TBC] News Factory** "Environmental pollution of fast fashion, EU regulation" (202.04.27)
- **[MBN]** Microplastic detection in Omega 3 (2022.08.08)
- **[KBS]** The Secret of the Elderly, the Micro-pandemic Part 1-The Disaster That Started, Microplastics (2022.10.12)
- **[Health Chosun]** Microplastics detected in **shrimp crackers and crabs**. (2023.07.13)
- **[SBS] Water is life. I ate plastic today too.**(2024. 3.22)

- **[KOFST]** 20th National Life Science Talk Lounge (**Microplastics in bottled water: What is the impact on health**?) (2024.05.17)
- **[Korea Daily]** Tracking: The sea has become hell. Grilled hairtail, crab soup, and raw black sea breamToday, too, we ate plastic. (2024.08.14)

Introduction to KIAST

Recent microplastic detection issues (2018-2024 by KIAST)

KIAST provides testing/analysis services for samples derived from the human and various biological specimens. After pretreating samples derived from the human body, they are filtered, and qualitative and quantitative analyses are performed on the filtered samples. *(Using by μ-FTIR, μ-Raman, Py-GC-MS & TED-GC-MS)*



CUSP international conference: 14 September 2023 | Matthew.Boyles@iom-world.org

❖ Human-derived sample matrices

for developing Micro & Nanoplastics analysis methods.

- **Blood**
- **Placenta**
- **Uterus/endometrium/ovary**
- **Cord blood**
- **Amniotic fluid**
- **Adipose tissue**
- **Breast milk**
- **Eyeball**
- Others

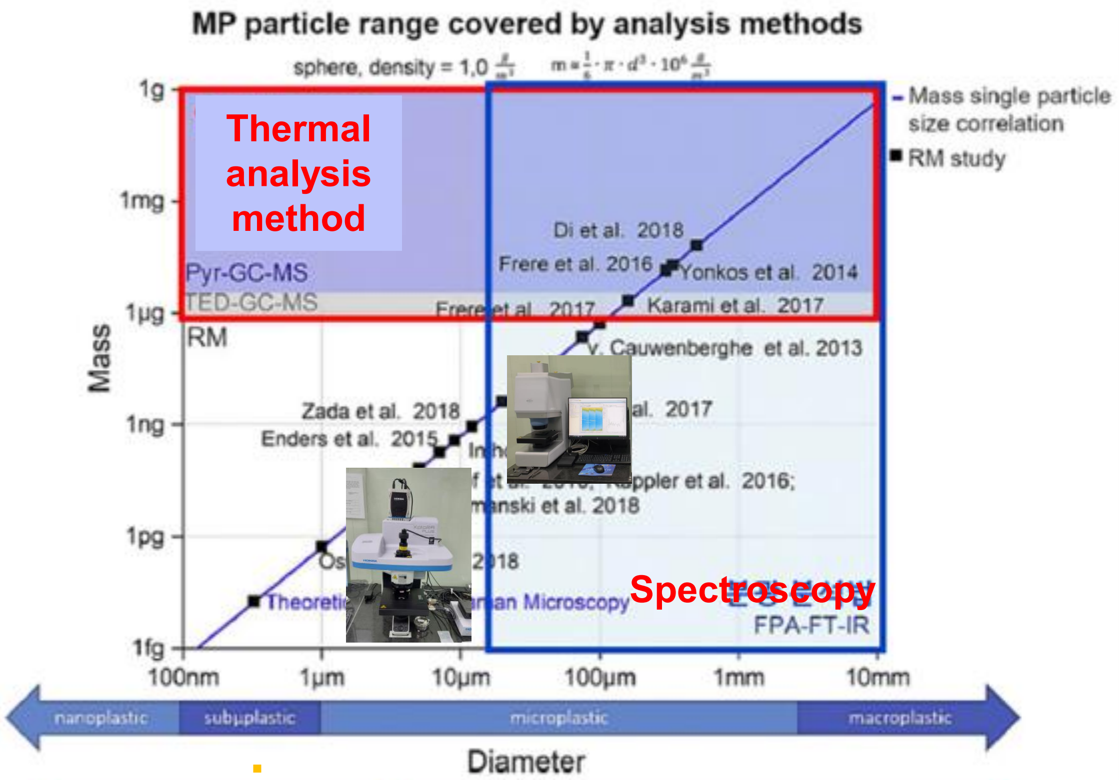
Microplastics Recent papers/standards published

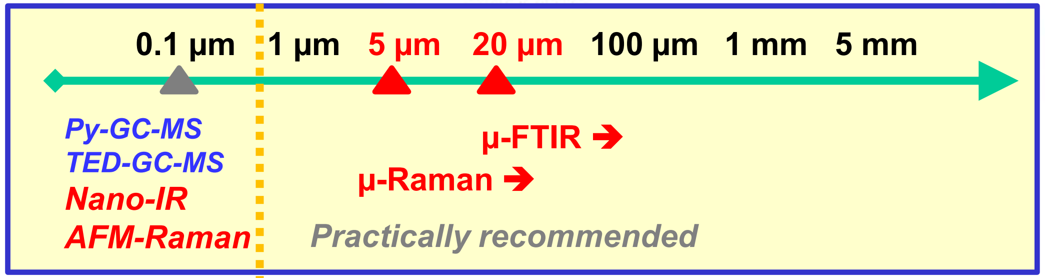
- *"First assessment of microplastic exposure from heated liquid herbal medicine: Packaging breakdown and ingestion risk" Ecotoxicology and Environmental Safety 303 (2025) 119069. doi.org/10.1016/j.ecoenv.2025.119069.*
- ***"Interlaboratory Comparison Reveals State of the Art in Microplastic Detection and Quantification Methods" Anal. Chem**. April 17, **2025**. doi.org/10.1021/acs.analchem.4c05403.*
- ***"Detection of microplastics in pterygium tissue: Implications for environmental hazards" Eur J Ophthalmol,. 2025** Jan 6:11206721241310467. doi: 10.1177/11206721241310467.*
- ***"Microplastic particles in human blood and their association with coagulation markers" Scientific Reports 2024** 14:30419 https://doi.org/10.1038/s41598-024-81931-9*
- ***"Microplastic contamination in artificial tears in South Korea: Potential for direct ocular exposure" Contact Llens and Anterior Eye** 12 November 2024, 102325 https://doi.org/10.1016/j.clae.2024.102325*
- ***"Determination of Microplastics in Omega-3 Oil Supplements" Foods/MDPI 2024,** 13(10), 1434; doi.org/10.3390/foods13101434*
- ***"Microplastics in gastrointestinal tracts of gentoo penguin (Pygoscelis papua) chicks on King George Island, Antarctica" Scientific Reports 2023** Aug 10;13(1):13016. doi: 10.1038/s41598-023-39844-6.*
- ***"Detection of microplastic traces in four different types of municipal wastewater treatment plants through FT-IR and TED-GC-MS" Environmental Pollution** Volume 333, 15 September **2023**, 122017, doi.org/10.1016/j.envpol.2023.122017*
- ***"Identification and characterization of microplastics in nasal irrigation fluids: a preliminary study" International Forum of Allergy and Rhinology 2023**, doi: 10.1002/alr.23239.*
- ***Analysis of microplastics in various foods and assessment of aggregate human exposure via food consumption in Korea" Environmental Pollution** 322 (**2023**) 121153*
- ***"Comparative profiling and exposure assessment of microplastics in differently sized Manila clams from South Korea by μFTIR and Nile Red staining" Marine Pollution Bulletin** 181 (**2022**) 113846*
- ***"Microplastics in Food: A Review on Analytical Methods and Challenges" Int. J. Environ. Res. Public Health 2020**, 17, 6710; doi:10.3390/ijerph17186710*
- ***"Determination of fluorine in Krill oils by combustion-ion chromatography", Korea Anal. Sci. Technol.**, Vol. 33, No. 6, **2020***
- ***"Identification of Microplastics in Sea Salts by Raman Microscopy and FT-IR Microscopy", Korea Anal. Sci. Technol.**, Vol. 32, No. 6, 243-251, **2019***
- ***"Determination of Microplastics in Cosmetics" Ministry of Food and Drug Safety (MFDS)**, **2019***
- ***"Determination of PFOS in LDPE and the Result for Proficiency Testing" Korean Chemical Society**, **2013**, Vol. 57, No. 1*
- ***"Rapid identification of brominated flame retardants by using direct exposure probe mass spectrometry" Microchemical Journal** 91 (**2009**) 140–146*
- ***KS M 9721:2017**, Determination of **PAHs (polycyclic aromatic hydrocarbons)** in polymer materials*
- ***IEC 62321-3-2:2020 (2nd Edition),** Determination of certain substances in electrotechnical products –Part 3-2: Screening – **Fluorine, chlorine and bromine** in polymers and electronics by combustion-ion chromatography (C-IC)*
- ***IEC 62321-10:2020**, Determination of certain substances in electrotechnical products – Part 10: **Polycyclic aromatic hydrocarbons (PAHs)** in polymers and electronics by gas chromatography-mass spectrometry (GC-MS)*

1. Test Methods for Microplastics & Nanoplastics

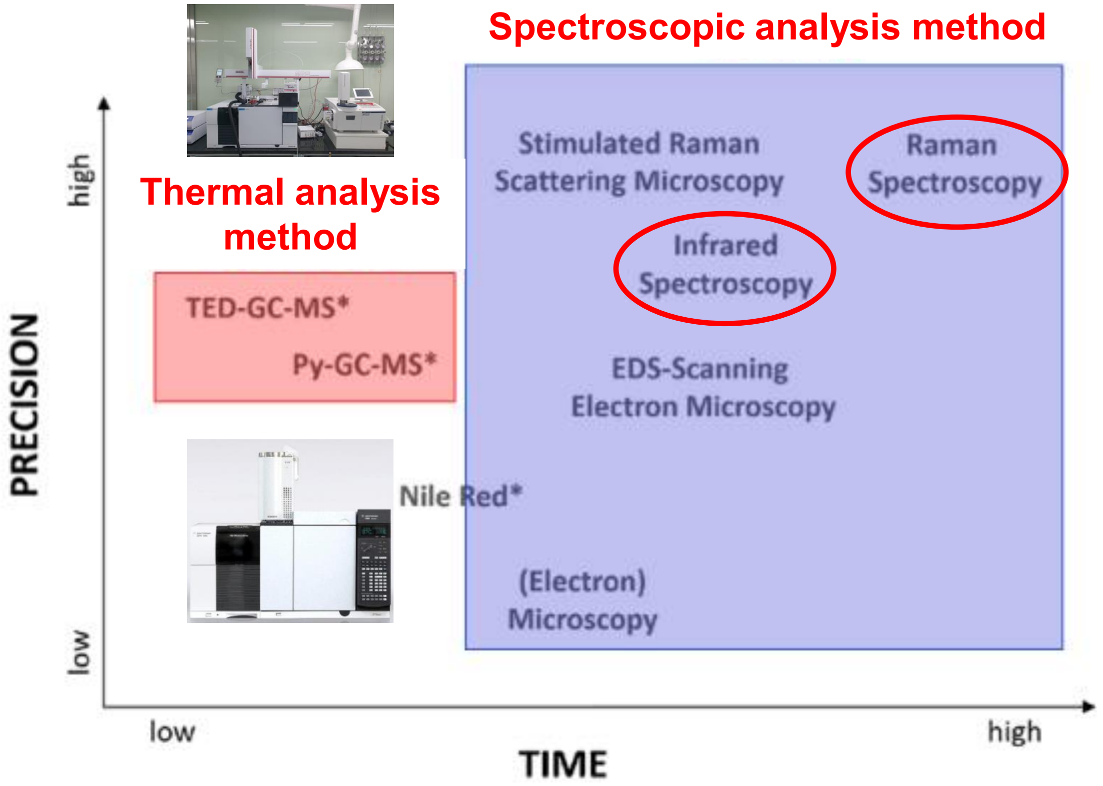
Muxia@Camino De Santiago in Spain
Photo by Jaehak Jung, (June 2017)

Analysis method according to the size and amount of MPs





Analysis method according to analysis time and precision



P.M. Anger et al. / Trends in Analytical Chemistry 109 (2018) 214e226

A Nano (& sub-micron) Plastics (5 ~ 0.3 µm) for Drinking Water by TED-GC-MS (KIAST)

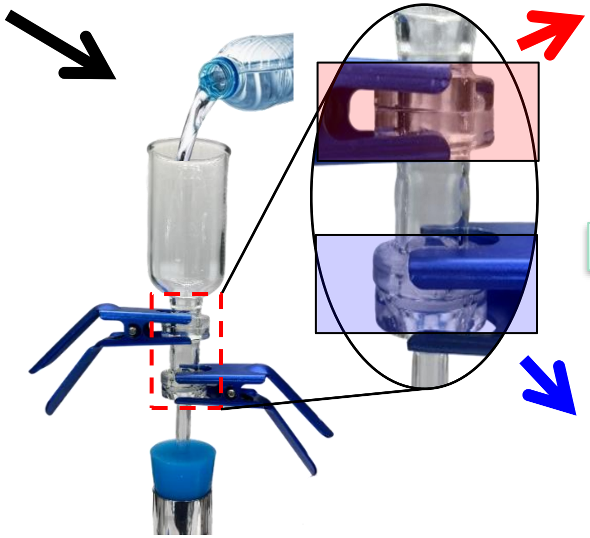
Sampling

Bottled water

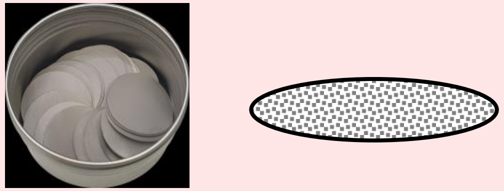
Beverages

At least 40 L

Cascade filtering



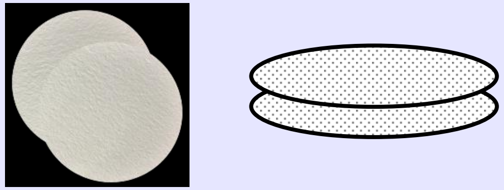
1st stage



5 µm
(stainless filter)

Particles on the filter
(≥ 5 µm)

2nd stage

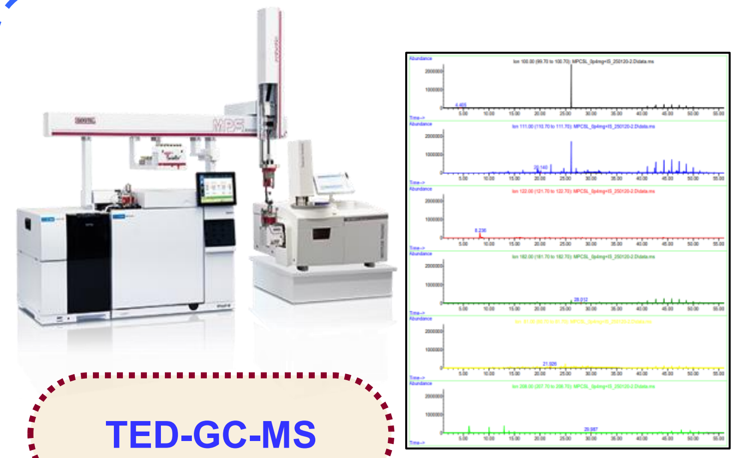


0.3 µm
(Quartz fiber filter)

Particles on the filters
(≥ 0.3 µm)

Analysis

In accordance with ISO/DIS 16094-3 (MPs by TED-GC-MS)



TED-GC-MS

Sequential filtering with 5 µm stainless filter and 0.3 µm Quartz fiber filter

A Analysis of nano- and submicron plastics (5–0.3 μm) in drinking water using by TED-GC-MS

Analysis by TED-GC-MS

Bottled water (PET)	Analysis results			
	Type	**5~0.3 μm**	**> 5 μm**	**LOD***
 A — 500 mL (80 bottles) Total 40 L	PE	N.D.	N.D.	1.5 μg
	PP	N.D.	N.D.	0.4 μg
	PS	N.D.	N.D.	0.08 μg
	PET	N.D.	N.D.	0.09 μg
	PMMA	1.6 μg	N.D.	0.1 μg
	Type	**5~0.3 μm**	**> 5 μm**	**LOD**
 B — 500 mL (80 bottles) Total 40 L	PE	N.D.	N.D.	1.5 μg
	PP	N.D.	N.D.	0.4 μg
	PS	N.D.	N.D.	0.08 μg
	PET	N.D.	0.13 μg	0.09 μg
	PMMA	N.D.	N.D.	0.1 μg
	Type	**5~0.3 μm**	**> 5 μm**	**LOD**
 C — 500 mL (80 bottles) Total 40 L	PE	6.8 μg	2.0 μg	1.5 μg
	PP	N.D.	N.D.	0.4 μg
	PS	N.D.	N.D.	0.08 μg
	PET	N.D.	0.19 μg	0.09 μg
	PMMA	N.D.	N.D.	0.1 μg

* LOD: limit of detection (ISO/DIS 16094-3) of KIAST

vs.

Paper Pack Water (PE coated)	Analysis results			
	Type	**5~0.3 μm**	**> 5 μm**	**LOD**
 D — 500 mL (80 bottles) Total 40 L	PE	N.D.	N.D.	1.5 μg
	PP	N.D.	N.D.	0.4 μg
	PS	N.D.	N.D.	0.08 μg
	PET	N.D.	N.D.	0.09 μg
	PMMA	N.D.	N.D.	0.1 μg
	Type	**5~0.3 μm**	**> 5 μm**	**LOD**
E — 500 mL (80 bottles) Total 40 L	PE	1.6 μg	5.2 μg	1.5 μg
	PP	N.D.	N.D.	0.4 μg
	PS	N.D.	N.D.	0.08 μg
	PET	N.D.	N.D.	0.09 μg
	PMMA	N.D.	N.D.	0.1 μg
	Type	**5~0.3 μm**	**> 5 μm**	**LOD**
F — 500 mL (80 bottles) Total 40 L	PE	11 μg	7.7 μg	1.5 μg
	PP	N.D.	N.D.	0.4 μg
	PS	N.D.	N.D.	0.08 μg
	PET	N.D.	N.D.	0.09 μg
	PMMA	N.D.	N.D.	0.1 μg

Since 2020, various studies on MNPs for human samples have continued to increase and move toward Nanoplastics!

Human sample	Pre-treatment chemical	Filtering	Analysis	Detection range	Reference
amniotic fluid, placenta	H_2O_2	50 μm metal	μFTIR	> 50 μm	Braun et al.(2021)
feces	Fenton's, HNO_3	13 μm metal	μFTIR	20–800 μm	Zhang et al.(2021)
blood	Proteinase K, $CaCl_2$, H_2O_2	**0.7 μm GFF**	**Py–GC–MS**	Total mass	Leslie et al.(2022)
sputum	HNO_3, $ZnCl_2$	0.8 μm silver	μFTIR,LDIR	20–500 μm	Huang et al.(2022)
breast milk	KOH	1.2 μm GFF	μRaman	2–12 μm	Ragusa et al.(2022)
lung tissue	H_2O_2	0.2 μm Al_2O_3	μFTIR	20–500 μm	Jenner et al.(2022)
liver tissue, kidney, spleen	KOH, NaClO, H_2O_2	0.8 μm silver	μRaman	3.3–30.1 μm	Horvatits et al.(2022)
placenta, breast milk, meconium, newborn feces	HNO_3	13 μm metal	LDIR	20–500 μm	Liu et al.(2022),(2023)
lower extremity vein tissue	H_2O_2	0.02 μm Al_2O_3	μFTIR	> 5 μm	Rotchell et al.(2023)
placenta	KOH	10 μm metal	LDIR	20–500 μm	Zhu et al.(2023)
piss	KOH	1.2 μm GFF	μRaman	4–15 μm	Pironti et al.(2023)
amniotic fluid, placenta	KOH	1.0 μm GFF	μFTIR	20-50 μm	Halfar et al.(2023)
blood	Proteinase K, $CaCl_2$, H_2O_2	**0.3 μm GFF**	**Py–GC–MS**	Total mass	Marthinus et al.(2024)
atheromas and cardiovascular	Enzyme others	**0.2 μm Al_2O_3**	**Py–GC–MS**, SEM/TEM	Total mass	Raffaele et al.(2024)
brain, liver & kidney	KOH others	**0.1 μm Al_2O_3**	**Py–GC–MS**,TEM	Total mass	Matthew et al. (2024)
blood	Proteinase K, Pancrelipase, $CaCl_2$, H_2O_2	**0.3/0.7 μm GFF**	**Py–GC–MS**	Total mass	Casandra et al.(2025)

B Human(blood, organs) samples Pretreatment!

Key 1: QA/QC for protecting cross contamination in human sampling & laboratory environment

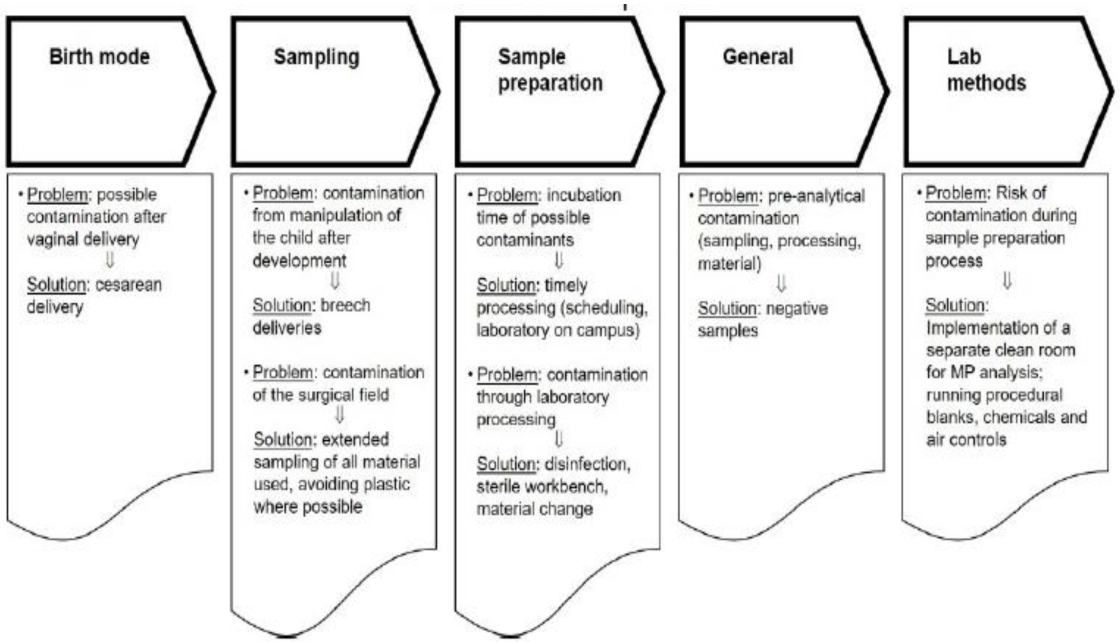
Article

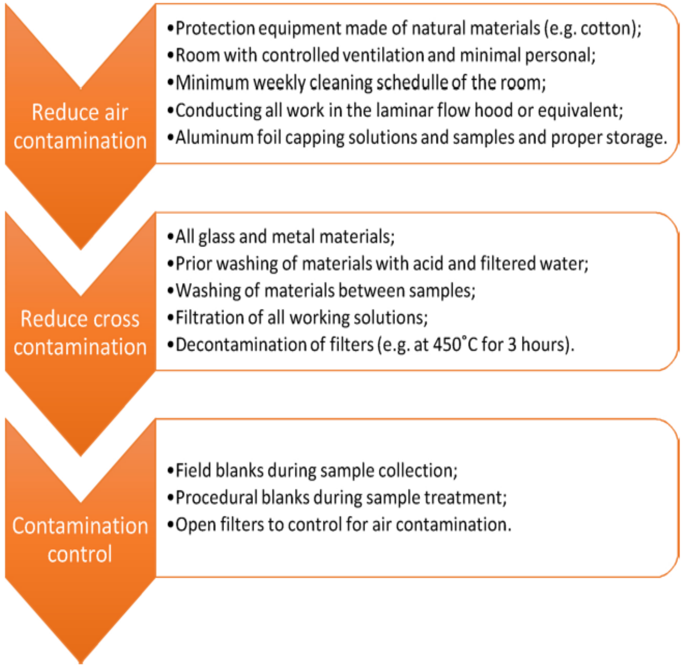
Detection of Microplastic in Human Placenta and Meconium in a Clinical Setting

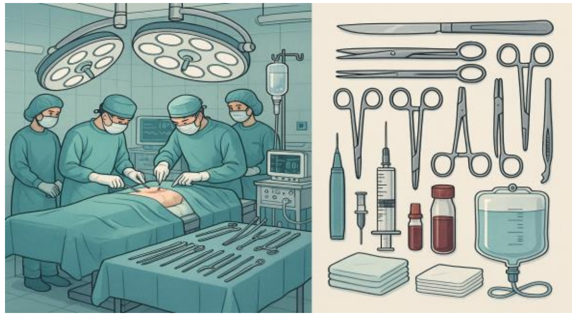
Thorsten Braun [1,2,*], Loreen Ehrlich [2], Wolfgang Henrich [1], Sebastian Koeppel [3], Ievgeniia Lomako [3], Philipp Schwabl [4,†] and Bettina Liebmann [3,†]

Contamination issues as a challenge in quality control and quality assurance in microplastics analytics

Joana C. Prata [a,*], Vanessa Reis [a], João P. da Costa [a], Catherine Mouneyrac [b], Armando C. Duarte [a], Teresa Rocha-Santos [a]







B Human(blood, organs) samples Pretreatment!

Key 2: Organic matter removal

1st step
Enzymatic Digestion

- Protease
- Lipase…

→

2nd Step
Chemical digestion

- H_2O_2

Before

After

Develop/optimize sample pre-treatment method through
cooperation with CUSP Cluster
(Helmholtz Centre for Environmental Research (UFZ) & Vrije Universiteit Amsterdam)

Appreciation

CUSP

Guyu Peng

UFZ HELMHOLTZ Centre for Environmental Research

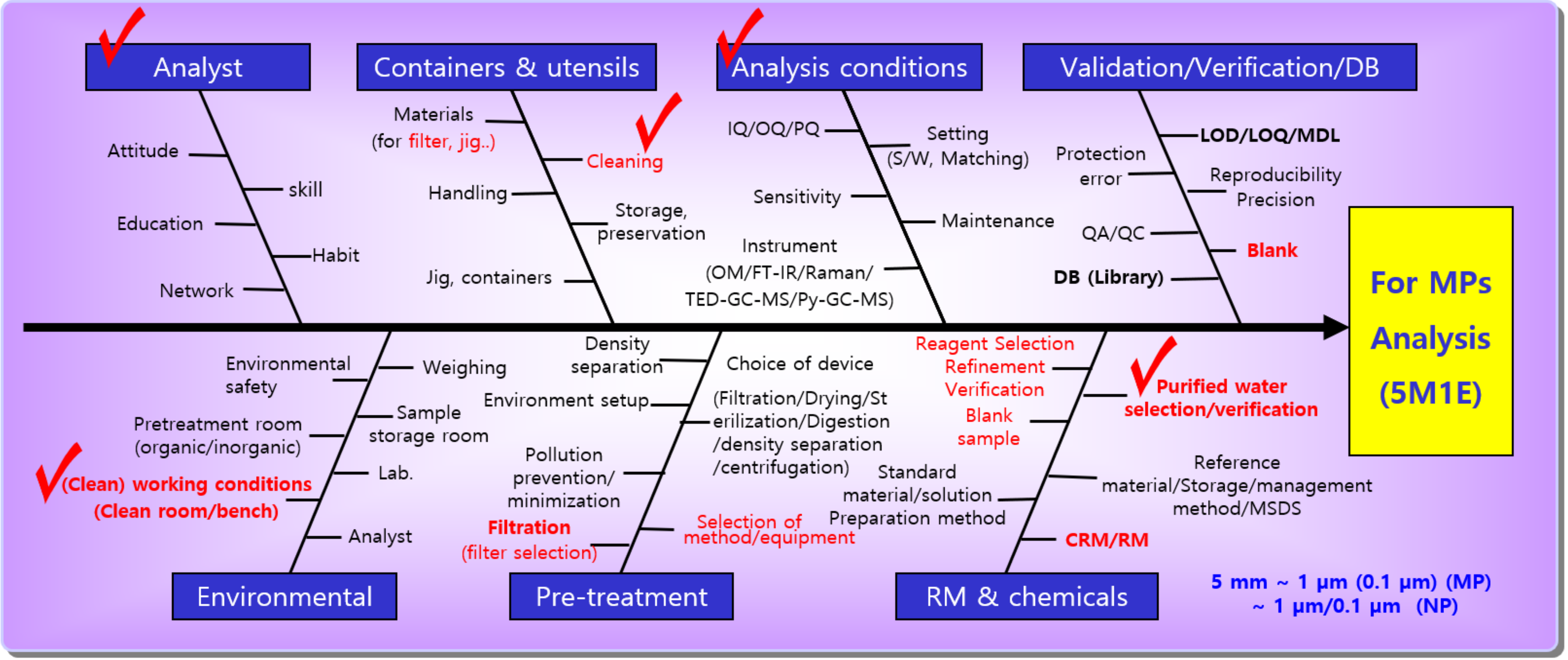
Lorenzo Scibetta

VU

KIAST 한국분석과학연구소 Korea Institute of Analytical Science and Technology

B

In order to perform sampling, sample preparation, and qualitative and quantitative analysis of Microplastics & Nanoplastics ranging in size from μm to nm, the laboratory must be operated after reviewing all factors that may affect the quality of the laboratory (cross-contamination, etc)

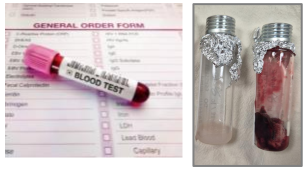


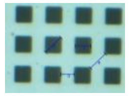
※ **Cause & Effect Diagram, Fish-bone Diagram, Ishikawa Diagram**

B Human(blood, organs) samples Pretreatment!

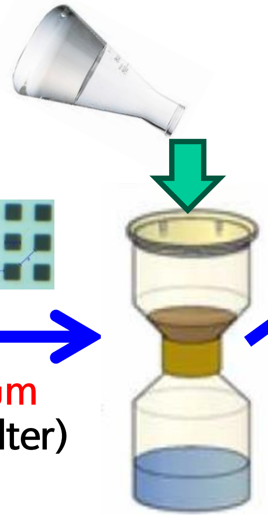
Key 3: Human(blood, organs) samples Pretreatment!(filtering)

Treated samples

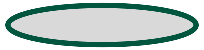




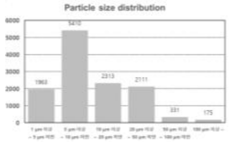
5 μm
(Si filter)

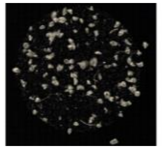


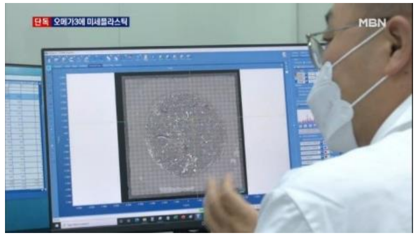
1st filtering



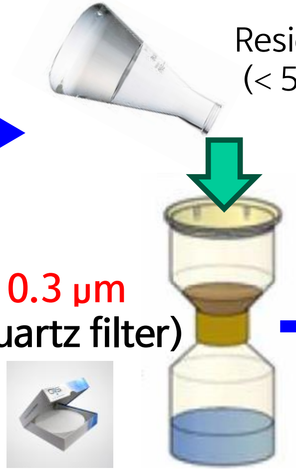
Particles on the filter
(≥5 μm)







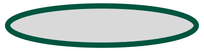
μ-Raman



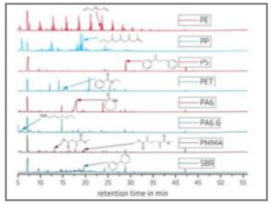
Residuals
(< 5 μm)

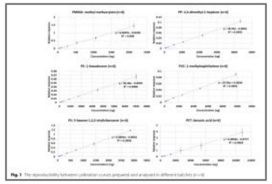
0.3 μm
(Quartz filter)

2nd filtering



Particles on the filter
(≥0.3 μm)





Py-GC-MS

After filtering with 5 μm Si filter, the residuals are filtered with 0.3 μm Quartz filter (2nd filter).

1. Test Methods for Microplastics & Nanoplastics

Participant for ILC (2020-2024)

2020

Microplastic in Water by JRC

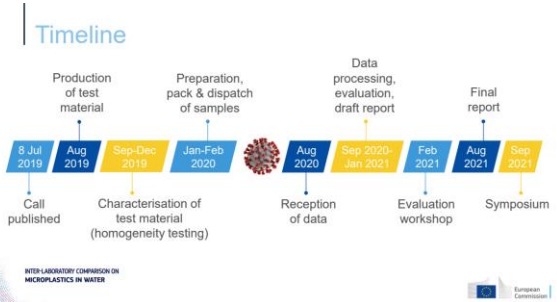
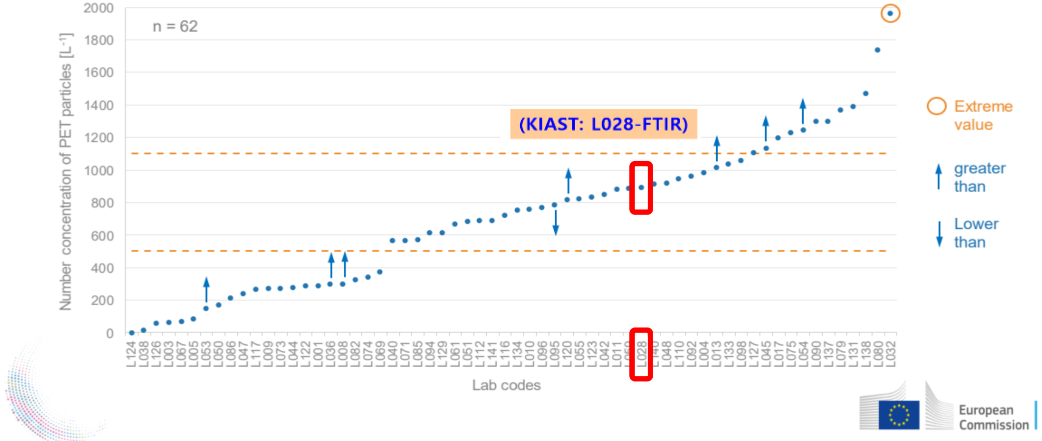


Table 1: Results of determination of number (n = 20) and mass concentration (n = 14) per litre and indicative ranges.

Parameter	Average	SD	RSD [%]	Indicative range, rounded
Number / L	797	151	19	500 – 1100
Mass / L	293 µg	41 µg	14	210 – 370 µg

Number of PET particles reported



2022

ISO/TC 38 (CEN/TC 248), RRT (ILC) on microfibers in textile samples.

General

The RRT on prEN ISO 4484-2 was carried out from January to March 5th 2022 on and the preliminary results are summarized in the next slides.

Trial was organized by Aquafil S.p.A (Italy) and CNR-STIIMA (Italy).

Participating laboratories

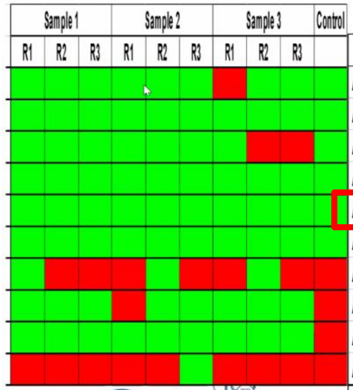
The geographical distribution of 18 laboratories applied for participation.

Italy	7
Germany	5
UK	2
France	1
Spain	1
South Korea	1
Sweden	1

UNI MONDO FATTO BENE

Accuracy

KIAST: lab07 (FT-IR & Raman)



Average	sample1	sample2	sample3	LAB recovery rate (AVG)
lab01	37%	24%	36%	32%
lab02	na	na	na	na
lab03	79%	65%	45%	63%
lab04	0%	75%	20%	32%
lab07	70%	113%	83%	89%
lab09	73%	72%	88%	77%
lab10	83%	25%	66%	58%
lab11	52%	58%	55%	55%
lab13	36%	16%	56%	36%
lab17	na	24%	na	24%
recovery rate (AVG)	54%	52%	56%	

1. Test Methods for Microplastics & Nanoplastics

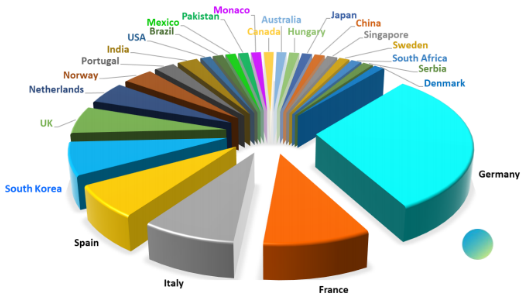
Participant for ILC (2020-2025)

2023

Microplastic in Water by VAMAS

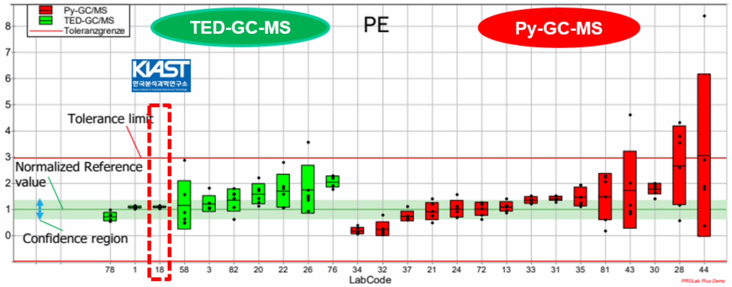
AIM: validation of detection methods

- 4 methods: μ-IR (FTIR +LDIR), μ-Raman, TED-GC/MS and Py-GC/MS
- 6 samples (each 2 tablets, PE+PET) + blank samples
- Individual concentrations for spectroscopical and thermo-analytical methods
- 84 Participants all over the world (but only 50 submitted the results)
- Participants from academia, industry, government, metrology institutes, etc.



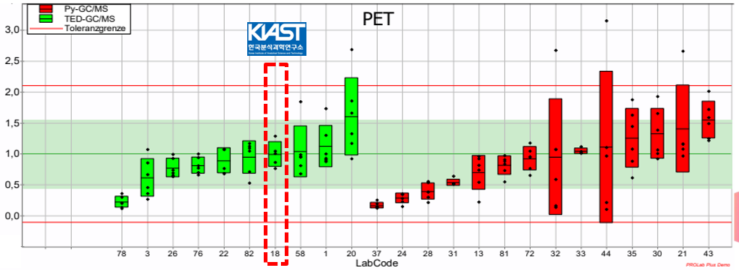
RESULTS ILC: THERMO-ANALYTICAL METHODS

Theoretically 265 μg/Tablet → 1.06 μg/mg
Reference value TED-GC/MS = 1.13 ± 0.33 μg/mg
Average mass Py-GC/MS = 1.11 ± 0.64 μg/mg



Mass fraction of particles in a tablet (normalized to a reference value obtained by an accredited lab)

Theoretically 556 μg/Tablet → 2.22 μg/mg
Reference value TED-GC/MS = 1.69 ± 0.67 μg/mg
Average mass Py-GC/MS = 1.67 ± 0.80 μg/mg



TED-GC-MS **Py-GC-MS**

2024

Microplastic in Water by PlasticTrace

Water quality – ISO 16094-2 interlaboratory validation

IOPLASTIC cost

www.icplastic.eu

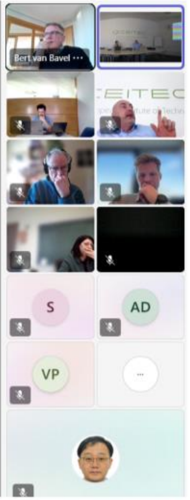
Water quality — Analysis of microplastics in water – Part 2: vibrational spectroscopy methods for waters with low content of suspended solids including drinking water

Call for Interlaboratory trial for validation of ISO 16094-2 according to ISO/DIS 16094-2 : 2023 September

In light of the limited availability (12) of specific reference materials designated for this interlaboratory trial, selection of 12 expert laboratories for participation through technical questionary : 2023 October

- **Final selection of 12 laboratories** : 2024 February
- **Samples sent to labs :** 2024 February-Mars
- **Samples measurement in labs :** 2024 February-July
- **Statistical treatment** : 2024 July-September

- **Final selection of 12 laboratories – 11 responding labs :**
  - Countries : Austria (1), France (3), Germany (2), Italy (1), Japan (1), Singapore (1) South Korea (1) USA (1)
  - Type of laboratories : Institute (5), Governemental Agency (1), Industry (2), Commercial (2), University (1)



norman PlasticTrace CHIRON NIVA European Commission Joint Research Centre BAM

35

KIAST 한국분석과학연구소

PlasticTrace norman

Water quality – ISO 16094-2 interlaboratory validation

SCHEME FOR INTERLABORATORY COMPARISON FOR VALIDATION OF ISO 16094-2:

- ❑ **Reference water control done by each lab**
- ❑ **2 replicates**

CHIRON by ZeptoMetrix NIVA	**Sample 1: NIVA**	Mix of tablets called to reconstitute two samples + blank tablet sample	Low numbers of microplastics, different types, size down to 50 µm	ISO-A
European Commission Joint Research Centre	**Sample 2: JRC**	Glass vials containing salt carrier microplastic + surfactant + deionized water to reconstitute one sample	High numbers of microplastics, one type, higher size down to 50 µm	ISO-B
BAM Bundesanstalt für Materialforschung und -prüfung	**Sample 3: BAM**	Glass vials containing one blank tablet and one test tablet as to reconstitute two samples	Low numbers of microplastics, one type, size down to 20 µm	ISO-C

➢ 2025 EU VAMAS "Nanoplastics" ILC program

※ Inter-laboratory Comparison (ILC)

PlasticTrace
Tracing Micro and NanoPlastics in Food and Environment

European Partnership — Co-funded by the European Union
METROLOGY PARTNERSHIP — EURAMET

VAMAS ILC on nano plastics

- Interlaboratory comparison on candidate referenc materials to support the standardisation of nano plastic analysis
- Material properties
  - Particle size distribution
  - Particle number concentration
  - Particle mass concentration
- Technologies
  - Light Scattering techniques (DLS, MADLS)
  - Fractionation techniques (FFF-MALS)
  - Particle trancing (PTA)
  - Thermoanalytical techniques (Py-GC/MS and TED-GC/MS)
- Registration or more information
  - Enrica Alasonati (Enrica.Alasonati@lne.fr) LNE
  - Dorota Bartczak (dorota.bartczak@lgcgroup.com) LGC
  - Andrea Giovannozzi (a.giovannozzi@inrim.it) INRIM

VAMAS — Micro and Nano Plastics in the Environment — Technical Work Area 45

Call for Participation — PlasticTrace

Project XX
An interlaboratory comparison on candidate reference materials to support the standardisation of nanoplastic analysis

Objectives

1. Validate the performance of the following targeted techniques to measure the size distribution, number concentration and mass fraction of nanoplastic particles: PTA, Light Scattering techniques (DLS, MADLS), hyphenated approaches based on fractionation techniques (FFF-MALS), and thermoanalytical techniques (Py-GC/MS and TED-GC/MS).
2. Support harmonization and pre-standardization by achieving precision and comparability among methods.

Background

Several research needs have been identified by International Organisations as the European Food Safety Agency (EFSA), the Science Advice for Policy by European Academies (SAPEA), and the World Health Organization (WHO). Among these is the development of representative reference materials for plastic particles across various size ranges. As part of the EURAMET Plastic Trace Project (https://plastictrace.eu/), sub-micron plastic particles and nanoplastics, reflective of common industrial polymers, have been produced and characterised. However, standardised measurement protocols and methodologies for the reliable analysis of the physico-chemical properties of nanoplastics are still absent.
For the validation of methods, instrumentation and parameters for nanoplastics, an interlaboratory comparison (ILC) will be organized to evaluate the performance of targeted techniques to measure the size distribution, number concentration and mass fraction of nanoplastic particles.

Standardization Needs

- There is a critical need for validated and standardized protocols for nanoplastics characterization.
- Results from this interlaboratory study aim to contribute to new ISO standards for nanoplastic analysis.

Work Programme

- Surfactant-free aqueous suspensions of nano-polypropylene test materials will be distributed in February 2025.
- A minimum of five measurement replicates is demanded. The time for carrying out the measurements may depend from the technique used but it is estimated roughly at 1 week.
- Participants will receive SOPs for sample preparation, measurement, and data analysis.

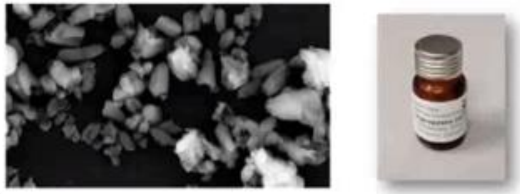


Figure: Morphology of nano-polypropylene test material captured via SEM imaging (left) and a photograph of the surfactant-free aqueous suspension sample (right).

- All participants are asked to return data and other requested information (e.g. quality control used, technical issues encountered, etc.) using data reporting templates provided by the study organizers.
- Measurement results will be statistically evaluated for repeatability and reproducibility using ISO 5725-2.

Deliverables and Dissemination

This interlaboratory study will be disseminated at scientific conferences and in a peer-reviewed scientific journal. Data produced in this ILC may contribute to assign the reference values to the test material.

Funding
Participants fund their own involvement in the project.

Status
The project is due to start in February 2025 for a duration of 6 months.

For more information on participation, please contact:

Enrica Alasonati
Project Lead
Laboratoire national de métrologie et d'essais (LNE), France
Email: enrica.alasonati@lne.fr

Dorota Bartczak
Project Lead
National Measurement Laboratory (NML) hosted at LGC Limited
Email: Dorota.Bartczak@lgcgroup.com

Andrea Mario Giovannozzi
Chair VAMAS TWA 45
Email: a.giovannozzi@inrim.it

www.vamas.org

December 2024

Participated/submitted Nanoplastics ILC by using Py-GC-MS & TED-GC-MS (2025.02~07)

2. Bio-sample Application of Microplastics

2. Bio-sample Application of Microplastics

SCIENTIFIC REPORTS

Gastrointestinal tissues in Gentoo Penguin

www.nature.com/scientificreports

scientific reports

Check for updates

OPEN

Microplastics in gastrointestinal tracts of gentoo penguin (*Pygoscelis papua*) chicks on King George Island, Antarctica

Youmin Kim[1,2], Hankyu Kim[1,6], Min-Su Jeong[1,6], Dowoon Kim[3], Juyang Kim[3], Jaehak Jung[3], Hae-Min Seo[1], Hyun-Jin Han[4], Woo-Shin Lee[1] & Chang-Yong Choi[1,5]✉

Microplastics (< 5 mm) have been found in marine ecosystems worldwide, even in Antarctic ecosystems. In this study, the stomach and upper intestines of 14 dead gentoo penguin (*Pygoscelis papua*) chicks were collected and screened for microplastics on King George Island, a gateway to Antarctic research and tourism. A total of 378 microplastics were identified by Fourier-transform infrared spectroscopy, with 27.0 ± 25.3 microplastics per individual. The detected number of microplastics did not increase with the mass of penguin chicks, suggesting no permanent accumulation of microplastics. However, the concentration of microplastics was much higher (9.1 ± 10.8 microplastics per individual within the size range 100–5000 µm) than the previously reported concentration in the penguin feces, and a greater number of smaller microplastics were found. Marine debris surveys near the breeding colony found various plastic (79.3%) to be the most frequent type of beached debris, suggesting that local sources of marine plastic waste could have contributed to microplastic contamination of penguin chicks being fed by parents that forage in nearby seas. This finding confirms the presence of microplastics in an Antarctic ecosystem and suggests the need for stronger waste management in Antarctica and a standardized scheme of microplastic monitoring in this once-pristine ecosystem.

Analysis of microplastics in the body of the dead Gentoo Penguin (young bird) (Sampling: SNU, KOPRI, Analysis: KIAST)

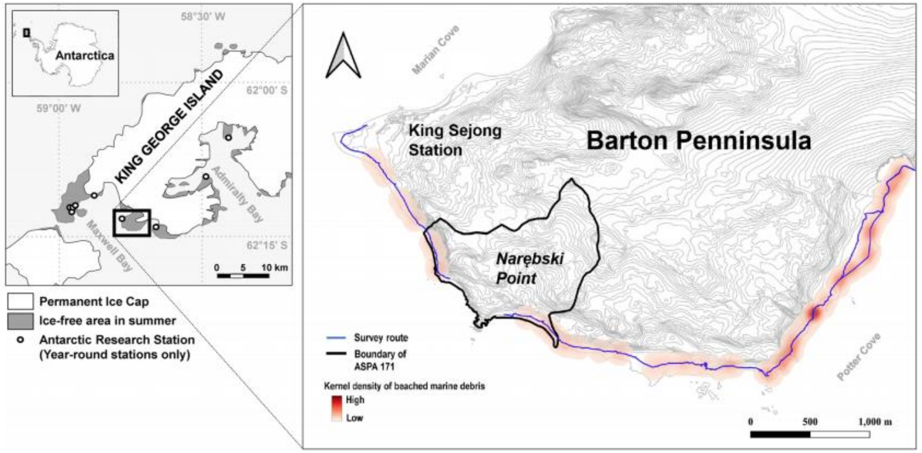


Figure 1. The distribution of beached marine debris on the Barton Peninsula of King George Island, South Shetland Islands, Antarctica. The boundary of Narębski Point (Antarctic Specially Protected Area 171: ASPA 171), where the penguin colonies are located, was marked by an orange line, and the kernel density of marine debris was shown as a red gradient. The year-round Antarctic Research Stations on King George Island were marked by circles in the index map. This map was created in ArcMap 10.2.2 from base map data in the public domain (the polar geographic information; http://map.ngii.go.kr/) provided by the Korean Government.

서 울 대 학 교
SEOUL NATIONAL UNIVERSITY
Lab. of
Wildlife Ecology and Management

KOPRI 극지연구소
Korea Polar Research Institute

[Sampling information]

- Samples : Dead Gentoo Penguin (young bird)
- Collection by SNU & KOPRI
- Periods : December 2018 ~ February 2019 (Breeding season)
- Sampling area: Narevsky Point, King George Island, Antarctica (ASPA 171; Penguin village)
- **Sampling**
  - After penguin autopsy, scrape the stomach & intestine with a metal scalpel and store in a glass container (including 1 control group under the same condition)
  - Analysis of 15 samples of approximately 2 g (1.381 ~ 2.840 g) from 10 ~ 26 days old Gentoo penguin carcasses

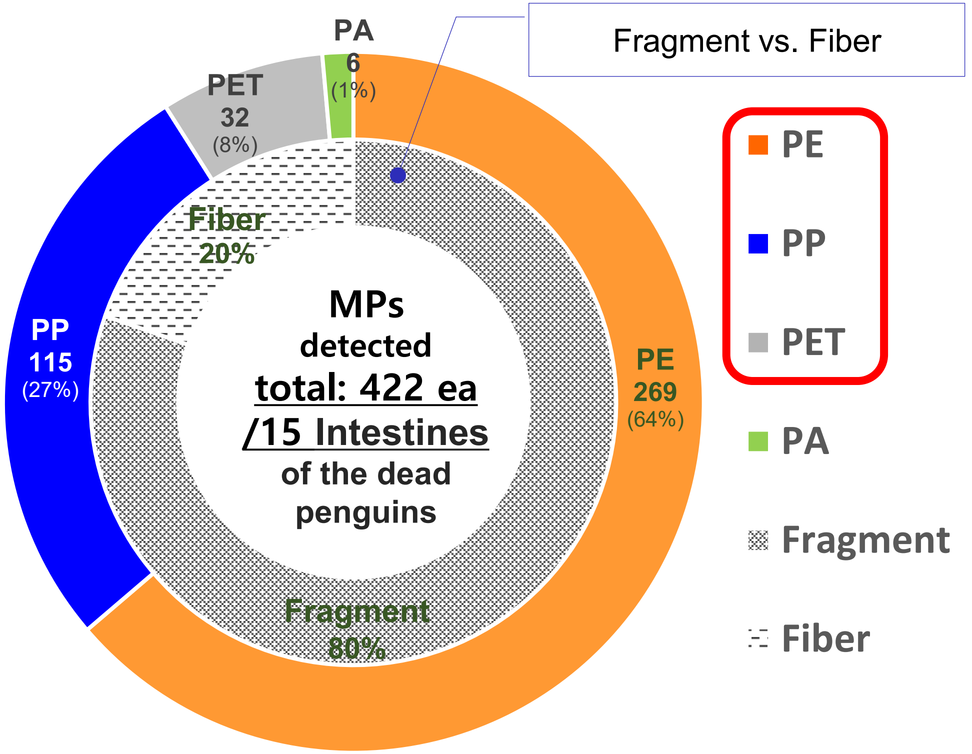
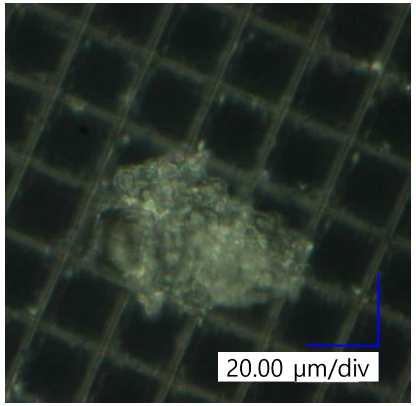
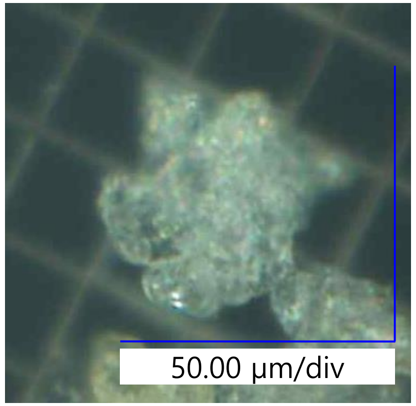
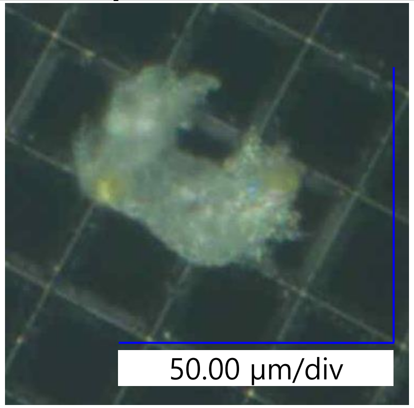
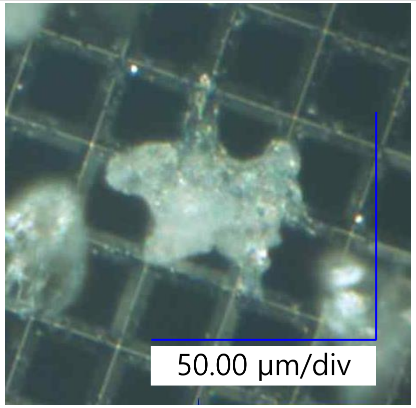
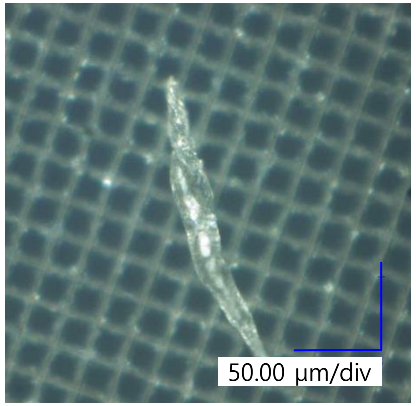
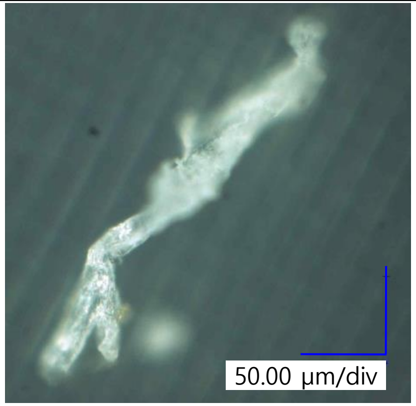


Fig. Analysis of microplastics in penguins (total 15).

2. Bio-sample Application of Microplastics

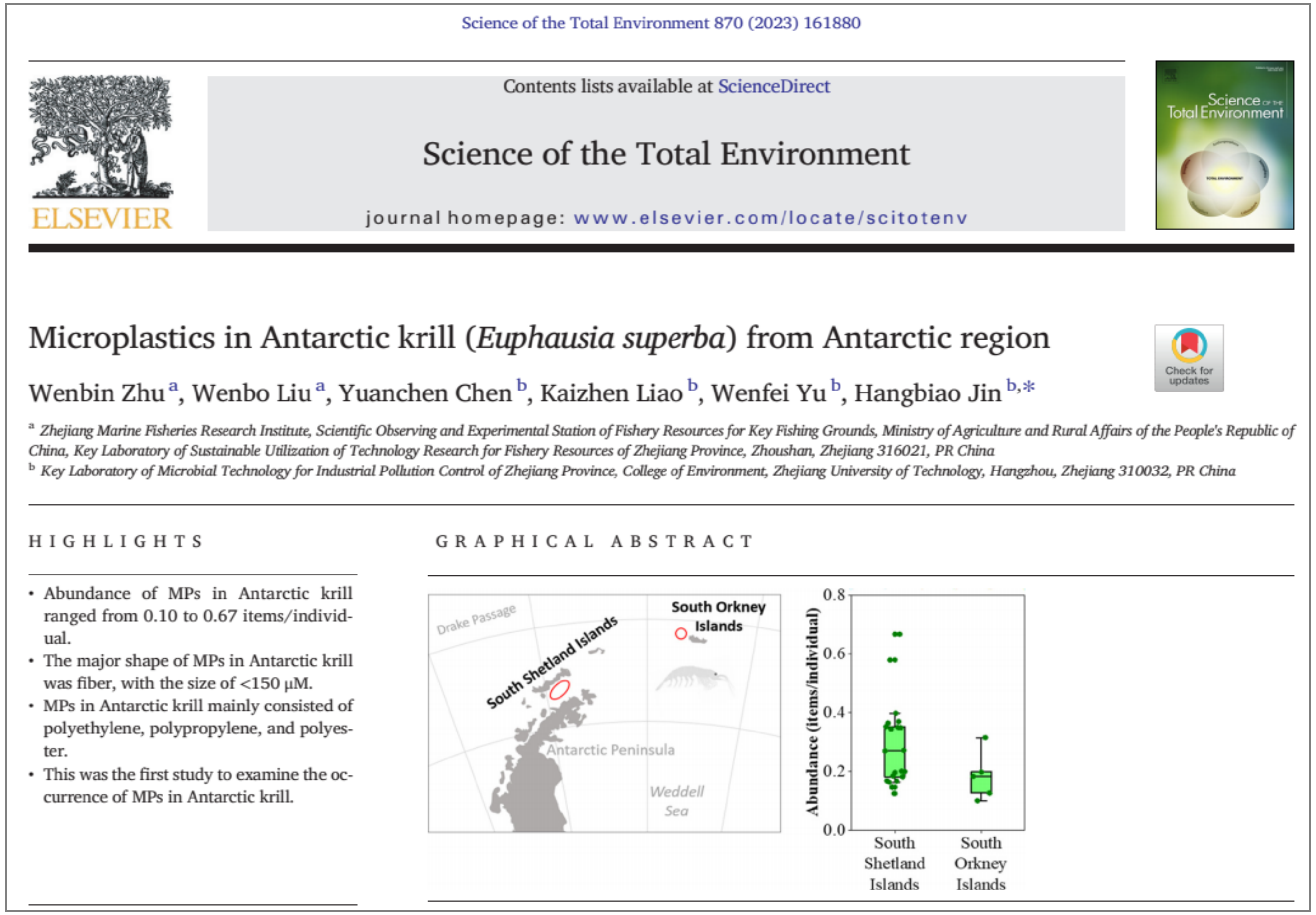
Penguins (2023)

Representative photographs of microplastics detected in penguins

MPs / Shape	Polypropylene (PP)	Polyethylene (PE)	Polyethylene terephthalate (PET)	Polyamide (PA)
Fragment				
Fiber				None

Microplastics detected in krill from Antarctica

- Abundance of MPs in Antarctic krill ranged from 0.10 to 0.67 items/individual.
- The major shape of MPs in Antarctic krill was fiber, with the size of <150 μm.
- MPs in Antarctic krill mainly consisted of **PE, PP, PET**



Science of the Total Environment 870 (2023) 161880

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Microplastics in Antarctic krill (*Euphausia superba*) from Antarctic region

Wenbin Zhu [a], Wenbo Liu [a], Yuanchen Chen [b], Kaizhen Liao [b], Wenfei Yu [b], Hangbiao Jin [b,*]

[a] *Zhejiang Marine Fisheries Research Institute, Scientific Observing and Experimental Station of Fishery Resources for Key Fishing Grounds, Ministry of Agriculture and Rural Affairs of the People's Republic of China, Key Laboratory of Sustainable Utilization of Technology Research for Fishery Resources of Zhejiang Province, Zhoushan, Zhejiang 316021, PR China*
[b] *Key Laboratory of Microbial Technology for Industrial Pollution Control of Zhejiang Province, College of Environment, Zhejiang University of Technology, Hangzhou, Zhejiang 310032, PR China*

HIGHLIGHTS

- Abundance of MPs in Antarctic krill ranged from 0.10 to 0.67 items/individual.
- The major shape of MPs in Antarctic krill was fiber, with the size of <150 μM.
- MPs in Antarctic krill mainly consisted of polyethylene, polypropylene, and polyester.
- This was the first study to examine the occurrence of MPs in Antarctic krill.

GRAPHICAL ABSTRACT

Main food source for Antarctic penguins

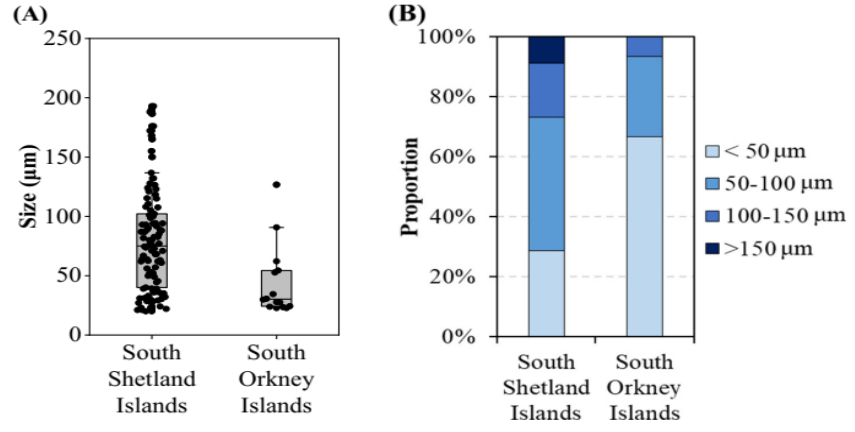


Fig. 3. (A) Size distribution and (B) size profile of MPs in Antarctic krill from two Antarctic sampling regions.

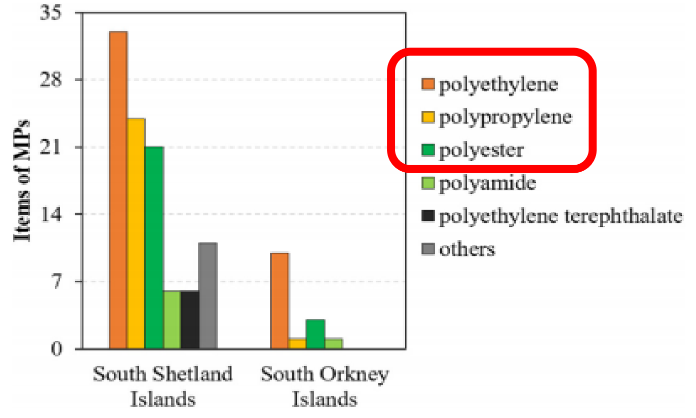
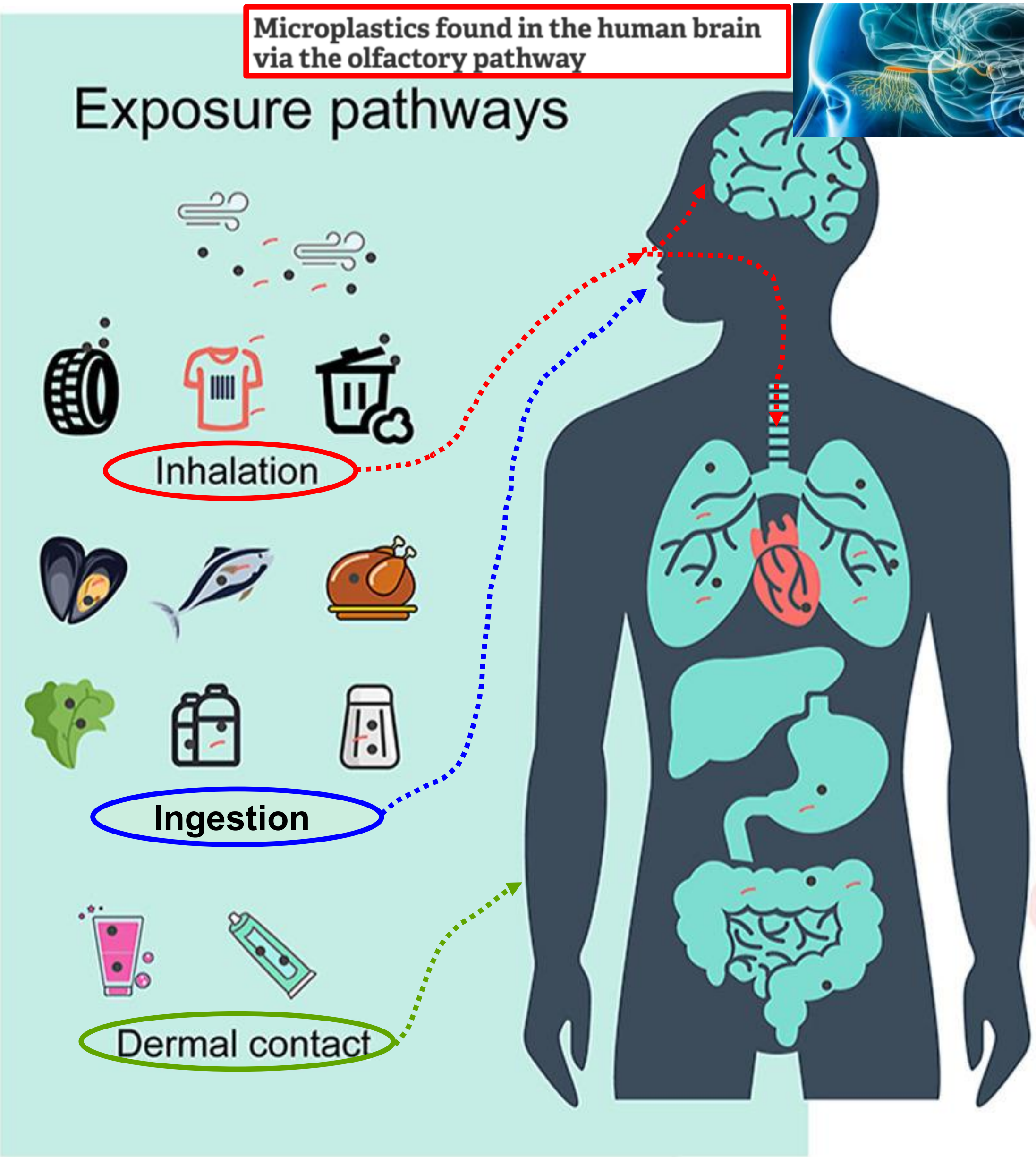


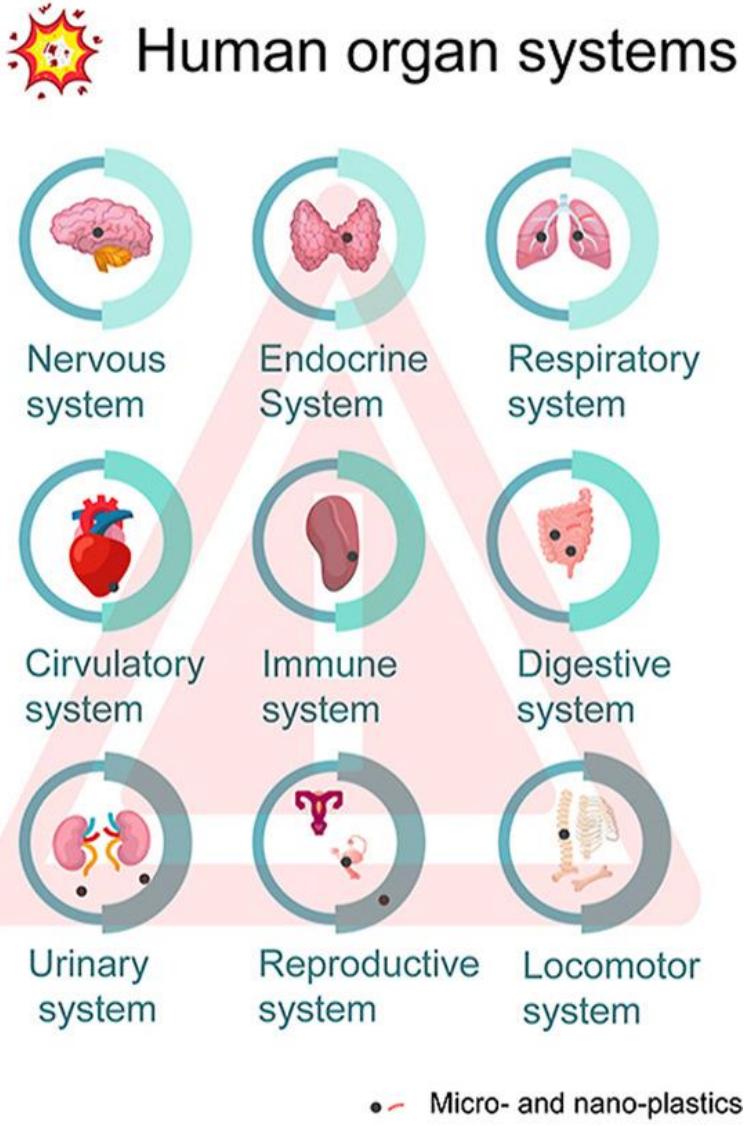
Fig. 5. Polymer composition of MPs in Antarctic krill from two Antarctic sampling regions.

2. Bio-sample Application of Microplastics

Microplastics found in the human brain via the olfactory pathway

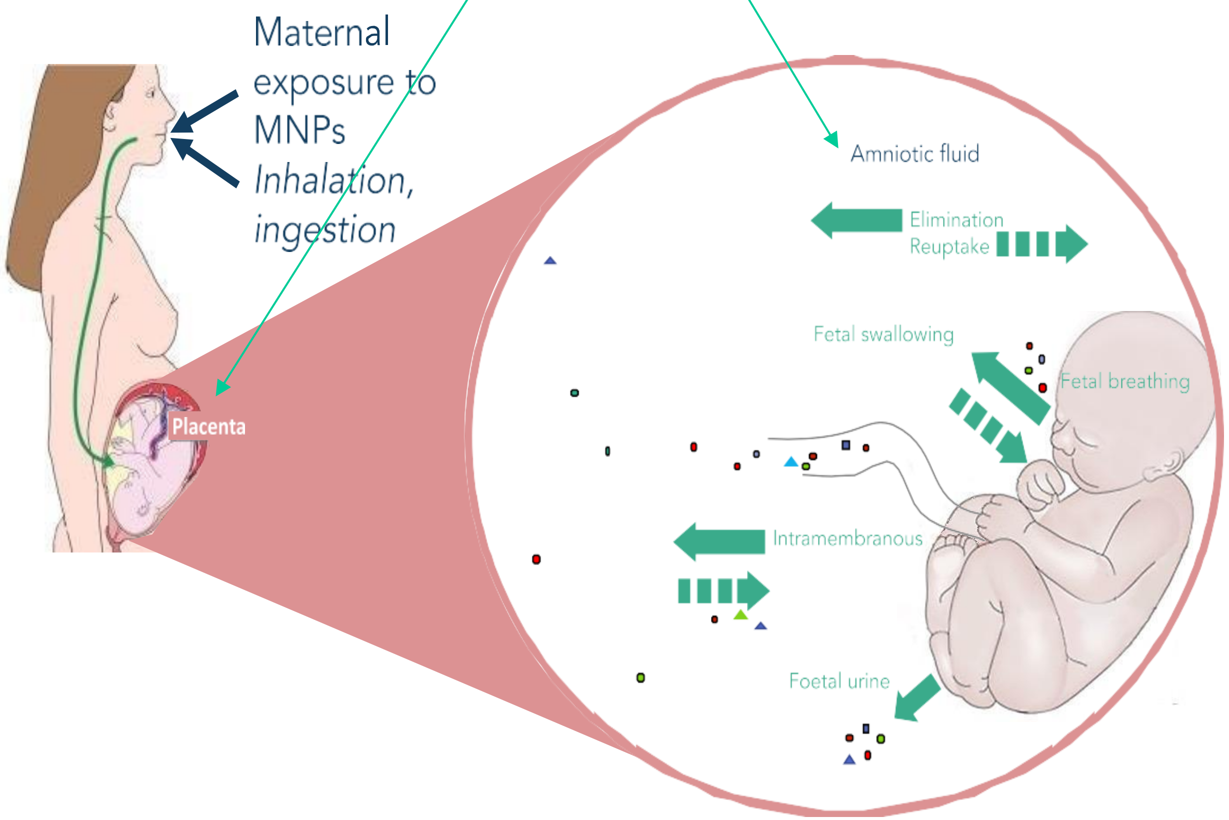


DOI: 10.1001/jamanetworkopen.2024.40018



A Amniotic fluid

- ***Placenta***, *uterus, endometrium, ovary*
- ✓ **Amniotic fluid**
- ***Blood, Cord blood***

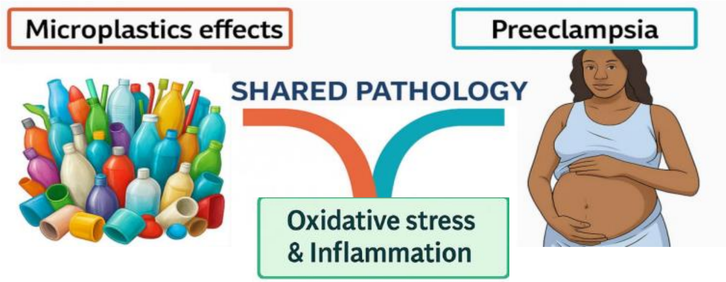


CUSP international conference: 14 September 2023 | Matthew.Boyles@iom-world.org

SNUH 분당서울대학교병원

Hyeon Ji Kim
MD, PhD

Detection of Microplastics in Amniotic Fluid in Preeclampsia and Healthy Full-Term Pregnant Women without Underlying Conditions



Preparation of sampling

❑ Study Design

- **Prospective cohort study** conducted at **Seoul National University Bundang Hospital**

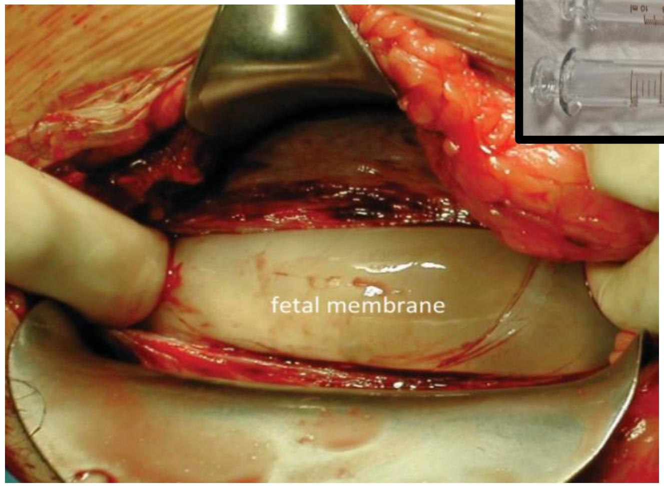
Preeclampsia group	• Preeclampsia / Eclampsia • Cesarean section
Normal group	• Full term delivery (37 week~) • No underlying diseases • Cesarean section

❑ Questionnaire survey

- **Maternal MP exposure was assessed** through a **questionnaire survey.**

❑ Sample collection

- Period: November 2023 to December 2024
- Amniotic fluid was collected during surgery
- All procedures followed **strict plastic-free protocols, using only cotton, metal, and glass instruments to avoid contamination**



Fetal membrane

Amniotic fluid

Placenta

MPs detection in amniotic fluid by μ-Raman

SNUH 분당서울대학교병원

Will be published

Analysis

Sample pre-treatment:

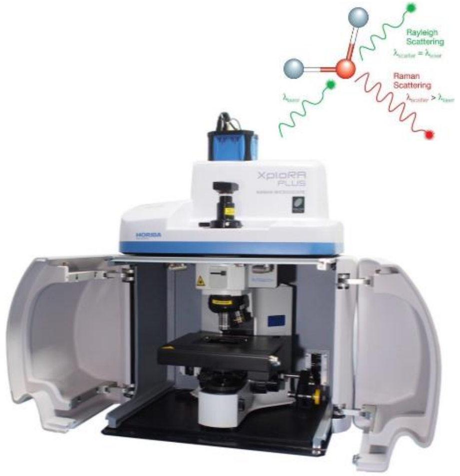
Samples were prepared by vacuum filtration using with *a* **5 μm pore size silicon (Si) filter**.
After filtration, the samples were air-dried naturally.

Instrument:

μ-Raman (XploRA+, Horiba, France)

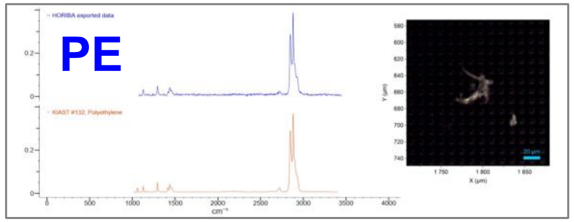
Measurement Conditions:

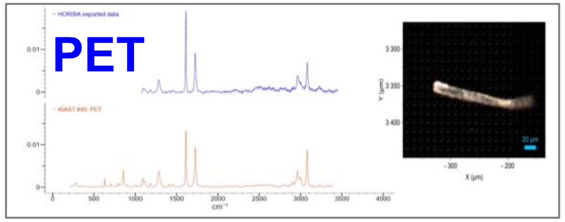
① 20x darkfield objective lens
② 532 nm laser
③ 10 mW (10%) laser power
④ Measurement time: (1 x 2) s
⑤ Darkfield mode
⑥ Particle Finder analysis



μ-Raman (XploRA+, Horiba)

Obstetric Operating Room	Amniotic fluid
Air sampling by Petri dish (Passive sampling)	Amniotic fluid 1 g + 30% H_2O_2 20 mL
↓	↓
Washed with 40 mL of deionized water and then filtered	Shaking incubator (60 ℃, 100 r/min, 7 d)
↓	↓
Analyzed the filtered sample using by μ-Raman	Analyzed the filtered sample using by μ-Raman





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Will be published

Test Results

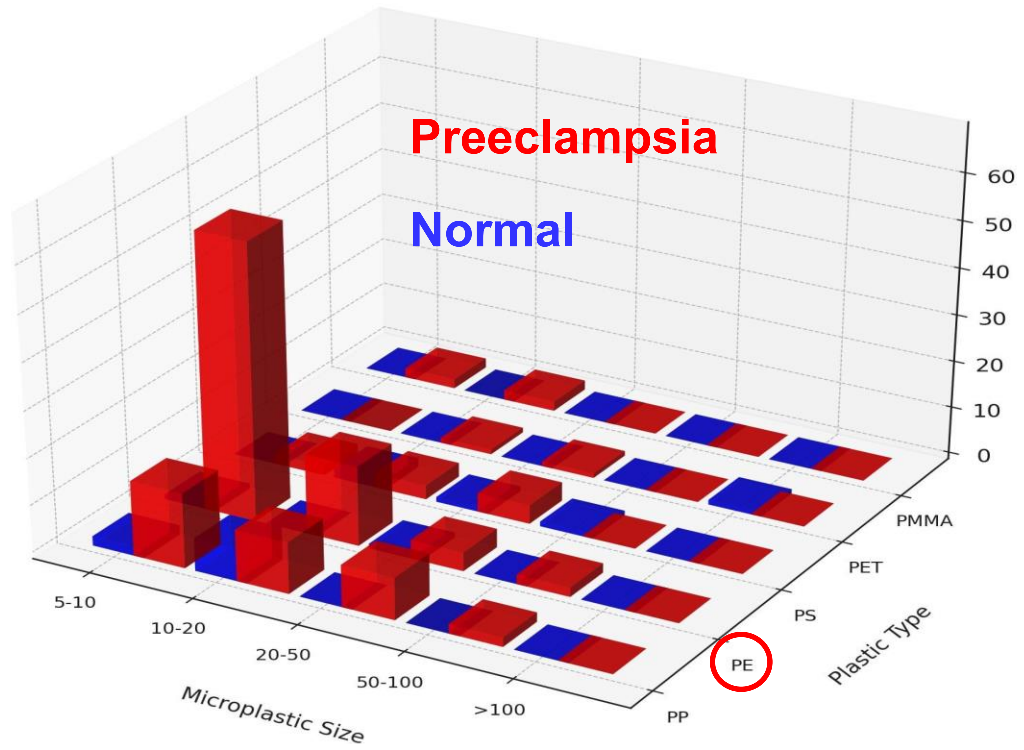
Preeclampsia

Preeclampsia	5_10μm	10_20μm	20_50μm	50_100μm	>100μm	Sum
PP	16	11	9	2		38
PE	59	17	4	2		82
PS	2	3	4			9
PET		1	1			2
PMMA	2	2				4
Sum	79	34	18	4	0	135

Normal	5_10μm	10_20μm	20_50μm	50_100μm	>100μm	Sum
PP	2	7				9
PE	1		1			2
PS		2	1	1		4
PET					1	1
PMMA						0
Sum	3	9	2	1	1	16

PP (polypropylene); PE (polyethylene); PS (polystyrene);
PET (polyethylene terephthalate); PMMA (polymethyl methacrylate)

Figure 1. Distribution of MPs according to size and type.



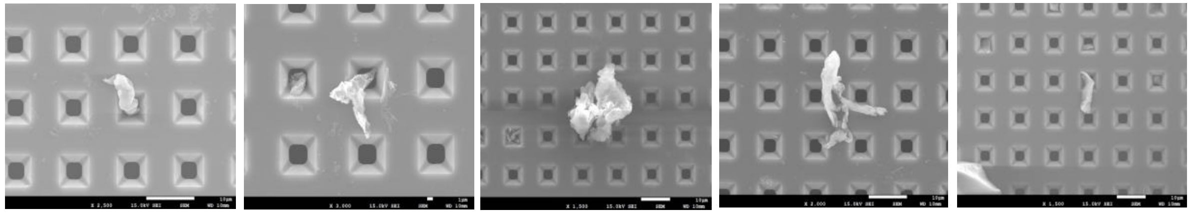


Figure 2. Microscopic photos of the different characteristics of MPs in Amniotic fluid.

Table. Factors associated with preeclampsia: Univariate and multivariate logistic regression results

Variables	Univariable OR (95% CI)	Univariable p-value	Multivariable OR (95% CI)	Multivariabe p-value
High MP levels (≥ 4)	14.00 (1.30-150.89)	**0.03**	35.37 (1.35-926.04)	**0.032**
Consumption of bottled water	9.33 (0.85-101.95)	0.067	7.04 (0.31-161.25)	0.222
Consumption of seafood >5 times/week	9.75 (1.38-68.78)	**0.022**	6.26 (0.40-98.86)	0.193
MP exposure awareness	0.15 (0.02-1.07)	0.058	0.10 (0.01-1.83)	0.122

OR, Odds ratio; CI, Confidence Interval

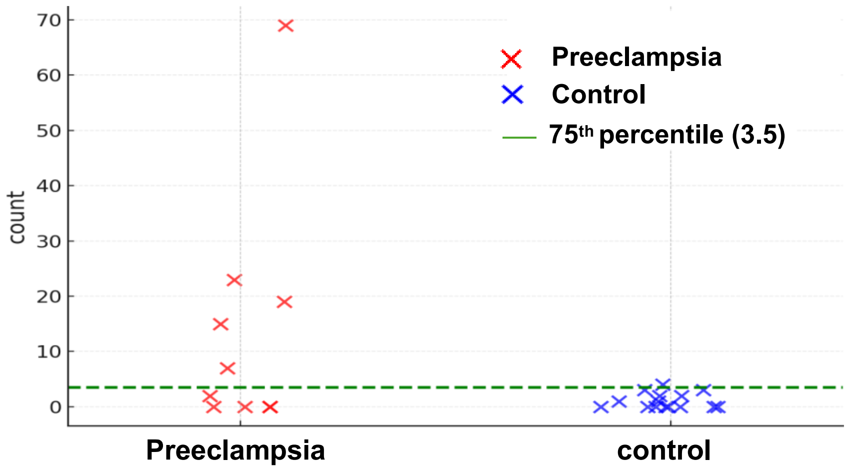


Figure 3. Distribution of MP counts in the preeclampsia and control groups

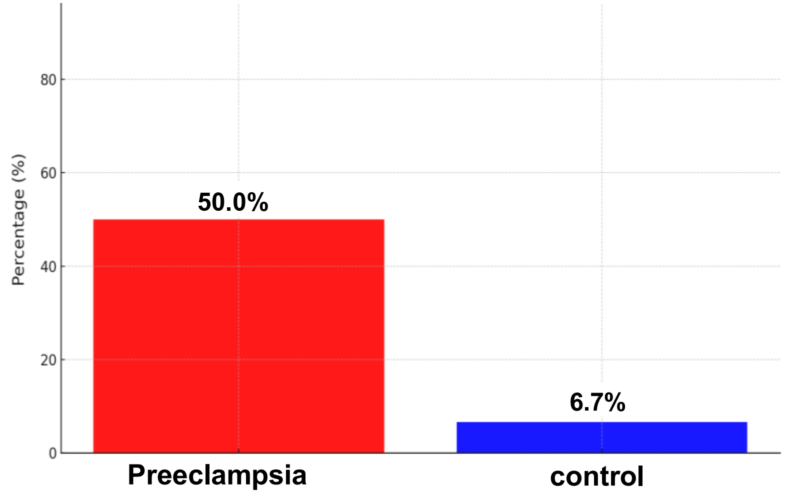


Figure 4. Comparison of the proportion of samples with high MP levels between the preeclampsia and control groups

B Human Blood

nature SCIENTIFIC REPORTS
Scientific Reports (2024) 14:30419

Detection of Microplastics in the blood of approximately 36 normal subjects in Korea

✓ Blood

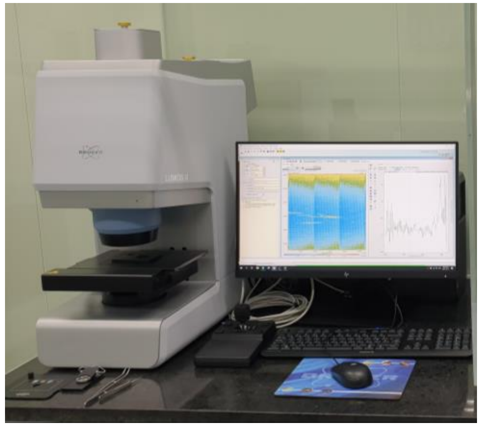
**Dong-wook Lee
MD, PhD**

Blood (1.0 g) by μ-FTIR

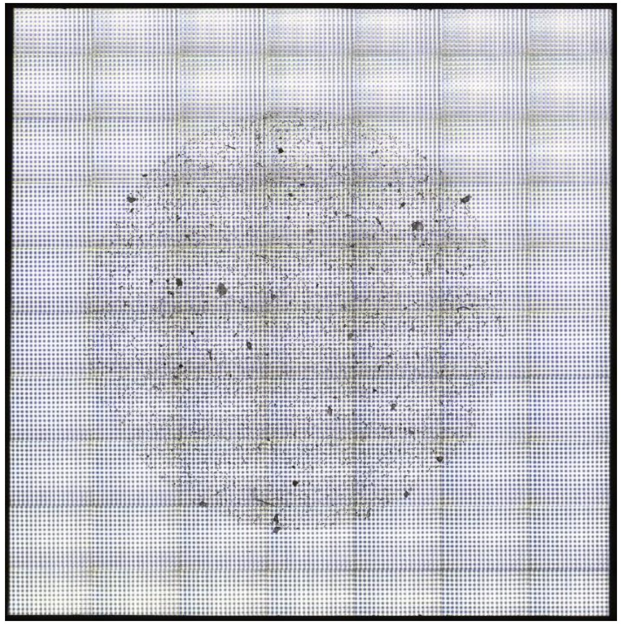
[UNIT: ea]

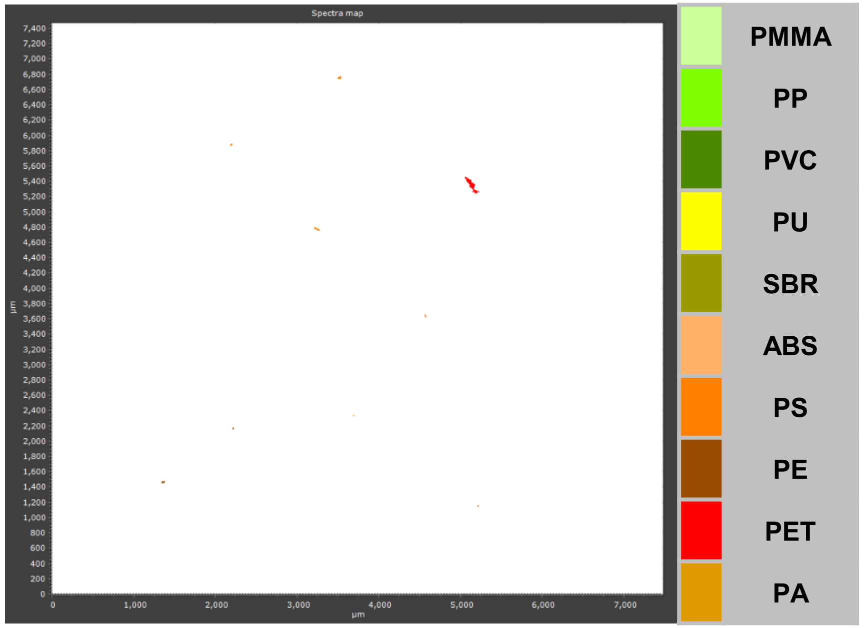
MPs	5 μm ~ 10 μm	10 μm ~ 20 μm	20 μm ~ 50 μm	50 μm ~ 100 μm	100 μm ~	Sum
Polyethylene (PE)	-	-	2	-	-	2
Polystyrene (PS)	-	-	4	2 (1)	-	6 (1)
Polyethylene terephthalate (PET)	-	-	-	-	1 (1)	1 (1)
Sum	-	-	6	2 (1)	1 (1)	9 (2)

( ) : Fiber



μ-FTIR (LUMOS 2, Bruker Optics)



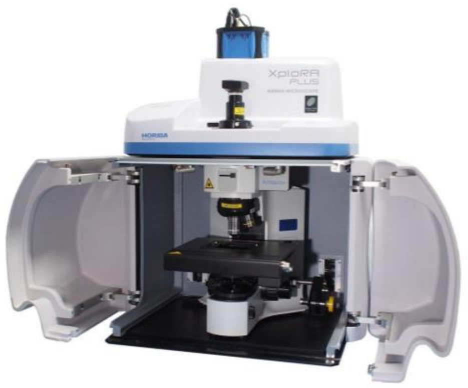


Blood (1.0 g) by μ-Raman

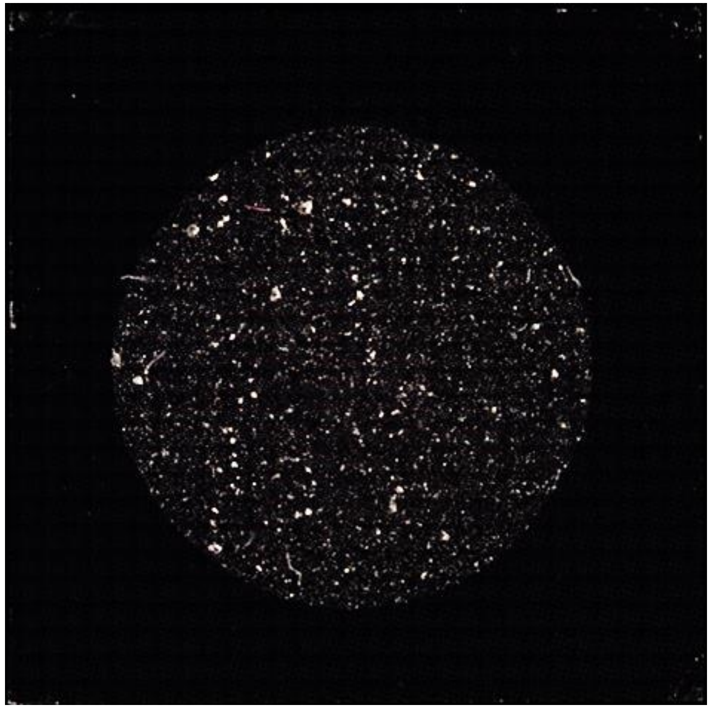
[UNIT: ea]

MPs	5 μm ~ 10 μm	10 μm ~ 20 μm	20 μm ~ 50 μm	50 μm ~ 100 μm	100 μm ~	Sum
Polypropylene (PP)	3	11	2 (1)	-	-	16 (1)
Polyethylene (PE)	1	-	-	-	-	1
Poly(ethylene terephthalate) (PET)	4	-	-	-	-	4
Sum	8	11	2 (1)	-	-	21 (1)

( ) : Fiber



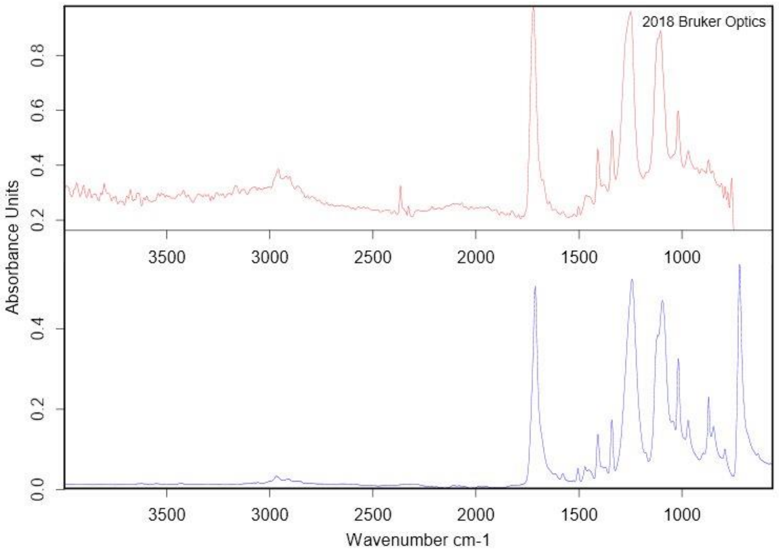
μ-Raman (XploRA+, Horiba)

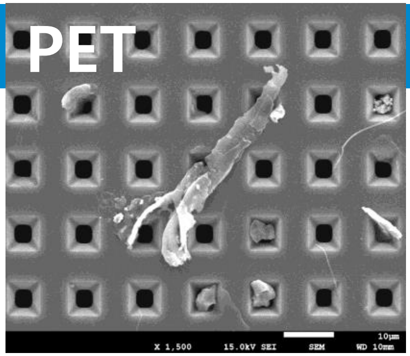


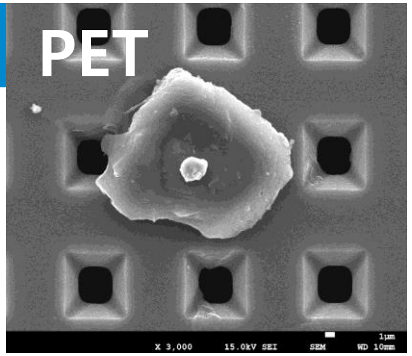
Number of particles measured : 31,986 ea

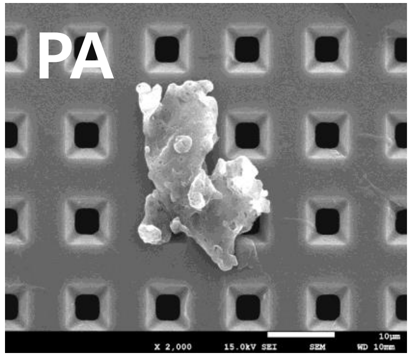
2. Bio-sample Application of Microplastics

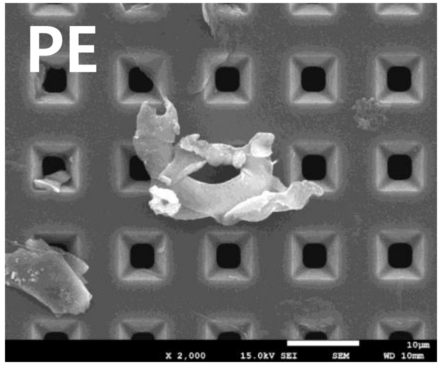
■ Polyethylene terephthalate (PET)



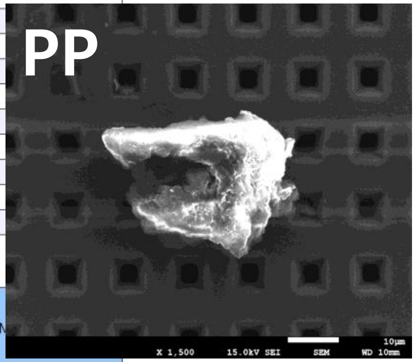


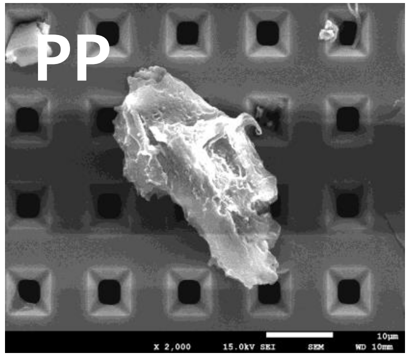


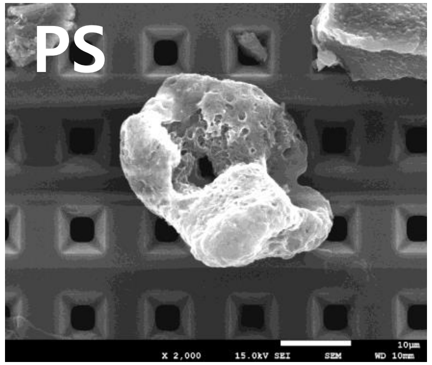




Polymer	PET
CAS Registry Number	25038-59-9
Substance	polyethylenterephthalate
Trade Name	Polyclear 1101
Supplier	AG Plastics
Filler	unfilled
Filler Content	0
Color	white
Applications	contact applications
Melting Point	252







Color	Hit Quality	Compound name	CAS Number	Molecular formula	M
	947	PET	25038-59-9		

Color	File	Path	Spectrum Type
	SEARCH_CC MA-31.0_AB_1435714.0	C:\Users\admin\Desktop\Search	Query Spectrum

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Association between Microplastics in Human Blood and Coagulation Markers

Table 4. The number of samples detected MP and the distribution of the number of MP particles by μ-FTIR, according to the lifestyle related factors.

		Detected Samples		Number of total MPs (N/ml)	
	N (%)	N (%)	P†	Mean	*P* *
Total	36 (100.0)	32 (88.9)		4.3	
Ready meals					
≥1/week	13 (36.1)	12 (92.3)	0.644	6.6	0.279
<1/week	23 (63.9)	20 (87.0)		2.9	
Plastic container %					
≥50%	**15 (41.7)**	**15 (100)**	**0.091**	**6.8**	**0.025**
<50%	**21 (58.3)**	**17 (81.0)**		**2.4**	
Discolored plastic container					
≥25%	8 (22.2)	6 (75.0)	0.181	2.0	0.154
<25%				4.9	
Vinyl contain					
≥1/week					
<1/week					
Seafood					
≥1/week					
<1/week					
Indoor ventil					
≥1/day	23 (63.9)	20 (87)	0.644	4.2	0.934
<1/day	13 (36.1)	12 (92.3)		4.4	

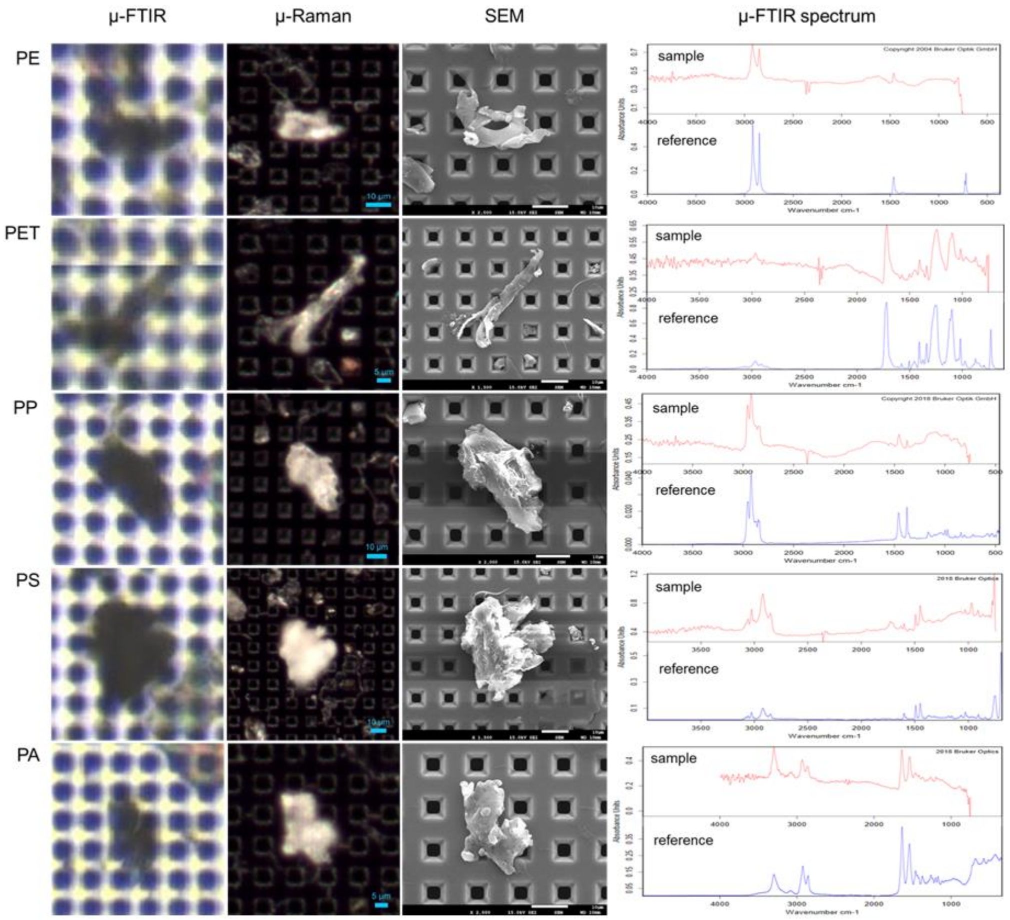


Figure S2 Microphotographs of MPs found in the blood samples using μ-FTIR, μ-Raman and SEM and μ-FTIR spectra of sample and reference in library

Scientific Reports (2024) 14:30419

C Microplastic contamination in artificial tears in South Korea: Potential for direct ocular exposure

Contact Lens and Anterior Eye 102325, November 11, 2024

Contents lists available at ScienceDirect

Contact Lens and Anterior Eye

journal homepage: www.elsevier.com/locate/clae

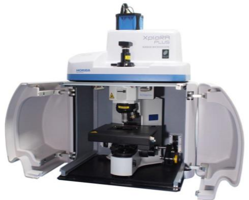
Microplastic contamination in artificial tears in South Korea: Potential for direct ocular exposure

Yun-Hee Choi [a,b], Nayoon Park [a], Juyang Kim [c], Seul-Ah Park [c], Jaehak Jung [c], Jong Suk Song [a], Yoon-Hyeong Choi [b,1,**], Dong Hyun Kim [a,*]

[a] Department of Ophthalmology, Korea University College of Medicine, Seoul, South Korea
[b] School of Health and Environmental Science, Korea University, Seoul, South Korea
[c] Korea Institute of Analytical Science and Technology, Seoul, South Korea

Table 1
Information of five selected artificial tear (AT) products.

Product no.	Type	Volume	Lid/ Container material	Characteristics
1	Multi-use	5 mL	PP/PE	Lid separated from the container
2	Multi-use	10 mL	PE/PE[1]	Lid containing the absorbent separated from the container
3	Disposable	0.5 mL	PE/PE	Lid combined with the container
4	Disposable	0.5 mL	PE/PE	Lid combined with the container
5	Disposable	0.5 mL	PE/PE	Lid combined with the container



μ-Raman (XploRA+, Horiba)

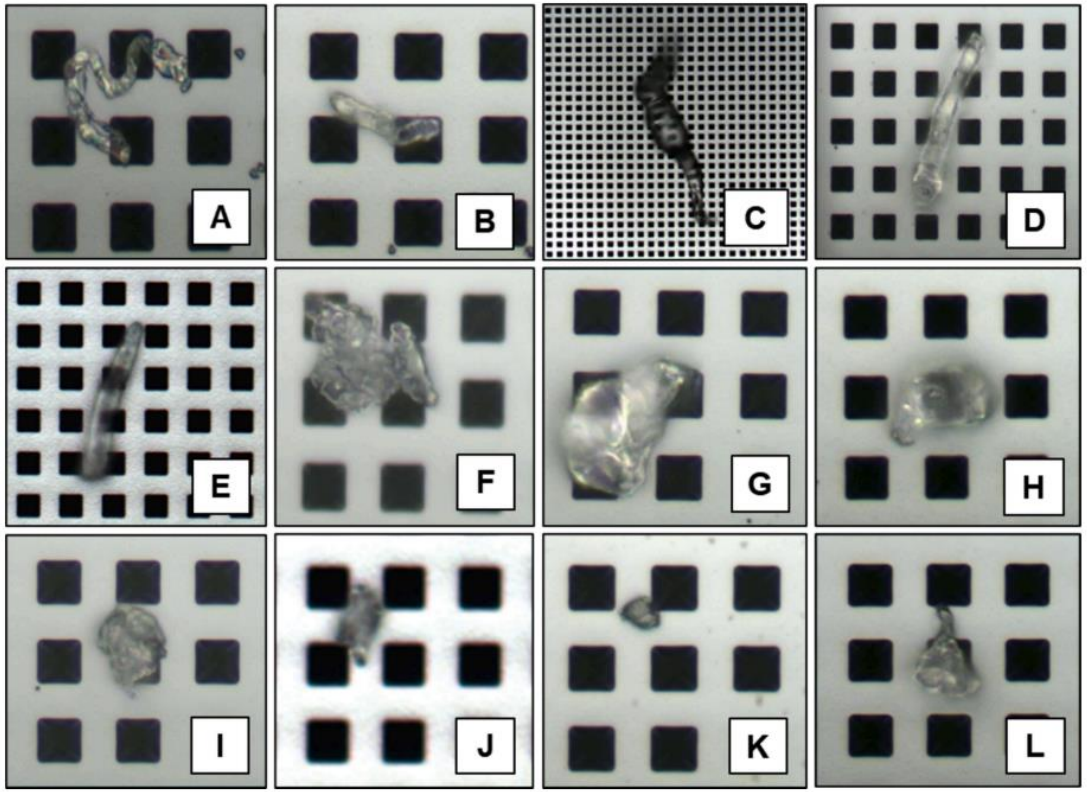


Fig. 1. Microscopic photos of the different characteristics of microplastics (MPs) found in five artificial tear (AT) products. A–E: transparent fibers; F–J: transparent irregular fragments; K: transparent round fragments; and L: opaque irregular fragments. The length of black box: 5 μm. A: product 2; B: product 5; C: product 1; D: product 3, E: product 5, F: product 1, G: product 4, H: product 4, I: product 1, J: product 5, K: product 1, L: product 2.

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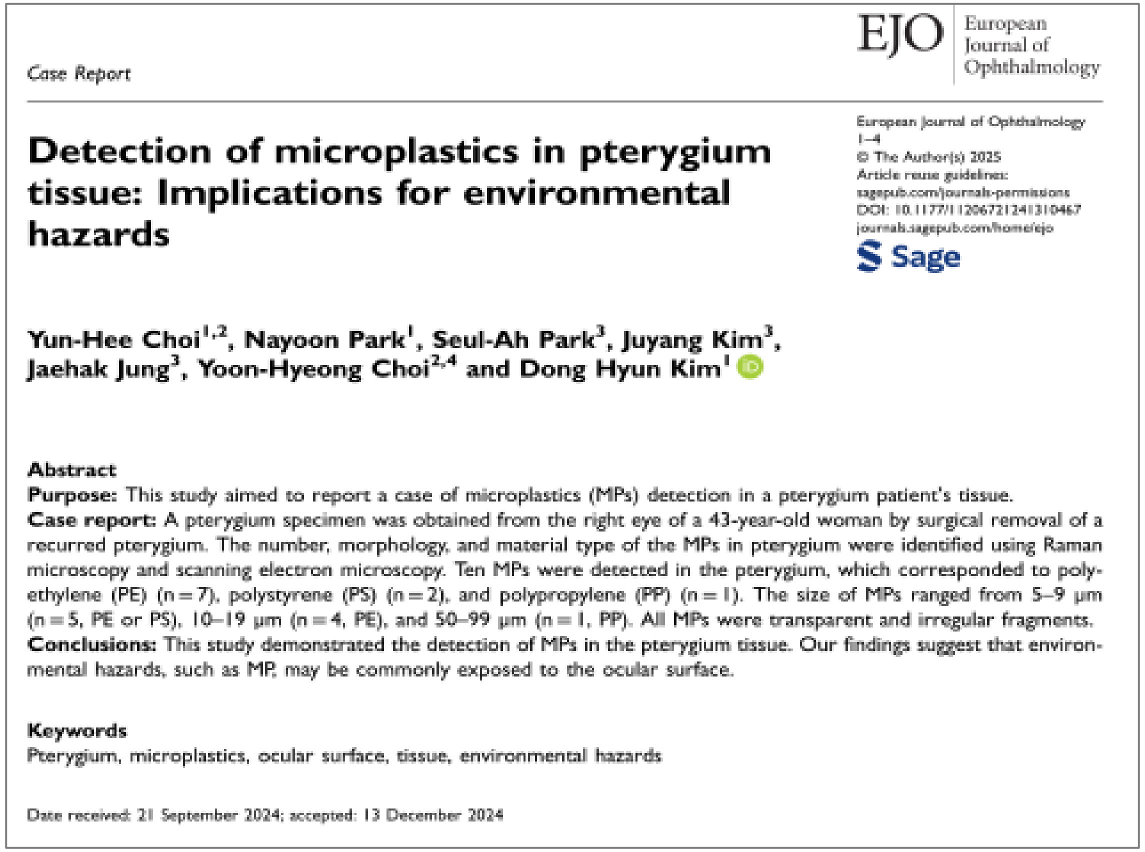
D Detection of Microplastics in pterygium tissue; Implications for environmental hazards

Ten MPs were detected in the pterygium, which corresponded to PE (n=7), PS (n=2), and PP (n=1).
The size of MPs ranged from 5–9 μm (n=5, PE or PS), 10–19 μm (n=4, PE), and 50–99 μm (n=1, PP).
All MPs were transparent and irregular fragments.

European Journal of Ophthalmology
13 December 2024



Case Report

EJO European Journal of Ophthalmology

European Journal of Ophthalmology
1–4
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Detection of microplastics in pterygium tissue: Implications for environmental hazards

Yun-Hee Choi[1,2], Nayoon Park[1], Seul-Ah Park[3], Juyang Kim[3], Jaehak Jung[3], Yoon-Hyeong Choi[2,4] and Dong Hyun Kim[1]

Abstract
Purpose: This study aimed to report a case of microplastics (MPs) detection in a pterygium patient's tissue.
Case report: A pterygium specimen was obtained from the right eye of a 43-year-old woman by surgical removal of a recurred pterygium. The number, morphology, and material type of the MPs in pterygium were identified using Raman microscopy and scanning electron microscopy. Ten MPs were detected in the pterygium, which corresponded to polyethylene (PE) (n = 7), polystyrene (PS) (n = 2), and polypropylene (PP) (n = 1). The size of MPs ranged from 5–9 μm (n = 5, PE or PS), 10–19 μm (n = 4, PE), and 50–99 μm (n = 1, PP). All MPs were transparent and irregular fragments.
Conclusions: This study demonstrated the detection of MPs in the pterygium tissue. Our findings suggest that environmental hazards, such as MP, may be commonly exposed to the ocular surface.

Keywords
Pterygium, microplastics, ocular surface, tissue, environmental hazards

Date received: 21 September 2024; accepted: 13 December 2024

https://doi.org/10.1177/11206721241310467

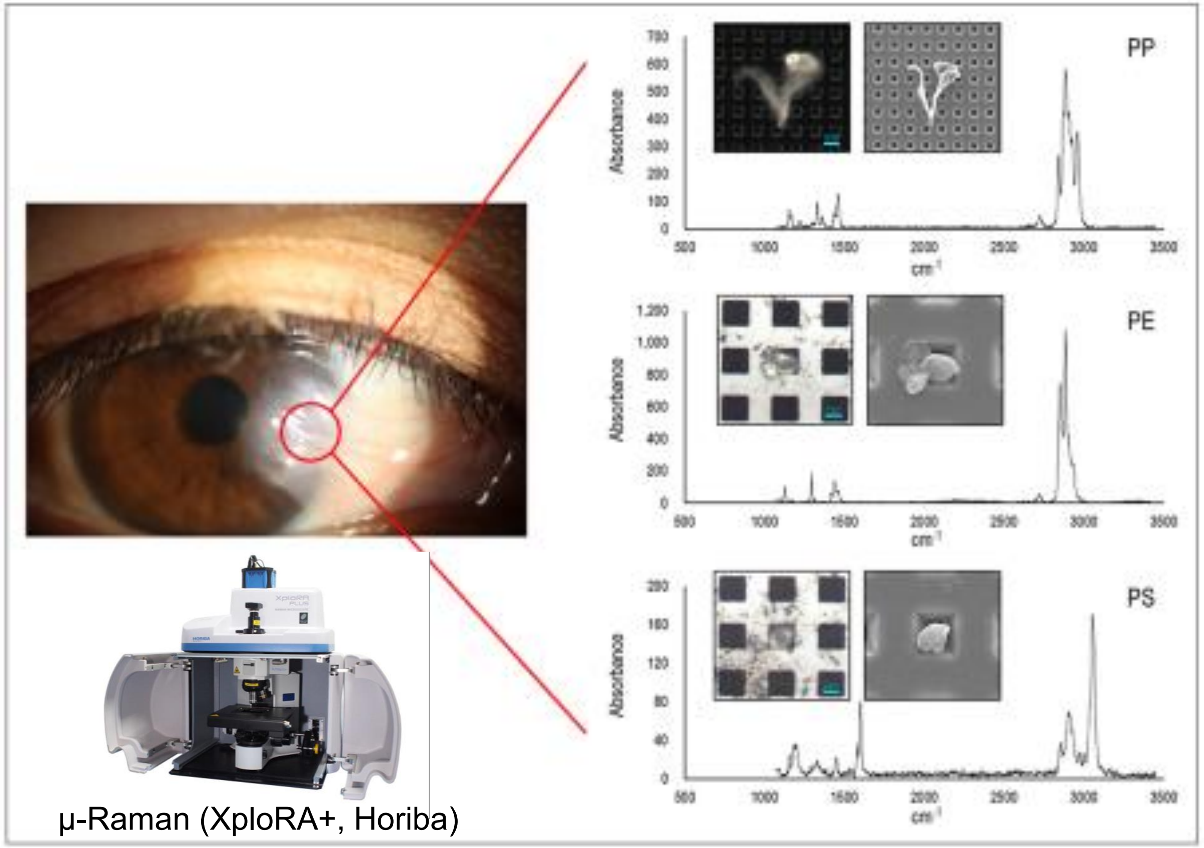
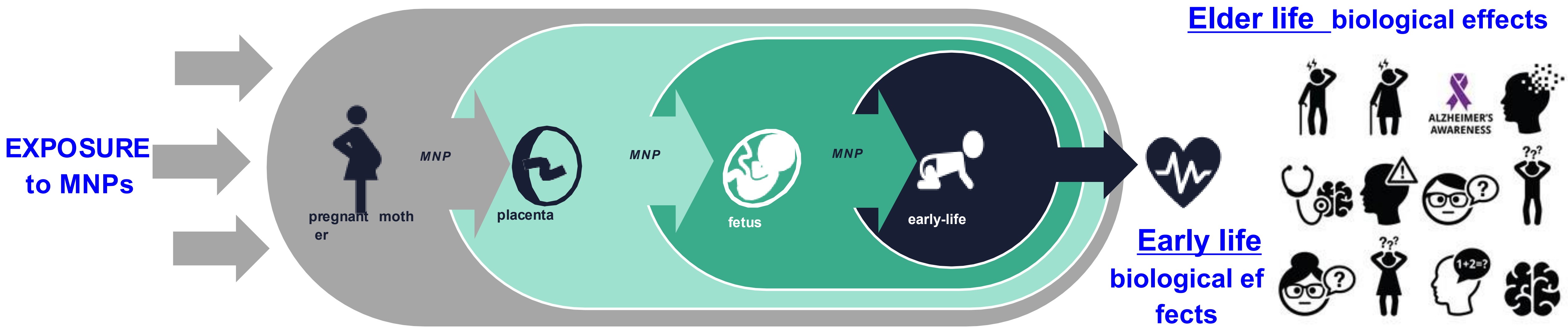


Figure 1. Raman spectra, optical images (left), and SEM micrographs (right) of three polymer types of microplastics detected in pterygium tissue. PP, polypropylene; PE, polyethylene; PS, polystyrene.

3. Conclusions

Future plan and suggestions for Development of Microplastics in Human samples



- It is important to identify human contamination of **plastics and hazardous substances** and their effects on the human body.
- Especially, additional research is needed on the relationship between **MNPs and various groups of diseases of concern** (stroke, heart attack, Alzheimer's disease, Parkinson's disease, allergies, etc.) in vulnerable groups such as mothers, fetuses, infants, and the elderly
- In order to identify the **correlation between major diseases and MNPs**, long-term complex convergence research is required through **large-scale cohort collaboration** among universities /hospitals/research institutes/government and global research institutes.

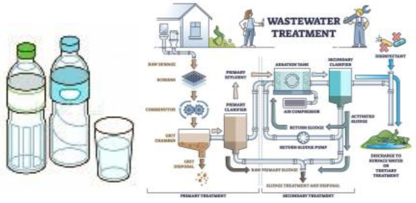
Roadmap for test method development on NMPs in foods, food containers and human samples by KIAST

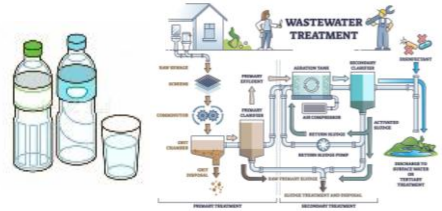
Nanoplastics & Microplastics Target : MPs (1 µm ~ 50 µm & ~ 5 mm)

- ○ Metal filter
- ● Si filter
- ● Al_2O_3 filter
- ● Quartz filter for Nano

0.05/0.1 µm — 1 µm — 10 µm — 50 µm — 5 mm

Sample
- Drinking Water
- Urban Wastewater ...





Sampling
- 1 bottle/piece
- Wastewater

0.05/0.1 µm – 1 µm	1 µm – 10 µm	10 µm – 50 µm	50 µm – 5 mm
1 bottle *Wastewater*	1 bottle Wastewater by ISO 5667-27	1 bottle Wastewater by ISO 5667-27	1 bottle Wastewater by ISO 5667-27

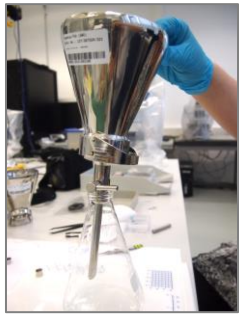
Sample pre-treatment
- Extraction solvent/temp/time
- Test equipment
- **Blank control with Clean room**

0.05/0.1 µm – 1 µm	1 µm – 10 µm	10 µm – 50 µm	50 µm – 5 mm
Extraction solvent/temp/time *0.05/0.34 µm (Alumina filter)* *0.5 µm (Si filter) (will ne soon)*	**Extraction solvent/temp/time** **Wastewater by ISO/WD 24899** **1 µm (Si filter)**	**Extraction solvent/temp/time** **Wastewater by ISO/WD 24899** **5 µm (Si filter)** **5 µm Smart Filter for TED-GC-MS**	**Extraction solvent/temp/time** **Wastewater by ISO/WD 24899** **20/45/100/400 µm (Metal filter)**

Instrument
- **µ-FTIR**
- **µ-Raman**
- **TED-GC-MS/Py-GC-MS**
- *Nano-IR, SEM-Raman..*
- *GC(LC)-MS/MS, FFF...*

New technique for NPs!
- *Nano-IR*
- *AFM-Raman*
- *SEM-Raman*

- **> 10 µm analysis by µ-FTIR**
- **> 1~5 µm analysis by µ-Raman**
- **1~20, 20-50 µm & greater, TED-GC-MS & Py-GC-MS**
- 0.05~1 µm analysis by Nano-IR / SEM-Raman
- *(PDP) > 5 µm by TOF-SIMS, Imaging MALDI-TOF-MS (HOLDI-MS)*
- *(*PDP) DEHP/PAHs/BPA/PFAS.. (GC-MS/MS, LC-MS/MS), metal (ICP-MS),*



Cascade Smart Filter

(SAICAS)

***Definition of microplastics by ECHA : 5 mm ~ 0.1 µm**

Thanks for your attention!

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Project Leader for IEC 62321-3-2 (Halogen by C-IC), IEC 62321-10 (PAHs by GC-MS) & IEC 62321-13 (BPA by LC, LC-MS, LC-MS/MS), PFAS Task
Microplastics Korean Delegate for ISO/TC 61(Plastics)/SC 14/WG 4, TC 38 (Textile), TC 147(Water Quality)/SC 2 & SC 6, IEC/TC 59/SC 59D

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