Nanoplastics and Human Health

Matthew Campen, PhD, MSPH
Distinguished Professor of Pharmaceutical Sciences
Co-Director, University of New Mexico Clinical and Translational Science Center
Director, University of New Mexico Center for Metals in Biology and Medicine

UNM COLLEGE OF PHARMACY

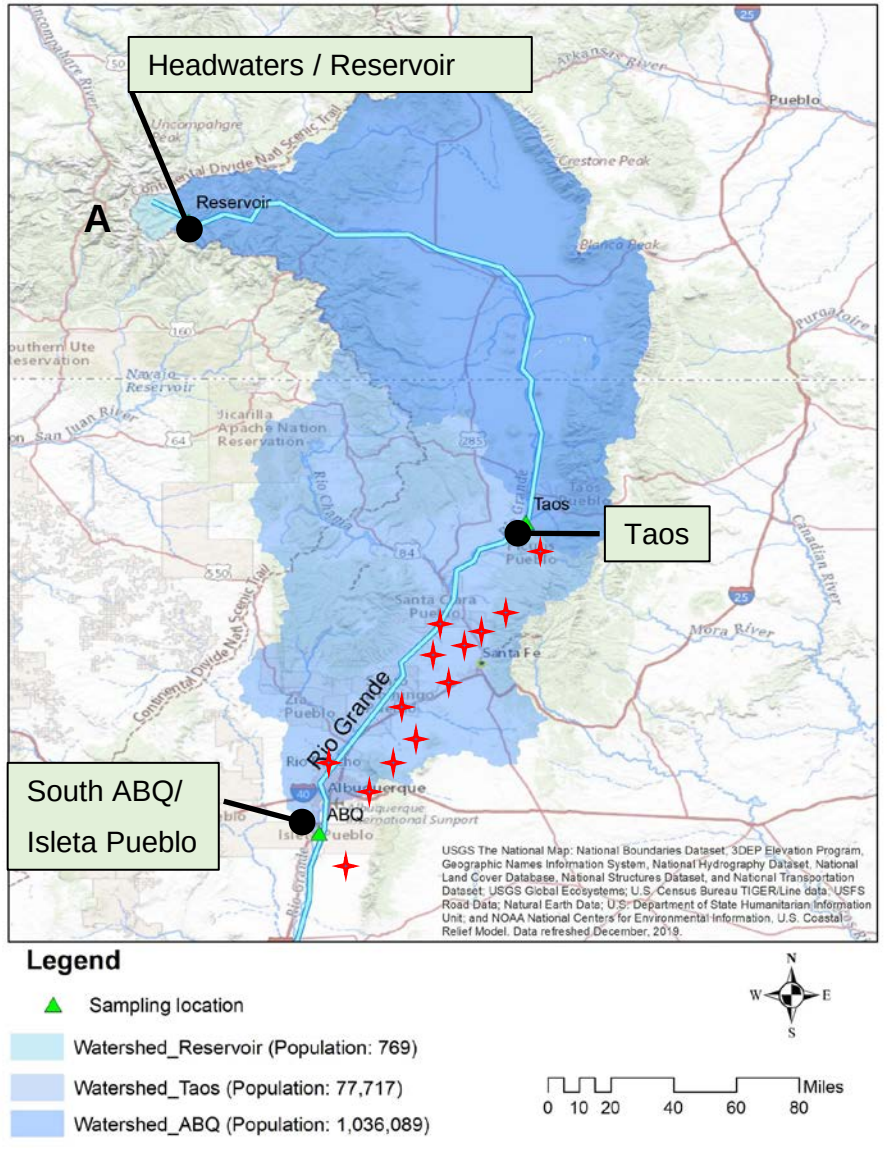
Financial Disclosure

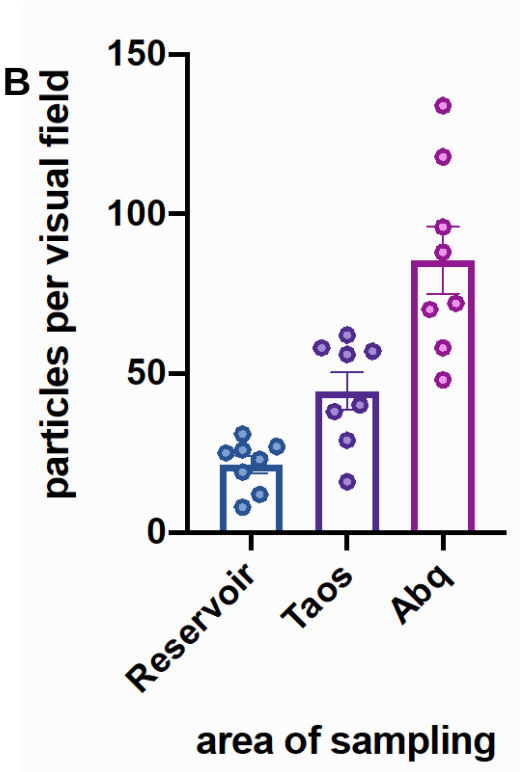
- Nothing to disclose
- Research funding comes from the NIH:

NIEHS (ES014639, ES026673)
NIA (AG070776)
NIGMS (P20 GM130422)

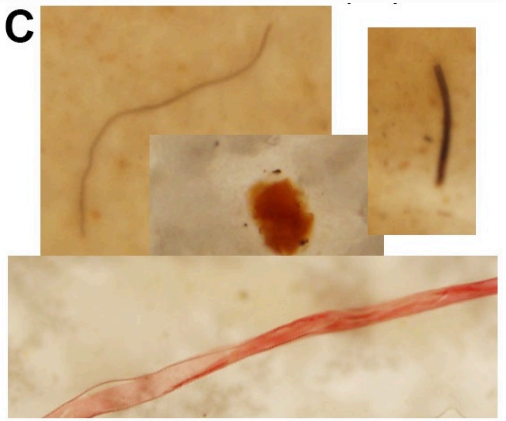
“…teach your children, that the rivers are our brothers, and yours, and you must henceforth give rivers the kindness you would give any brother”

Chief Seattle

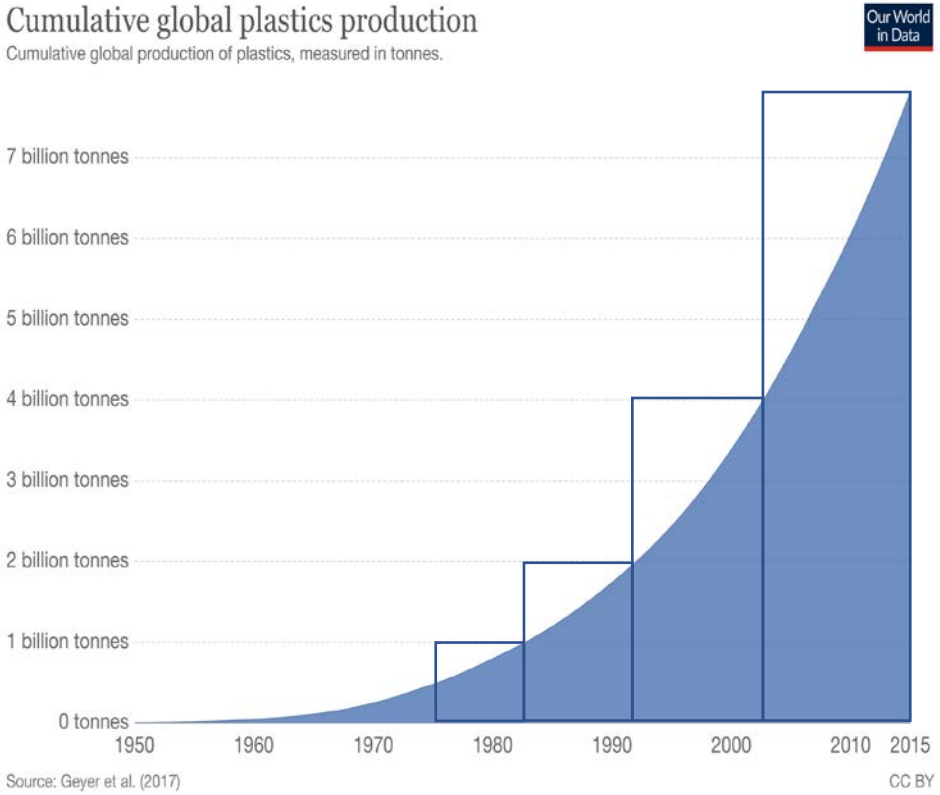


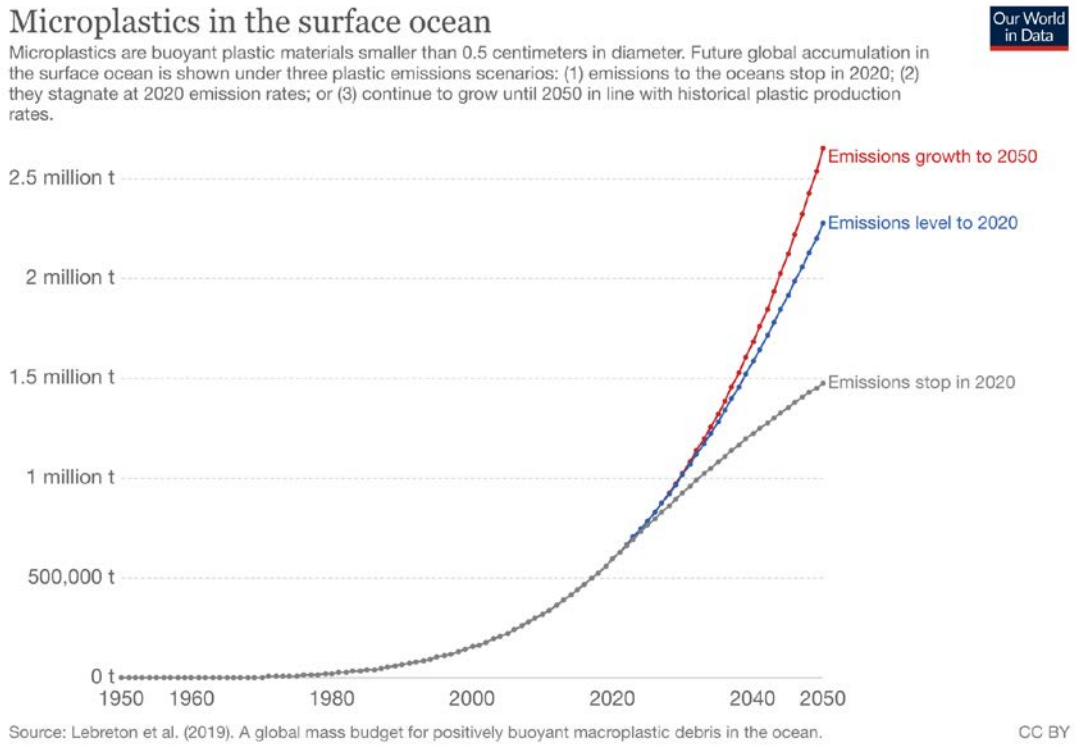


area of sampling



New plastic generation doubles every ~14 years

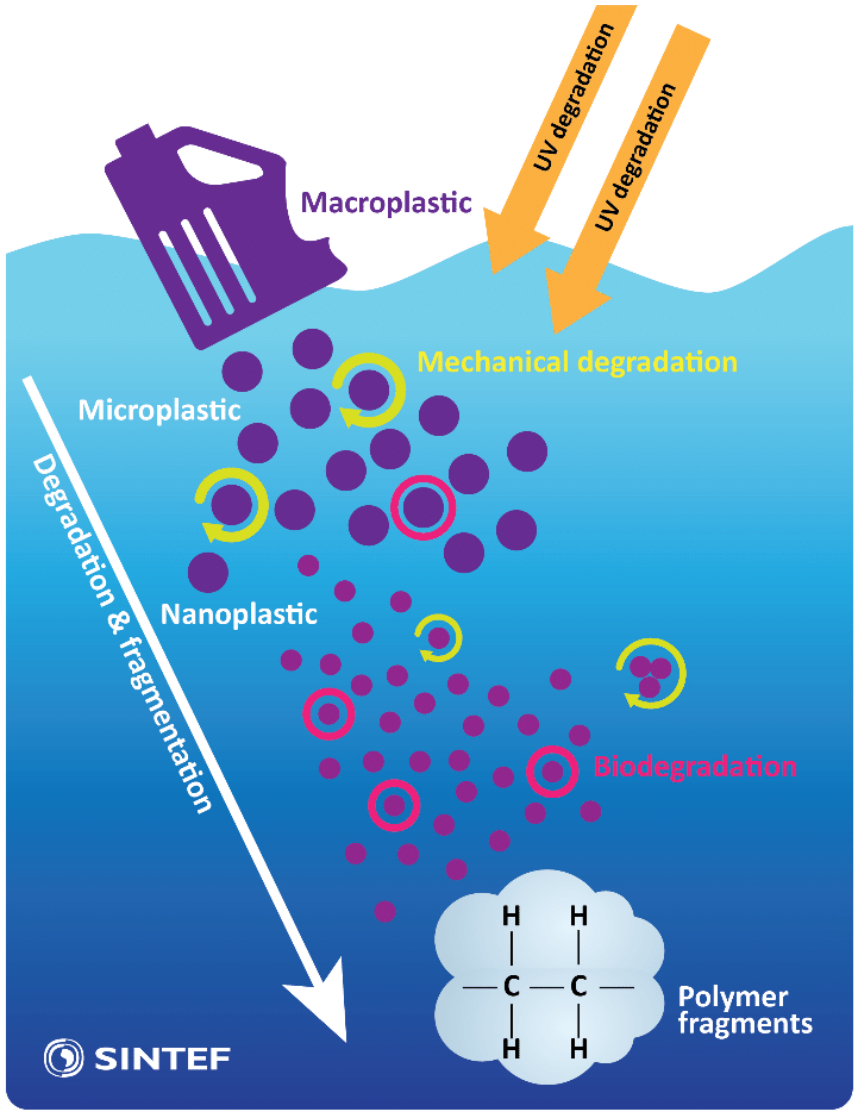


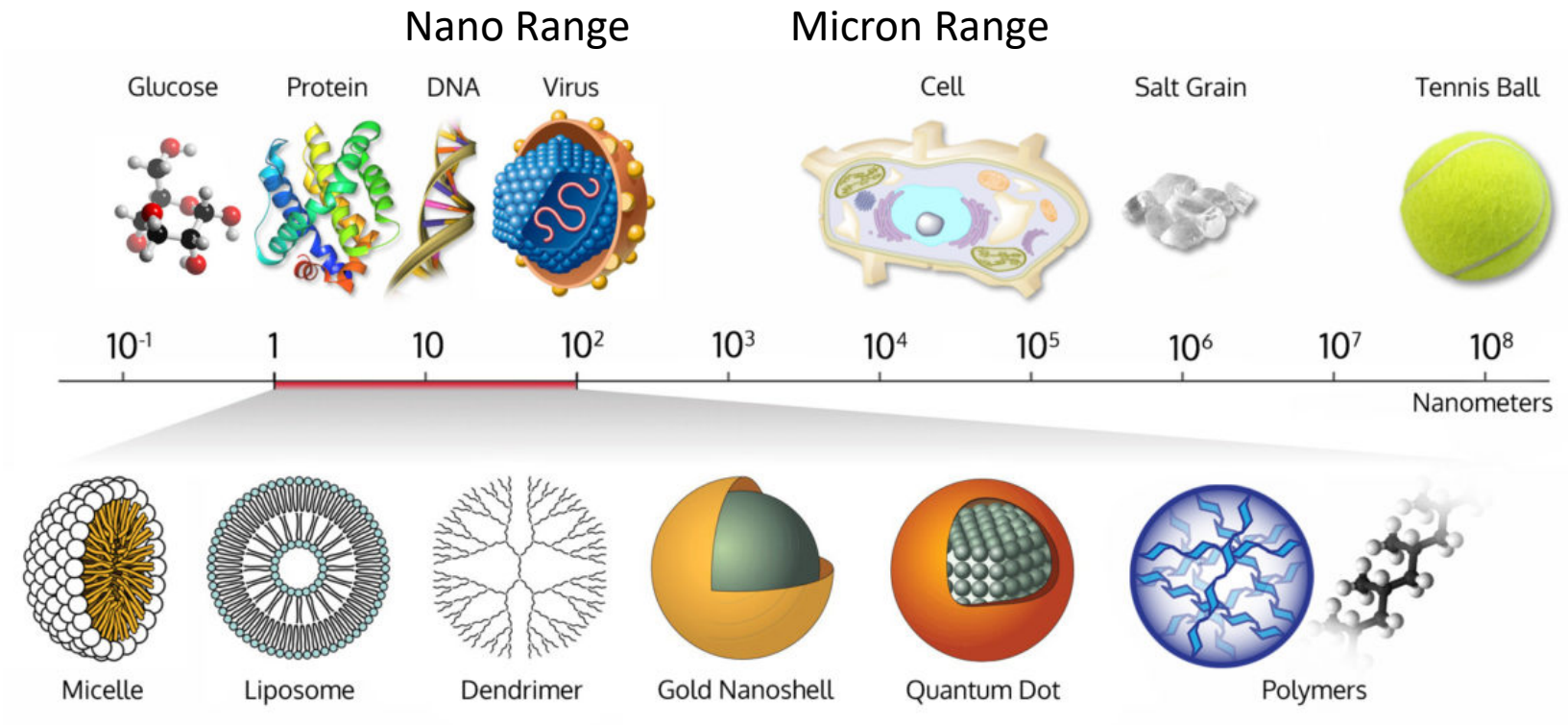


Converts to micro and nanoplastics over decades

"Anyone who believes that exponential growth can go on forever in a finite world is either a madman or an economist"
-Kenneth Boulding

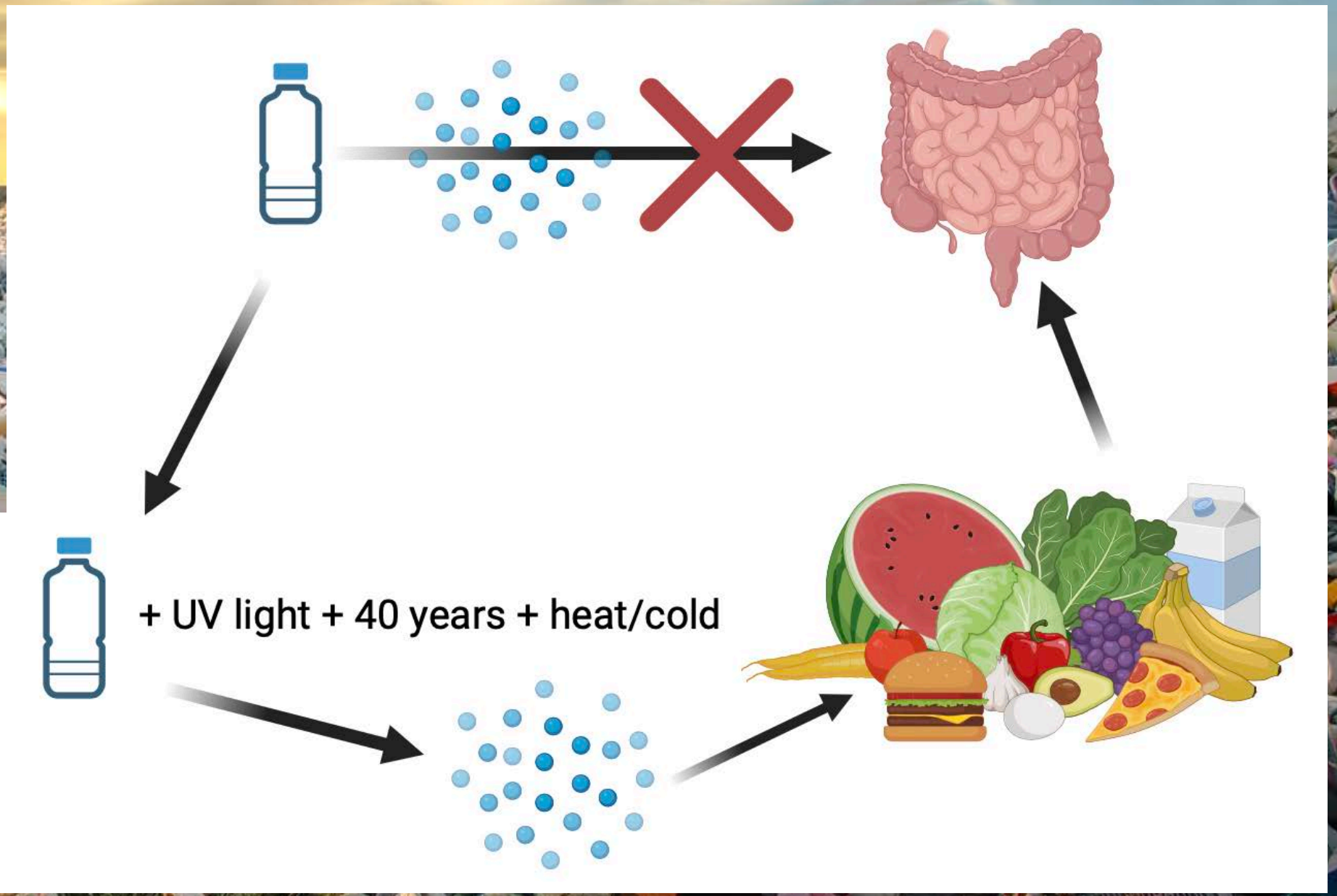
”Microplastics” include even smaller nanoparticles



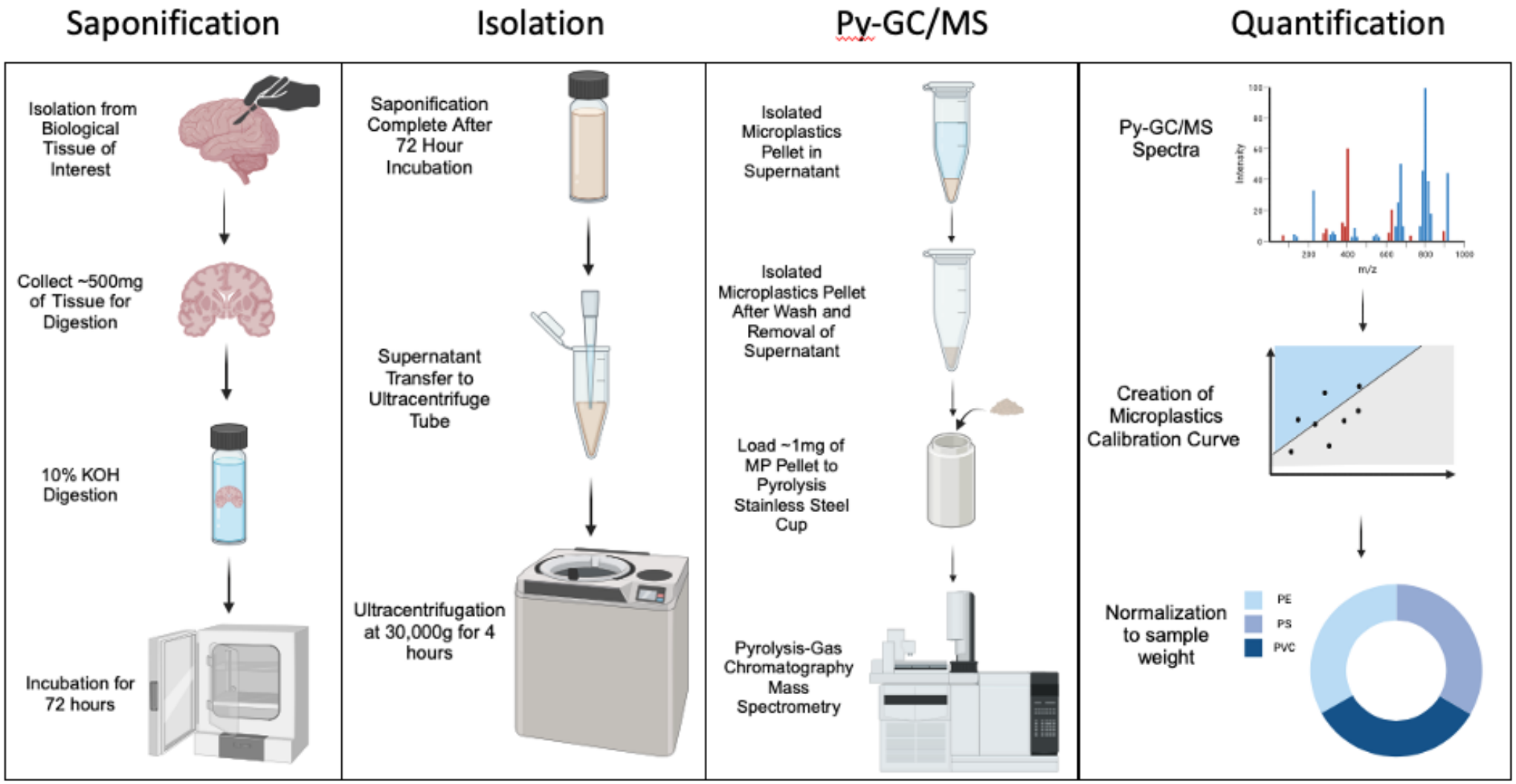


https://www.wichlab.com/nanometer-scale-comparison-nanoparticle-size-comparison-nanotechnology-chart-ruler-2/

Microplastics are **not** shed from fresh plastics



Process to fully quantify nano- and micro plastics in tissues



Process of turning organs into soap! Leaves plastics intact

Spinning pulls solids to the bottom of the tube, biological material is removable

Specific polymers combust at specific temperatures

Specific polymers have specific mass spectra!

Py-GC/MS Assessment of Total Plastics in Placentas reveals another level of concern…

- **Measurable in all samples tested**

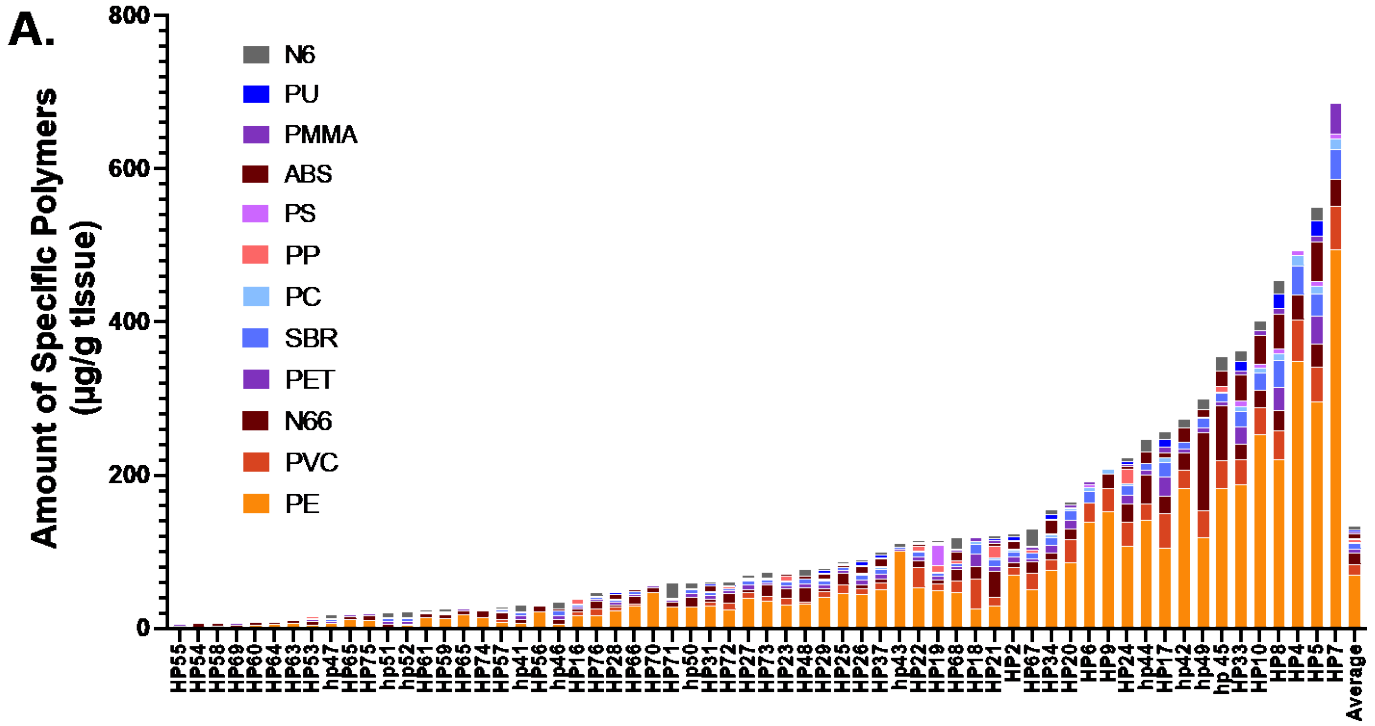
Marcus Garcia, PharmD
ASERT Fellow
College of Pharmacy

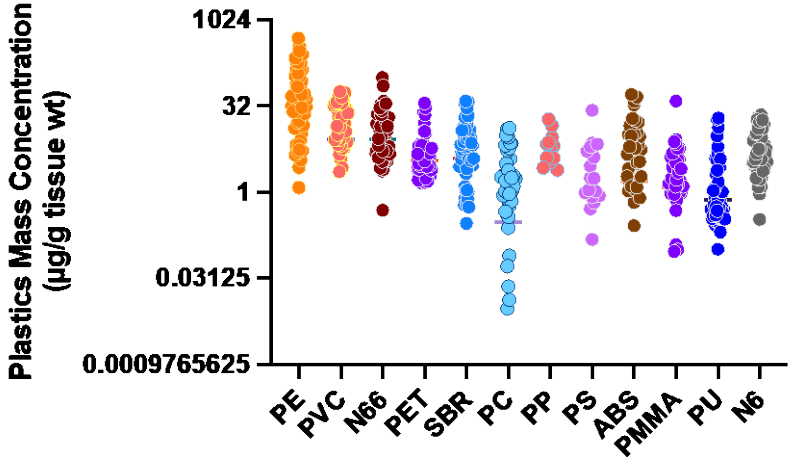
JOURNAL ARTICLE FEATURED

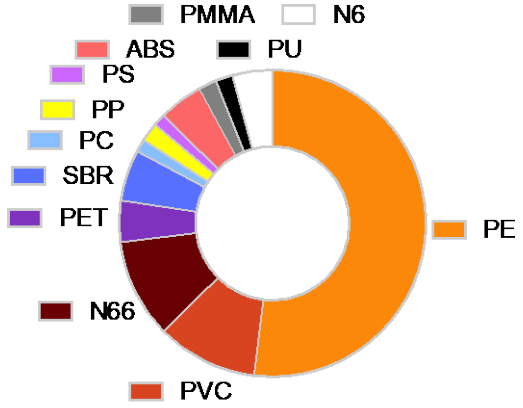
Quantitation and identification of microplastics accumulation in human placental specimens using pyrolysis gas chromatography mass spectrometry

Marcus A Garcia, Rui Liu, Alex Nihart, Eliane El Hayek, Eliseo Castillo, Enrico R Barrozo, Melissa A Suter, Barry Bleske, Justin Scott, Kyle Forsythe ... Show more

Toxicological Sciences, Volume 199, Issue 1, May 2024, Pages 81–88,
https://doi.org/10.1093/toxsci/kfae021
Published: 17 February 2024 **Article history** ▾

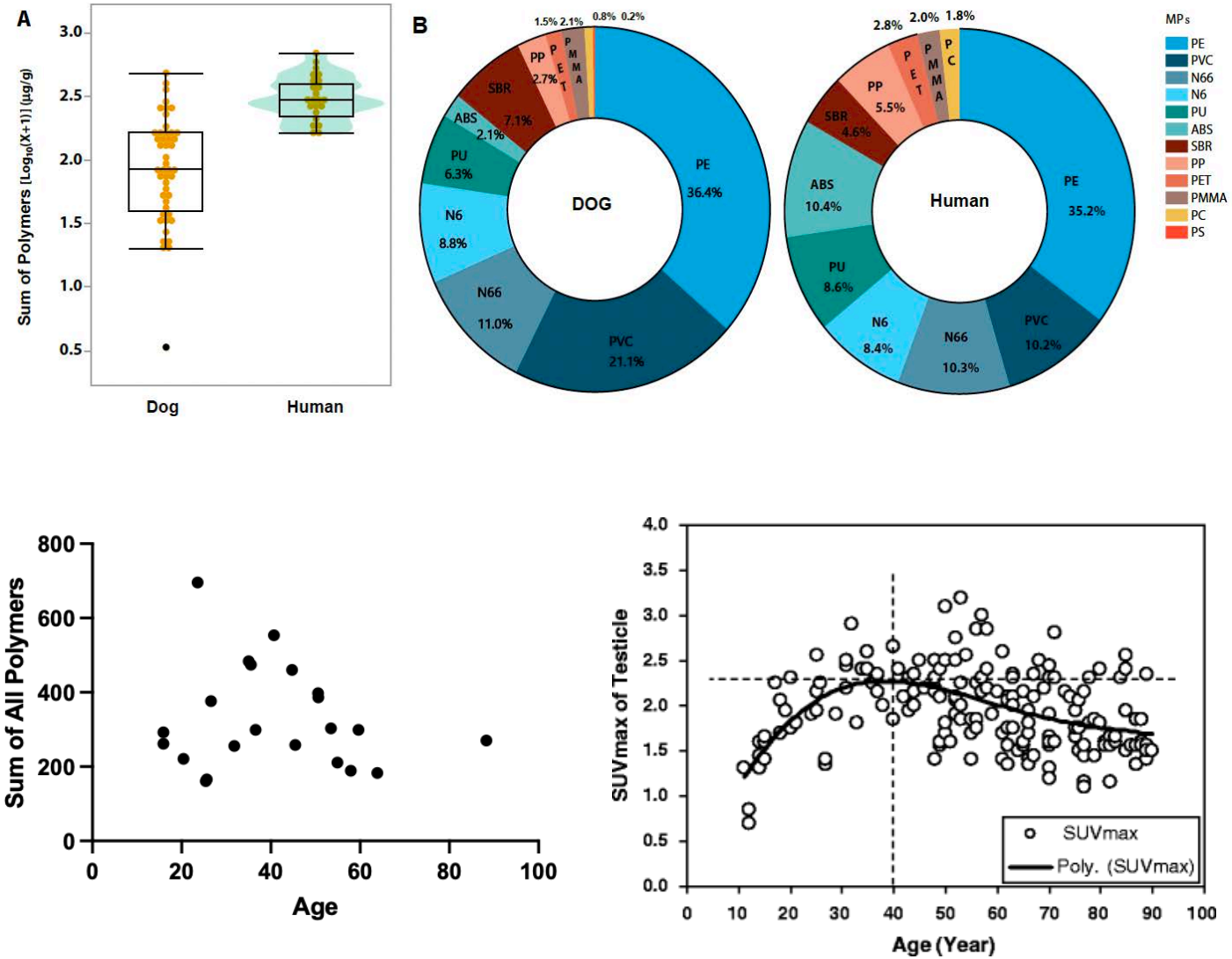






Plastics concentrations in human testes are dynamic with age

Xiaozhong Yu, MD, PhD
Professor
UNM College of Nursing

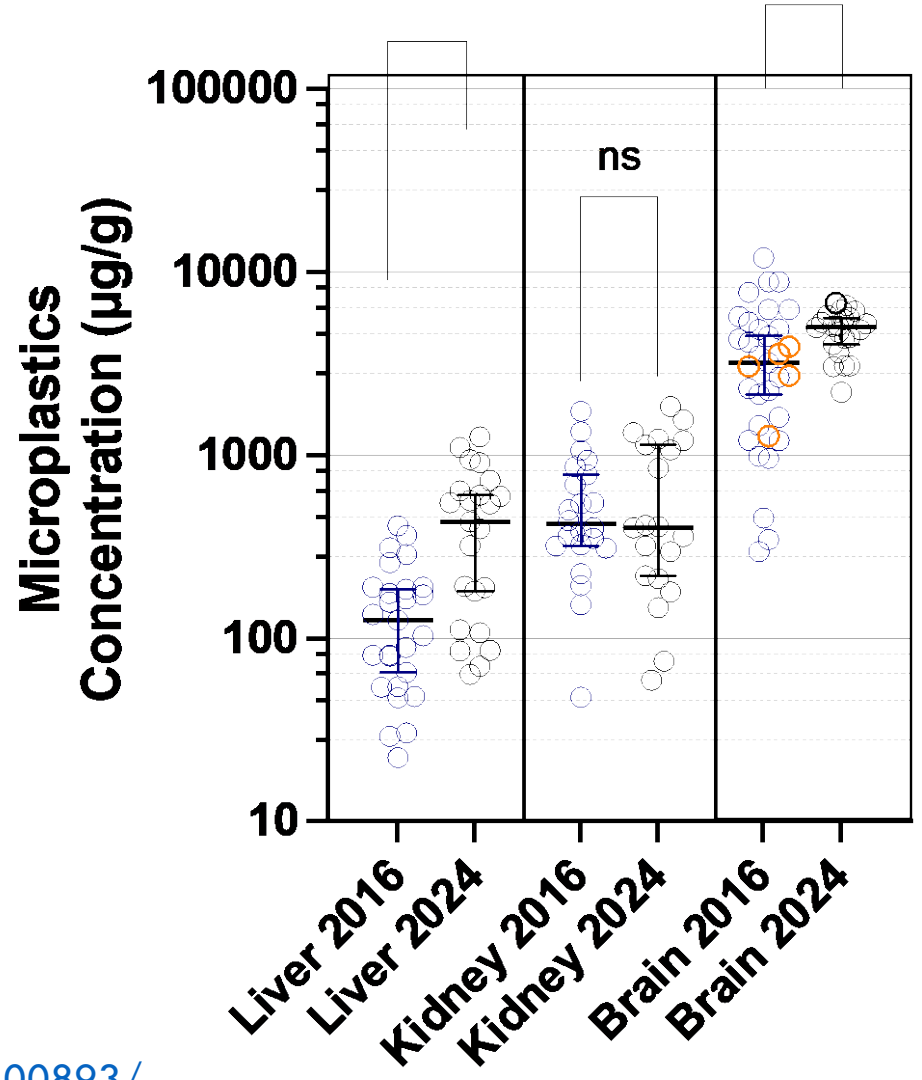


Hu et al., In press, *Toxicological Sciences*, 2024

Comparison of microplastics across organ systems from decedents

Broader systemic distribution

- Samples from decedents (deceased humans from the Office of the Medical Investigator)
  - Liver
  - Kidney
  - Brain (Frontal cortex)
- Samples collected in 2016 and 2024 for comparison across an 8-year gap
- Initial data confirm significant presence of plastics in all organs measured
- **Orange:** independently run in a separate lab (OSU)

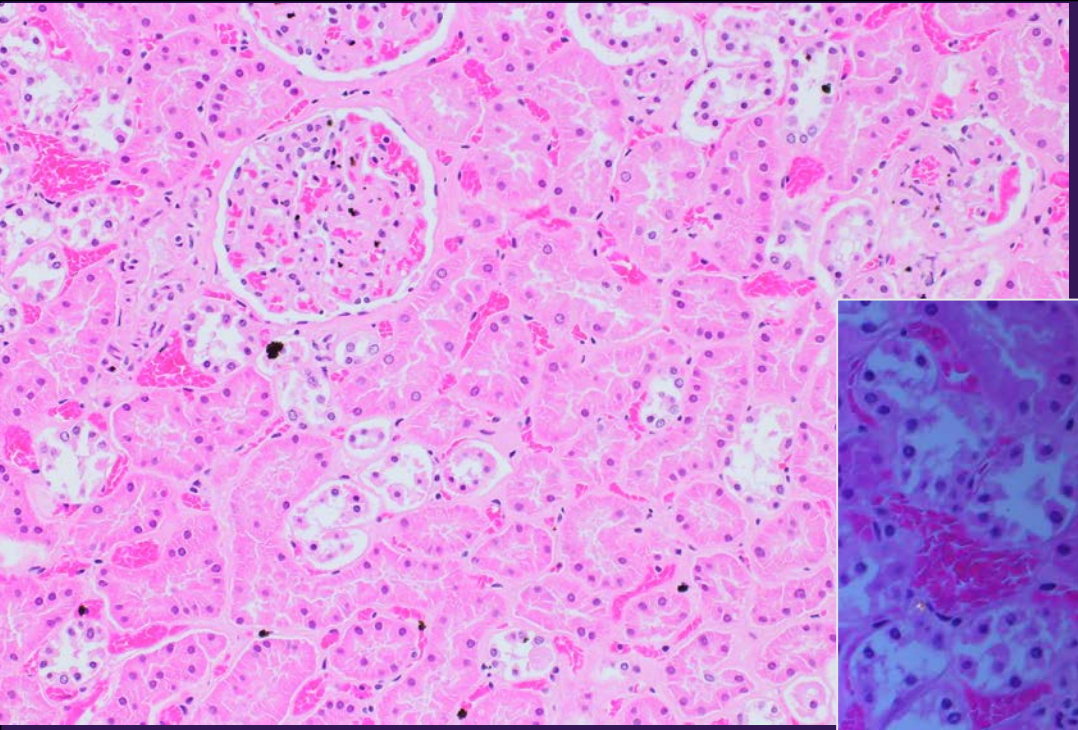


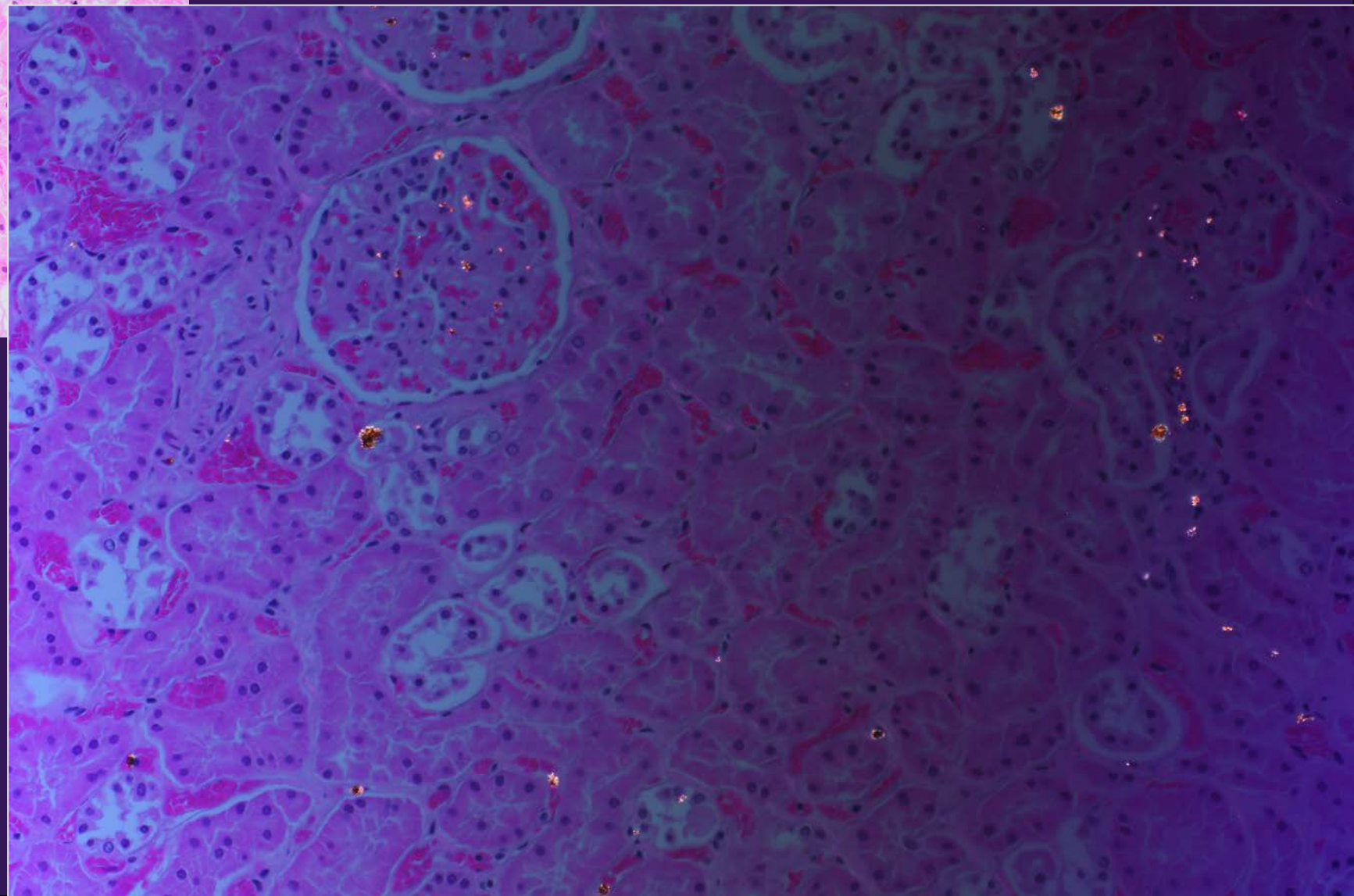
Alex Nihart
PharmD Candidate
UNM College of Pharmacy

Natalie Adolphi, PhD
and
Daniel Gallego, M.D.
Forensic Pathologist
New Mexico Office of the Medical Investigator

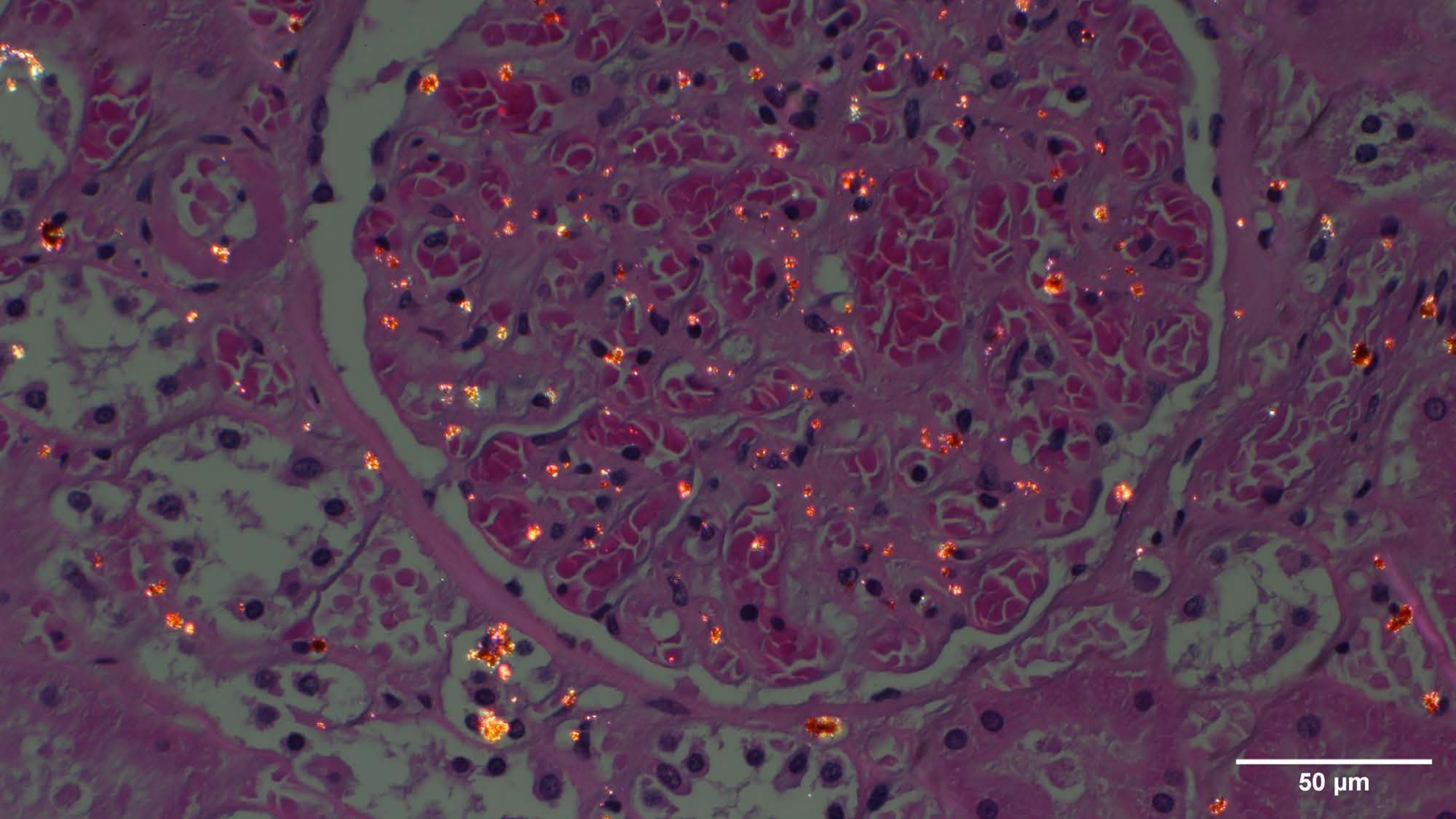
Preprint
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11100893/

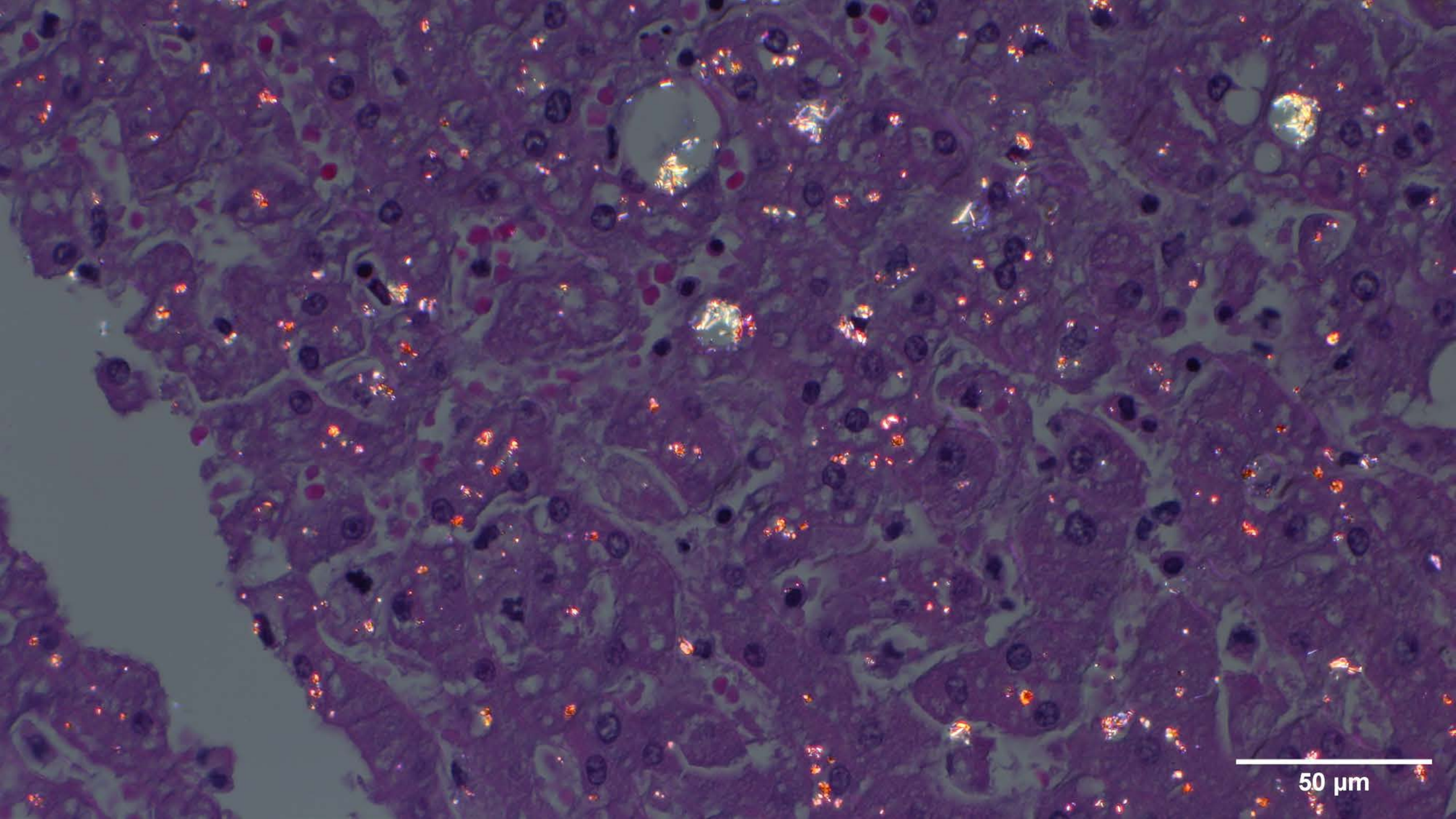
Kidney



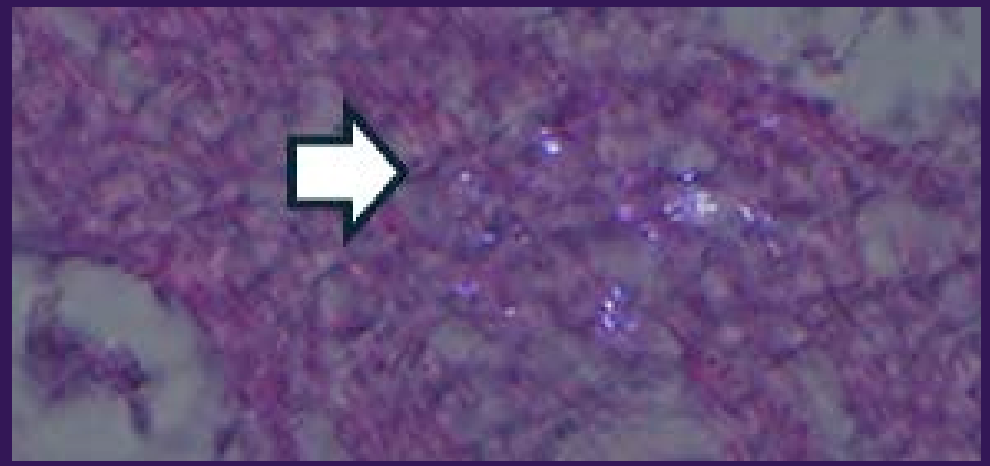


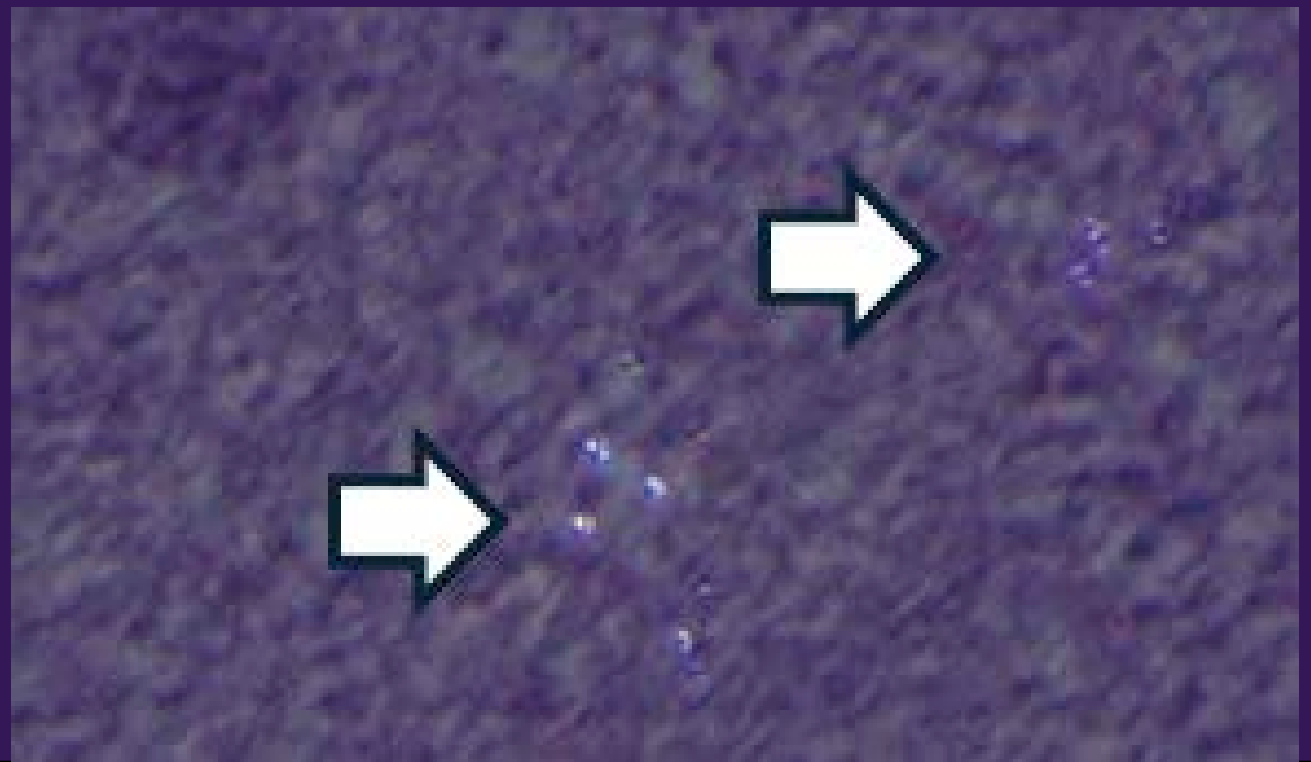
Rama Gullapalli, MD, PhD
Clinical Assistant Professor
School of Medicine

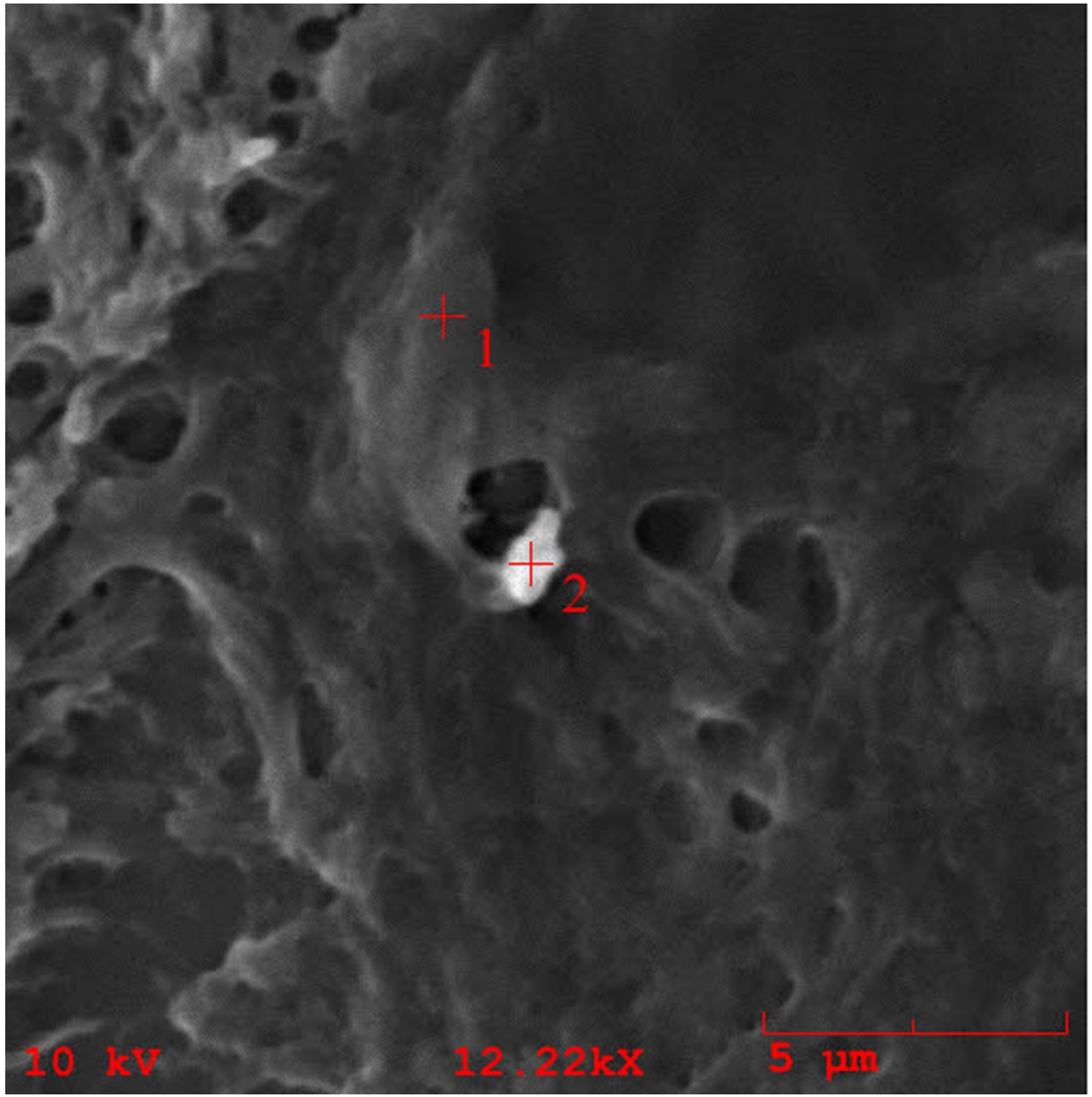

50 µm

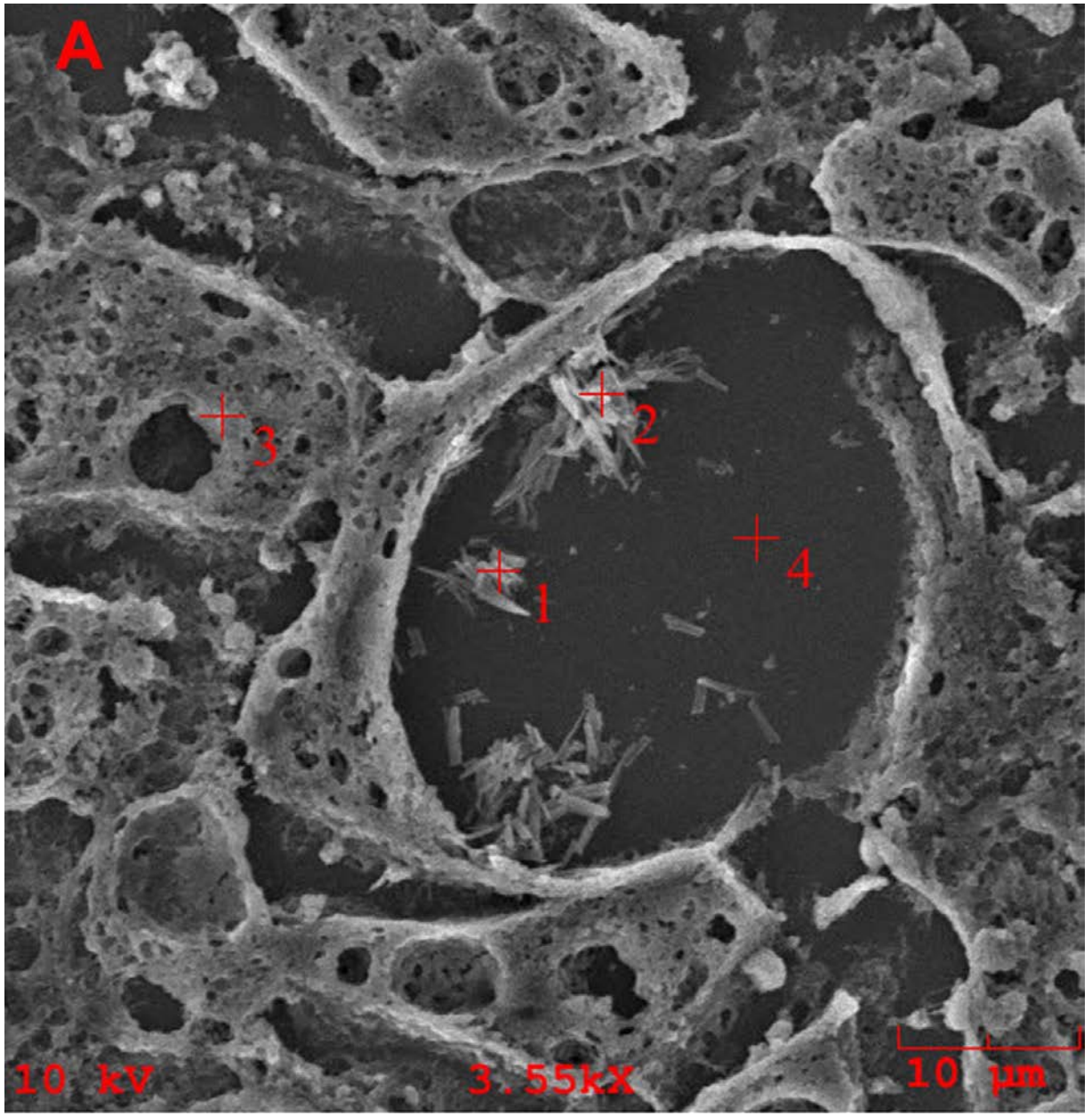

50 µm

Brain



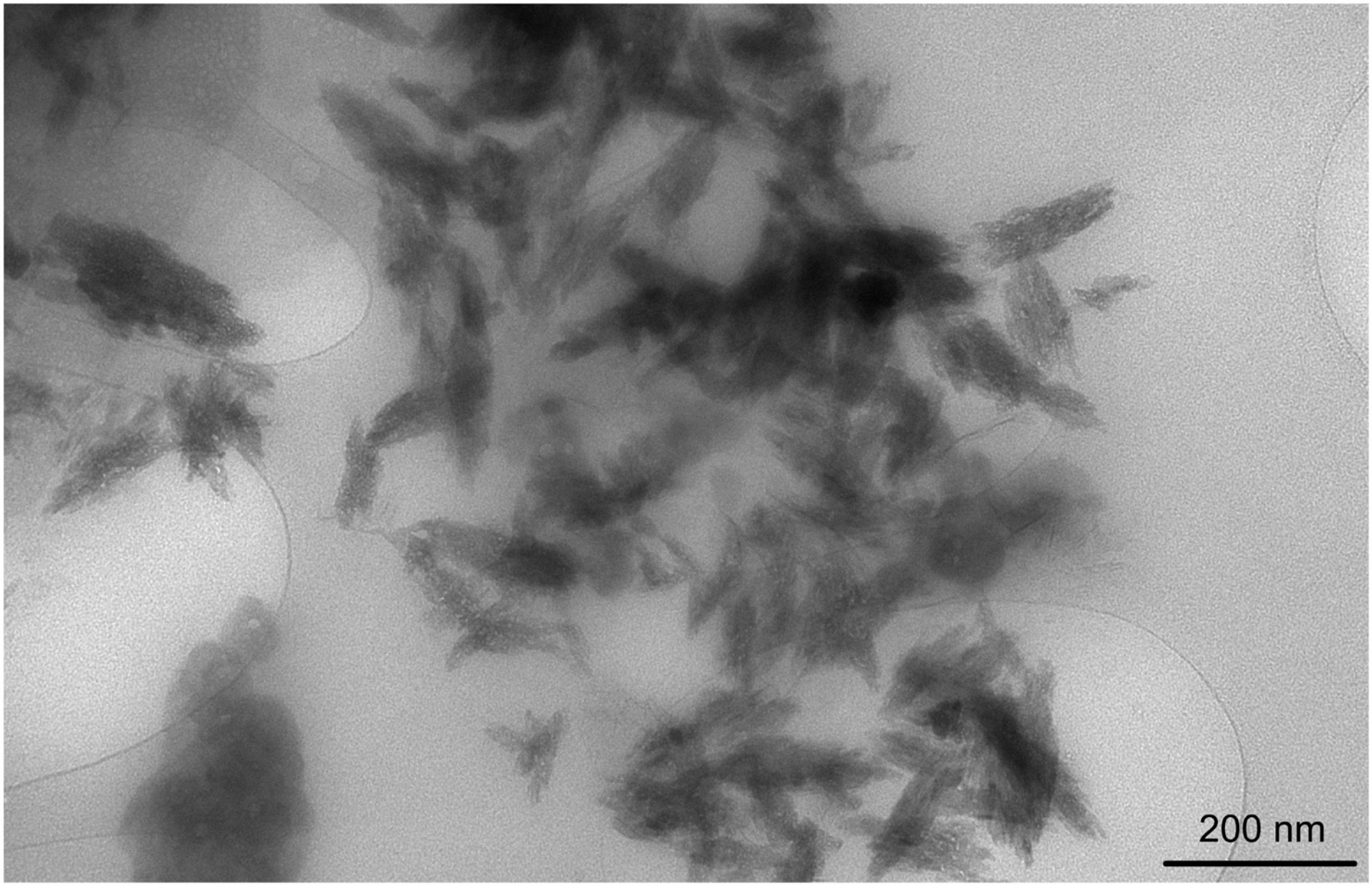


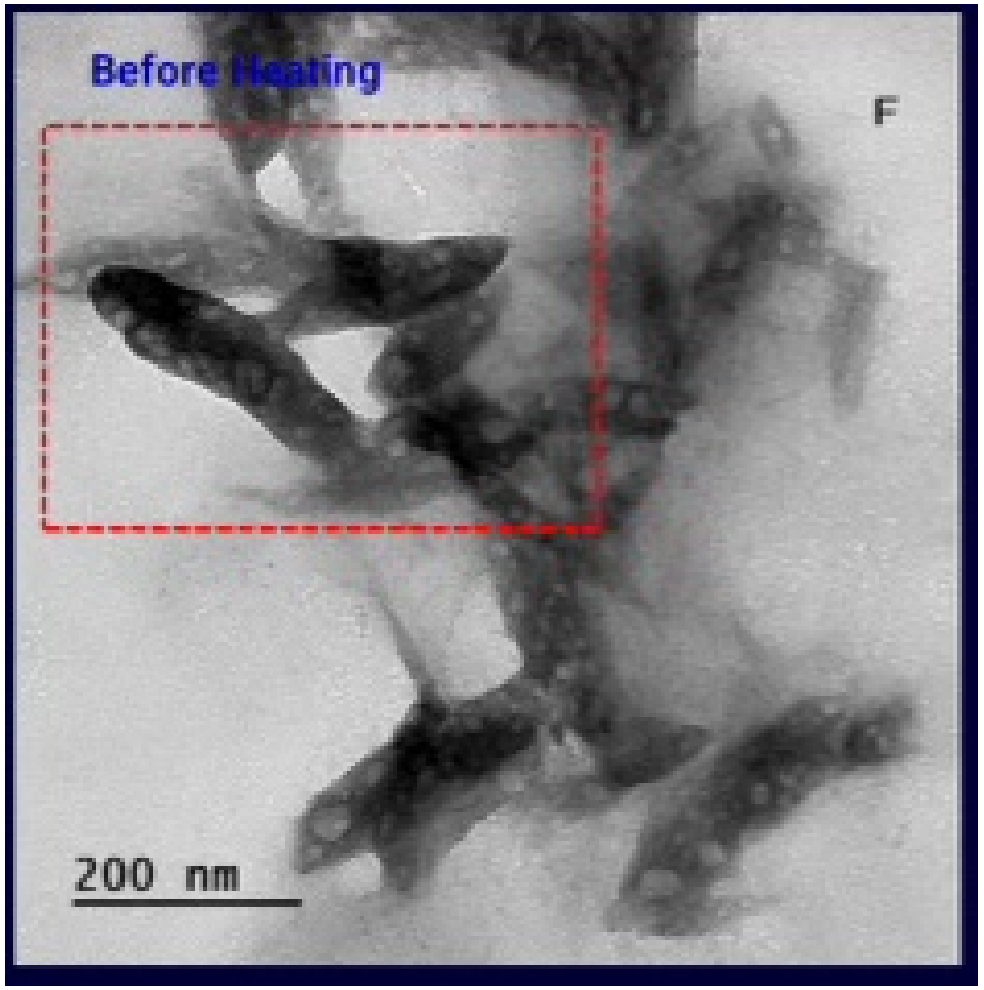

1
2
10 kV
12.22kX
5 µm

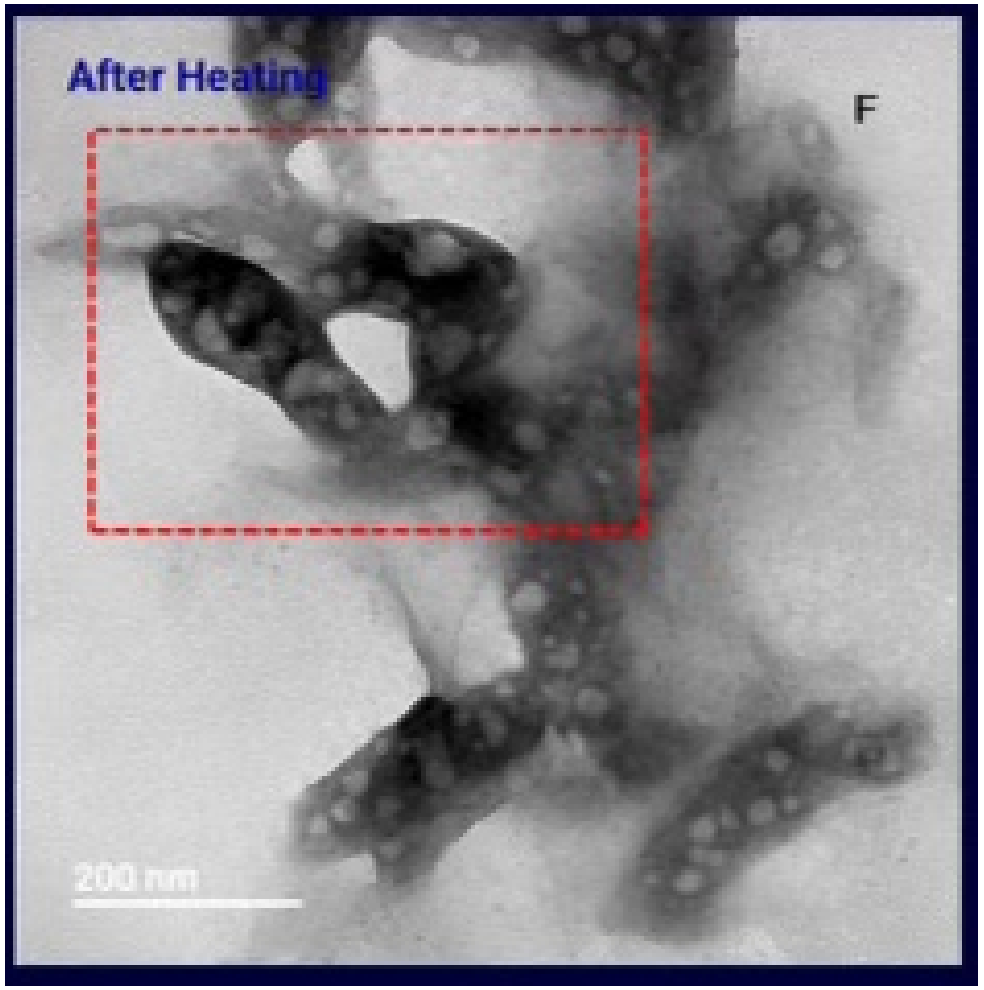

A
3
2
4
1
10 kV
3.55kX
10 µm

TEM imaging of particles from isolated pellets

Eliane El Hayek, PhD
Research Assistant Professor
College of Pharmacy




Before Heating
F
200 nm


After Heating
F
200 nm

The final revelation:
We are really, really late to the game

Natural Resources for Human Health

visagaa publishing house

Original Research

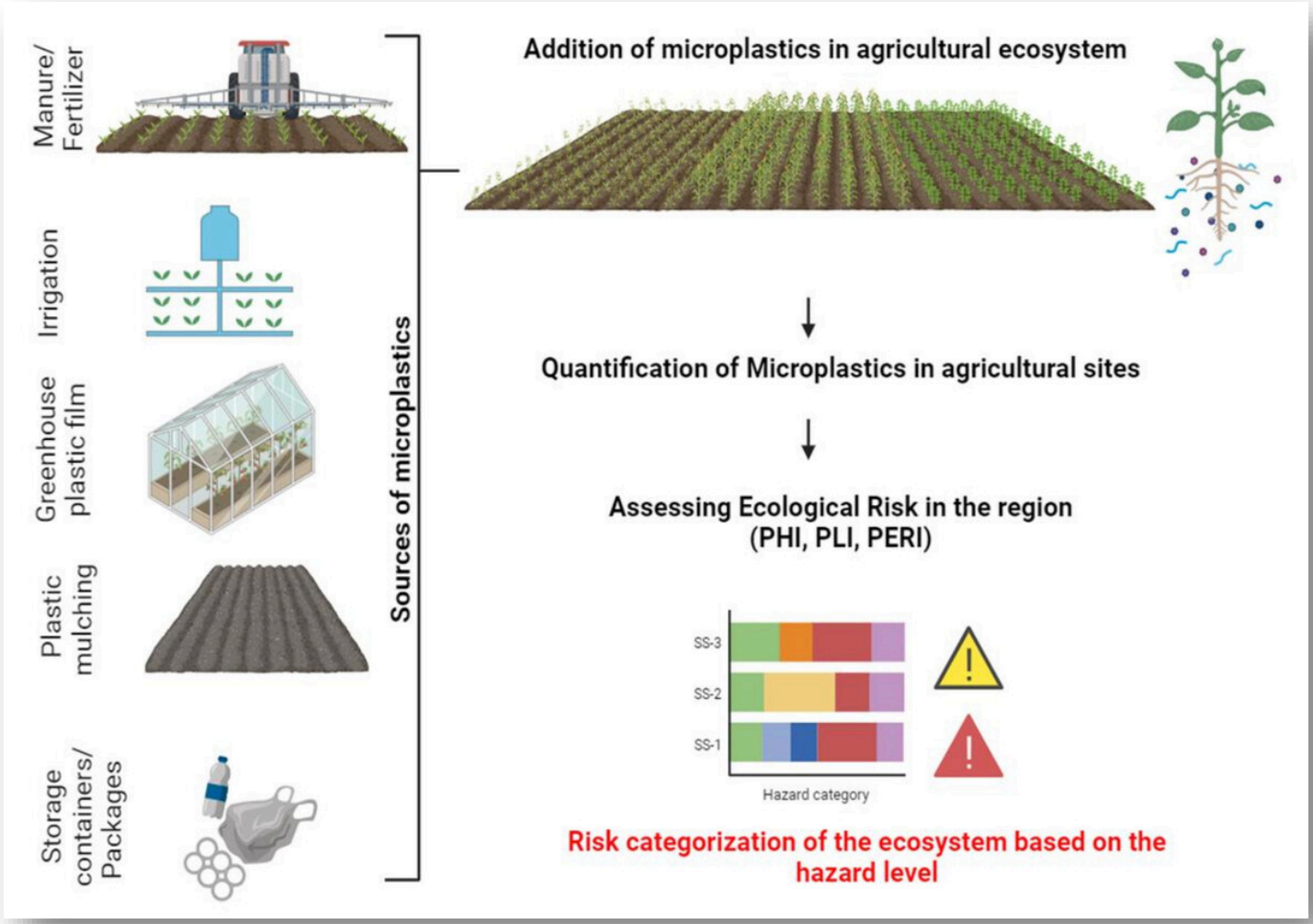
View Article Online

Check for updates

Received 12 January 2024
Revised 31 January 2024
Accepted 12 February 2024

Ecological risk assessment of microplastics in agricultural soils of Coimbatore region, India

Karthika Sangilidurai [1], Sivasubramanian Karuppusamy [1,*], Dhevagi Periyasamy [1], Rajkishore Subramani Krishnaraj [1], Chitra Narayanasamy [2], Lakshmanan Arunachalam [3], Dinesh Govindaraj Kamalam [4, 5]



Concluding thoughts

Nanoplastics are here, ubiquitous, and exponentially accumulating in the environment

They are clearly present throughout the human body, selectively taken up into the brain and other lipid-rich areas

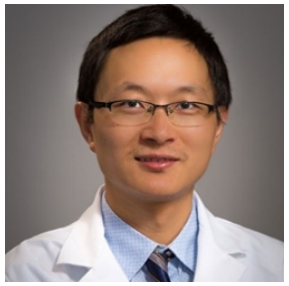
The predominant form of plastics in human samples appears to be nanoshards, which have not been described in the literature to date

New technology for detection, quantitation, and removal is needed urgently to address these unique shapes and sizes

Organ (normal decedent)	Mean Concentration (µg/g)
Placenta	110
Testes	329
Liver	465
Kidney	660
Brain	4800

Eliane El Hayek, PhD
Research Assistant Professor
College of Pharmacy

Eliseo Castillo, PhD
Associate Professor
Internal Medicine, Div of Gastroenterology



Xiang Xue, PhD
Assistant Professor
Biochemistry & Molecular Biology

Marcus Garcia, PharmD
ASERT Fellow
College of Pharmacy

Alex Nihart
PharmD Candidate
UNM College of Pharmacy

Xiaozhong Yu, MD, PhD
Professor
College of Nursing

Jose Cerrato, PhD
Associate Professor
Civil Engineering
Director, Superfund Center

Jorge Gonzalez Estrella, PhD
Assistant Professor
Civil Engineering
Oklahoma State University

Deb Mackenzie, PhD
Res Assistant Professor
Director, Environmental Health Disparities P50

Natalie Adolphi, PhD
and
Daniel Gallego, M.D.
Forensic Pathologist
New Mexico Office of the Medical Investigator
Also from OMI
Heather Jarrell, MD
Gabrielle Dvorscak
Maria Gomez Zuluaga

Lillian Chhoak
PharmD Candidate
UNM College of Pharmacy

Rama Gullapalli, MD, PhD
Clinical Assistant Professor
School of Medicine

Rui Liu, PhD
Research Scientist
College of Pharmacy

Aaron Erdely, PhD
Scientist, NIOSH

Key Contributors: The real heroes of this story