NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE | Nanyang Environment and Water Research Institute

Bioaccumulation and Toxicological Pathways of Micro- and Nano-plastics in Aquatic Food Systems

Abstract:
The increasing prevalence of micro- and nanoplastics (MNPs) in marine environments has raised growing concerns about their entry into the human food chain, particularly through seafood consumption. Singapore presents a compelling case for studying MNPs in seafood due to its high per-capita seafood intake, strong reliance on imported and locally farmed marine products, and its location within heavily trafficked and urbanized coastal waters of Southeast Asia. As a global shipping hub with dense maritime activities, Singapore's surrounding marine environment is potentially exposed to significant plastic inputs, increasing the likelihood of MNPs contamination in commercially important seafood species.

Investigating the presence, abundance, and characteristics of MNPs in seafood consumed in Singapore is therefore essential for assessing potential dietary exposure risks, informing food safety regulations, and supporting evidence-based policies aimed at protecting public health and ensuring the sustainability of marine resources.

Characterization:
This project will establish a matrix-informed analytical and toxicological framework followed by a series of biological and toxicological experiments including:

1) Fish and human cell lines will be used to assess MNP toxicity and size-dependent cellular uptake.
2) Key toxicological endpoints will be evaluated using established biochemical and imaging-based assays.
3) Priority MNP types and sizes identified from baseline contamination will establish quantitative exposure-response relationships.
4) Raw aquatic food tissues will be examined for histological and cellular changes and correlated with measured MNP levels to assess potential biological effects in aquatic organisms.

The MNPs problem in aquatic food

- Ubiquitous in water & bioaccumulation in aquatic food
- Challenges in
  - Efficient sample processing
  - Quantitative detection in food matrices
  - Elucidation of potential toxicities

Our approach to solution

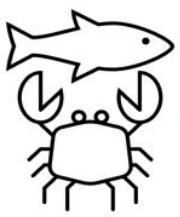
- State-of-the-art instruments utilized for detection of different sizes of MNPs
- Optimize workflow for different aquatic food matrices
- Elucidate matrix-dependent retention and transformation of MNPs
- Establish exposure-response relationship based cellular toxicities and MNPs exposure

Detection and Characterization of MNPs

LDIR | Pyrolysis-GC-MS | FTIR with micro-tip ATR

Cell Assays for Toxicity and mechanistic insights

Multimode plate reader | Automated imager



- Baseline contamination level of MNPs in local aquatic food
- Effect of matrix composition on the bioaccumulation of MNPs
- Toxicities examination of samples with concerning levels of MNPs

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