Risks of micro and nanoplastics to the food chain

(SciCom 2024/05)

FASFC and SciCom

The Federal Agency for the Safety of the Food Chain (FASFC) is the authority tasked with ensuring the quality and safety of foodstuffs in Belgium. It is responsible for the assessment and management of risks that may be harmful to the health of consumers as well as the health of animals and plants

SCIENTIFIC COMMITTEE
Federal Agency for the Safety of the Food Chain

The Scientific Committee (SciCom) is a consultative body established at the FASFC. It has a central position in the **assessment of the risks in the food chain**

SciCom functioning

The main task of the Scientific Committee is to provide **independent** scientific opinions in relation to **risk assessment** and **options for risk management** in the matters related to the competencies of the FASFC :

- ✓ (emerging) **Risks in the food chain** (food, feed, animal and plant health)
- ✓ All **draft laws and royal decrees** in relation to risk assessment and risk management of the food chain, animal health and plant protection
- ✓ The **analysis and inspection program of the FASFC**
- ✓ **Self-checking guides**

The Scientific Committee issues opinions on request

- Chief Executive Officer of the FASFC
- Minister in charge
- **On its own initiative (dossier "Risks of micro and nanoplastics to the food chain")**

SciCom 2024/05 – Risks of MNP to the food chain

Terms of reference (proposition) :

- Micro- and nanoplastics:
  - Type of hazard (physical/chemical)
  - Routes of introduction into the food chain
  - Processing/packaging effects
  - Microbiological or chemical hazard vectors
  - Toxicology
  - Occurrence and exposure data in the Belgian population.

- Can a health-based guidance value (HBGV) be established based on current knowledge? What are current analytical capabilities?

SciCom 2024/05 – Risks of MNP to the food chain

In recent years, several competent authorities have concentrated their efforts on different scientific opinions concerning MNP

The outcomes of these scientific opinions are usually inconclusive due to a **lack of pertinent data** and **analytical capabilities**


STATEMENT

EFSA Journal

ADOPTED: 11 May 2016

doi: 10.2903/j.efsa.2016.4501

Presence of microplastics and nanoplastics in food, with particular focus on seafood

EFSA Panel on Contaminants in the Food Chain (CONTAM)

Report of the Scientific Committee of the Spanish Agency for Food Safety and Nutrition (AESAN) on the presence and safety of plastics as contaminants in food

Reference number: AESAN-2019-007

Report approved by the Scientific Committee in its plenary session on 26 November 2019


European Commission

Scientific Advice Mechanism (SAM)

Environmental and Health Risks of

Microplastic Pollution

Group of Chief Scientific Advisors

Scientific Opinion 6/2019

Independent Expert Report


VKM Report 2019: 16

Microplastics; occurrence, levels and implications for environment and human health related to food

Opinion of the Steering Committee of the Norwegian Scientific Committee for Food and Environment

→ A classical risk assessment or the establishment of a health-based guidance value for MNP is not yet possible

SciCom 2024/05 – Risks of MNP to the food chain

Different approach - Study of research gaps and data needed :

- Elaboration of a general list of the data needed, available, and missing in the scientific literature concerning MNP

- Elaborate a system to quantify and score missing data in order to identify the areas of MNP research where more efforts are currently needed to achieve risk assessment in the shortest possible time and with the greatest possible certainty

  ↳ Evaluation of the necessary criteria to reach a classical risk assessment

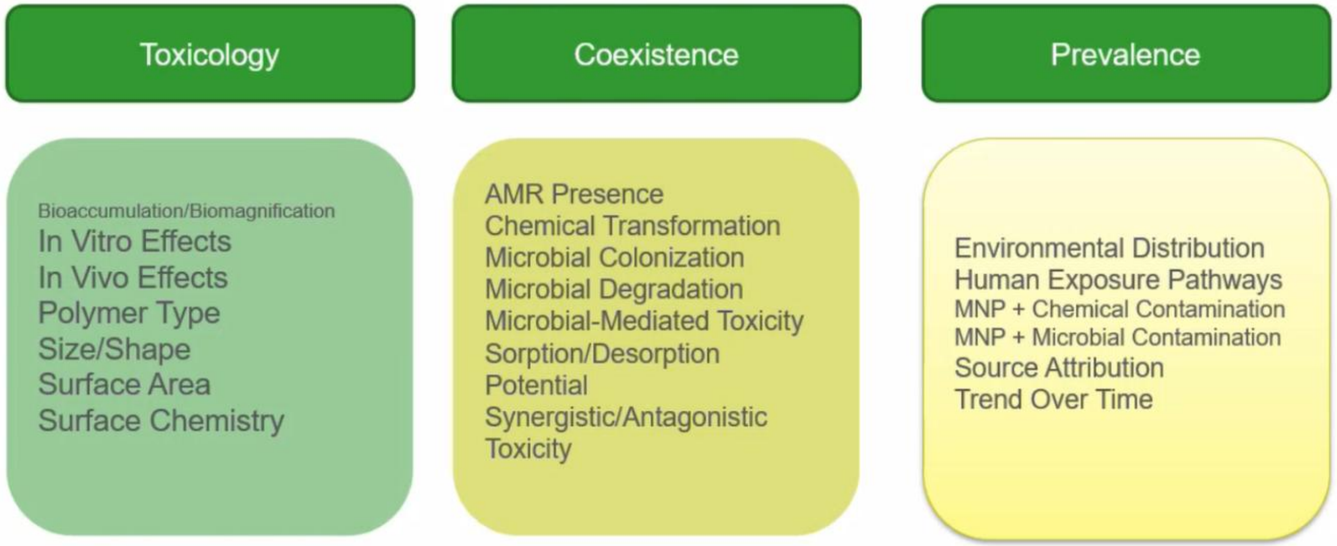
  ↳ Establishment of a risk assessment score

SciCom 2024/05 – Risks of MNP to the food chain

Multi-scoring system

- Intended as a tool to support the risk assessment of MNP by integrating toxicological potential, co-contaminant interactions, and exposure relevance
  It aids in prioritizing research, regulatory actions, and monitoring needs

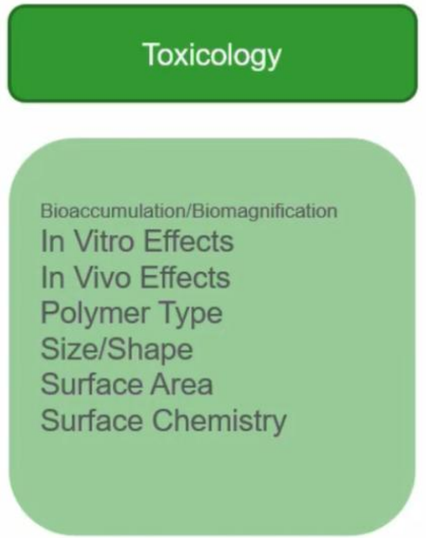
- The criteria are divided into three main pillars:



SciCom 2024/05 – Risks of MNP to the food chain

Multi-scoring system

Each criterion is assigned a risk score related to food safety, depending on its characteristics



Toxicology

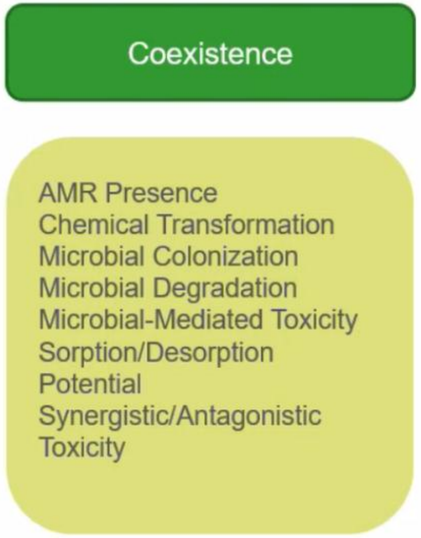
Criterion	Score	Definition
Size/Shape	0	Particles >100 µm or spherical/rounded; low cellular uptake expected
Size/Shape	1	Particles 10–100 µm or irregular shapes; potential for ingestion or limited uptake
Size/Shape	2	Particles <10 µm or fibrous/needle-like; high likelihood of tissue penetration or cellular uptake
Polymer type	0	Known low-toxicity polymers (e.g., PE, PP) with low additive load
Polymer type	1	Moderate concern polymers (e.g., PET, PS) or some additive presence
Polymer type	2	Polymers with known harmful additives (e.g., PVC, PU) or degradation byproducts
Polymer type	3	Polymers linked to specific toxic effects or endocrine disruption (e.g., heavily plasticized PVC, PC with BPA)
Surface area	0	Low surface-to-volume ratio (large, smooth particles)
Surface area	1	Moderate surface area (e.g., fragmented surfaces, rough textures)
Surface area	2	High surface-to-volume ratio (e.g., nano-sized, porous, fibrillar)
Surface Chemistry	0	Chemically inert, uncharged, no additives
Surface Chemistry	1	Slightly reactive or mildly hydrophobic/hydrophilic
Surface Chemistry	2	Charged, hydrophobic, or containing known toxic additives (e.g., plasticizers, dyes)
Surface Chemistry	3	Highly reactive, contains multiple harmful additives, or capable of catalysis or ROS production
In-vivo effects	0	No significant effects in cell models
In-vivo effects	1	Mild cytotoxicity or inflammatory markers at high concentrations
In-vivo effects	2	Moderate effects at environmentally relevant doses (e.g., oxidative stress, apoptosis)
In-vivo effects	3	Strong effects at low doses (e.g., immune activation, genotoxicity)
In-vivo effects	0	No observed effects in whole organisms
In-vivo effects	1	Sublethal effects (e.g., behavioral changes, weight loss)
In-vivo effects	2	Reproductive or immunological effects
In-vivo effects	3	Severe outcomes (e.g., carcinogenicity, organ damage, translocation to tissues)
In-vivo effects	0	No accumulation or trophic transfer observed
In-vivo effects	1	Detected in organism but not in higher trophic levels
In-vivo effects	2	Bioaccumulation within organism (e.g., liver, gut), some trophic transfer
In-vivo effects	3	Strong evidence for biomagnification and persistence through food chain

sciensano

SciCom 2024/05 – Risks of MNP to the food chain

Multi-scoring system

Risk Assessment Score X Evidence Score = Combined Score



Coexistence

sciensano

Criterion	Score	Definition	Evidence Score	Combined Score
Sorption/Desorption Potential	0	No sorption of contaminants; chemically inert surface		0
Sorption/Desorption Potential	1	Moderate sorption; selective binding of some hydrophobic/charged pollutants		0
Sorption/Desorption Potential	2	High sorption affinity for multiple contaminants; demonstrated desorption in simulated biological fluids (e.g., gut juice, mucus)		0
Chemical Transformation	0	No evidence of transformation or catalytic activity		0
Chemical Transformation	1	Minor transformation of contaminants (e.g., oxidation, photolysis)		0
Chemical Transformation	2	Significant transformation altering toxicity, stability, or mobility of bound chemicals		0
Synergistic/Antagonistic Toxicity	0	No additive or interactive effect observed		0
Synergistic/Antagonistic Toxicity	1	Minor interaction effects (additive or antagonistic) in vitro or in vivo		0
Synergistic/Antagonistic Toxicity	2	Synergistic toxicity (i.e., combined effect > sum of individual effects) at moderate concentrations		0
Synergistic/Antagonistic Toxicity	3	Strong synergistic effects at low concentrations or across multiple biological systems (e.g., endocrine, immune, neurological)		0
Microbial Colonization	0	No colonization observed		0
Microbial Colonization	1	Sparse colonization; isolated colonies (<10^2 CFU/cm² or similar microscopic observation)		0
Microbial Colonization	2	Moderate colonization; developing biofilm or mixed community (10^2–10^5 CFU/cm²)		0
Microbial Colonization	3	Dense colonization; structured or diverse biofilm with clear community formation (>10^5 CFU/cm², multiple species, sequencing confirmed diversity)		0
AMR Presence	0	No antibiotic resistance genes or phenotypes detected		0
AMR Presence	1	One AMR gene or resistant species (e.g., basic resistance to a single antibiotic)		0
AMR Presence	2	Multiple AMR genes or strains; no horizontal gene transfer shown		0
AMR Presence	3	Clinical relevance: multi-drug resistant strains, gene transfer potential (e.g., plasmid-borne), confirmed risk to human/animal health		0
Microbial Degradation	0	No evidence of microbial degradation		0
Microbial Degradation	1	Partial degradation by known microbial strains (e.g., PETase activity)		0
Microbial Degradation	2	Efficient or broad-spectrum microbial degradation; biodegradation of multiple polymer types or full breakdown products identified		0
Microbial-Mediated Toxicity	0	No added toxicity due to associated microbes		0
Microbial-Mediated Toxicity	1	Microbial colonization alters immune response mildly (e.g., increased cytokines)		0
Microbial-Mediated Toxicity	2	Microbial community presence enhances toxicity of MNPs or leads to gut/mucosal disturbances in animal models		0
Microbial-Mediated Toxicity	3	Clear amplification of toxicity (e.g., immune dysregulation, infection facilitation, gut microbiome disruption) from microbial-MNP interaction in vivo or human-relevant models		0

SciCom 2024/05 – Risks of MNP to the food chain

Multi-scoring system

The **evidence score** provides an indication of **how much data is available** concerning a given criterion (for example, the number of papers available on that specific topic), the **quality of the available data**, or both

Evidence Score (0–2) – Interpretation Guide

Score	Definition
0	No data available: No studies, reports, or monitoring data found. May indicate a data gap rather than absence of risk.
1	Limited data: One or two studies, case reports, or modeling data. Findings may be context-specific or uncertain.
2	Robust data: Multiple independent studies, monitoring datasets, or recognized evaluations (e.g., EFSA, WHO, national authorities). Data supports consistent interpretation.

SciCom 2024/05 – Risks of MNP to the food chain

Multi-scoring system

Independent scoring of both **risk potential** and **evidence strength** to distinguish between **established concerns** and **data gaps**.

Prevalence

sciensano

Criterion	Risk Score	Definition	Evidence Score (0-2)	Combined Score
MNP Contamination in Food	0	No detection of MNPs in food		0
MNP Contamination in Food	1	Trace amounts detected; rare product types or low frequency (<5% of samples)		0
MNP Contamination in Food	2	Moderate prevalence; common in some food groups (5–25% of samples)		0
MNP Contamination in Food	3	High prevalence across multiple food types; common detection (>25% of samples or high levels)		0
MNP + Microbial Contamination	0	No microbial presence detected on/in MNPs in food		0
MNP + Microbial Contamination	1	Sporadic detection; occasional biofilm-forming or culturable bacteria		0
MNP + Microbial Contamination	2	Moderate evidence of microbial co-contamination in multiple food types or studies		0
MNP + Microbial Contamination	3	Widespread detection; frequent microbial colonization (including AMR or high diversity) in food-based MNP samples		0
MNP + Chemical Contamination	0	No adsorbed or associated chemicals detected on MNPs in food		0
MNP + Chemical Contamination	1	Chemicals occasionally detected; low toxicological concern		0
MNP + Chemical Contamination	2	Known toxicants detected in several food samples (e.g., endocrine disruptors, metals)		0
MNP + Chemical Contamination	3	High prevalence of hazardous chemicals sorbed on MNPs across food types or in high concentrations		0
Source Attribution	0	No identifiable sources, or unclear origin		0
Source Attribution	1	Probable sources identified (e.g., packaging, wastewater) in some studies		0
Trend Over Time	0	No trend data available		0
Trend Over Time	1	Some evidence of increase or variable patterns across studies/years		0
Trend Over Time	2	Clear trend of increasing levels in environment or foods over time		0
Human Exposure Pathways	0	No identified pathways		0
Human Exposure Pathways	1	One or two plausible exposure routes (e.g., ingestion through specific food types)		0
Human Exposure Pathways	2	Multiple confirmed exposure routes (e.g., ingestion, inhalation, dermal in combination) in real-world settings or biomonitoring-supported scenarios		0
Environmental Distribution	0	No detection in environmental compartments (air, water, soil)		
Environmental Distribution	1	Detected in one compartment or limited geographic range		
Environmental Distribution	2	Detected in multiple compartments (e.g., water + soil) or several regions		
Environmental Distribution	3	Widespread presence across environmental compartments and global datasets		

The **combined score** is a **weighted parameter** of the risk and evidence scores.
It serves to **identify priority issues** for risk managers, researchers, and regulatory bodies

SciCom 2024/05

Risks of micro and nanoplastics to the food chain (self-tasking mandate)

Working Group members

SciCom members:	Johan Robbens *(Rapporteur)*, Nathalie Gillard, Bruno De Meulenaer, Marie-Louise Scippo, Isabel Van Driessche
External experts:	Mirjana Andjelkovic *(Sciensano)*, Tanja Cirkovic Velickovic *(University of Belgrade)*, Guillaume Duflos *(ANSES)*, Jan Mast *(Sciensano)*, Andreja Rajkovic *(UGent)*, Maaike Vercauteren *(UGent)*, Pascal Veys *(CRA-W)*
DirRisk experts:	O. Rojo Poveda *(FASFC, staff Direction for risk assessment)*