



**Safety**  
**Quality**  
**Traceability**

# Nanoparticles in food

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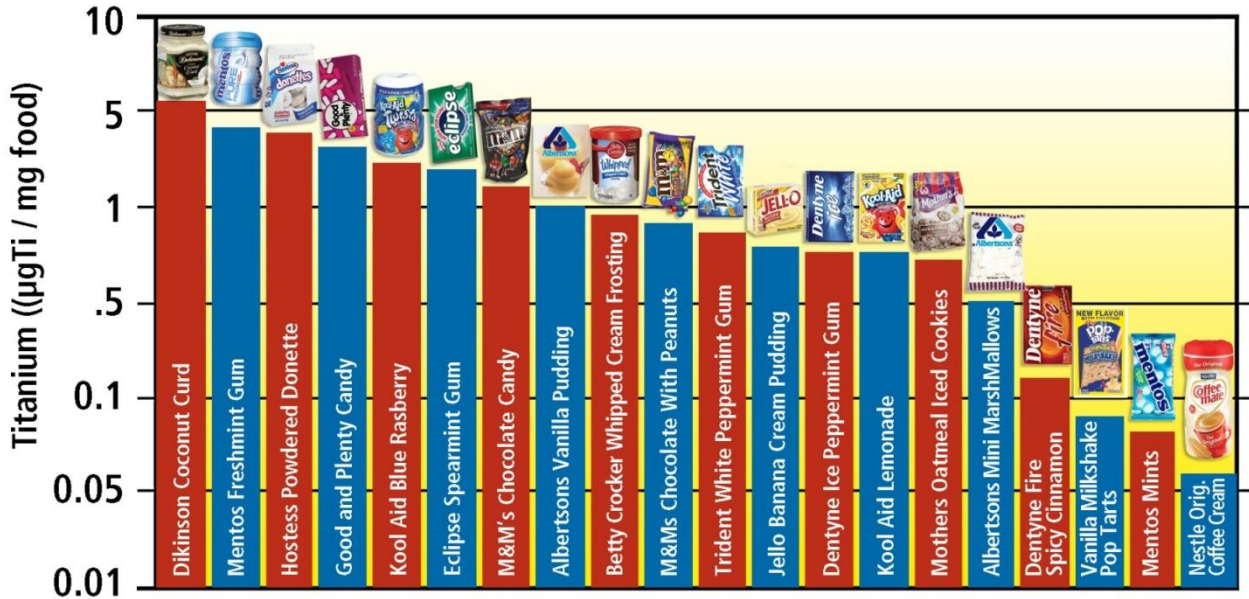
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# Definition

- ‘Nanomaterial’ means a natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1nm - 100nm (2011/696/EU).



Foods that contain titanium dioxide in nano form.

# Nanoparticles in food

- **Natural NPs**

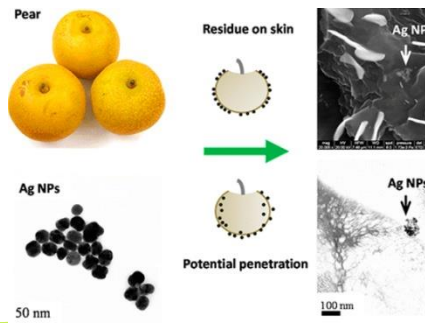
- **Intentionally added engineered NPs:** metal-based NPs (Ag-NP, TiO<sub>2</sub>-NP, ZnO-NP, Fe-NP)

- materials with new functionality (anti-caking, thickening and colouring agents)
- for antimicrobial activity
- for food conservation
- to help deliver nutrients (nanoencapsulation of food ingredients and additives)



- **NPs from contamination**

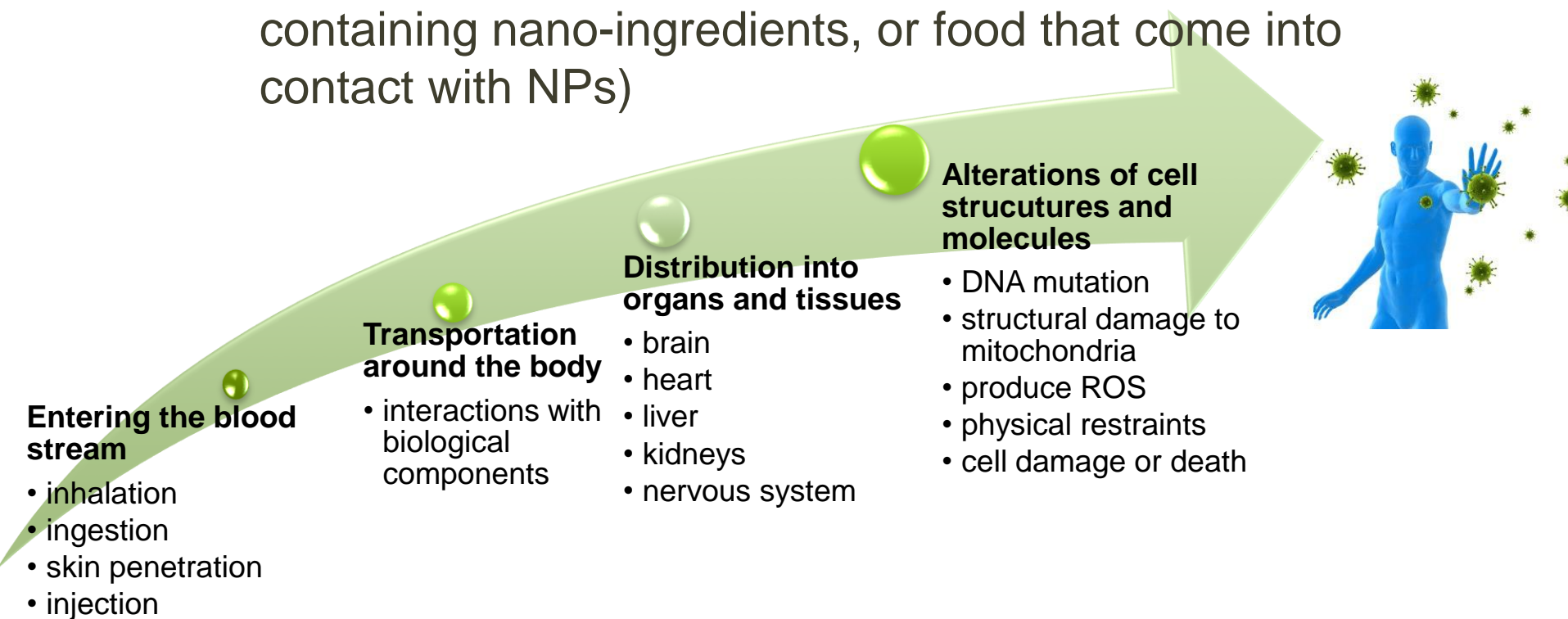
- during food preparation and processing
- potential migration of NPs from food packaging containing nanomaterials
- during agriculture production (nano-based pesticides)



# Exposure and health effects of NPs in food

Exposure to NPs through:

- Dermal contact
- Inhalation (atmospheric dust on food)
- Ingestion (consuming food and health supplements containing nano-ingredients, or food that come into contact with NPs)



# Challenges in analysis of NPs in food

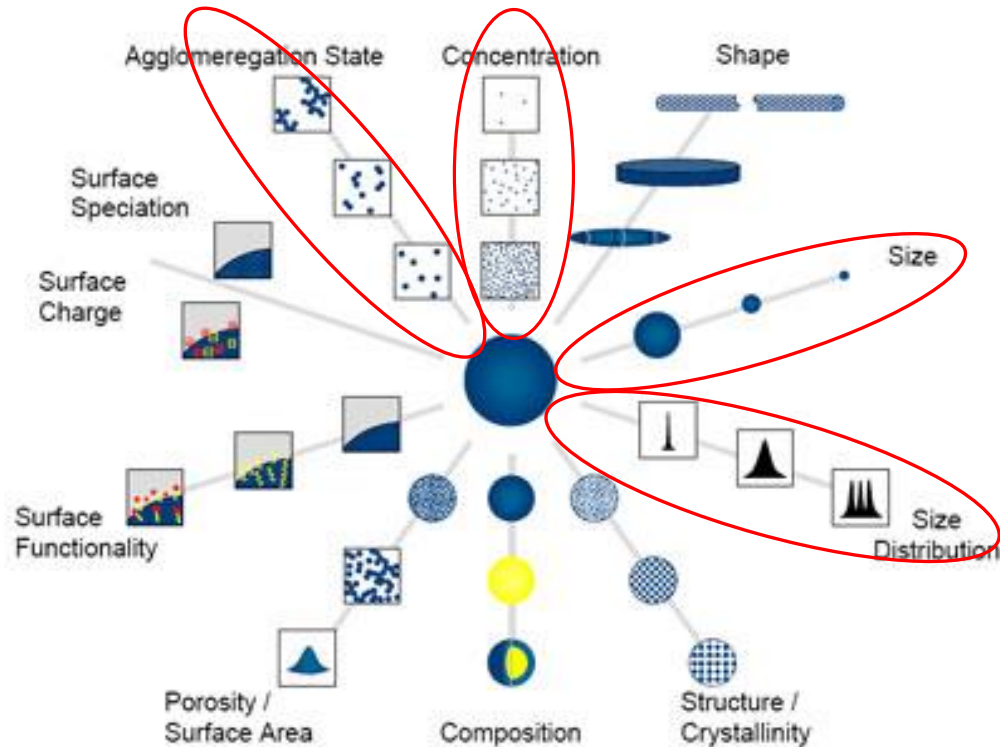
- complex sample matrix (high background of natural or anthropogenic NPs)
- heterogeneous and polydisperse natural NPs
- very low concentrations ( $< \mu\text{g/L}$  or  $\mu\text{g/kg}$ )
- instable samples
- dynamic processes (alteration of NPs` physicochemical properties)



Toxicological research and risk assessments in nanotechnologies in the food sector are scarce.

# What do we want to measure?

- Chemical composition
- Particle size and size distribution
- Mass/particle number concentration
- State of agglomeration/aggregation



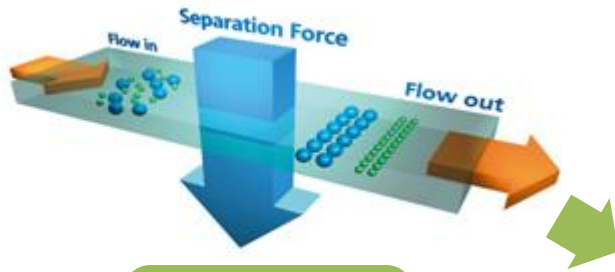


# Methods for measuring metal-based NPs in food



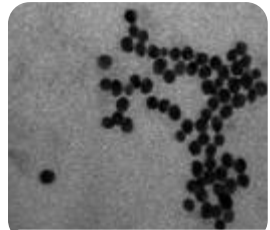
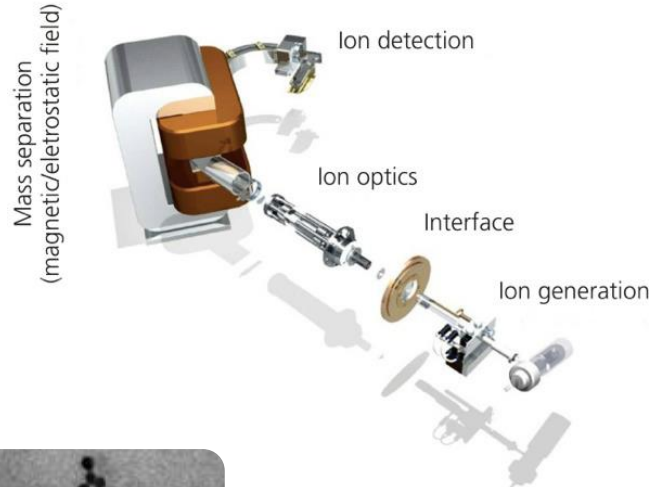
**Sample preparation**

- Sonication
- Vortexing and centrifugation
- Wet digestion
- Phase-transfer agents



**Separation and size fractionation**

- FFF
- HPLC (SEC, HDC, RP)



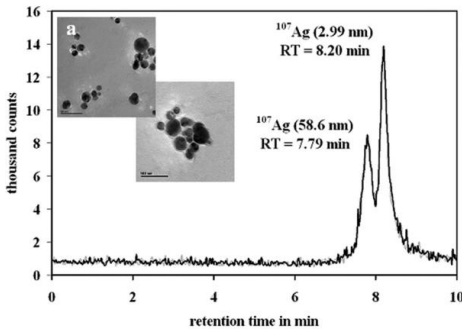
**Visualisation**

- Microscopy



**Elemental analysis**

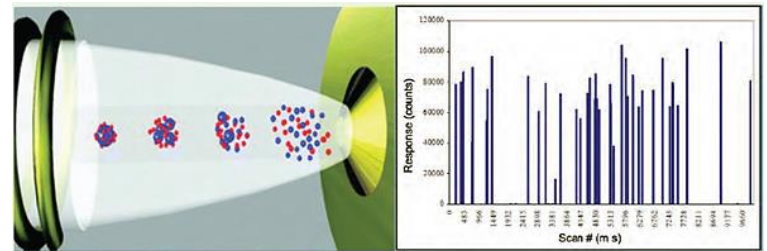
- (SP)-ICP-MS



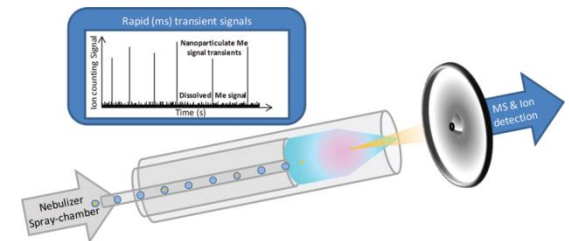
# Single particle ICP-MS

New approach for determination of particle mass/number concentration and size of metal-based NPs.

- ✓ low detection limits (<ng/L)
- ✓ easy sample preparation
- ✓ fast analysis
- ✓ eliminates many matrix interferences
- ✓ simultaneous measuring of both ionic and particulate species



- ✗ only single-element detection
- ✗ lack of reference materials with known NPs size





# Future work

- With the combination of sensitive and reliable analytical techniques characterize and quantify NPs in complex food samples:
  - at low detection limits
  - minimize sample alteration
- Improve the existing risk assessment methodology of nanotechnology within food.

nanofood?