EFSA evaluation of an additive with a nano-size fraction

Laurence Castle. Member of EFSA WG-FCM

Examples used:

- FCM substance No 1075: Montmorillonite clay modified with hexadecyltrimethylammonium bromide
- FCM substance No. 1077: Titanium dioxide surface treated with fluoride-modified alumina

Both opinions published in 2019

With a focus on:

- the particle size distribution of the additive as such and after incorporation into plastics;
- the polymers, the level of addition, and the food contact (types and conditions) intended;
- migration potential of the particles, including under conditions of polymer swelling and/or abrasion if relevant;
- migration of any inorganic or organic materials released in solubilised form from the additive.

Nanomaterials in the EU

EU only region in the world having provisions for nanotechnology and nanomaterials in its legislation

Nanomaterials in Food and Food Contact Materials (FCM)

EU Food and Food contact Legislation

- Novel Foods
- Food Contact Materials
- Food information to Consumers (impacts Food Additives)

EU Non-food legislation

- Specific provisions: Cosmetics, Biocidal products, Active and Intelligent Materials
- Reference to nano: REACH, Medical Devices

From: Nanomaterials in the EU Food Regulations. Takis Daskaleros (European Commission). EFSA stakeholder workshop on nanoscience and nanotechnology, 1-2 April 2019 – Parma, Italy. Available on-line.

Nanomaterials in the EU 2

Nanomaterial definitions in EU Food legislation (Novel Food, Food Information to Consumers (Food Additives) stemming from the Definition of Commission Recommendation 2011/696/EU

Some differences (e.g. intentionally produced, number size distribution)

No definition of nanomaterials in Food Contact Material legislation – direct reliance on Commission Recommendation definition

From: Nanomaterials in the EU Food Regulations. Takis Daskaleros (European Commission). EFSA stakeholder workshop on nanoscience and nanotechnology, 1-2 April 2019 – Parma, Italy. Available on-line.

Nanomaterials in the EU 3

Revision/adaptation of Commission Recommendation 2011/696/EU ongoing

Revision/adaptations aims to include state of the art innovative materials

Adaptation of Recommendation 2011/696/EU will serve as the basis for the update/revision of Food nanodefinition

EFSA updated (2018) guidance on the Risk Assessment of nanomaterials

From: Nanomaterials in the EU Food Regulations. Takis Daskaleros (European Commission). EFSA stakeholder workshop on nanoscience and nanotechnology, 1-2 April 2019 – Parma, Italy. Available on-line.

	Modified montmorillonite clay	**TiO_2, surface treated**
Function	Barrier & other properties	Filler & colourant / uv filter
Use level	? % w/w	Up to 25% w/w
Polymer types	PLA bottles	All polymer types
Food types	Water	All food types
Contact conditions	Long term, room temp & below	Any time & temperature

Characterisation of the additive

as such- and after incorporation into plastic

Transmission electron microscopy (TEM)

- gives direct information on size in x, y, z
  - ✓ for the m-clay and the m-TiO_2

X-ray disk centrifuge

- gives hydrodynamic diameter from which the 'size' must be estimated
  - ✓ for the m-TiO_2

Guideline says to use two techniques to measure particle size and size-distribution. What if they do not agree? TEM is more informative.

Approaches used to assess migration potential

Potential migration of the substance (at max use level in 'worse-case' plastic(s)) was assessed by:-	**m-Clay**	**m-TiO_2**
a) theoretical considerations, migration modelling	✓	✓
b) specific migration from plastic(s) into simulants using an element as indicator	✓	✓
c) migration test using a surfactant solution to stabilise NPs followed by MALLS and AF4-ICP-MS	x	✓
d) surface analysis of plastic before and after exposure to a potentially swelling simulant/solvent	✓	✓
e) an abrasion test of a plastic	x	✓

Migration modelling

Using the generally-recognised diffusion models and plastic-specific parameters. Possible to assign a MW to the NP, that is equivalent to its size. Using conservative assumptions:

- high solubility in food / simulants
- small particles/effective molecular masses

➢ The migration was estimated to be < 0.1 ppb m-TiO_2.

Informative, but not validated for NPs.

Also, such modelling does not cover situations where a strong interaction may give rise to polymer swelling.

Measure migration of an indicator

Rationale: Measure the migration of an indicator substance e.g. an element, and this both:-

- measures the total migration of that substance/element (both solubilised and any in NP form)
- places a upper estimate of NP migration, using an appropriate conversion factor.

m-clay -> monitored Al

m-TiO_2 -> monitored Al, Ti & F

Alternative simulant

Migration test using a proprietary surfactant solution (as an alternative food simulant) to stabilise any NPs, followed by MALLS and AF4-ICP-MS.

Well validated.

Even with swelling of the host plastic, no migration was detected, with an LoD of ca. 4 ppb

Abrasion test

Abrasion test of a plastic using sand, followed by rinsing with the proprietary surfactant solution and then AF4-ICP-MS.

Well validated.

Even with aggressive abrasion, no migration was detected, with an LoD of ca. 6 ppb.

No migration = no exposure = no risk under the conditions of use described.

So the LoD of 4-6 ppb is considered adequate.

- If there had been migration, then the AF4-ICP-MS results would have to be expressed on a particle-size distribution basis.
- Would not be able to use TEM without risk of disturbing the size-range by sample prep?
- Are 2 independent measuring techniques likely to be available?