ISO Fd Food ERA Chair

Safety Quality Traceability

Nanoparticles in food-II

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- Nanotechnology
- Nanoparticles in food
- Mass vis-a-vis numbers
- Detection of nanoparticles in air
- PhD proposal

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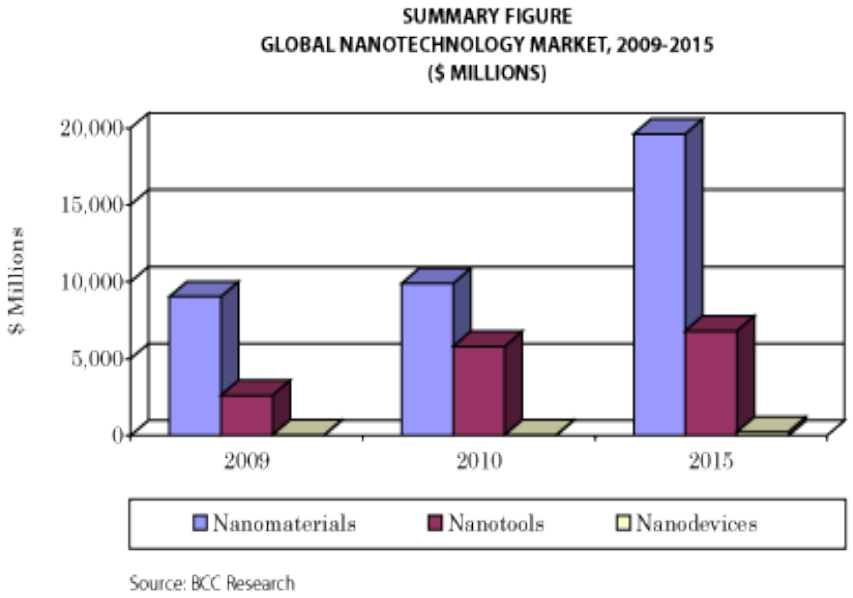
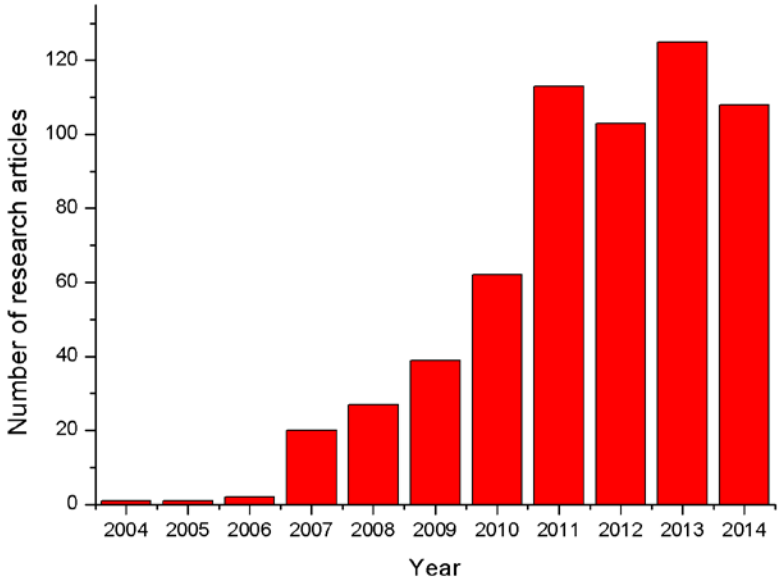


Market will increase from 9 billion $ in year 2009 to 19 billion $ in year 2015: 14,7 % annual growth rate.



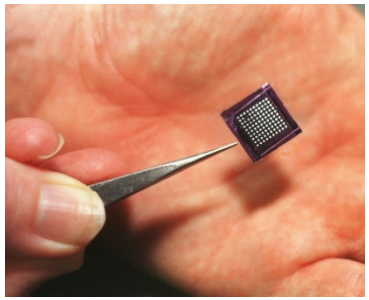
Number of scientific publications search with a kew word: NANOTOXICITY

Unintended presence of nanomaterials in food:

- Air pollution during the production and processing of food
- Insoluble residues or condensed pesticides and fungicides
- Tool wear during the manufacturing process
- The presence of nanoparticles in water
- Release of nanoparticles from the packaging

Intentional use of nanoparticles in food industry:

- Extension of life time of food
- Improvement of manufacturing processes
- Quality control: sensors of food decomposition
- Tracking of handling: temperature, pressure
- Protection of trade marks against falsification
- Improvement of taste and nutrition
- Smart packaging
- Nano-chip for tracking animals and semi-products
- Protection of seeds against mold
- Antibacterial fight and cleaning, etc..



Nano-jezik za kontrolo napitkov

Some examples:

1. Packaging: Nanoparticles of silver, titanium and silicon dioxide, exfoliated nanoclay; purpose: to lower the permeability of oxygen, to improve mechanical properties of materials, to reduced influence of UV-light, increase heat resistance, anti-bacterial effects.
2. Antibacterial protection: nanosilver in refrigerators, pots of baby food and tea, bottles for beverages, cooking pots
3. Facilitation of preparing food: Frying oil with added ceramic nanoparticles, which prevent heat concentration in the oil and reduce odors. The oil also stays fresh and usable for a long time;
4. Dietary supplements: nanocapsules as carriers for vitamins, minerals, essential fatty acids (omega 3), antioxidants, coenzyme Q10, for improving bio-availability of substances;

‘Tip-Top Up’ - Omega 3 bread

Nanocapsule with fish oil, which open in stomach

Vir: Tip Top Bakery, Australia

Rapeseed active oil

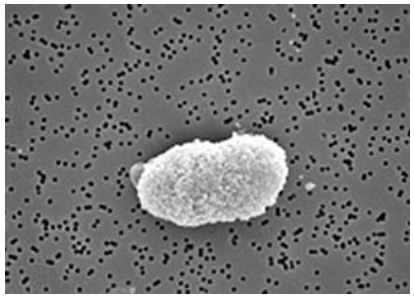
Nanocapsules of fitosterol, which decrease intake of cholesterol for 14%

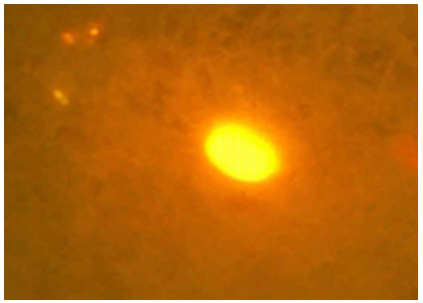
Vir: Shemen Industries, Israel

Dietary supplements in form of spray

www.sprayforlife.com, BASF, The Chemical Company

Fluorescent nanoparticles for optical sensing of bacteria in food (*Weihong Tan, Univ. of Florida)*





Self-cleaning kitchen textil- *on sale in Ljubljana*.

Polymeric foil with nanoflakes of metal oxides for prevention of oxidation

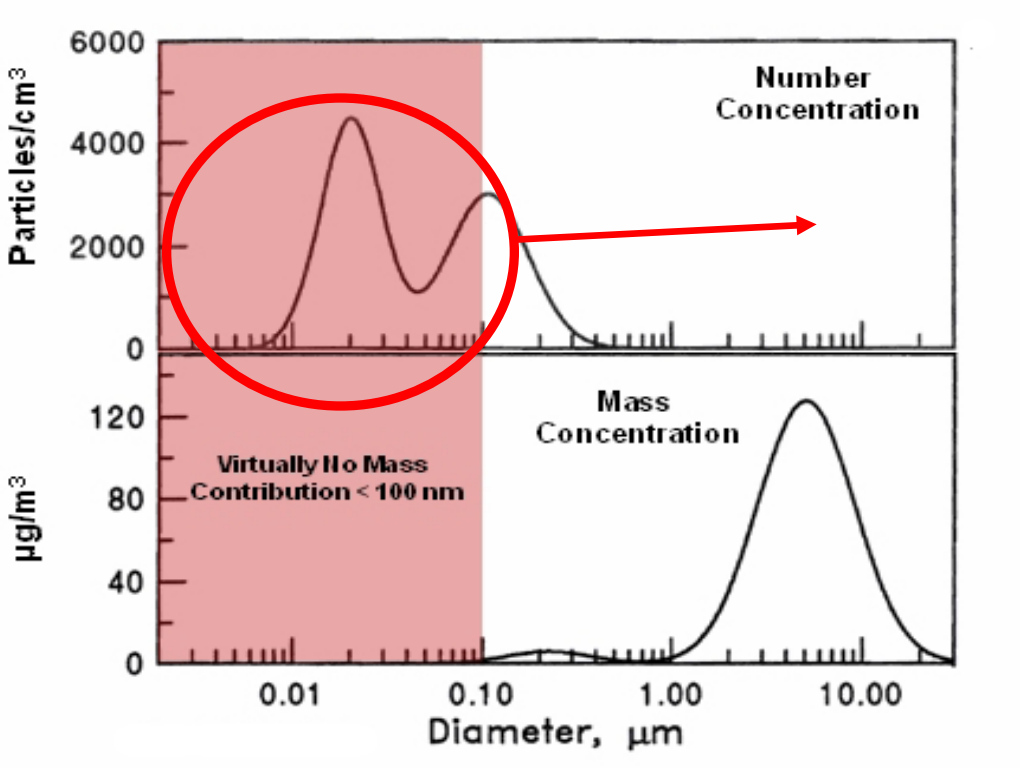
Food with tunable color, taste and nutrition level

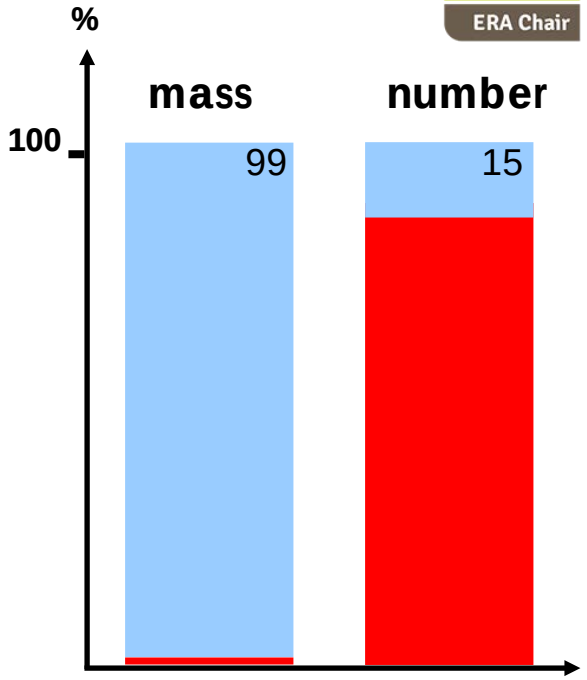
still in research

Protection of seeds

On-sale in Medvode

Mass concentration vis-a-vis number concentration



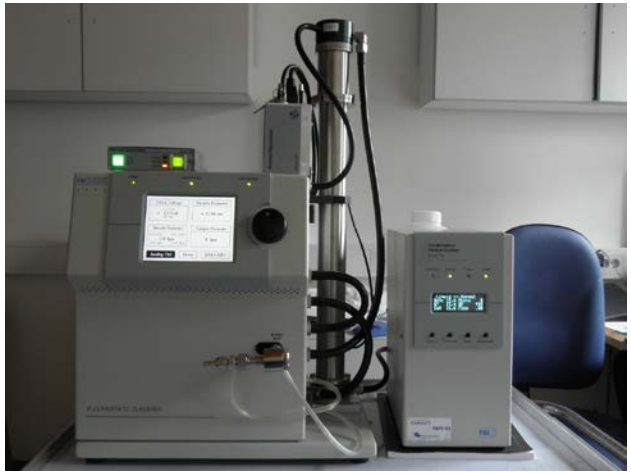


Seinfeld et al, 1998

Traditionally: - mass based measurements
(PM_{10} and $PM_{2.5}$) [mg/m^3]

Measuring of air pollution with nanoparticles

Scanning Mobility Particle Sizer-SMPS

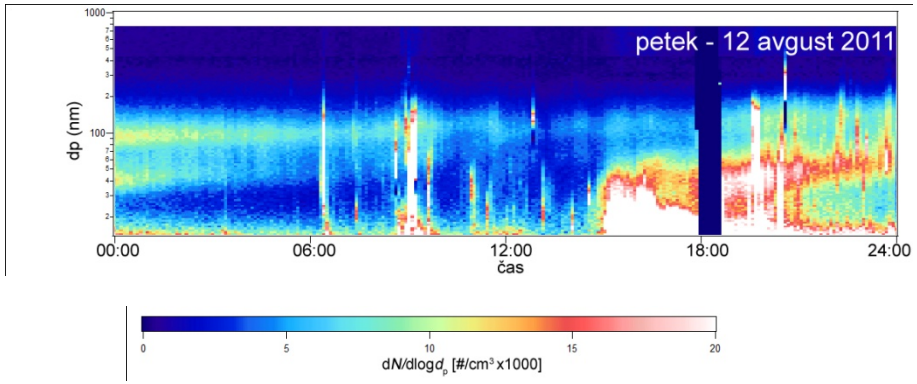


Particle Size Range:
10 to 487nm

Concentrations: up to 2,4 . 10^6 NPs / cm^3

Differential mobility analyzer (selection of particles by size)

Condensation particle chamber (condensation of water on particles with aim to count them by laser scattering)



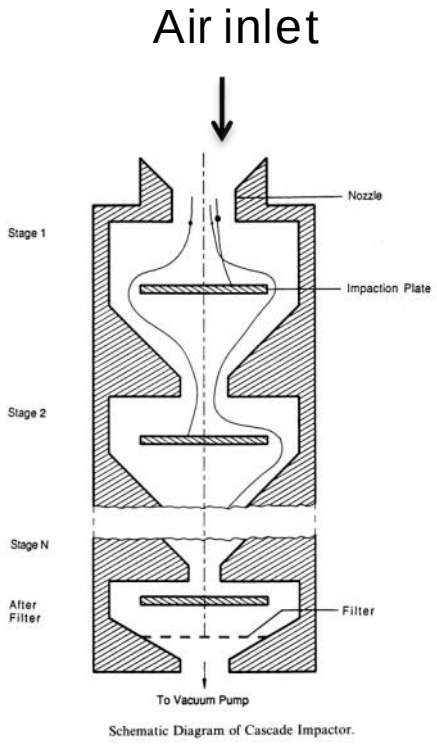
Maximum total concentration values exceeded 100.000 particles/cm^3

Pollution caused by diesel engines (tractor) and wood and hay burning.

Background concentration in rurar area: 5000 particles/cm^3

DEKATI Low Presure Impactor-DLPI

Monitoring of nano and micro particles from 30 nm up to 10 μm. Weight or mass size distributions of nanoparticles are obtained. The collected particles are available for chemical and microscopy investigation.



Schematic Diagram of Cascade Impactor.

Nominal values

Stage	D50% [μm]
13	10
12	6.8
11	4.4
10	2.5
9	1.6
8	1.0
7	0.65
6	0.40
5	0.26
4	0.17
3	0.108
2	0.06
1	0.030
Filter	~ 0

The objectives of PhD research are:

1. To monitor pollution of air with nanoparticles at locations, where food is processed

2. To investigate the effect of air pollution with nanoparticles during protective measures during food production

3. To prepare some necessary steps for accreditation of the laboratory for measuring nanoparticles in air in food production and food processing

4. To make a protocol of determination and characterization of nanoparticles in nanofood, where nanomaterials are intentionally added and in food, where nanoparticles originate from air or processing pollution.

5. To elucidate the interaction between nanoparticles and cells

The main hypothesis is that air pollution with nanoparticles affects pollution of food with nanoparticles.

Task	Time
1. Literature survey on the topic	Oct. 14
2. Learning how to operate scanning mobility particles sizer (SMPS) for detection of nanoparticles in air	Nov.-Dec. 2014
3. Learning how to operate Dekati low pressure impactor	Jan -Feb 2015
4. The first monitoring in open air	Mar –Sept 2015
5. Learning con-focal Raman spectroscopy for nanoparticle investigation	Jan 15-Dec 15
6. Learning SEM microscopy	Jan 15-Dec 15
7. The second monitoring in open air and in food processing companies	Jan 16-Dec.16
8. Microscopy studies of selected food products	Jan 16-dec.16
9. Preparation of some necessary steps for accreditation of the laboratory	2016-2017
10. Preparing a protocol for detection of nanoparticles in food	2017
11. Writing thesis and preparing recommendations for public bodies	2017