

Lecture: nanotoxicology / nanobiotechnology

Toxicological evaluation of nanomaterials in cosmetic products

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Nanoparticle are particles with one or more dimensions at the nanoscale (at least one dimension <100nm). A nanomaterial is a material with one or more external dimensions, or an internal structure, on the nanoscale, which could exhibit novel characteristics compared to the same material without nanoscale features. Nanoparticles can be divided into two groups: i) soluble and/or biodegradable nanoparticles which disintegrate upon application to skin into their molecular components (e.g. liposomes, microemulsions, nanoemulsions), and ii) insoluble particles (e.g. TiO₂, fullerenes, quantum dots).

For the soluble and/or biodegradable group, conventional risk assessment methodologies based on mass metrics may be adequate, whereas for the insoluble particles other metrics, such as the number of particles, and their surface area as well as their distribution are also required. It is crucial when assessing possible risks associated with nanoparticles to consider their uptake. It is primarily for the insoluble particles that health concerns related to possible uptake may arise. Should they become systemically available, translocation/transportation and eventual accumulation in secondary target organs may occur.

At present, there is inadequate information on: i) hazard identification, ii) exposure assessment, iii) uptake (including physiologically normal and compromised human skin), iv) the role of physico-chemical parameters of nanoparticles determining absorption and trans-port across membranes in the gut and lungs, v) the role of physico-chemical parameters of nanoparticles in systemic circulation determining biokinetics and accumulation in secondary target organs, vi) possible health effects (including susceptible individuals), vii) translocation of nanoparticles via the placenta to the foetus.

For the safety assessment of cosmetics, the 7th Amendment imposes animal testing and marketing bans, which prohibit *in vivo* testing of finished cosmetics now and their ingredients in the near future. All *in vivo* and *in vitro* risk assessment methods for nanomaterials are still under development. Although some validated *in vitro* methods do exist they have not yet been validated and/or optimized with nanoparticles as reference compounds. This implies that for safety assessment of cosmetic ingredients, there are no validated *in vitro* methods available for nanoparticles.

Keywords: nanomaterials, skin, nanoparticle, cosmetics, safety, toxicology, alternative methods, skin penetration