

Ingested nanoparticle toxicity

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Ingestion of commonly encountered nanoparticles at typical environmental levels is unlikely to cause overt toxicity, according to US researchers. Nevertheless there is insufficient evidence to determine whether chronic exposures could lead to subtle alterations in intestinal immune function, protein profiles, or microbial balance.

Writing in a forthcoming issue of the *International Journal of Biomedical Nanoscience and Nanotechnology*, researchers have compared existing laboratory and experimental animal studies pertaining to the toxicity of nanoparticles most likely to be intentionally or accidentally ingested. Based on their review, the researchers determined ingestion of nanoparticles at likely exposure levels is unlikely to cause health problems, at least with respect to acute toxicity. Furthermore, in vitro laboratory testing, which often shows toxicity at a cellular level, does not correspond well with in vivo testing, which tends to show less adverse effects.

Ingrid Bergin in the Unit for Laboratory Animal Medicine, at the University of Michigan in Ann Arbor and Frank Witzmann in the Department of Cellular and Integrative Physiology, at Indiana University School of Medicine, in Indianapolis, explain that the use of particles that are in the nano size range (from 1 billionth to 100 billionths of a meter in diameter, 1-100 nm, other thereabouts) are finding applications in [consumer products](#) and medicine. These include particles such as nano-silver, which is increasingly used in consumer products and dietary supplements for its purported [antimicrobial properties](#). Nanoparticles can have some intriguing and useful properties because they do not

necessarily behave in the same chemical and physical ways as non-nanoparticle versions of the same material.

Nanoparticles are now used as natural flavor enhancers in the form of [liposomes](#) and related materials, food pigments and in some so-called "[health supplements](#)". They are also used in antibacterial toothbrushes coated with silver nanoparticles, for instance in food and drink containers and in hygienic infant feeding equipment. They are also used to carry pharmaceuticals to specific disease sites in the body to reduce side effects. Nanoparticles actually encompass a very wide range of materials from pure metals and alloys, to metal oxide nanoparticles, and carbon-based and plastic nanoparticles. Because of their increasing utilization in consumer products, there has been concern over whether these small scale materials could have unique toxicity effects when compared to more traditional versions of the same materials.

Difficulties in assessing the health risks of nanoparticles include the fact that particles of differing materials and shapes can have different properties. Furthermore, the route of exposure (e.g. ingestion vs. inhalation) affects the likelihood of toxicity. The U.S. researchers evaluated the current literature specifically with respect to toxicity of ingested nanoparticles. They point out that, in addition to intentional ingestion as with dietary supplements, unintentional ingestion can occur due to nanoparticle presence in water or as a breakdown product from coated consumer goods. Inhaled nanoparticles also represent an ingestion hazard since they are coughed up, swallowed, and eliminated through the intestinal tract.

Based on their review, the team concludes that, "Ingested nanoparticles appear unlikely to have acute or severe toxic effects at typical levels of exposure." Nevertheless, they add that the current literature is inadequate to assess whether nanoparticles can accumulate in tissues and have long-term effects or whether they might cause subtle alterations in

gut microbial populations. The researchers stress that better methods are needed for correlating particle concentrations used for cell-based assessment of toxicity with the actual likely exposure levels to body cells. Such methods may lead to better predictive value for laboratory in vitro testing, which currently over-predicts [toxicity](#) of ingested [nanoparticles](#) as compared to in vivo testing.

More information: "Nanoparticle toxicity by the gastrointestinal route: evidence and knowledge gaps" in Int. J. Biomed Nanosci Nanotechnol, 2013, 3, 163-210 www.inderscience.com/dev/searc...=record&rec_id=54515

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