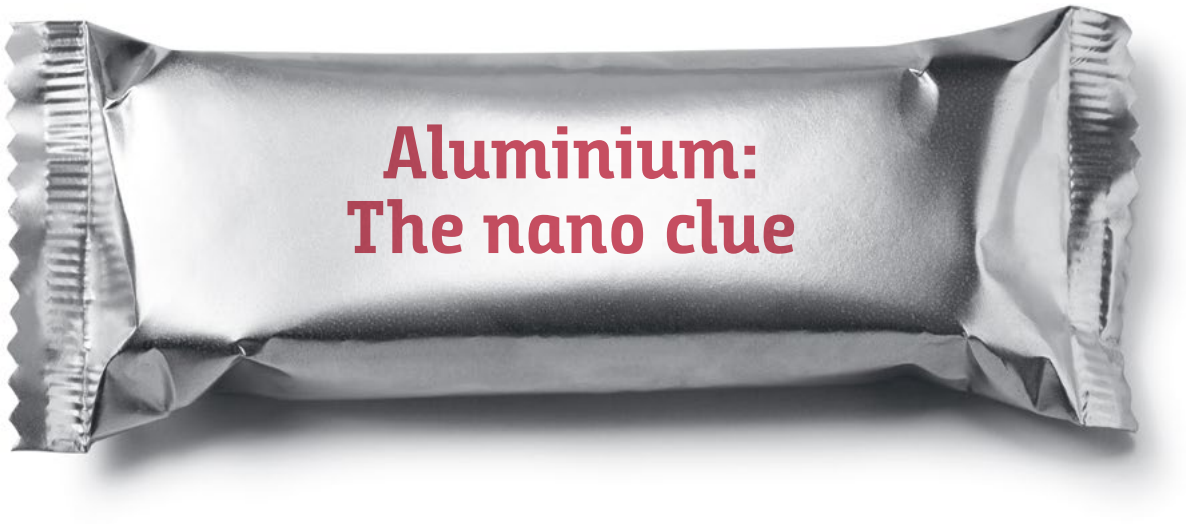


Aluminium: The nano clue

Used as a packaging material, in deodorants and in dishes, the metal is found in many products of daily use and in food, too. The BfR is investigating how the nano form of aluminium takes effect in the human body.

Aluminium is the most common metal in the earth crust. As a trace element, it has no known function for the human body, but it is controversial from a health point of view. The principles of action of aluminium on the human body have not yet been fully understood. Add to this the question as to how aluminium affects human health when it is ingested via food in the form of nanoparticles. Generally speaking, special properties are attributed to nanoparticles, such as increased reactivity or additional uptake to human cells. These general statements must be examined and assessed for every single nanomaterial, however, and that is precisely what the SolNanoTOX project is doing.

Aluminium is a common nanoparticle in the environment

SolNanoTOX is a Franco-German cooperation project in which the BfR is involved along with the French ANSES institute and the universities of Rennes and Leipzig, and which is being funded by the German Research Foundation (DFG) and the French Agence Nationale de la Recherche (ANR). In the project, various aluminium-containing nanoparticles are being examined, together with water-soluble salts, representing the most common forms of aluminium in the environment: metallic and mineral aluminium. Metallic particles are aluminium in its pure form, such as manufactured aluminium sheets or foils, whereas mineral particles occur naturally as aluminium oxides.

Solubility determines uptake by the body

Nanoparticles can dissolve in water or biological fluids such as digestive juices, thereby releasing metal ions into their environment. The project observes how digestive juices influence this solubility, because the solubility of the particles determines how they are taken up by the body. It was established that more metallic aluminium particles dissolve in simulated digestive juices than mineral aluminium particles. The majority of the dissolution takes place in the gastric juice, whereas a re-formation of nanoparticles was measured in intestinal juice (see chart). The uptake of aluminium

Reduce aluminium intake – how does that work?

Possible ways to reduce aluminium uptake are not using uncoated cooking utensils containing aluminium and not or only briefly wrapping up fatty, acidic or salty foods in aluminium foil. Only coated dishes are recommended as warming trays. Antiperspirants containing aluminium should not be applied immediately after shaving or to damaged skin in the armpits. Deodorants without aluminium salts are also commercially available.

into cultivated intestinal and liver cells was also examined. Whereas dissolved aluminium (aluminium ions) was hardly to be found in the intestinal cells, at least a proportion of the nanoparticles were ingested. Effects on the cells were only observed after the use of high quantities of dissolved aluminium which lay well above the usual uptake quantities.

Aluminium in nano form without effect

Although it is not possible to draw any conclusions on the real mechanisms in the body from these assays with cell models, the results of SolNanoTox permit a statement nevertheless: no "nano-specific effect", i.e. no potentially increased health danger, is to be expected with average aluminium uptake via nanoparticles compared to dissolved ionic aluminium. It is still recommended, however, to generally reduce aluminium intake. ◘

More information:

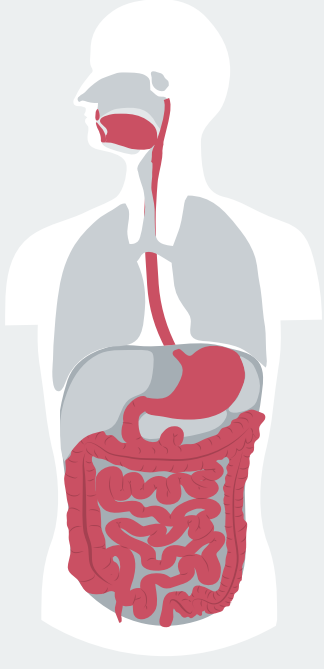
Sieg et al. 2017. Impact of an Artificial Digestion Procedure on Aluminum-Containing Nanomaterials. Langmuir, 33, 10726–10735

www.bfr.bund.de/en > Research > Third party projects of the BfR > Nanotechnology 2017

BfR junior research groups

Since 2017, there have been five junior research groups at the BfR which serve to promote research along with the scientific careers of young scientists in selected key areas at the BfR. With the help of toxicological test procedures on cell models of the intestines and liver, the Nanotoxicology junior research group conducts research into nanomaterials which can find their way into the body via food. The junior research group, which also consists of two doctoral candidates and a technical assistant, has been headed by Dr. Holger Sieg (photo left) since August 2017. The junior research group belongs to the Food Safety department at the BfR.

Aluminium nanoparticles in the digestive tract



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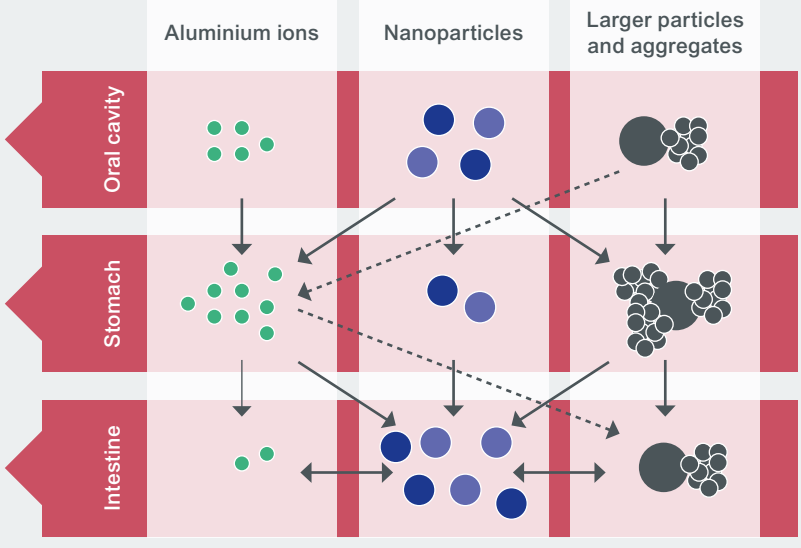
We ingest aluminium in dissolved form (ions) and as nanoparticles (mineral and metallic forms) via food. The particles can also occur as aggregates. The solubility of the particlesdetermines how they are taken up by the body.



The arrows show the transitions between particle form and dissolved form during digestion (thick arrows = clear transitions, thin/dotted arrows = less pronounced transitions).