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Nanoparticles Found in Many Foods Could Wreak Havoc With Your Gut Microbiome

A Cornell University study published in Antioxidants provided more evidence that titanium, silicon, zinc and iron nanoparticles present in many foods and supplements may cause serious disturbances to intestinal health and function, and to the gut microbiome.

By Rob Verkerk Ph.D.

If anyone tried to convince you that size isn't important, let them know that sometimes it is. Especially when it comes to the size of things we consume or inject into our bodies.

Remember the lipid nanoparticles used to carry mRNA "vaccine" cargo into our cells?

Well, it turns out that some metal compounds, like zinc or iron oxide that are used as sources of zinc and iron in cheap food supplements, may damage the mucosal lining, increase the permeability of our guts and disrupt gut microbial communities when delivered as nanoparticles.

Worse than that, nanoparticles of titanium and silicon dioxide, especially the former, could be more harmful still.

A study out of Cornell University published in the journal Antioxidants in February has provided more evidence that titanium, silicon, zinc and iron nanoparticles present in many foods and supplements have the potential to cause serious disturbances to intestinal health and function, as well as to microbial populations within the gut (microbiome).

What's particularly interesting is that three out of four of the forms of metals (iron and zinc) or metalloids (silicon) studied, excluding titanium, are widely recognized as nutritionally essential trace elements for human health.

Yet there is an emerging picture that shows the combination of the chemical form (all forms in the latest Cornell study were oxides) — and the size and distribution of particles of these metallic or metalloid compounds (all of which were dispersed nanoparticles, being between one and 100 nanometers in size i.e. one to 100 billionth of a meter in size), can create profoundly different biological effects.

Are all metallic nanoparticles unsafe?

The science of nanoparticle interactions in biological systems is extremely complex and is only partially understood. There is a widely held view, one increasingly upheld by regulatory authorities, that the smaller the particle, the more of a safety concern it is likely to be. This is a gross generalization and can be incorrect.

A more accurate generalization is as follows: the physical, chemical and biological properties of a nano-scale element or compound are typically different from those of the same element or compound when compared with its presentation in a larger size range.

Taking this notion a little further, the science also suggests that if the particle in question is intrinsically safe and beneficial to the human body, the very tiny, nano-sized particles of that element or compound may deliver more rapid or beneficial effects on health compared with the same element or compound in its non-nano form. That means it might be especially useful for someone with a health challenge.

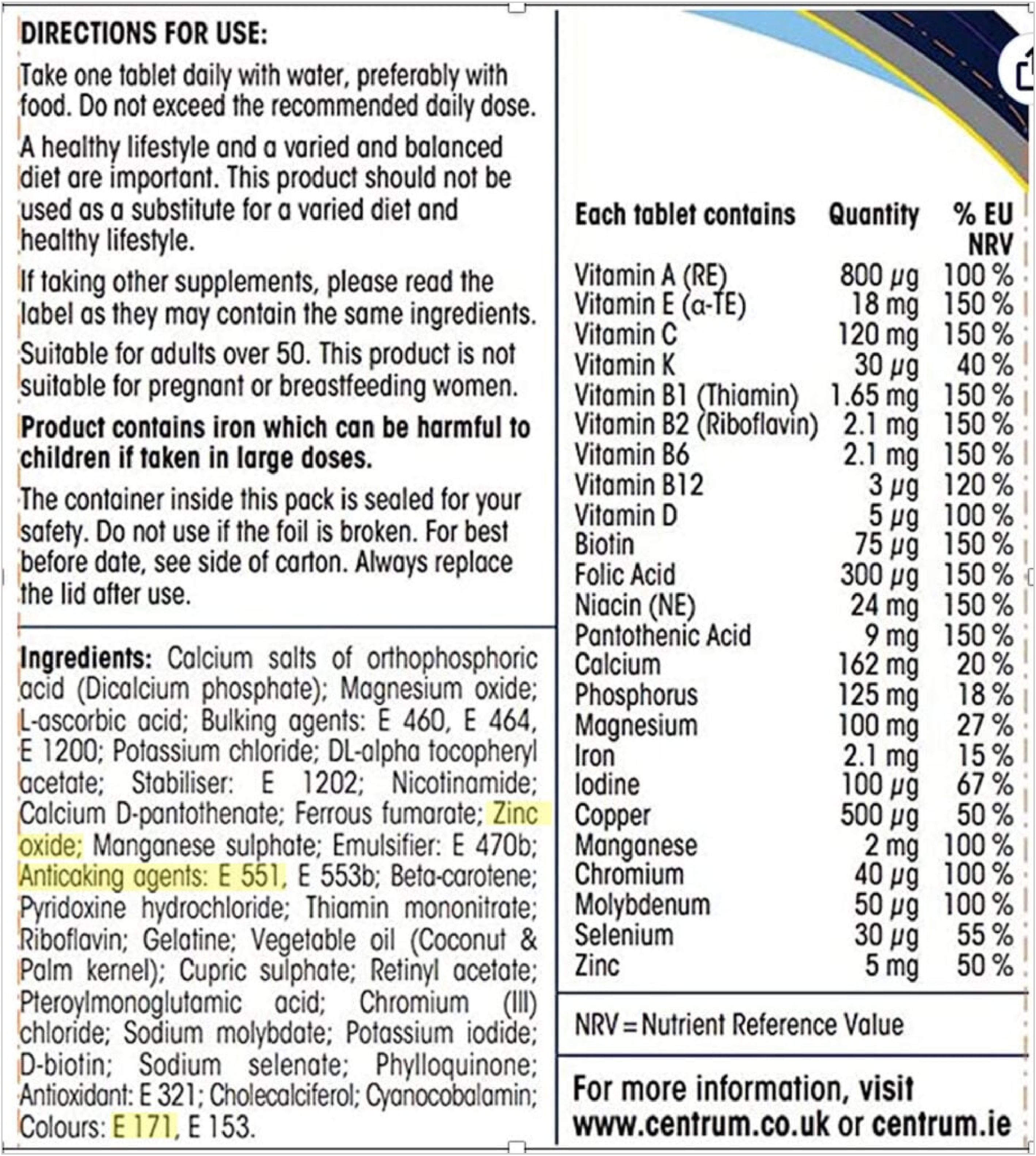
This is because the nanoscale of the particles facilitates entry into target tissues and cells, via mucosal barriers and cell membranes, to a greater extent than larger particles or agglomerations (atomic or molecular clusters) of the same element or compound.

Conversely, that's why, if the particle is intrinsically unsafe, it might give rise to greater health concerns or risks.

Another generalization that's emerging from the extensive work on so-called engineered nanoparticles reveals that when technological processes are applied to elemental particles or compounds, such as through the application of coatings, their physical, chemical and biological properties can also change, sometimes quite dramatically, creating legitimate health and environmental concerns.

Findings from the Cornell study

The four metal or metalloid nanoparticles selected for the study are widely distributed in the food supply, being used, in particular, as technological food additives in the food industry, as anti-caking, coloring or whitening agents (e.g. in table salt), as well as in some low-cost nutritional supplements (e.g. Centrum multivitamin and mineral supplements, fig. 1).



DIRECTIONS FOR USE:

Take one tablet daily with water, preferably with food. Do not exceed the recommended daily dose.

A healthy lifestyle and a varied and balanced diet are important. This product should not be used as a substitute for a varied diet and healthy lifestyle.

If taking other supplements, please read the label as they may contain the same ingredients.

Suitable for adults over 50. This product is not suitable for pregnant or breastfeeding women.

Product contains iron which can be harmful to children if taken in large doses.

The container inside this pack is sealed for your safety. Do not use if the foil is broken. For best before date, see side of carton. Always replace the lid after use.

Ingredients: Calcium salts of orthophosphoric acid (Dicalcium phosphate); Magnesium oxide; L-ascorbic acid; Bulking agents: E 460, E 464, E 1200; Potassium chloride; DL-alpha tocopheryl acetate; Stabiliser: E 1202; Nicotinamide; Calcium D-pantothenate; Ferrous fumarate; Zinc oxide; Manganese sulphate; Emulsifier: E 470b; Anticaking agents: E 551, E 553b; Beta-carotene; Pyridoxine hydrochloride; Thiamin mononitrate; Riboflavin; Gelatine; Vegetable oil (Coconut & Palm kernel); Cupric sulphate; Retinyl acetate; Pteroylmonoglutamic acid; Chromium (III) chloride; Sodium molybdate; Potassium iodide; D-biotin; Sodium selenate; Phylloquinone; Antioxidant: E 321; Cholecalciferol; Cyanocobalamin; Colours: E 171, E 153.

Each tablet contains	Quantity	% EU NRV
Vitamin A (RE)	800 µg	100 %
Vitamin E (α-TE)	18 mg	150 %
Vitamin C	120 mg	150 %
Vitamin K	30 µg	40 %
Vitamin B1 (Thiamin)	1.65 mg	150 %
Vitamin B2 (Riboflavin)	2.1 mg	150 %
Vitamin B6	2.1 mg	150 %
Vitamin B12	3 µg	120 %
Vitamin D	5 µg	100 %
Biotin	75 µg	150 %
Folic Acid	300 µg	150 %
Niacin (NE)	24 mg	150 %
Pantothenic Acid	9 mg	150 %
Calcium	162 mg	20 %
Phosphorus	125 mg	18 %
Magnesium	100 mg	27 %
Iron	2.1 mg	15 %
Iodine	100 µg	67 %
Copper	500 µg	50 %
Manganese	2 mg	100 %
Chromium	40 µg	100 %
Molybdenum	50 µg	100 %
Selenium	30 µg	55 %
Zinc	5 mg	50 %

NRV = Nutrient Reference Value

For more information, visit www.centrum.co.uk or centrum.ie

Figure 1. *Centrum Advance 50+ Multivitamin & Mineral Tablets (U.K. and Ireland) — with zinc oxide, silicon dioxide (E 551) and titanium dioxide (E 171) highlighted, these being three of four of the chemical compounds that were subject to the Cornell study. Important note: The size of the particles present in this product is unknown and may or may not be in the nano-scale. Magnesium oxide is another metal oxide in the Centrum product, but this was not included in the Cornell study.*

The Cornell study carried out in collaboration with Binghamton University (in the state of New York), was an animal study involving an increasingly well-recognized in vivo model using chickens.

The study type offers relatively fast and low-cost screening of nanoparticles that might cause disturbances to the gut lining or gut-based microbial communities.

The characterized food-grade nanoparticles were injected, following sonication to ensure dispersal (non-clustering), into the amniotic fluid of the eggs, which was in turn consumed by the developing embryos.

On hatching, the chickens were euthanized, dissected and specific tissues were frozen to preserve them and subsequently sectioned and prepared for extensive testing and analysis.

The amounts and forms of the titanium, silicon, iron and zinc oxide nanoparticles were selected to be approximately representative of the amounts to which humans would be exposed when consuming food additives or supplements based on these metal or metalloid compounds.

The key findings for some, or all, of the four nanoparticles studied can be summarized as follows:

- The nanoparticles impacted intestinal development in chicks.
- The surface area of the intestinal lining was altered by exposure, reducing the length of villi/depth of crypts, so reducing the potential for nutrient absorption.
- The nanoparticles, compared with controls, induced changes in the production of mucin that forms the mucosal layer of the intestinal lining, reducing its potential as an appropriate habitat for commensal bacteria and other microorganisms, as well as its protective role as a barrier to pathogens and harmful chemicals.
- The nanoparticles had a negative impact on gut microbial communities, notably beneficial Bifidobacterium and Lacticaseibacillus bacteria.

What does the study mean to us?

While we can't be certain that all findings from the Cornell study apply directly to humans, the study is yet another that suggests that there may well be health concerns with technological additives or excipients commonly used by the food and nutritional industries — as well as the pharmaceutical industry.

We have evolved over millennia with exposure to metals and metalloid compounds, these being vital to a very wide array of functions, from immune health to collagen formation, oxygen transport in blood, neurotransmitter function, enzyme activity, detoxification — almost every metabolic and physiological system operating on the body.

We cannot always directly transfer results from an experimental model, such as the in vivo chicken model used by the Cornell group, to human health and our dietary exposures.

But at the same time, there is increasing evidence that in vivo (living organism) based models like the one used in the Cornell study, rather than in vitro ("test tube") ones, are useful surrogates for what happens in the real world.

We ignore what Paracelsus taught us some 500 years ago at our peril: it's the dose that makes the poison. Therefore, minimizing the amounts of frequency of exposure to technological additives of any form is a very good starting point.

More than this, if we know that the product in question poses a potential health risk in its non-nano form when it is delivered in nano form, it may well present an even greater risk to our health.

This principle is particularly applicable to titanium dioxide which, according to its non-nutritional and toxicological properties, is quite distinct from the oxides or dioxides of silicon, iron or zinc, all of which have well-understood nutritional roles.

Then again, these oxidized forms are also known to not be the most effective or safest forms of these nutritional elements.

Other salts, compounds or chelates have been found through extensive research over many decades to be both safer and more effective. Hence their use in higher-quality nutritional supplements.

Titanium dioxide — the bad egg in the basket

Concerns over the safety of titanium dioxide have been gathering over recent years, with the EU and Northern Ireland imposing a ban on the compound effective as of Feb. 7, 2022, this ban having been rejected by England, Wales or Scotland, one of the first signs of post-Brexit non-EU conformity in the nutritional sector, albeit not the example we had necessarily been hoping for!

The safety concerns have been greatest with respect to inhalation risks of titanium dioxide, especially following its classification by the International Agency for Research on Cancer as a potential human carcinogen.

In a landmark decision in November 2022, the European court annulled the European Commission's "Delegated Regulation of 2019 in so far as it concerns the harmonised classification and labelling of titanium dioxide as a carcinogenic substance by inhalation in certain powder forms" that was in turn informed by an earlier decision again titanium dioxide by the French government.

The court's decision was based on its finding of "manifest errors of assessment and infringement of the criteria established for harmonised classification and labelling under Regulation No 1272/2008."

The French government has recently announced its decision to appeal the European court's decision.

This ongoing battle over titanium dioxide's safety, or otherwise, complicates an already complex and poorly understood area of science.

It potentially raises questions over whether the precautionary principle approach taken by the European Commission may result in overreach by the national regulators in the EU.

The fact that the Commission's decision was annulled by the European court also reminds us of the power of the nanoparticle lobby that comes with the backing of Big Pharma and Big Food.

There's a lot at stake if the carcinogen label for titanium dioxide sticks. The titanium dioxide industry continues to grow at around 6% year on year and was valued at 17.19 billion USD in 2020.

It is a very widely used excipient (technological additive) in pharmaceutical products and Big Pharma won't want a "potential carcinogen" classification hanging around its neck given the potential for downstream litigation.

One can presume if the concerns are restricted to inhalation exposure, Big Pharma might be prepared to live with it.

But risks with developmental or intestinal damage or dysbiosis from oral exposure have quite different implications.

Clearly, the Cornell study in question, and another from 2022 published in the journal Food and Chemical Toxicology suggesting genotoxicity (DNA damage) in human intestinal cells, will make uneasy reading for Big Pharma.

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The views and opinions expressed in this article are those of the authors and do not necessarily reflect the views of Children's Health Defense.

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