FACT SHEET

16 September 2014

Nano-silver

What is nano-silver?

Nano-silver is the term applied to nanoparticles of silver. Nano-silver is a much more efficient antimicrobial than bulk silver and is used for its antimicrobial properties in an increasingly wide variety of consumer products.

What are nanoparticles?

Nanoparticles are tiny particles – typically 1-100 nanometres across - with one nanometre being one billionth of a metre. The properties of matter change at the nano-scale and nanoparticles can therefore behave quite differently from larger particles of the same substance. They also have a greater surface area relative to volume. This makes them much more chemically reactive – and potentially toxic - than larger particles.

Where is nano-silver used?

Nano-silver is one of the most commonly used nanomaterial in consumer products. Of the 1801 products listed on the Project on Emerging Technologies' Consumer Products Inventory, 437 products contain nano-silver. [1] These include toothpastes, pet shampoos, water filters, fabric softeners, bath towels, shoes, socks, computer keyboards, cosmetics, deodorisers, baby clothes, baby bottles, baby toys, refrigerators, food containers, kitchen cutting boards, electric shavers, curling irons, and much more.

Health concerns

There is strong evidence that nano-silver is more toxic than bulk silver. It can also go places in the body that larger silver particles can't, and it may be small enough to enter cells[2] or cross the blood-brain barrier.[3] Animal studies have shown placental transfer and foetal uptake of nano-silver. This finding is disturbing when one considers a recent study which found that exposure to nano-silver caused zebra fish embryos to develop with head abnormalities and no eyes. Zebra fish are widely used as a model organism for the study of embryological development in other vertebrates including humans.[4]

The widespread use of nano-silver can help breed superbugs

The numbers of deaths caused by bacterial resistance to antimicrobials and antibiotics in hospitals continues to rise. Hospital-associated infections kill around 100,000 people in the United States and 150,000 people in Europe each year. More than 7,000 similar deaths occur annually in Australia.

As superbugs in hospitals develop resistance to increasing numbers of antimicrobials, the medical community has been turning to nano-silver as an antimicrobial of last resort. Nano-silver is being increasingly used as an antiseptic, disinfectant and treatment for external wounds. However, medical experts have warned that, as with antibiotics, the overuse of nano-silver will promote resistance to this important antimicrobial.[5]

Most worryingly, nano-silver has a high likelihood of promoting not just silver resistance but also antibiotic resistance because of the process of co-selection. Co-selection occurs when bacteria exposed to one antimicrobial find a resistance gene to it by swapping DNA with bacteria that are also resistant to other antimicrobials.

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Widespread use of nano-silver may increase the incidence of allergies

Public health experts agree that interactions with bacteria are essential to develop strong immune systems in children. As concern grows about our allergy epidemic[6], scientists have realised that, in addition to breeding resistance in bacteria, our unchecked use of antimicrobial compounds like nano-silver may further increase the incidence of allergies.[7]

Environmental concerns

Nano-silver waste that is not recycled will end up in the environment "either as solid waste in landfills, emission from wastewater treatment plants, or as residual waste from incineration plants."[8] Serious concerns have been raised regarding the influx of silver nanoparticles into the environment, especially given nano-silver's high toxicity to aquatic organisms.[9]

There is evidence that nano-silver applied to agricultural soils in sewage sludge may harm beneficial microbes. A recent study by Colman *et al.* found an adverse impact on plants and microorganisms in a long-term field experiment following the application of sewage sludge containing a low dose of nano-silver.[10] The nano-silver treatment led to changes in microbial community composition and biomass, as well as affecting some of the above ground plant species. It also led to an increase in nitrous oxide fluxes. This is significant, as nitrous oxide is a notorious greenhouse gas, with 296 times the global warming potential of carbon dioxide.

A recent European study suggests that repeated applications of sewage sludge containing nano-silver can cause it to accumulate in soil.[11] The researchers calculated that a maximum of 30mg of nano-silver per kilogram of sludge can be applied to land before harm occurs, based on typical application rates in Germany of five tons per hectare of farmland every three years.

What action is needed?

Friends of the Earth is calling for:

- The use of nano-silver to be restricted to hospital settings where it is needed most.
- A mandatory register of nanomaterial use so that regulators can assess the amount of nanomaterials entering the environment and conduct much needed risk assessments.

Find out more

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[1] http://www.nanotechproject.org/cpi/ - viewed 10/9/14
[2] Hussain SM, *et al.* (2005) In vitro toxicity of nanoparticles in BRL 3A rat liver cells. *Toxicol in Vitro* **19(7)**:975–983, http://dx.doi.org/10.1016/j.tiv.2005.06.034
[3] El-Badawy A, *et al.* (2010) State of the Science Literature Review: Everything Nano-silver and More. Washington, DC:U.S. Environmental Protection Agency (August 2010). Available at http://www.epa.gov/nanoscience/files/NanoPaper1.pdf, (accessed 9/9/14)
[4] FoEA (2014) Way too little: our government's failure to regulate nanomaterials in food and agriculture, http://emergingtech.foe.org.au/resources/way-too-little/
[5] FoEA (2011)
[6] Murdoch Children's Research Institute (2013) Brightest allergy minds collaborate to tackle allergy epidemic, http://www.mcri.edu.au/news/2013/april/brightest-allergy-minds-collaborate-to-tackle-allergy-epidemic/
[7] FoEA (2011)
[8] Scientific Committee on Emerging and Newly Identified Health Risks (2013) Preliminary Opinion, Nano-silver: safety, health and environmental effects and role in antimicrobial resistance, December 2013, p 4, http://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_039.pdf (accessed 13 March 2014)
[9] FoEA (2014)
[10] Colman, B.P. *et al.* (2013). Low Concentrations of Silver Nanoparticles in Biosolids Cause Adverse Ecosystem Responses under Realistic Field Scenario, *PLOS ONE*, 8(2):1-10
[11] Schlich, K. et al. (2013) Hazard assessment of a silver nanoparticle in soil applied via sewage sludge, *Environmental Sciences Europe*, **25**:17