

# Science for Environment Policy

## Potential health risks from different forms of nanosized cellulose crystals

**A new study** has found evidence for lung toxicity of different forms of 'cellulose nanocrystals' (CNCs) in mice. The study suggests that physical characteristics, such as length, of the CNC relates to the type of effect it has on the lung. These nanosized crystals, made from plant-derived materials, are increasingly being used in novel applications, such as cleaning up oil spills in water and flexible electronic displays, and consumer products, which raises concerns about their potential health impacts.

**Cellulose is the substance that makes the cells of trees** and other plants rigid. It is the most abundant organic compound on Earth and can easily be extracted from wood/plant pulp. When cellulose is treated with an acid it can be broken down into CNCs, which are nanosized rod-like crystals around 100 to 1000 nanometres (nm) in length.

CNCs have better electrical, optical, and mechanical properties than their original non-nanosized form. These properties and some of their eco-friendly aspects – such as their sustainable method of production and biodegradability – have made CNCs attractive to industry. Applications range from electronics to cosmetics and pharmaceutical products.

However, the rod-like shape of CNCs suggests there may be a risk of toxicity, similar to other nanosized fibres. It is well known that inhalation of similar particles can cause lung inflammation, and recent studies have suggested that materials containing CNCs are associated with lung toxicity.

This new research examined the effects of two similar forms of CNCs on the lungs of mice. The first form was a dry powder CNC (CNCP), and the second was a gel-based CNC suspension (CNCS). Asbestos was also used as a control for lung damage. Mice were exposed to asbestos and both CNC forms at different concentrations and the effect on their lungs examined after 24 hours. The researchers inspected them for signs of tissue damage and inflammation, as well as changes in the numbers and types of immune cells. The physical dimensions of the two CNC formats were also examined.

The CNCs in the powder form were around three times longer (300 nm) than those of the gel form (88 nm). Inflammation biomarkers increased with greater concentrations of both CNCS and CNCP after 24 hours. There were some differences between CNCS and CNCP, both in type of damage to the mice and degree of increase in these biomarkers. Biomarker profiles, which differed from those of asbestos, were typically higher for both CNC types. The number of immune cells increased in both treatments, but was slightly higher in mice treated with CNCP. Both CNC types elicited higher cellular responses than the asbestos control.

Differences in the levels and types of biomarkers and immune cells between the two CNCs preparations suggest that the physical characteristics, such as length, of the CNCs could result in different types of immune response. For example, longer-term or repeated exposure to one form could result in a more long term allergic response, while another form may result in temporary local inflammatory tissue damage.

More research is needed to analyse the risks that CNCs may present to human health. CNCs are increasingly used in industrial processes, which means that there is a growing risk of exposure, including through inhalation, to humans. Although results in animals, such as mice, do not always translate to identical effects in humans, this study suggests that the use of CNCs in industry could potentially cause lung damage in humans, and that precautions, such as respiratory protective equipment, may be prudent for those occupationally exposed to CNCs.



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