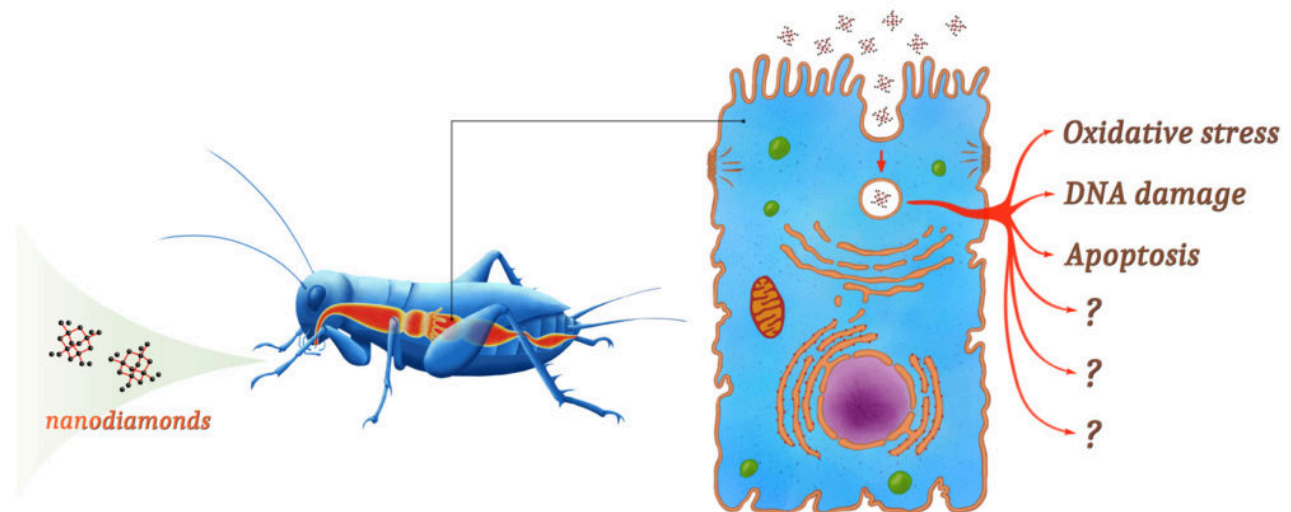


## What if nanodiamonds aren't people's best friends?

The dynamic development of nanotechnology and nanoscience is associated with the increasing production and use of nanomaterials, such as nanodiamonds (ND), which have a diamond structure at a nanometer scale. They possess a variety of superior characteristics of diamonds and they also have the advantages of nanomaterials. Moreover, from the viewpoint of medical and biotechnological applications, the interest arises from the fact that they are small enough to interact with cellular structures and organelles and to reach previously unapproachable targets. The proper surface functionalization of nanoparticles with a variety of ligands as well as antibodies significantly increases their usefulness and the possibility of using them in medicine. However, the properties that make them so unique and beneficial for technological and medical applications may also cause adverse effects on living organisms.



The question arises: *Can nanodiamonds cross defensive barriers, enter the circulation system and come into the contact with the tissues originally not exposed to the ND?* It is believed that ND can penetrate biological barriers (cell membranes) and move easily within biological systems. This may potentially cause negative effects on entire organisms, because it is not known what the fate of such particles is inside an organism.

With all of this in mind, it is unquestionable that a biosafety assessment of nanodiamonds is definitely needed. The assessment of the toxicity (cellular damage) of ND *in vivo* using electron microscopy is very limited at present. The aim of this study was to describe the ultrastructure of the gut epithelium after exposure to different concentrations of nanodiamonds administered with food during the whole lifespan of *Acheta domesticus*.

We have undisputedly proven that there was a number of changes in the ultrastructure of the gut

epithelium in the animals which consumed nanodiamond-contaminated food and also that the ND toxicity depends on the concentration of these particles. In insects that received the lower dose of ND, changes to the structure of the cells were not as severe as in the insects from the group treated with the higher dose. It makes us believe that trace contamination with ND results in no overt harm and may be safe for organisms, as they can cope with the stress using the defense mechanisms available in a cell. Through evolution, organisms have developed a number of defensive barriers, both physical ones and chemical ones, which maintain the integrity of an organism and protect it from the adverse influence of environmental stress factors. Nanoparticles are new stressors for organisms and the way of their toxicity is still unknown. The hydrophobic nature of nanodiamonds allows them to pass through the cell membranes into a cell. Subsequently, ND may function as centers of oxidative damage inside the cell. It is known that one of the possible nanoparticle toxicity mechanisms is connected with generating reactive oxygen species (ROS) and disrupting the redox balance in cells. However, an important effect observed in the organism was selective autophagy, which is commonly accepted as an adaptation mechanism for stress conditions. Than a different scenario can be taken into consideration where directing a cell into apoptosis in which an early activation of autophagy is involved. Moreover, the autophagy can also be a symptom of a cell's reaction to the stress resulting from nutrient deprivation/starvation. In this way the variable reactivity of nanodiamonds could change the accessibility of important nutrients in a cell, thus causing stress through starvation. Therefore, it cannot be excluded that as a consequence of the nanoparticles/nanowaste migration, including nanodiamonds, along food chains results in the contamination of animal and human food.

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## **Publication**

[Ultrastructure of the gut epithelium in \*Acheta domesticus\* after long-term exposure to nanodiamonds supplied with food.](#)

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