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Environmental contamination by nanoparticles may threat human health

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Core tip

Nanotechnology as an emerging technology has potential risks that consider concerns about plant, environment and human health. Understanding food safety issues associated with nanomaterials (NMs) of agriculture systems, is a critical aspect in gaining public acceptance of this technology around the world.

Nanomaterials, agriculture and human health

Nanomaterials (NMs) release into environment through soil, water, and air, during their use may lead to unintended contamination of terrestrial and aquatic ecosystems (1,2). One route in which NMs enter the environment and humans is through agriculture. NMs are entering waste streams in increasing quantities as the result of their use in an increasing variety of consumer products employing nanotechnology (3). The majority of these NMs have been shown to partition to the sludge within waste water treatment plants (4). Sewage sludges are an important route to entrance of NMs in agriculture fields (e.g. presence of carbon nanotube in biosolid referred to Wallheimer 2013 (5). While regulations exist that limit the land application of biosolids that contain elevated concentrations of certain metals, these regulations do not specifically consider the incorporation of metal-containing NMs (6). The farm workers who apply the biosolids with carbon nanotubes (CNTs), for example, might be at risk of the afflictions of laboratory rats lungs exposed to CNTs: inflammation, fibrosis, and toxicological changes in the lung. It was also found that the CNTs were applied to skin cells increased biochemicals indicating cellular damage (7). Reports showed chemicals in pre-nano biosolids have been identified as carcinogens and hormonal endocrine disruptors, leading to many human health problems (8).

In other sides, NMs entrance in to the edible plants present a more serious issue to human risks, because it comprise an important route for human exposure (9). When NPs ingested, pass into the blood and lymph system, circulate through the body and reach potentially sensitive sites such as the spleen, brain, liver and heart (10). The penetration of silver (Ag) nanoparticles, as a pesticide in agricultural practice, is dangerous to consumers because they have the ability to relocate in the human body after digestion. In an article, contamination of Ag NPs in pears fruit was detected (11). Hernández Viezcas et al (12) on working the complex process to detect nano zinc oxide (ZnO) and nano cerium dioxide (CeO) particles in the edible part of the soybean found that NMs can enter into the food chain. Their tests determined that only CeO NMs was detected in the edible part of the soybean. There is sufficient proof in storage of NMs and/or component metals (e.g. Zn from ZnO NMs) in the edible portions of food crops such as cilantro, barley, rice, maize, green peas, tomato, cucumber, beans, and peanut (9). Edible plants tested in aforementioned studies would never exposed to that tested doses. But it should be mentioned direct purposeful application of NMs products (e.g. fertilizer and pesticide) in agricultural practices repeat every year, cause accumulation of NMs that could present a more serious and direct threat to human risks. For example, under conventional cropping systems and fertilizing patterns in major soybean growing countries, the inclusion of NM soil additives, whether intentional or in the application of biosolids, would be at least annual. Therefore it is highly possible that edible plants could be exposed to high levels of NMs. Although accumulation of NM in plants depends on crop species and type of NM; however, once NMs are absorbed by

plants, they can move through trophic levels and compromise the food web. There is no report especially address effect of edible portion of plant contained NMs on the human health via ingestion. But In fact, there are studies indicating the trophic transfer and biomagnification of NMs in terrestrial organisms (13). Notably in some studies, the elemental concentration of NMs significantly reduced at each subsequent trophic level, indicating that although trophic transfer was evident, biomagnification was not (14,15).

Conclusion

The difference between the potential benefits and harm from nano products may be quite subtle and a large knowledge gap exists on the long-term impacts of NMs to the environment, crop, and human health.

Authors' contribution

SSBM and NGS wrote the manuscript equally.

Conflicts of interest

The authors declared no competing interests.

Ethical considerations

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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