Applications of nanotechnology for food contact materials and food safety

Area of research interest: Chemical hazards in food and feed
Study duration: 2006-09-01
Project code: A03063
Conducted by: Central Science Laboratory
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Background

Nanotechnology is an emerging science, which offers a wide range of opportunities for the development of innovative products and applications for food packaging. New materials manufactured with small particles (up to 100 nanometres) may exhibit novel properties that have been utilised to develop improved food packaging materials in terms of better mechanical, thermal, gas-barrier, and anti-microbial properties. The rapid proliferation of nanotechnology-derived consumer products has raised some safety, environmental, ethical, policy and regulatory issues. These stem from the lack of knowledge about the potential effects and impact of nanomaterials on human health and the environment because physicochemical and biological properties of nanomaterials may be substantially different from their conventional forms. The purpose of this project was to assess the current and projected applications of nanotechnology for Food Contact Materials (FCMs), identify potential implications for consumer safety and regulatory controls, and to identify any gaps in knowledge that may need further research.

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Research Approach

The study was carried out by a Panel of Experts from Safety of Nanomaterials Interdisciplinary Research Centre (SnIRC), led by the Central Science Laboratory. Information was collated on current and projected processes, products, and applications of nanotechnologies for food contact materials through comprehensive searches of published literature, industry information, and key market reports. Experimental testing of nanomaterial migration in two typical nanotechnology-derived food contact materials was carried-out. The findings of the study were disseminated and discussed at a workshop, attended by representatives from academia, consumer forums, industry, regulatory agencies, and R&D stakeholders.

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Results

Consumer exposure from the use of nanotechnology derived FCMs is dependant on the migration of nanoparticles into food and drinks. Research carried out as part of this project involved testing migration of nanoparticles from two typical FCMs made of nanomaterial-polymer composites. The

results showed that there was no detectable migration from the polymer composite that had nanoclay embedded between PET layers. A very low level of migration of silver was detectable in the case of food containers made of polypropylene-nanosilver composite (nano silver pp). In both cases, the presence of nanoparticles did not affect migration of non-nano components. This limited study provided some reassurance in the safety of nanotechnology-derived FCMs but migration is likely to be dependant on the type and composition of the polymer, and more testing on other types of materials would be required to build up a broader picture for different FCMs. Attempts were made to image nanoparticles in aqueous extracts prepared from the two study FCMs (nanoclay-PET bottles, nanosilver-PP containers), using electron microscopy coupled with analysis by energy dispersive electron (EDX) analysis. The results did not show any nanoparticles in the extracts, but this could be due to limitations of the technology rather than the absence of nanoparticles.

The study also assessed current regulatory frameworks for adequacy to control any risks from nanotechnology derived FCMs. The assessment showed that most FCMs derived from nanotechnology will be subject to some form of approval process before being permitted for use. Current legislation for food contact materials, however, does not differentiate between substances produced routinely by 'standard' manufacturing methods and those that may be developed by nanotechnology. The assessment identified a few uncertainties in this regard that may be addressed through clarifications and/ or appropriate adjustments.

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Additional Info

Nanotechnology applications in the food sector are on the increase worldwide and are expected to grow rapidly in the future. Nanotechnology-derived FCMs make up the largest share of the current and short-term predicted market in this sector and it is widely expected that they will become increasingly available on the EU market over the next few years. Certain concerns have been raised in regard to the safety of the consumer resulting from a growing body of scientific evidence, which indicates that some free nanoparticles may cause harm to biological systems because they can penetrate cellular barriers, and induce oxyradical generation that may cause oxidative damage to the cell. However, the nature and extent of risk to consumer health from ingestion of nanoparticles via food and drink are largely unknown.

The study highlighted knowledge gaps that may warrant further research; for example, to better understand nanoparticle migration patterns from different FCMs; the behaviour, fate and toxicology of nanoparticles; their interactions with other food components and absorption in the gastrointestinal tract, effects on the function of gut epithelium and other cells, and on the gut natural microflora; and improvements in imaging technology.

Following completion of the study, a workshop was organised as part of the project to discuss the state-of-the-art, and the key issues emerging from the applications of nanotechnology for FCMs. The workshop was attended by representatives from the scientific community, industry, consumer forums, and regulatory agencies. Several UK/ EU experts presented their studies and views at the workshop, highlighting the benefits that nanotechnology applications would bring to the food sector, and any potential risks to consumer health and the environment.

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Published Papers

Chaudhry Q., Scotter M., Blackburn J., Ross B., Boxall A., Castle L., Aitken R., Watkins R., Applications and implications of nanotechnologies for the food sector, Food Additives & Contaminants., 2008, Volume 25, Issue 3, 2008, Pages 241 – 258

Research report

England, Northern Ireland and Wales

PDF
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