Leatherhead Food International & Nanotechnology Knowledge Transfer Network

Submission in response to the Call for Evidence: Nanotechnologies and Food From the House of Lords Science and Technology Select Committee

Background

Leatherhead Food International (LFI) is proudly independent and has been providing solutions and services to the food and drink industry since 1919.

LFI is renowned for its comprehensive Global Food Regulation services, applied Food Safety Research, Nutrition and Food Innovation expertise. These technical areas are complemented by a wide range of Knowledge services including publications, training, consultancy, market research, conferences, and online databases.

LFI clients use our services and solutions to ensure their businesses, from dynamic start-ups and SMEs through to the largest multinationals, can meet the challenges of today's ever changing market place. The client list includes the major global companies in the food industry as well as ingredient suppliers, manufacturers, retailers and foodservice businesses.

As part of the need to provide cutting edge information and research, LFI has started a working group called NanoWatch. This group is composed of food and drink companies who wish to understand the potential benefits and concerns of new technologies. In addition, in collaboration with the nanotechnology Knowledge Transfer Network (NanoKTN) LFI has formed a food focus group. This group will enable the industry to have a voice on research funding, regulation and other developments that could impact on the industry.

State of the science and its current use in the food sector

- **What are the main potential applications and benefits of nanotechnologies and nanomaterials in the food sector, either in products or in the food production process?**

  Currently the main applications and benefits for nanotechnologies and nanomaterials in the food sector are in packaging and in the addition of nutraceuticals or vitamins to foods. Examples for the packaging sector include the addition of antimicrobial coatings to packaging matrices to reduce bacterial contamination / growth and the addition of specific additives to the packaging matrices to improve resistance to oxygen permeability and preserve freshness of the product. With respect to the addition of nutraceuticals to foods, examples include nano-/microencapsulation (the formation of very small capsules around the nutraceutical) to preserve them from oxidation. Furthermore, research is published indicating that nanoscale nutraceuticals have increased effectiveness because of their small sizes and increased surface areas.

  Nanomaterials are being used to coat surfaces of buildings, windows, electronics, appliances (such as washing machines and refrigerators), personal clothing etc, In the

main, the use of these has not transferred to the food industry, however the potential benefits are great. For example, it is likely that as well as preventing bacterial contamination on food surfaces in food preparation areas, the use of inert non-sticky nano-materials on machinery could also be used to prevent fouling of food processing machinery. This would reduce the frequency of cleaning the machinery and not only result in greater efficiency of the process and energy usage but also reduce the amount of detergent needed for cleaning.

The potential applications are extensive. Some examples are:

- Development of smart sensors. These could be used in packaging to alert the retailer or customer when the contents are not safe to eat.
- Development of smart sensors for food analysis. Very rapid detection of the presence of food poisoning bacteria or viruses would be extremely beneficial. Additionally many products are analysed for nutritional content, and these are done by traditional laboratory analyses. Smart lab-on-a-chip or lab-on-a-foil sets are being developed which could increase the speed and accuracy of analysis and cut the cost.
- Development of smart filters that could selectively remove allergenic ingredients from foods while they are being manufactured. This would be very beneficial for removing trace amounts of peanut or similar allergenic material.
- Development of technologies that allow the formation of nanoscale emulsions. The properties of these are not known but could include higher stability of the emulsions, reducing or eliminating the need for the addition of emulsifiers. This would contribute greatly to "cleaner-label" foods by reducing additives. In addition, complex multiple emulsions could be made which would allow a fat reduction in foods whilst keeping the popular creamy sensory mouthfeel that consumers like.
- Manipulation of the size and structure of ingredients to increase their functional properties. Examples of this include making smaller crystals of salt that would have a higher salty taste allowing a salt reduction in foods which would be a healthy benefit for the consumer. Other examples could include an increase in thickening or gelling ability of the hydrocolloids/thickening agents, or in emulsifying ability of hydrocolloids/emulsifiers, reducing the need for several chemical additives to stabilise a food product

- **What is the current state of the market for, and the use of, food products and food production processes involving nanotechnologies or nanomaterials, either abroad or in the UK?**
  Cientifica predicted that the value of the nanotechnology applications in the food industry would rise from $410 million in 2006 to £5.8 billion in 2012. . Currently, the technology and applications are mainly in the packaging and food contact materials sectors, but potentially the whole of the food & drink industry and market would benefit from the very diverse materials and technologies being developed.

- **What might the 'next-generation' of nanotechnologies and nanomaterials look like? How might they be applied in the food sector, and when might they enter the market?**
  In the area of nanotechnologies, ultra high mixing technologies are likely to be implemented in the next few years. In food products these are likely to be applied to emulsions in the first instance and then to other ingredients and products. In the area of nanomaterials, coatings such as the glass-like nano coatings will be applied to food preparation surfaces to minimise bacterial contamination, to interior surfaces of fridges, microwaves, cookers and also to food contact machinery in manufacturing processes. They will probably reduce the amount of "downtime" due to cleaning needed and therefore reduce water wastage, energy costs and level of detergents used. It is likely that application of these will grow rapidly in the next 5 years. In addition, self-assembly technology to create functional nanomaterials will be of significant interest for the food and drink industry.

Beyond this there will be developments in the chemical and microbiological analyses based on nanotechnology and nano materials that will make for faster and better detection of contaminants. There will also be applications in structuring of food products to make healthier ingredients and products.

As the pharmaceutical industry is very active in nanotechnology applications; an overview and transfer of the technologies adopted for the production of pharmaceutical products across to the food industry would be essential.

- **What is the current state of research and development in the UK regarding nanotechnologies and nanomaterials which have or may have an application within the food sector? How does it compare to research and development in other countries?**
  There is very little research and development in the UK regarding nanotechnology within the food and drink industry. In spite of enormous interest from the food & drink industry in the potential, very little is known about what is out there, what is feasible, what is safe and how it might be applied. The industry needs independently-reviewed knowledge and expertise that can be transferred to food product development, along with a scientific approach to be able to see the potentials. To achieve this, Leatherhead Food International has formed a NanoWatch Working Group to inform members of the group on new developments and also to carry out small proof-of-principle trials. In addition, Leatherhead is in collaboration with the Nanotechnology Knowledge Transfer Network (nanoKTN), having formed a Food Focus Group to promote awareness of the potential for these emerging technologies and materials for the food industry and to encourage the industry to make their voice heard.

  The main developments are being carried out outside the UK in countries (such as USA, Japan, India) that see the potential benefits to the industry and are being actively encouraged to develop further.

- **What are the barriers to the development of new nano-products or processes in the food sector?**
  - Possible confusion over nanotechnologies and nanomaterials.
  - Legislation on safety/novel foods that would impose unviable costs and delays to development.
  - Lack of knowledge on developments in the non-food areas and in transference of such knowledge to the food & drink industry.
  - Lack of funding for research into the potential benefits for the food & drink industry and Consumer
  - Lack of funding for research into the safety / toxicology of nanomaterials in food & drink industry
  - Fear of consumer backlash driven by the media spotlight on “Franckenfoods” - this in turn is driven by a lack of consumer understanding on how foods are manufactured, why they are made the way they are, and what the industry is trying to achieve
  - Lack of funds for education of the public in relation to nanotechnology in foods

Health and safety

- **What is the current state of scientific knowledge about the risks posed to consumers by the use of nanotechnologies and nanomaterials in the food sector? In which areas does our understanding need to be developed?**
  The scientific understanding is very limited and confused by various experiments that do not apply to foods; an example is the direct treatment of cells or animals with selected nano particles especially those unlikely to be used in the food industry applications. Specific research within the specific food & drink model systems is essential.

- **Is research funding into the health and safety implications of nanotechnologies and nanomaterials in the food sector sufficient? Are current funding mechanisms fit for purpose?**
  There needs to be a clear distinction between nano particles naturally and currently present in foods (this will include ones made during manufacture), and those that are not normally expected such as the persistent materials. The development and use of nanotechnologies that restructure accepted current ingredients also is unlikely to need safety or toxicology testing.

  There needs to be more funding in certain areas but this should go hand in hand with the development of the technology in foods.

- **Can current risk assessment frameworks within the food sector adequately assess the risks of exposure to nanotechnologies and nanomaterials for consumers? If not, what amendments are necessary?**
  In some cases current frameworks are thought to be sufficient. However further research within specific food & drink model systems is required for assessment of the risk of exposure to materials not normally used in food and drinks.

- **Are the risks associated with the presence of naturally occurring nanomaterials in food products any different to those relating to manufactured nanomaterials? Should both types of nanomaterials be treated the same for regulatory purposes?**
  It is unnecessary to treat naturally present nano materials or particles in the same way as certain manufactured materials. It is important to recognise that natural ingredients in foods are already subjected to processes that create nanoparticles. These have been eaten and considered as safe for a long time. A common sense approach is needed and the realisation that elimination of total risk is not possible.

Regulatory framework

- **Is the regulatory framework for nanotechnologies and nanomaterials fit for purpose? How well are imported food products containing nanotechnologies and nanomaterials regulated?**
  It has been acknowledged by the Food Standards Agency in its regulatory review report on potential implications of nanotechnologies for regulations and risk assessment in relation to food[1] (August 2008) that the existing European/UK legislative framework is broadly adequate to cover potential risks of nanotechnology-based products.

  Under general food law, “unsafe food” (as defined in Article 14, Regulation (EC) 178/2002 on general food law) cannot be placed on the market.

  Additionally, new food ingredients and agents used in food and feed manufacture and processing marketed in the European Union (EU) must be subject to a pre-market safety assessment. These include:
  - novel foods and novel food processes,
  - food additives
  - flavourings and
  - food packaging materials.

  It is anticipated that the engineered nanomaterials in food will fall into one of these categories and would therefore require a pre-market approval before being placed on the European/UK market.

[1] See at: http://www.food.gov.uk/multimedia/pdfs/nanoregreviewreport.pdf

These procedures involve the submission of dossier to the Commission or an EU Member States by the company asking for approval of the placing on the EU market of its new food ingredient or agent. Compositional, production and safety data must be provided in this dossier, as required by the Commission.

Any imported nanomaterials engineered using nanotechnologies will have to comply wit EU law and be subject to the EU approval procedures mentioned above.

- **How effective is voluntary self-regulation either in the UK or EU or at an international level? What is the take up by companies working in the food sector?**
  According to EU/UK food law, it is the responsibility of a food manufacturer to ensure that its food products are safe for human consumption and have been submitted to the relevant EU approval procedures, when these apply.

  In terms of voluntary reporting on the use of nanotechnologies, in the UK, Defra has set up a voluntary reporting scheme. After a 2 year trial, they have received a very low response from the Industry and this may reflect the very limited use of nanotechnologies by the UK/EU food industry.

  According to UK government officials from the Food Standards Agency, the food industry claims not to use nanomaterials.

- **Will current regulations be able adequately to control the next generation of nanotechnologies and nanomaterials?**
  Yes, as aforementioned, the current European/UK legislative framework is adequate to cover potential risks of nanotechnology-based products. Moreover, although nanotechnologies is not specifically mentioned in current food-related legislative texts, the new regulation on food additives published in December 2008 and the proposal for a new novel food regulation which may be adopted by 2010 both refer to nanotechnologies for their pre-market approval requirements.

- **Is there any inter-governmental co-operation on regulations and standards? What lessons can be learned from regulatory systems in other countries?**
  The European Commission has set up an international co-operation program in order to develop a common strategy on nanotechnologies with specific countries or regions around the world[2]. The Commission intends to develop with Member States, international organisations, European agencies, industry and other stakeholders, terminology, guidelines, models and standards for risk assessment throughout the whole life-cycle of nanosciences and nanotechnologies products. It also aims at looking at current risk assessment and management procedures to verify if they are adapted for ensuring a high level of consumer/environment protection.

  In terms of regulatory systems in other parts of the world, the EU regulatory framework can be compared to the ones in the USA and Japan.

  In the USA, like in the EU, there are currently no special regulations for the application or utilisation of nanotechnology in foods. The U.S. Food and Drug Administration (FDA) states that it regulates “products, not technologies,” and anticipates that many products of nanotechnology will fall under the jurisdiction of multiple centers within FDA and will therefore be regulated by the Office of Combination Products. As in the EU, any new materials sold in the USA, regardless of the technology used to create them, must be subject to the standard battery of safety tests. Therefore, like in the EU, any new nanomaterials will undergo a pre-market safety assessment. The difference with the EU is that some US States have decided to enact laws on nanotechnologies that are more stringent than federal laws. For example, Bekerley, CA adopted a municipal ordinance on

[2] See at: http://cordis.europa.eu/nanotechnology/home.html

nanotechnology in December 2006 to impose reporting obligation on facilities that manufacture or use manufactured nanoparticles. Cambridge MA, city council recently declined to adopt an ordinance regulating nanomaterials, but agreed to take numerous steps, including developing an inventory of commercial, industrial and research facilities in the city that manufacturer, process, handle or store engineered nanoscale materials.

In Japan, no provisions are laid down specifically on nanotechnology in their current legislation. They have like in the EC, legislative requirements on ensuring that that food sold on their market in safe for human consumption and this would apply to nanomaterials. The Japanese government is not currently intending to set up committees or workshops to discuss nanotechnologies and food safety. Although a network is being developed for European researchers in Japan (ERA-Link/Japan), via the Commission international co-operation program on naotechnologies. In 2002, the Japanese government emphasised in its Biotechnology Strategy guidelines that nanotechnology along with biotechnology and IT can be used as a tool to achieve developments in medical science, food safety, agriculture and the environment.

Public engagement and consumer information

- **What is the current level of public awareness of nanotechnologies, and the issues surrounding the use of nanotechnologies and nanomaterials in the food sector? What is the public perception of the use of such technologies and materials?**
  From studies on consumer acceptance, there appears to be a lack of knowledge of nanotechnology generally, but those who do know something about it are more prepared to accept it if they see a benefit to themselves or society.

- **How effective have the Government, industry and other stakeholders been in engaging and informing the public on these issues? How can the public best be engaged in future?**
  It is not known how effective they have been. A survey is currently being undertaken by BRASS at Cardiff University on the importance of company responsibility in considering safety issue in research. It is unlikely that the food industry will engage with this to any extent. A series of educational days would be useful for the public

- **What lessons can be learned from public engagement activities that have taken place during the development of other new technologies?**
  The lack of any obvious benefit to the consumer leads to a refusal to accept GM foods. The benefits from nanotechnology need to be understood and clearly communicated to the public

- **Should consumers be provided with information on the use of nanotechnologies and nanomaterials in food products?**
  The information could involve lengthy technical data in order to avoid over simplification. Yes the consumer should know but not necessarily on the label. Regulations on the information need to be considered together with education on the technology

Additional Comments

It is of concern that any specific legislation will increase consumer concerns on nanotechnology and demonise it. The food industry is careful to ensure that foods are safely produced and current legislation requires ingredients, foods and food packaging to be safe for the public. In the main, nanotechnology is a new tool for the industry to produce safe foods but with added benefits.