

» By Dr Kristen Lyons

# Nanotech Food and Farming and Impacts for Organics

**I**n the Ronald Dahl classic 'Charlie and the Chocolate Factory', Willy Wonka was able to create sweets with magical properties; from 'ever-lasting gob-stoppers' to chewing gum able to alter its flavour, from a creamy soup to a roast dinner, and finishing with blueberry pie. In 1971 when this book was originally released such food technologies defied explanation. By the 21<sup>st</sup> century, however, nanotechnology has shifted novel and 'designer' foods from the realm of children's fiction to commercial reality.

Nano-food and food packaging is now out of the laboratory and onto supermarket shelves and kitchen tables. Nano-seeds and nano-chemicals have also made their way onto farms. The food and farming nanotech industry is supported by some of the world's largest food companies – including Heinz, Nestle, Unilever and Kraft. Many governments around the world – including the Australian Federal Government – are backing the nano industry, and by 2010 the global nano agri-food industries will be worth in excess of \$US20 billion (ETC Group, 2004). Agri-food nanotechnologies bring with them a range of health, social and environmental risks. A nano future also poses specific problems and risks for the organic sector. With this in mind, there is a crucial need for the organic community to participate in emerging local and international nanotechnology debates. The Australian organic sector has now entered this debate. The Biological Farmers of Australia have proposed their revised organic standard will exclude nanotechnology. Standards Australia has also now adopted a prohibition on nanotechnology in the draft Australian Standard for Organic and Biodynamic Products. By excluding nano-materials and nano-techniques, the Australian organic industry is acknowledging the current gaps in scientific knowledge related to the health and environmental impacts of nanotechnology. By taking this position, the Australian organic industry is also sending a strong message to food regulators to adopt a precautionary approach towards new and emerging agri-food technologies.

## What is nanotechnology?

Nanotechnology does not simply refer to a specific technology, but rather to a range of technologies that operate at the nano-scale.

What exactly is recognised as nano-scale is the subject of significant debate, and varies to include engineered materials, structures and systems that operate at a scale of 100 to 300 nanometres (one nanometre is equivalent to one billionth of a metre) (Bowman and Hodge, 2007). To give a sense of this minute scale, a strand of DNA is 2.5 nm wide, a red blood cell is 7000 nm and a human hair is 80,000 nm. Friends of the Earth Australia recommend defining nanoparticles up to 300 nm in size (Friends of the Earth, 2008). They argue "particles up to a few hundred nanometres in size share many of the novel biological behaviours of nanoparticles, including novel toxicity risks", and that "nanomaterials up to approximately 300nm in size can be taken up by individual cells".

The UK Soil Association defines nanotechnology to include manufactured nanoparticles where the mean particle size is 200nm or smaller. Meanwhile in Australia, the Biological Farmers of Australia identifies the nano-scale where mean particle size is 300 nm or less, and where the minimum particle size is 200 nm or less.

At the nano-scale, nano-materials – relative to the same material at a larger size – have significantly different properties, including chemical reactivity, electrical conductivity, strength, mobility and solubility (Royal Society and Royal Academy of Engineering, 2004). Indeed, it is these very novel properties of nano-materials that make them attractive to industry and government. These novel properties are being exploited in the first phase of nanotechnologies now being applied across the agri-food sector.

## Nanotechnology in the Field and on the Table

Nano-applications are being applied across the entire agriculture and food sectors. In agriculture, for example, nano-pesticides and nano-sensors are changing the nature of agricultural production. A number of nano-pesticides, which give an earlier version of a pesticide new beneficial properties – including increased dissolvability in water, increased stability, the capacity for absorption into plants, or increased toxicity to pests – are already commercially available. The global agribusiness company Syngenta currently retails a number of pesticides with emulsions that contain

nanoparticles, including 'Primo MAXX Plant Growth Regulator' and 'Banner MAXX Fungicide' (ETC, 2004). Proponents argue nano-pesticides will enable more precise chemical delivery, therefore reducing overall chemical use. However, the opposite is actually more likely to occur; as nano-pesticides continue to entrench chemically dependent farming systems. At the same time, nano farming inputs provide agribusiness companies with opportunities to further extend their reach and control over agricultural production (Friends of the Earth, 2008).

Nanotechnologies are also being applied across the food sector. For example, nano-scale materials are being added to foods to alter their character traits, such as their nutritional value, texture and flavour. Nano-materials may be encapsulated – in a similar way to nano-pesticides – and can then be released in certain conditions, thereby enabling the controlled delivery of nutrients and other characteristics. Omega-3 additives are commonly added to foods (such as bread) in both nano and micro encapsulated sizes. On the one hand, such nano-foods might appear to increase the nutritional value of our diets by increasing the nutrient content of those foods we enjoy eating. However, it is not yet clear if we are actually able to absorb nano-nutrients in the same way we absorb nutrients in their bulk form.

Proponents of nano-foods also pin their hopes on a tech-fix solution for a range of food related problems, from food insecurity and malnutrition to obesity; if we could only have ready access to nutrient dense nano-foods then these problems, proponents argue, would be solved. However, the reality is that these problems – and their solutions – are much more complex. Achieving food security and malnutrition will require political and economic changes, not just technological changes. At the same time, seeing nano-food as a 'magic bullet' is likely to discourage us from thinking about what we eat, instead deferring responsibility to scientists and corporate interests to define a healthy and balanced diet.

Nanotechnologies are also being applied across the food packaging industry, with manufacturers claiming that nano-techniques can improve the quality, durability and shelf-life of packaged foods (Scrini and Lyons, 2007). For example, nano-sensors are being



applied to develop a new range of 'smart packaging' that can detect the release of particular chemicals. Electronic 'noses' and 'tongues' can 'taste' or 'smell' scents and flavours, and packaging itself can respond to these sensors by changing colour to warn us if a food is beginning to spoil, or has been contaminated (ETC Group, 2004). On the one hand it might be argued that nano-sensors will deliver 'safer', pathogen-free food. At the same time, however, this technology may underestimate the capacity of our own senses to determine the freshness and safety of food (Scrinis and Lyons, 2007). While the organic movement – along with the Slow Food and local food movements – encourage us to connect in meaningful ways with our food and those who produce it (see for example Lyons, 2006), nanotechnologies are likely to disconnect us from our food, natural environments, farmers, and even our own senses.

### Growing Concerns with Nano Food and Farming

The number of nanotechnologies being applied across the food and farming sector continues to grow. At the same time, so too are concerns regarding the social, economic and environmental impacts of nanotechnologies. Concerns are voiced by consumer groups and environmental NGOs, but also by scientists working in the field. Dr Qasim Chaudhry, for example, who leads the nanotechnology team at the Central Science Laboratory, an agency of the UK Department for Environment, Food and Rural Affairs, argues that nanotechnology products may have unanticipated effects, involving far greater absorption than intended, or altering the uptake of other nutrients. He points out that little, if anything is currently known about such possible impacts (Anonymous, 2006). The Woodrow Wilson Centre 'Project on Emerging Technologies' also states there is

insufficient funding for human health and safety research related to nanotechnology. On this basis, they conclude there is currently limited understanding of the human health and safety risks associated with nanotechnology (Institute for Food and Agricultural Standards, 2007). In this milieu of uncertainty, a number of scientific organizations – including the British Royal Society – have urged caution in developing nanotechnologies (RS/RAE, 2004).

Despite the concerns, nowhere in the world are nano-products and processes scrutinised for any potential nano-specific health, environmental or other risks. Nor do foods that contain nano-materials or derived from nano-techniques require specific labelling. As such, agricultural inputs, food items and food packaging that contain nano-materials are already on the market in Australia and elsewhere. The current limits in nano-regulation make it impossible to differentiate nano-products from their conventional counterparts (Bowman and Hodge, 2007). By prohibiting nanotechnology, the organic sector can provide consumers with a clear choice for avoiding nanotech food by buying certified organic.

### The Organic Sector Can Play a Central Role in the Nano-Debate

In January this year, the UK Soil Association entered the nanotechnology debate – announcing their revised organic standard would prohibit products and processes derived from nanotechnologies (200nm or smaller) (Smithers, 2008). In doing so, the UK Soil Association has become a significant player in the movement to ensure the democratic and responsible development of nanotechnologies. By entering the global nano-debate, the UK Soil Association has also demonstrated that nanotechnologies pose specific concerns for the organic industry.

Also this year, the Australian organic

industry has entered the nano-debate. The revised BFA standard now excludes nano products and processes from all aspects of organic production systems and products. Similarly, the draft Australian Standard for Organic and Biodynamic Products released in July (and open for comment until 22 September) states that organics would exclude nanotechnology. By prohibiting nano products and processes, the Australian organic sector, like the UK Soil Association, can provide a clear alternative for consumers – who are already wary about the lack of labeling for nano-food (see for example MARS, 2008) – and wish to avoid the risks associated with nanotechnology.

By excluding nanotechnology, the organic sector can play a significant role in shaping the emerging nanotechnology regulation debate, as well as broader debates about the future of Australian food and farming. Now is the time to write to Standards Australia with a clear message of support for excluding nano products and processes from the Australian organic standard.

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