

## Nano-Tech Food Futures?

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Remember the moment when Willy Wonka<sup>1</sup> opened the doors to his chocolate factory and invited children in to experience an unimaginable world filled with chocolate rivers, Oompa Loumpas, and an astonishing mix of sweet edible treats? As a child, I thought Wonka's most remarkable invention was his 'ever-lasting gob-stopper', a chewing gum that could alter its flavour – from a creamy soup, to a roast dinner, and finishing up this three course meal with blueberry pie – all while it was being chewed. This invention defied explanation in 1971 when 'Charlie and the Chocolate Factory' was originally released. However, recent applications of nano-technology to the food and agricultural industries mean designer flavour-changing food is now possible to fathom, and if developments in nano-tech continue at the current momentum they are set to radically alter food systems. Confirming this, the director of Rutgers' Centre for Advanced Food Technology in New Brunswick recently announced, "This is one technology that will have profound implications for the food industry, even though they're not very clear to a lot of people".<sup>2</sup> If this sounds far fetched, consider that the market for nano-technology food and food processing is currently valued at over \$2 billion, and this is projected to grow to \$20 billion by 2010<sup>3</sup>. With hefty financial investment in nano-tech research and development, backed by a well co-ordinated cheer squad comprising national governments (including the Australian Federal Government) and all major food companies, nano-technology has the potential to move out of the chocolate factory and onto the kitchen table. Indeed, it has already arrived!

So what is this technology that has captured the imagination of government and food industries? Nano-technology, as the name suggests, refers to the manipulation of matter at the scale of atoms and molecules (under 100nm). Either breaking material down to the nano-scale, or the self-assembly of individual atoms or molecules into nanoparticles, produces nano-materials.<sup>4</sup> These display new – and often unpredictable – properties, including altered electrical conductivity, strength, colour, and perhaps of most concern, toxicity levels. Due to their minute scale, nanoparticles can make their way deeper into the bodies of human and non-human animal species, in ways we don't understand, and producing impacts we have not yet realized and are perhaps currently unable to detect<sup>5</sup>.

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<sup>1</sup> Willy Wonka was one of the lead characters in 'Charlie and the Chocolate Factory'. This film, made in 1971, traces the story of five children who gain entry to Willy Wonka's mysterious Chocolate Factory after finding one of five lucky golden tickets. Wonka is an inventor of chocolate, and the film follows the children and their guardians as they traverse the factory discovering Wonka's inventions.

<sup>2</sup> Gardener, E. (2002) 'Brainy food: academia, industry sink their teeth into edible nano', *Small Times*, June 21.

<sup>3</sup> ETC Group, (2004) 'Down on the farm: the impact of nano-scale technologies on food and agriculture', November. [www.etcgroup.org](http://www.etcgroup.org).

<sup>4</sup> Kuzma, J. (2005) The nanotechnology-biology interface: exploring models for oversight, Workshop Report (September 15), Centre for Science, Technology and Public Policy, University of Minnesota.

<sup>5</sup> ETC Group (2004) *ibid*.

Despite the risks of nano-technology, food industries appear determined to add nano-materials to the mixing bowl. Leading the pack, in 2000 the \$34 billion company Kraft launched 'NanoteK', a global research consortium involving universities and research labs. According to the research director, the rationale driving this project is to "keep a leadership position in food science. . . (and) to know how to use this technology for food safety and quality".<sup>6</sup> It is somewhat ironic that while food safety appears a significant driver for nano-technology research, recent scientific findings indicate nano-materials can cause adverse health impacts, by introducing new toxins into food chains.<sup>7</sup> Despite this research, and the rumblings of dissent from the global belly, nano-technology R and D and its translation into commercial nano-materials largely proceeds in a regulatory vacuum.

There is a range of applications of nano-technology to the food industry, some of which are available in Australia. These include:

- Functional foods that contain nutrient rich nano-materials. For example, since 2005 Australian food company George Weston have sold 'Tip Top Up Omega-3 DHA' bread containing Omega-3 powder. The source of Omega-3 is tuna fish oil from Canadian company Ocean Nutrition, encapsulated (packaged) via cochealates that are able to mask the undesirable smell and taste of the tuna. If you think this sounds a bit fishy, consider that Tip Top Up is sold throughout Australia, and there is currently no government regulation for the entry of nano-materials into our food supply.
- Other nano-technology functional foods available on the global market include: 'Canola Active', an encapsulated cooking oil that reduces absorption of cholesterol (currently sold in Israel); nano-scale capsules to prevent flavour and aroma loss; and nano-scale technologies able to create "on-demand" functional foods, enabling consumers to design when specific traits of food (for example specific minerals and nutrients) will be available to their body.
- A range of "intelligent packaging" materials. For example, Nanocor produces Nanomer Nanoclays. By limiting the passage of oxygen and carbon dioxide, this packaging is able to keep food fresh longer. It is unclear whether this product is currently used in Australia, however with the market for "active, controlled and smart" food and beverage packaging worth at least \$38 billion, it is not difficult to envisage the expansion of nano-packaging in Australia.<sup>8</sup>
- Meanwhile, Kraft is funding university scientists to build "electronic tongues" that are capable of detecting food pathogens. When the pathogen is detected, packaging will change colour to alert consumers. Research into other forms of "smart packaging" includes a wrapper that releases a preservative when the food is beginning to spoil.
- And Samsung has recently released a 'Nano Silver Seal' refrigerator in Australia (and elsewhere). For \$5999<sup>9</sup>, you can rely on nanosilver coatings to sanitise the air and water in your fridge, keeping out bacteria and fungus.

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<sup>6</sup> Arabe, K. (2002) 'Food: edible nano is the new frontier', *Industrial Market Trends*, September 5.

<sup>7</sup> ETC Group, (2004) *ibid.*

<sup>8</sup> Kuzma, J. (2005) *ibid.*

<sup>9</sup> This price was quoted on an 800 litre fridge from the Samsung National Distributor, Sydney, in March 2006.

The unreal world of nano-technology does not stop here. It has also extended its reach beyond the farm gate and into the paddock, and includes:

- Nano-technology seeds with in-built switches for specific traits that can be externally turned on or off (including fertility)
- encapsulating nano-scale active ingredients into an “envelope” to control the conditions in which a pesticide will become active
- “smart fields” that are monitored via wireless nano-sensors that can detect when to apply water, pesticides and fertilizers. These inputs can then be supplied via encapsulated seeds
- “particle farming” by growing plants that are able to soak up nano-particles that can then be industrially harvested.

At face value, nano-technology may sound like just the technological fix we need to remedy our food insecure world: nutrient enriched foods for busy people who don't have time or the knowledge to ensure they eat a healthy balanced diet; packaging that tells us when our food is no longer safe to eat, rather than relying on our old-fashioned senses of smell, sight and taste; and increased control over the application of pesticides. Indeed, at first glance a nano-tech food future might appear to be as “intelligent” as nano-technology packaging, or as shiny and bright as a ‘Nano Silver Seal’ refrigerator.

However, despite the hopes pinned on nano-technology, the claims made by its proponents do little to address the underlying challenges to ensure the world's population has secure access to reasonable quantities of safe food, procured in culturally respectful and environmentally responsible ways. To begin, the addition of functional foods might appear to complement nutrient poor diets of modern processed food gastronomes. However, while functional foods might address one dietary deficiency – for example by providing food consumers with a powerful punch of Omega-3 – they overlook the range of other health problems associated with modern industrial diets. These health problems arise from the hidden caloric, sugar, salt and fat content of highly processed foods (many of which are ingredients in functional foods). In addition, our sedentary car-based lifestyles increasingly shape how we buy (for example our dependence on drive-through restaurants) as well as what we buy (including ‘neat’ food that can be eaten while driving). It is no coincidence the emergence of a processed, packaged fast food diet has coincided with an increase in rates of preventable diseases, including heart disease, diabetes and obesity. Will nano-technology come to the rescue? While some food companies claim new functional foods could solve these health problems, surely a simpler option is to eat fresh fruit and vegetables, and to support local food networks that encourage people leave their cars behind when procuring food.

In addition to the problems associated with nano-tech foods, the reliance on nano-tech packaging for determining food safety ignores the capacity of intelligent people, particularly women who are the primary food shoppers and food preparers. At the same time, suggesting we rely on colour-coded packaging to indicate food pathogens and the health status of food defers responsibility from governments and food industries to food eaters. On an international scale, governments take a minimal role in regulating the development and application of nano-technology. This leaves food industries to cook up a storm in the nano-kitchen without needing to share their recipes with anyone. Protected by patenting and trademark laws, food companies defy

consumers' fundamental right to know what they are eating. The expansion of nano-tech foods also intensifies the concentration of ownership and profits amongst few global food, plastics and bio-delivery companies. At the same time, small-scale farmers are increasingly vulnerable, unable to compete with large-scale farms, and not able to access any of the (potential) benefits of nano-technology.

While some herald the application of nano-technology to food and agriculture as a panacea for addressing the health, safety and environmental problems associated with modern food systems, emerging evidence suggests the contrary. Perhaps more critically, in a political and regulatory vacuum, it is difficult to envisage how we might even begin to accurately recognise the problems associated with these new technologies. Violet, the obnoxious child in 'Charlie and the Chocolate Factory' discovered the 'ever-lasting gob-stopper' was not all it was cracked up to be when not only her gum became blueberry flavoured, but she herself turned into a blueberry. Like Willy Wonka, food industries and government will also need to more adequately assess the impacts of new food technologies before they sneak any further into our daily meals.