

# Nanotechnology - the new threat to food

By [Georgia Miller](#)

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Following on from genetic engineering, nanotechnology represents the latest high technology attempt to infiltrate our food supply. Senior scientists have warned that nanotechnology, the manipulation of matter at the scale of atoms and molecules, introduces serious new risks to human and environmental health. Yet in the absence of public debate, or oversight from regulators, unlabelled foods manufactured using nanotechnology have begun to appear on our supermarket shelves.

Around the world there is an increase in interest in our food, health and environment. Where are products produced, how, why, by whom, how far have they travelled, how long have they been stored etc. The organic and local food movements have emerged as an intuitive and practical response to the increasing use of chemicals in food production, and to the growing alienation of industrial agribusiness from holistic agricultural systems. People have chosen to eat organic foods because they care about the health of their families and the health of the environment. Organic agriculture also enables people to support integrated, environmentally friendly agriculture, and appropriate technology, rather than chemical-intensive factory farming.

Support for organics has also grown as a direct response to biotechnology giants' efforts to genetically engineer our food crops. Farmers and food buyers around the world were, and continue to be, enraged by the introduction of genetically engineered food crops. For many, the inevitable conclusion was that whereas the biotechnology companies stood to benefit from the entry of genetically engineered foods into the food chain, consumers, farmers and the environment shouldered all the risks.

Now, nanotechnology introduces a new wave of assaults on our foods. Nanotechnology is the high technology, atomically processed antithesis to organic agriculture, which values the natural health-giving properties of fresh, unprocessed wholefoods. It further transforms the farm into an automated extension of the high technology factory production line, using patented products that will inevitably concentrate corporate control. It also introduces serious new risks for human health and the environment.

## Introduction to nanotechnology - what is it, why is it different

Nanotechnology is a powerful new technology for taking apart and reconstructing nature at the atomic and molecular level. Nanotechnology embodies the dream that scientists can remake the world from the atom up, using atomic level manipulation to transform and construct a wide range of new materials, devices, living organisms and technological systems.

Nanotechnology and nanoscience involve the study of phenomena and materials, and the

manipulation of structures, devices and systems that exist at the nanoscale, <100 nanometres (nm) in size. To put 100nm in context: a strand of DNA is 2.5nm wide, a protein molecule is 5nm, a red blood cell 7,000 nm and a human hair is 80, 000 nm wide.

The properties of nanoparticles are not governed by the same physical laws as larger particles, but by quantum mechanics. The physical and chemical properties of nanoparticles – for example, colour, solubility, strength, chemical reactivity and toxicity – can therefore be quite different from those of larger particles of the same substance.

The altered properties of nanoparticles have created the possibility for many new profitable products and applications. Engineered nanoparticles are used in literally hundreds of products that are already available on supermarket shelves – including transparent sunscreens, light-diffracting cosmetics, penetration enhanced moisturisers, stain and odour repellent fabrics, dirt repellent coatings, long lasting paints and furniture varnishes, and even some food products.

The Asia Pacific Economic Cooperation (APEC) Centre for Technology Foresight has predicted that nanotechnology will revolutionise all aspects of our economy and all aspects of society, with associated large-scale social upheaval.

How will nanotechnology be used for food production and processing?

Industry analysts and proponents predict that nanotechnology will be used to transform food from the atom up: “Thanks to nanotechnology, tomorrow’s food will be designed by shaping molecules and atoms. Food will be wrapped in “smart” safety packaging that can detect spoilage or harmful contaminants. Future products will enhance and adjust their color, flavor, or nutrient content to accommodate each consumer’s taste or health needs. And in agriculture, nanotechnology promises to reduce pesticide use, improve plant and animal breeding, and create new nano-bioindustrial products” – or so states the US Project on Emerging Nanotechnologies’ recent report on the use of nanotechnology in food and agriculture (available at <http://www.nanotechproject.org>).

The food and agriculture industries have been investing billions of dollars into nanotechnology research, with an unknown number of unlabeled nano food products already on the market. In the absence of mandatory product labelling anywhere in the world, it is impossible to tell how many commercial food products now contain nano ingredients. The Helmut Kaiser Consultancy Group, a pro-nanotechnology analyst, suggests that there are now over 300 nano food products available on the market worldwide. It estimates that the global nano food market was worth US\$5.3 billion in 2005 and will rise to US\$20.4 billion by 2010. It predicts that nanotechnology will be used in 40% of the food industries by 2015.

There are four key focus areas for nanotechnology food research:

- Nano-modification of seed and fertilisers/ pesticides
- Food ‘fortification’ and modification
- Interactive ‘smart’ food
- ‘Smart’ packaging and food tracking

Nano-modification of seed and fertilisers/ pesticides

Proponents say that nanotechnology will be used to further automate the modern

agribusiness unit. All farm inputs – seeds, fertilisers, pesticides and labour – will become increasingly technologically modified. Nanotechnology will take the genetic engineering of agriculture to the next level down – atomic engineering. Atomic engineering could enable the DNA of seeds to be rearranged in order to obtain different plant properties including colour, growth season, yield etc. Highly potent atomically engineered fertilisers and pesticides will be used to maintain plant growth. Nano-sensors will enable plant growth, pH levels, the presence of nutrients, moisture, pests or disease to be monitored from far away, significantly reducing the need for on-farm labour inputs. The concerned organisation, The Action Group on Erosion, Technology and Concentration (ETC) warns in its seminal report “Down on the Farm” (available at <http://www.etcgroup.org>), in a nanotechnology shaped future, “the farm will be a wide area biofactory that can be monitored and managed from a laptop and food will be crafted from designer substances delivering nutrients efficiently to the body”.

#### Food ‘fortification’ and modification

Nanotech companies are working to fortify processed food with nano-encapsulated nutrients, its appearance and taste boosted by nano-developed colours, its fat and sugar content removed or disabled by nano-modification, and ‘mouth feel’ improved. Food ‘fortification’ will be used to increase the nutritional claims that can be made about a given processed food – for example the inclusion of ‘medically beneficial’ nano-capsules will soon enable chocolate chip cookies or hot chips to be marketed as health promoting or artery cleansing. Nanotechnology will also enable junk foods like ice cream and chocolate to be modified to reduce the amount of fats and sugars that the body can absorb. This could happen either by replacing some of the fats and sugars with other substances, or by using nanoparticles to prevent the body from digesting or absorbing these components of the food. In this way, the nano industry could market vitamin and fibre-fortified, fat and sugar-blocked junk food as health promoting and weight reducing.

#### Interactive ‘smart’ food

Companies such as Kraft and Nestlé are designing ‘smart’ foods that will interact with consumers to ‘personalise’ food, changing colour, flavour or nutrients on demand. Kraft is developing a clear tasteless drink that contains hundreds of flavours in latent nanocapsules. A domestic microwave could be used to trigger release of the colour, flavour, concentration and texture of the individual’s choice. ‘Smart’ foods could also sense when an individual was allergic to a food’s ingredients, and block the offending ingredient. Or alternatively, ‘smart’ packaging could release a dose of additional nutrients to those which it identifies as having special dietary needs, for example calcium molecules to people suffering from osteoporosis.

#### ‘Smart’ packaging and food tracking

Nanotechnology will dramatically extend food shelf life. Mars Inc. already has a patent on an invisible, edible, nano wrapper which will envelope foods, preventing gas and moisture exchange. ‘Smart’ packaging (containing nano-sensors and anti-microbial activators) is being developed that will be capable of detecting food spoilage and releasing nano-anti-microbes to extend food shelf life, enabling supermarkets to keep food for even greater periods before its sale. Nano-sensors, embedded into food products as tiny chips that were invisible to the human eye, would also act as electronic barcodes. They would emit a signal that would allow food, including fresh food, to be tracked from paddock to factory to supermarket and beyond.

What are the key concerns about nanotechnology in food and agriculture?

Concerns about the use of nanotechnology in agriculture and food production relate to the further automation and alienation of food production, serious new toxicity risks for humans and the environment, and the further loss of privacy as nano surveillance tracks each step in the food chain. The failure of governments to introduce laws to protect the public and the environment from nanotechnology's risks is a most serious concern.

Nanotechnology in agriculture is based on the premise that we can improve efficiency and productivity by rearranging atoms in seeds, by developing even more potent chemical inputs, by using high technology surveillance to allow electronic, rather than person-based surveillance of on-farm conditions, and by further automating inputs to plant growth. Applications of nanotechnology to food processing assume that humans can 'improve' the taste, texture, appearance, nutritional content and longevity of food by manipulating it at the atomic level. It has even been argued that this will result in food that is 'safer'.

These assumptions are based on a flawed belief that humans can remake the natural world from the atom up – and get a better result. It assumes that we can predict the consequences of our actions, even when we are dealing with highly unpredictable processes and forces – such as quantum mechanics. Unfortunately, history tells us that we are simply not very good at predicting the outcomes of complex systems – witness the disasters that resulted from the introduction of biological controls such as the Cane Toad, or the introduction of rabbits and foxes for sport. History is similarly littered with examples of huge health and environmental problems that resulted from the failure to respond to early warning signs about previously perceived “wonder” materials such as CFCs, DDT and asbestos. This suggests that we should take the early warning signs associated with the toxicity of nanoparticles very seriously.

There is a small but growing body of toxicological literature that suggests that nanoparticles are more reactive, more mobile, and more likely than larger particles to be toxic to humans and the environment. Preliminary scientific research has shown that many types of nanoparticles can result in increased oxidative stress which can result in the formation of free radicals that can lead to cancer, DNA mutation and even cell death. Fullerenes, carbon nanoparticles, have been found to cause brain damage in largemouth bass, a species accepted by regulatory agencies as a model for defining ecotoxicological effects.

In its 2004 report, the United Kingdom's Royal Society recognised the serious risks of nanotoxicity and recommended that “ingredients in the form of nanoparticles should undergo a full safety assessment by the relevant scientific advisory body before they are permitted for use in products”. Despite this warning, two years after the Royal Society's report, there are still no laws governing the use of nanomaterials in consumer products to ensure that they do not cause harm to the public using them, the workers producing them, or the environmental systems in which waste nanoproducts are released.

The use of nano-surveillance in food packaging will also introduce new privacy concerns. As the food industry's use of nano-tracking increases, it will gain the capacity to track the movement of food from the paddock, to the factory, to the supermarket and to your dinner plate. This will raise serious new privacy issues for which we are poorly prepared.

Alarmingly, despite the release into supermarkets and into the environment of nano food and agriculture products, governments world wide have yet to introduce any regulation to

manage nanotechnology's risks.

The struggle for a healthy food future – what are the alternatives to nanotechnology?

What will our food and technological future look like? We are in an epic battle for control of our food supply. Corporate or community ownership, global or local, small versus massive, processed versus wholesome. These are the paradigms that we need to choose between. A key way to promote healthy, holistic agriculture is to support it with our purchasing choices. Certified organic foods offer you better health, a better environment and a way for you to support a nano-free food future. With personal care products, buy organic or from a company that states they do not use nanotechnology.

There are many ways to help create a healthy food future. Shop at a farmers market or buy from a box scheme direct from a farmer, buy from an organic store or from the organic section in a supermarket. Consider joining a community garden, or starting a garden of your own. Start an organic kitchen garden at your pre school or school. Read product labels, get involved and interested. Talk to your friends and family about the food issues that matter most to you. Let companies know through their 1800 feedback lines that you are concerned about the use of nanotechnology in their products. Tell your local member of parliament that you want to see products that contain engineered nano ingredients labelled to allow you to make an informed purchasing choice.

It is exciting to see food politics debated by our mainstream media and our research and education institutions. However while there are already unlabelled food products that contain engineered nano ingredients available in our supermarkets, nanotechnology is only just starting to gain some attention. There are no regulations in place to protect public and environmental health, and almost no corporate or public monies being spent looking at the long-term consequences of manipulating our food at the atomic level. The similarity to the introduction of genetic engineering with the added risk that there is no regulatory oversight is chilling.

We must all get politically active on nanotechnology just as we did with genetic engineering. It is essential that we get moratoria enacted on the use of nanotechnology until we have regulatory systems in place to protect human and environmental health, and until we have genuine public involvement in decision making regarding nanotechnology's introduction. We must also ensure our Governments put our hard-earned taxpayer dollars into support for the organic sector.

Together, we can create a healthy food future that delivers to our community not corporate profits.

*By Georgia Miller, Coordinator of the Friends of the Earth Nanotechnology Project and Scott Kinnear, board member of Biological Farmers of Australia and owner of Organic Wholefoods.*

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