

Inside the Microscopic World of Food Nanotechnology

Imagine food packaging that changes color to alert you to a chemical released when a food spoils. It may sound like the stuff of science fiction, but this kind of technology is real thanks to nanotechnology, which has quietly come to the forefront of scientific innovation and is poised to revolutionize the food industry. In a nutshell, nanotechnology involves manipulating matter at the nanoscale level—much too small for the human eye to see. A nanometer is one-billionth of a meter; a single human hair measures 100,000 nanometers wide.

Our own body's cell membranes, hormones and DNA are examples of vital structures that measure in the nanometer range. According to the Institute of Food Technologists (IFT) Scientific Status Summary, even food molecules such as carbohydrates, protein and fats are the result of nanoscale-level mergers between sugars, amino acids and fatty acids. While some nanoparticles appear naturally, the vast majority of interest in the field of nanotechnology involves synthesizing nanoparticles and nanomaterials.

Nanotech in the marketplace. The number of newly developed applications of nanotechnology in food has grown rapidly around the world to over 1,000. Both the government and private industry have spent billions of dollars on nanotechnology research and development, with virtually every major food corporation quietly involved.

One scientist who's fascinated with the possibilities of nanotechnology is Rickey Y. Yada, Ph.D., Professor in the Department of Food Science at the University of Guelph in Ontario, Canada. He offers a prime example of nanotechnology at work: the extension of the shelf life of certain foods, such as bananas. "It's frustrating to buy bananas. The first few are fine, but later on they may spoil. Is there a way we can slow down the ripening?" asks Yada. He points out that a nanotech solution is a bag that slows down the ripening by absorbing the gas that's produced naturally by bananas.

So far, there are few actual nanotech foods, according to the Project on Emerging Nanotechnologies at the Woodrow Wilson International Center for Scholars in Washington, D.C. There are more nanotech food contact products, such as food packing, storage or cooking products, as well as nanotech dietary supplements.

Certain industries have utilized nanotechnology for some time. If you're using light-diffracting cosmetics, transparent sunscreens, deep-penetrating moisturizers, personalized skin care products and certain dental adhesives, you are already taking advantage of nanotechnology. Other uses include stain and odor-repellent fabrics, dirt repellent coatings, long-lasting paints, lightweight tennis racquets and furniture varnishes.

Nanotechnology meets food applications. Food packaging is one area in which nano science can offer tremendous benefits. For example, the silver magnesium oxide or zinc oxide nanoparticles are already being incorporated into food packages to kill disease-causing microorganisms. Soon nanosensors will be added to food packages that will detect chemicals, pathogens and toxins in foods. Coatings that repel dirt are also being developed for food packages.

At least one food company is interested in interactive foods and beverages derived from nanotechnology that can be personalized to fit individual preferences. In the future, these might be beverages that change flavors or colors or foods that can adjust for a person's allergies or nutritional needs.

The bioavailability of nutrients in foods and beverages might also be enhanced by the delivery system of nanotechnology. For example, nanocapsules (minute capsules) may be used as carriers for substances such as antimicrobial compounds, antioxidants, coenzyme Q10, essential oils, flavor compounds, proteins, vitamins, minerals and phytochemicals in order to improve their bioavailability and provide the ability to release these nutrients on demand.

Another future use is the nano bar code, the molecular version of traditional bar codes, which can be used to track foods in a supply chain that normally can't be tagged with traditional bar codes. And nano-biosensors might detect the slightest trace of pathogens, such as *E. coli*, in a food supply.

Nanotechnology is an exciting frontier, yet few people know about it. A landmark nationwide poll conducted by Hart Research Associates and the Project on Emerging Nanotechnologies in September 2009 found that among 1,001 U.S. adults, just 30 percent are aware of nanotechnology—a percentage virtually unchanged from 2006.

What about safety? Depending on your perspective, food nanotechnology either opens a whole universe of new possibilities or is a frightening new technology being shoved down your throat. According to a July 2008 Reuters news service article, nanofoods may be the next target for consumers already worried about genetically-engineered or cloned foods.

Canadian-based Centre for Research on Globalisation, Christine is this the organization ETC? an independent research organization and media group, reported in October 2008 that their concerns over nanotechnology in agriculture and food production include 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. Michael Hansen, Ph.D., Senior Scientist with the Consumers Union also expresses caution, because a substance at the nanometer level can behave very differently and have different properties than substances at the macrolevel.

While there is little scientific proof of health risks related to nanotechnology, scientists argue that there is a lack of research that addresses safety. In the June 2009 issue of *Human & Experimental Toxicology*, Italian researchers reported that there is still a huge gap between technological progress and research into the health and safety aspects of nanomaterials. These gaps include limited information, difficulties in relating nanotechnologies and production of nanomaterials to specific areas of application, efforts required to assess the hazards posed by nanomaterials in realistic exposure conditions, ethical issues about nanotechnology in the workplace likely to arise from knowledge about the hazards of nanomaterials, and the risks they may pose to workers.

“The industry needs to do a better job communicating the benefits of nanotechnology to consumers, while also performing rigorous safety testing,” says Yada. “While nanotechnology

appears safe, there's nothing in life you can guarantee as being 100 percent safe because there's so much variability as to how individuals react to something."

Regulatory woes. Many experts express concern about the lack of regulation of nanotechnology in the U.S. and abroad. Products produced through nanotechnology are not labeled as such by the companies that produce them, due to the fact that there is no requirement for labeling—the Food and Drug Administration regulates *products*, not technologies. And there is no definition or standard of identity for nanomaterials.

"The regulatory standards we develop for nanotechnology should be the standards we use for all new technologies," suggests Yada. "What we should be working toward is a model that—regardless of the technology—produces a common set of standards so we don't develop a separate set of regulatory standards for this technology and that technology. As consumers, we should be assured it will be safe."

Nanotech bottom line. Nanotechnology exhibits great potential. Right now, the best use appears to be in food packaging. Until more knowledge about the long-term safety for nanotechnology is available, it seems only fair that nanoparticles should be listed on ingredient labels in order to help consumers make informed decisions.

Current Nanotechnology Food Applications

Here are some examples of nanotechnology in the food aisle:

- Non-stick coating for aluminum foil
- Antibacterial kitchenware and tableware (forks, knives)
- Beer bottle plastics
- Canola Active Oil (Shemen Industries)
- Refrigerator interior (LG® and Samsung® brands)
- Lifepack® Nano nutritional anti-aging program
- Nanoceuticals™ Slim Shakes

Source: Project on Emerging Nanotechnologies at the Woodrow Wilson International Center for Scholars

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