

Nanofood – lessons to be learnt from the debate on GM crops?

Mette Ebbesen*

Centre for Bioethics & Interdisciplinary Nanoscience Center (iNANO)

University of Aarhus

Taasingegade 3, Building 1443

DK-8000 Aarhus C

Denmark

meb@teo.au.dk

Abstract

Basic research into nanoscience has shown tremendous potential for the use of nanotechnology to improve food safety and nutritional composition, so-called nanofood. Nanotechnology may for instance provide solutions to nanoscale biosensors for pathogen detection and to delivery systems for bioactive ingredients in foodstuffs through improved knowledge of food materials and their uptake at the nanoscale. However, researchers and society in general need to be aware of the risk that nanofood may suffer the same destiny as Genetically Modified (GM) crops, which have been boycotted by consumers in many parts of the world. This paper outlines the lessons to be learnt from the public debate on GM crops.

Public acceptance of nanotechnology is assumed to depend on confidence, which is created through information, education, openness and debate. However, empirical studies indicate that public attitudes towards biotechnology are shaped not only by information, education, openness and debate but also by risk perception and by moral and democratic considerations. This paper shows that from these empirical studies we can learn that public information on nanofood should address political, sociological and ethical aspects to meet the public requirements. The humanities and the social sciences do research into several of these aspects, for instance, they reflect on the objectives we wish to realise by introducing new technology and the values at stake. These reflections aim not to build trust and acceptance in the public, but to critically assess new technology so that the public can make informed judgement.

Keywords

Nanofood, GM crops, Ethics, Public, Information

Introduction

Two of the keystones in modern food technology are safety of groceries and healthy nutrition. Both fields are considered high priority areas in the food industry and at the governing authorities. A contamination of foodstuff may have indescribable consequences, not only for the consumers, but also economically for the implicated companies. Unhealthy nutrition is one of the most essential factors for development of several chronic diseases and of reduced life quality. Importantly, basic research into nanoscience has shown tremendous potential for the use of nanotechnology to improve food safety and nutritional composition, so-called nanofood.

On one hand, the use of nanotechnology within food and nutrition research has remarkable potential. However, on the other hand, reports on strategies for nanotechnology research point out the importance of avoiding that nanotechnology suffers the same destiny as GM crops which have been boycotted by the consumers (NSF 2001: 63; Royal Netherlands Academy of Art and Sciences 2004: 27). According to these reports nanotechnology can avoid the crisis of GM crops by informing the public about scientific and technological developments; and moreover by including the public in discussions of the pros and cons of nanotechnology.

This paper explores which factors shape public attitudes towards new technology and it explores which lessons the field of nanofood can learn from the debate on GM crops. Essentially, the paper

focuses on the role of the humanities and social sciences regarding the implementation of nanotechnology.

The use of nanotechnology within food and nutrition research

Nanotechnology refers to a cluster of technologies directed at making, studying and manipulating structures at the nanometre scale. The prefix 'nano' comes from the Greek word nanos meaning dwarf, i.e. nano refers to something small. Nano designates 10^{-9} , which means that one nanometre (nm) is one thousand millionth of a metre. Research on the nanoscale is not new in the sense that researchers have studied atoms and molecules for well over a century. However, it is not this 'old-fashioned' nanotechnology that creates so much interest. What is new about nanotechnology is the fact that researchers are now capable of handling and characterizing nanostructures by means of advanced microscopes and thus are gaining the power to alter physical structure at the atomic level. A variety of disciplines contribute to nanotechnology, such as molecular biology, biology, medicine, food and nutrition research, chemistry, physics, electronics, engineering and materials science. These disciplines co-operate, share knowledge and develop a culture beyond traditional disciplinary boundaries to explore and fulfil some of the visions and goals of nanotechnology. For instance, in the field of food and nutrition research various disciplines contribute with their specific expertise to develop nanoscale biosensors for pathogen detection and to develop nanostructured surfaces that can reduce bacteria growth on food processing equipment (Figure 1).

Examples of the use of nanotechnology within food and nutrition research:

- Nanorobots with biosensors for detection of fungal spores, insects, bacteria or viruses
- Development of nanostructured surfaces that can reduce bacteria growth on food processing equipment
- Development of thinner, stronger and cheaper packaging material
- Research into the effect of micro and macronutrients in foodstuffs on the human health
- Development of tasty food products with a more desirable nutrient profile
- Development of delivery systems for bioactive ingredients in foodstuffs through improved knowledge of food materials at the nanoscale

Figure 1: Examples of the use of nanotechnology within food and nutrition research (Nanofood Consortium 2005)

The humanities and social sciences as a means of gaining public acceptance

It appears from European and American reports that particular efforts are devoted to integrating the humanities and the social sciences into the interdisciplinary approach to nanotechnology. The overall objective is to gain the general public's acceptance of nanotechnology in order not to provoke a consumer boycott, as it happened with GM crops and foods. It is stated implicitly that this acceptance depends on the public's confidence in the technology and that the confidence is created on the basis of information, education, openness and debate. Thus, in a European report it says: "Without a serious communication effort, nanotechnology innovations could face an unjust negative public reception. An effective two-way dialogue is indispensable, whereby the general public's views are taken into account and may

be seen to influence decisions concerning R&D¹ policy. The public trust and acceptance of nanotechnology will be crucial for its long-term development and allow us to profit from its potential benefits. It is evident that the scientific community will have to improve its communication skills” (EU Commission 2004a: 19).

An American report states that the integration of researchers within the humanities and social sciences can establish a dialogue between nanotechnologists and the public. According to the report, this dialogue will assist in maximising the social benefits of the technology and in minimising the risk of debilitating public controversies: “The inclusion of social scientists and humanistic scholars, such as philosophers of ethics, in the social process of setting visions for nanotechnology is an important step for the NNI². As scientists or dedicated scholars in their own right, they can respect the professional integrity of nanoscientists and nanotechnologists, while contributing a fresh perspective. Given appropriate support, they could inform themselves deeply enough about a particular nanotechnology to have a well-grounded evaluation. At the same time, they are professionally trained representatives of the public interest and capable of functioning as communicators between nanotechnologists and the public or government officials. Their input may help maximize the societal benefits of the technology while reducing the possibility of debilitating public controversies” (NSF 2001: 15).

In the American report, it is mentioned that informing the public is not enough; the public have to be educated to perceive the advantages of nanotechnology (NSF 2001: 100-101).

Thus, it is assumed that informing and educating the public will create trust and consequently an acceptance of nanotechnology. In that way, according to the American report, research into the societal implications of nanotechnology will boost the success of nanotechnology, and hence it will be possible to take advantage of the benefits of nanotechnology sooner, more effectively and with greater confidence (NSF 2001: 2). Hence, it is not assumed that information about nanotechnology may lead to scepticism. The public must perceive and be convinced of the benefits of the introduction of nanotechnology and no importance is attached on the public’s informed judgment. However, a few EU reports assume the citizen’s right to informed judgement. But in these reports it is also stressed that educating people in science and technology must be prioritised in order to obtain this informed judgement (European Commission 2004b: 7-18).

Nonetheless, researchers point out that information and education are not the only factors influencing the public attitudes towards new technology. Returning to the Europeans’ sceptical attitude towards GM foods, there is disagreement whether the scepticism is exclusively due to lack of information and education. If we first look at the results of the so-called Eurobarometer survey on the European’s attitudes towards GM crops and foods, it shows an increasing scepticism from 1996-1999 about GM crops (a rise from 20% to 32%) and about GM foods (a rise from 39% to 52%), respectively. In contrast, the figures were relatively stable from 1999 to 2002 (European Commission 2003). However, regarding the application of biotechnology in medical science, the Europeans’ attitudes were positive in 2002: E.g. only 9% were opposed to genetic testing and 17% to cloning of human cells (European Commission 2003). Hence, the general public’s attitudes varied according to the specific biotechnological application. Applications within the plant and food area were assessed considerably more negatively than applications in the field of medicine. The ethicist *Bryn Williams-Jones* from the University of Cambridge writes: “Indeed, there tends to be widespread positive public regard for technologies that appear to have a clear benefit and minimal or at least well understood risks (e.g. biotechnologies that improve health care, such as genetic diagnostics or bio-pharmaceuticals). But when the benefits are dubious and the risks are potentially very serious and not well understood, as in the case of GM foods, then the public as consumer of new technologies may be very wary. The lesson for a nascent field such as nanotechnology – in which there are as yet few applications, but which is receiving billions of dollars of public monies – is that there must be broad and genuine public engagement in determining the scope and possible futures for this field” (William-Jones 2004).

The Eurobarometer surveys, which are based on responses from approx. 1000 individuals in each EU country, depict how different perceptions of biotechnology are distributed among the population on EU level and within the individual countries. However, these quantitative investigations are not sufficient to explain *why* the general public responds the way it does. As mentioned above, the reports on

¹ Research and Development (R&D).

² National Nanotechnology Initiative (NNI).

research into nanotechnology blame the general public's lack of knowledge of new technology for the boycott of GM food products (Royal Netherlands Academy of Arts and Sciences 2004: 27). Taking the studies on the Europeans' knowledge of GM crops and foods into consideration, it is fair to point out the lack of knowledge, for instance 64% of the European population believed that GM tomatoes contain genes as opposed to ordinary tomatoes (European Commission 2003). However, science sociologist *Claire Marris* emphasises that studies have shown that a greater insight into GM organisms does not necessarily lead to a more positive attitude; on the contrary, it makes the public more sceptical and polarised (Marris 2001; Sjöberg 2004). Marris dismisses it as a myth that persons who are against GM foods are irrational, and that they would accept GM foods if they knew more about biotechnology (Marris 2001). In the debate on GM crops and foods there has been much focus on the public's confidence in the experts. The argument goes that without confidence in the experts the public will misunderstand risks and uncertainties. The public will then be persuaded by the opposing organisations using eye-catching headlines. Consequently, risk communications by trusted experts has long been offered as the solution to public scepticism (Gaskell *et al.* 2003). However, a Swedish study shows that confidence in experts only plays a small role in connection with the public perception of risk. Topics like 'intervention in nature' and moral considerations generally mean a lot more (Sjöberg 2004). Researchers claim that the European population's perception of risk in connection with GM foods is much broader than the technical-scientific perception communicated by experts. In the public mind, risk also involves moral considerations (is it right doing this?), democratic considerations (who is funding and controlling biotechnology?) and uncertainties (will there be any yet unknown adverse consequences?) (Gaskell *et al.* 2003). This is also the conclusion of a Danish qualitative investigation made in year 2000 based on focus group interviews. The interviewees' assessment of risk included considerations on the possible violation of the order of nature, violation of the eigenvalue of nature and of God's creation. The respondents also mentioned power relations, democratic rights and the possible application of biotechnology to prevent poverty in developing countries (Lassen & Jamison 2006; Tveit *et al.* 2003: 9-14). The referred studies indicate that viewed from a traditional (technical-scientific) risk assessment perspective, the use of new technology may be unproblematic. However, the application of the new technology may yet still be rejected by the public on social, economic, ethical and political grounds.

The studies referred to above indicate that social, economical, ethical and political dimensions of implementation of new technology are important to the public. A lesson to be learnt from the introduction of GM foods regarding the implementation of nanotechnology may hence be that information to the public on nanotechnology should encompass more aspects than specific technical-scientific facts. It must also deal with political, sociological and ethical aspects of nanotechnology.

The critical function of the humanities and social sciences

As described above, it appears from reports on nanotechnology that the role of the humanities and social sciences is to maximise the societal advantages of nanotechnology, boost nanotechnology and reduce the possibility of debilitating public controversies. This entails e.g. that ethics is reduced to a tool or a means to an instrumental end, which can be expressed as a reduction of ethics to a PR agent for the laboratory. I object that this is a narrow apprehension of the role of the humanities and the social sciences to focus on creating trust in and acceptance of nanotechnology in the general public. The humanities and social sciences have a critical function. I believe that the function of philosophy and ethics regarding the implementation of any kind of new technology is to ask the fundamental questions such as: What impact will this new technology have on humanity? What is a good life? And will this new technology impact the realisation of a good life? The aim of posing these questions is not to build trust and acceptance in the public, but to make a critical assessment of new technology so that the public may make an informed judgement. This critical assessment does not have to be a negative one. Ethics is not only a demarcator saying thus far and no further. Instead, ethics may be viewed as a co-player firstly discussing the needs and goals of the public and society, and secondly serving as a framework to guide society towards these goals. As for nanotechnology, it should be contemplated, which goals we wish to obtain by means of technology. Is it the goals stated in the reports on nanotechnology research strategies? Or is it totally different goals? To mention a specific example, some reports state that the aim of research into nanotechnology is to improve human quality of life

(European Commission 2004a: 1). But what does it mean to improve human quality of life? An American report claims that the answer lies in the improvement of human capabilities and performance, which includes improving work efficiency and learning and enhancing individual sensory and cognitive capabilities while at the same time respecting fundamental values (NSF/DOC 2002: ix-x). Ethics could contribute to a reflection on whether improving human quality of life really equals improving its capabilities and performance, and in the first place whether it is possible to improve human subjects without compromising fundamental ethical values.

Closing remarks

The above may be an idealisation of the role of ethics regarding the implementation of nanotechnology. Maybe in reality, nanotechnologists are most likely to include an ethical dimension in their research projects, since it is required in their applications for research funding. However, ethics should take advantage of the fact that there is a market for ethics in connection with the current research into nanotechnology; ethics should take advantage of the fact that it can be voiced and heard. The ethicist must then retain his or her critical sense and provide the society with impartial information on nanotechnology. I believe that nanotechnologists have a duty to take part in ethical discussions within both the professional and the political context. Nanotechnologists are not only practitioners of a profession dealing with ethically relevant matters. They are also citizens with a special expertise creating a specific responsibility. Within both the professional and political context, ethical reflection demands an interdisciplinary co-operation between nanotechnologists and ethicists. To create the optimum basis for this kind of co-operation, it is necessary to establish interdisciplinary research environments integrating the humanities and the social sciences, where for instance ethicists and nanotechnologists are in daily dialogue facilitating ethical reflection as an integral part of the research process of nanotechnology.

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