

Introduction

Lynn Frewer, Arnout Fischer, Willem Norde, and Frans Kampers

As a basic science, nanotechnology has advanced considerably over the past decades. It has generally been agreed that nanotechnology deals with structures of size 100 nm (nanometers) or less in at least one dimension, and involves developing materials or devices within these size limits. Research in nanotechnology has resulted in applications across a wide range of areas, perhaps more so than for most areas of fundamental research in the natural sciences. The potential applications range from those within the medical and pharmaceutical sectors, the development of new materials, personal care products, to applications in agriculture and food (the focus of this particular volume).

In common with other emerging technologies, as well as existing technologies that are being re-evaluated, the opportunities for technological advancement are potentially profound. However, many scholars in the risk assessment community have raised concerns about the *toxicity* in regard to both human health and the environment. As a consequence, there is an ongoing discussion regarding whether specific measures regarding the regulation of nanoparticles are required. This is as true in the agri-food sector as in other nanotechnology application areas. Some academics have called for stricter application of the *precautionary principle*, with delayed marketing approval, enhanced labeling, and additional safety data development requirements in relation to certain forms of nanotechnology. From this, there have been discussions of the need to invoke the precautionary principle with regard to the application of nanotechnology. The precautionary principle states that, if an activity – for example, the application of an emerging technology – is potentially associated with health or environmental risks, the burden of proof that it is not harmful falls on those who advocate taking the action, if there is no evidence to suggest otherwise. On the one hand, the application of the precautionary principle allows policy-makers to take discretion in the absence of complete scientific proof of safety. On the other hand, this means that delays occur in marketing approval, and additional safety data may be needed in relation to specific applications of nanotechnology in the agri-food sector. In addition, appropriate labeling strategies may be needed to ensure informed consumer choice, given the emerging societal debate about nanotechnology and its applications to the agri-food sector.

The editors have attempted to address these (and related) issues in the current volume. In Part One, the fundamentals of nanotechnology applied to the agri-food sector are discussed, in particular, intermolecular interactions and self-assembly of macromolecules. In Part Two, the basic applications of nanotechnology in the agri-food sector are identified. Novel techniques such as encapsulation, diagnostics and sensing, and packaging are presented in detail, and their applications to food production are described. Part Three, on specific applications to food, deals with application in crop and livestock production, the application to improving the food supply (in terms of quality, safety, and security), discussion of functionality, and commercialization. Finally, Part Four, which deals with nanotechnology and society, focuses not only on the potential benefits of nanotechnology, but also on potentially emerging risks and what needs to be done to ensure safety. As well as a chapter focusing on the toxicology of nanomaterials in the agri-food sector, there is additional consideration of what this implies in terms of putative changes to risk regulation and governance. As part of this, it is essential to take account of the views and preferences of society, in terms of risk–benefit perceptions and preferences for co-development. These issues are addressed from both a theoretical and a practical perspective. The question that is asked is how should consumers and citizens be *effectively* involved in the societal debate about the development, application, and commercialization of food nanotechnology. As part of this, emerging ethical issues need to be addressed, and a chapter has been dedicated to discussion of these.