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Sustainable agriculture is a rapidly growing field aiming at producing food and energy in a sustainable way for humans and their children. Sustainable agriculture is a discipline that addresses current issues such as climate change, increasing food and fuel prices, poor-nation starvation, rich-nation obesity, water pollution, soil erosion, fertility loss, pest control, and biodiversity depletion.

Novel, environmentally-friendly solutions are proposed based on integrated knowledge from sciences as diverse as agronomy, soil science, molecular biology, chemistry, toxicology, ecology, economy, and social sciences. Indeed, sustainable agriculture decipher mechanisms of processes that occur from the molecular level to the farming system to the global level at time scales ranging from seconds to centuries. For that, scientists use the system approach that involves studying components and interactions of a whole system to address scientific, economic and social issues. In that respect, sustainable agriculture is not a classical, narrow science. Instead of solving problems using the classical painkiller approach that treats only negative impacts, sustainable agriculture treats problem sources.

Because most actual society issues are now intertwined, global, and fast-developing, sustainable agriculture will bring solutions to build a safer world. This book series gathers review articles that analyze current agricultural issues and knowledge, then propose alternative solutions. It will therefore help all scientists, decision-makers, professors, farmers and politicians who wish to build a safe agriculture, energy and food system for future generations.

More information about this series at http://www.springer.com/series/8380

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Editors

Nanoscience in Food and Agriculture 4

Springer

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We dedicate this book to our parents

Nano-materials: Anciently Present
But Recently Discovered

Nandita Dasgupta
Shivendu Ranjan

Preface

This book is the fourth of several volumes on *Nanoscience in Food and Agriculture*, published in the series *Sustainable Agriculture Reviews* (http://www.springer.com/series/8380). Nanotechnology, which is the use of techniques to build nanomaterials, is a fast emerging scientific topic. However, nanomaterials are not new; they have always occurred in nature. What is new is the methods that allow to synthesize unprecedented nanomaterials of tailored, fine-tuned properties, thus opening many applications in diverse fields. In particular, the high surface to volume ratio of engineered nanomaterials makes them often more efficient than in nature. Surprisingly, some nanomaterials even exhibit contrasting properties compared to their macro-counterpart. While nanomaterials are actually commercialized in various sectors, their use in food industries is still slowly emerging and debated. Results show that nanomaterials improve bioavailability, shelf life and nutrient delivery; they reduce nutrient loss and are essential in active packaging. Active packaging, also named intelligent or smart packaging, refers to packaging systems that help to extend shelf life, monitor freshness, display information on quality, improve safety, and improve convenience. Nevertheless, the potential toxicity of new nanomaterials should be studied before their use in consumer products (Fig. 1). This book presents comprehensive reviews on the principles, design and applications of nanomaterials in food, water and pharmaceutical sectors.

A nanocomposite is a multicomponent solid where one of the components has dimensions of less than 100 nm. It is a solid combination of a bulk matrix and nano-dimensional components differing in properties due to dissimilarities in structure and chemistry. In the broadest sense, nanocomposites include porous media, colloids, gels and copolymers. The principles and application of nanomaterials in food packaging, with focus on nanocomposites, are presented in the first two chapters by Ramos et al. and Ahmad et al. The synthesis and applications of nanoemulsions, which are stable systems containing two immiscible liquids, are then reviewed by Bhushani and Anandharamakrishnan in Chap. 3. Aiming at the safe design nanomaterials for food, Manickam et al. discuss recent advances on the genotoxicity of nanomaterials in Chap. 4. Chaurasiya and Hebbar then describe in Chap. 5 the use of reverse micelles as nanoreactors for the synthesis of nanomaterials and for the

Fig. 1 Nano-food products are reaching stores. This image has been modified and designed from a copyright-free image source by Nandita Dasgupta – VIT University, India

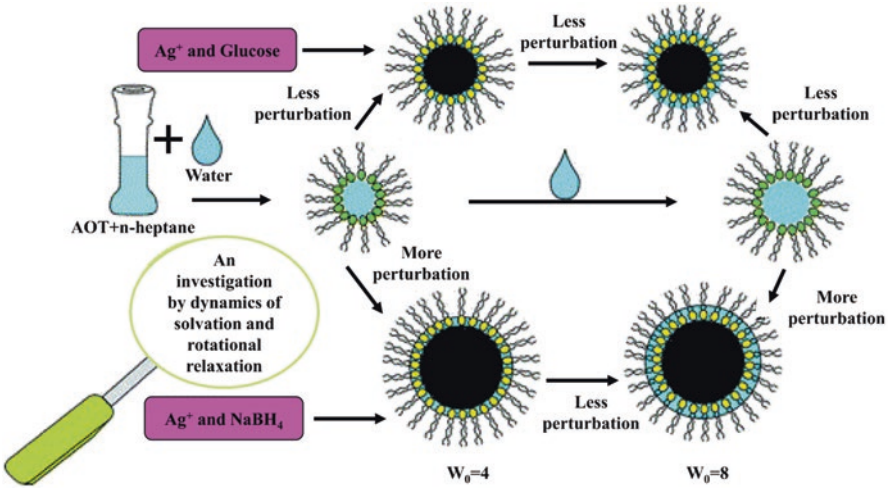

Fig. 2 Effect of the different reducing agents (glucose and sodium tetrahydroboride) on the size of silver nanoparticle synthesized in bis(2-ethylhexyl) sulfosuccinate sodium salt/n-heptane system. Sodium tetrahydroboride thus produces bigger size of silver nanoparticles, which causes more perturbation to reverse micelles. Chaurasia and Hebbar, Chap. 5

separation of biomolecules (Fig. 2). Chapter 6 by Paroha et al. reviews nanotechnology applications for the efficient delivery of coenzyme Q10, a health supplement.

The use of enzymatic nanosensor for detection of contaminants in food, water and agriculture is presented in Chap. 7 by Verma. Health supplements and nutraceuticals can be developed by nano-co-polymerization of natural products with

polyethylene glycol and polydimethylsiloxane, as reviewed by Pandey et al. in Chap. 8. Biofuel production from waste using nanotechnology is then discussed by Srivastava et al. in Chap. 9. Arsenic remediation by nanotechnologies, with emphasis on iron oxide nanomaterials, is presented by Paroda et al. in the last chapter.

Thanks for reading

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Contents

1	**Active Nanocomposites in Food Contact Materials** ..... Marina Ramos, Alfonso Jiménez, and María Carmen Garrigós	1
2	**Nanopackaging in Food and Electronics** ..... Nabeel Ahmad, Sharad Bhatnagar, Shyam Dhar Dubey, Ritika Saxena, Shweta Sharma, and Rajiv Dutta	45
3	**Food-Grade Nanoemulsions for Protection and Delivery of Nutrients** ..... Anu Bhushani and C. Anandharamakrishnan	99
4	**Genotoxicity of Nanomaterials in Food** ..... Venkatraman Manickam, Ranjith Kumar Velusamy, Rajeeva Lochana, Amiti, Bhavapriya Rajendran, and Tamizhselvi Ramasamy	141
5	**Reverse Micelles for Nanoparticle Synthesis and Biomolecule Separation**..... Ram Saran Chaurasiya and H. Umesh Hebbar	181
6	**Nanotechnology Delivery Systems of Coenzyme Q10: Pharmacokinetic and Clinical Implications** ..... Shweta Paroha, Arvind K. Singh Chandel, and Ravindra Dhar Dubey	213
7	**Enzymatic Nanobiosensors in the Agricultural and Food Industry**..... Madan L. Verma	229
8	**Transformation of Natural Products into Synthetic Copolymers** ..... Mukesh K. Pandey, Virinder S. Parmar, and Arthur C. Watterson	247

9 Nanoparticles for Biofuels Production from Lignocellulosic Waste 263
Neha Srivastava, Manish Srivastava, P.K. Mishra, Pardeep Singh, Himanshu Pandey, and P.W. Ramteke

10 Iron Oxide Nanoparticles to Remove Arsenic from Water 279
Prabhat Parida, Mayura Lolage, Ashwini Angal, and Debabrata Rautaray

Index 301

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His area of research is multidisciplinary which includes, but not limited to, nano-food technology, nano-agri technology, nanobiotechnology, nano-toxicology, natural products technology, natural products chemistry, bio-business, food chemistry and food engineering. He has published many scientific articles in international peer-reviewed journals and also served as editorial board member and referee for reputed international peer-reviewed journals. He has bagged several awards from different organizations, e.g. best poster award, achiever award, research award, young researcher award, etc.

Nandita Dasgupta is currently serving as research associate at VIT University, Vellore, Tamil Nadu, India. She has exposure of research institutes and industries including CSIR-Central Food Technological Research Institute, Mysore, India, and Uttar Pradesh Drugs and Pharmaceutical Co. Ltd., Lucknow, India. Her areas of interest include toxicological analysis, natural products technology, nanobiotechnology and agri-food technology.

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Eric Lichtfouse, 56, PhD in organic chemistry at Strasbourg University, is a geochemist designing new materials and techniques to increase soil carbon sequestration at the French National Institute for Agricultural Research (INRA). He has invented the ^{13}C-dating method[1] allowing to measure the dynamics of soil organic molecules[2], thus opening the field of molecular-level investigations of soil carbon sequestration. Chief editor of the awarded journal *Agronomy for Sustainable Development*[3], he has raised the journal rank from 29/53 in 2003, with an impact factor of 0.56, to 2/81 in 2014, with an impact factor of 3.99, in the agronomy category. He is also chief editor and founder of the journal *Environmental Chemistry Letters*[4] and the book series *Sustainable Agriculture Reviews*[5]. He is lecturing scientific writing and communication in universities worldwide[6]. His publication assistance service at the INRA has founded the French-English newsletter *Publier La*

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[6] http://fr.slideshare.net/lichtfouse/scientific-writing-and-communication, https://www.youtube.com/playlist?list=PLKEz5Pbi4p3By53Q0gclKPeSBTK2HJGK_

Science[7]. He has published the book *Scientific Writing for Impact Factor Journal*[8]. This textbook describes in particular the micro-article[9], a new tool to identify the novelty of experimental results. Further details are available on Slideshare[10], LinkedIn[11], ResearchGate[12], ResearcherID[13] and Orcid[14].

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