Sustainable Agriculture Reviews 24

Shivendu Ranjan
Nandita Dasgupta
Eric Lichtfouse *Editors*

Nanoscience in Food and Agriculture 4

Sanjeev Agarwal
REGISTRAR
IFTM UNIVERSITY
MORADABAD

Springer

Editors
Shivendu Ranjan
Nano-food Research Group, Instrumental and Food Analysis Lab
School of BioSciences and Technology
Vellore, TN, India

Nandita Dasgupta
Nano-food Research Group, Instrumental and Food Analysis Lab
School of BioSciences and Technology
Vellore, TN, India

Eric Lichtfouse
Europole Mediterraneen de l'Arbois
CEREGE INRA Europole Mediterraneen de l'Arbois
Aix en Provence Cedex 04, France

ISSN 2210-4410
Sustainable Agriculture Reviews
ISBN 978-3-319-53111-3
DOI 10.1007/978-3-319-53112-0

ISSN 2210-4429 (electronic)

ISBN 978-3-319-53112-0 (eBook)

Library of Congress Control Number: 2016947716

1st edition: © Springer International Publishing Switzerland 2016
2nd edition: © Springer International Publishing Switzerland 2016
3rd edition: © Springer International Publishing Switzerland 2016
© Springer International Publishing AG 2017
This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Sanjeev Bansal
REGISTRAR
IFTM UNIVERSITY
MORADABAD

Contents

Sanjeev Agrawal
REGISTRAR
IFTM UNIVERSITY
MORADABAD

Sanjeev Agrawal
REGISTRAR
IFTM UNIVERSITY
MORADABAD

Chapter 2
Nanopackaging in Food and Electronics

Nabeel Ahmad, Sharad Bhatnagar, Shyam Dhar Dubey, Ritika Saxena, Shweta Sharma, and Rajiv Dutta

Abstract Nanoscience has induced a profound revolution in all industrial domains, notably in the food and electronic industries. The food industry has constantly augment the quality, shelf life, safety and traceability of products. This has led to development of nanomaterials for food packaging and nanosensors to detect contaminations. Nanomaterials are to develop 'improved', 'active' and 'intelligent food packaging. Nanomaterials have also been conjugated with biobased polymers to develop environmentally friendly nanocomposites. This article review nanopackaging of food with emphasis on carbon nanotubes, nanosensors, nanowires, nanolaminates, nanocomposites, nanocrystals, biobased fillers for nanocomposite, and antimicrobial nanoparticles.

Keywords Nanotechnology • Food packaging • Electronic packaging • Nanocomposites • Carbon nanotubes

2.1 Introduction

As the population of the world keeps on increasing, the issues of food security, safety and preservation are steadily being thrust into the spotlight. Advances in food packaging technology have become one of the important tools to ensure the safety of the produced food worldwide. A large amount of food is being wasted annually on account of microbial contamination and exposure to deleterious components of

N. Ahmad (✉) • S. Bhatnagar • S.D. Dubey • R. Saxena
Department of Biotechnology, School of Engineering & Technology (SET), IFTM University, Moradabad 244001, India
e-mail: nabeel.biotech@gmail.com

S. Sharma
School of Biotechnology, Rajeev Gandhi Technical University, Bhopal 462036, Madhya Pradesh, India

R. Dutta
Department of Biotechnology, School of Engineering & Technology (SET), Sharada University, 32-34, Knowledge Park-III, Greater Noida, UP 201306, India

© Springer International Publishing AG 2017
S. Ranjan et al. (eds.), *Nanoscience in Food and Agriculture 4*, Sustainable Agriculture Reviews 24, DOI 10.1007/978-3-319-53112-0_2

Sanjeev Agarwal
REGISTRAR
IFTM UNIVERSITY
MORADABAD