Sustainable Agriculture Reviews

Volume 36

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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.

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Sustainable Agriculture Reviews 36

Chitin and Chitosan: Applications in Food, Agriculture, Pharmacy, Medicine and Wastewater Treatment

Springer

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Preface

*La chitine des arthropodes, traitée par la potasse à 180°C, puis lavée à l'eau, devient soluble dans l'acide acétique étendu, et la solution donne avec la potasse un volumineux précipité. Ce corps, nommé chitosane, présente des propriétés basiques et fournit des sels cristallisables, solubles dans l'eau.**

1894, The Discovery of Chitosan
Professor Felix Hoppe-Seyler
Professor of Physiological Chemistry and Hygiene, Strasbourg

**Arthropod chitin treated with potassium hydroxide, then water-washed, becomes soluble in diluted acetic acid. This solution yields a bulky precipitate, named chitosan, upon addition of potassium hydroxide. Chitosan has basic properties and provides crystallizable salts that are soluble in water.*

Professor Felix Hoppe-Seyler (1825–1895). (Source: Baumann E and Kossel A. Zur erinnerung an Felix Hoppe-Seyler. Zeitschrift für Physiologische Chemie, volume 21 (1895) pp. I–LXI)

Most commercial polymers are actually derived from petroleum-based raw products using chemical processes, which are not always safe and environmental friendly. Over the past three decades, there has been a growing interest in developing natural alternatives to synthetic polymers, namely, biopolymers. Biopolymers are

polymers derived directly from living organisms or extracted from renewable resources. Biopolymer production has been growing steadily due to their biodegradability and absence of toxicity. Biopolymers include polysaccharides such as chitin and chitosan. Chitosan is produced by deacetylation of chitin, which is the structural element in the exoskeleton of crustaceans, such as crabs and shrimp, and cell walls of fungi. Due to their remarkable macromolecular structure, physical and chemical properties, and bioactivities, chitin and chitosan have received much attention in fundamental science, applied research, and industrial biotechnology.

This book is the second volume of two volumes on *Chitin and Chitosan* published in the series Sustainable Agriculture Reviews. Written by 57 international contributors coming from 21 different countries who are leading experts in the chitin and chitosan field, these two volumes focus on the developments, research trends, methods, and issues related to the use of chitin and chitosan for both fundamental research and applied technology. The first volume focuses on the history, fundamentals, and innovations of chitin and chitosan.

This second volume presents the applications of chitin and chitosan in food, agriculture, pharmacy, medicine, and wastewater treatment. The first chapter by Carla Harkin et al. discusses the nutritional and additive uses of chitin and chitosan in the food industry. The second chapter by Piotr Kulawik et al. describes the functional properties of chitosan in the context of recent discoveries in seafood processing and preservation. The applications of chitosan as food packaging materials are detailed by Patricia Cazón and Manuel Vázquez in Chap. 3. Then, Julia Shamshina et al. present the use of chitin in agriculture in the fourth chapter. The synthesis and applications of chitosan-based hydrogels are presented by Janaína Oliveira Gonçalves et al. in Chap. 5. Applications of chitin and chitosan in pharmacy and medicine are detailed in three chapters: for drug delivery in Chap. 6 by Rabinarayan Parhi and in Chap. 7 by Jacques Desbrieres et al. and for tissue engineering and molecular delivery in Chap. 8 by Sheriff Adewuyi et al. The last chapters summarize recent applications of chitosan in wastewater treatment. The use of chitosan for direct bioflocculation processes is given by Eric Lichtfouse et al. in Chap. 9; then, Grégorio Crini et al. describe the use of cross-linked chitosan hydrogels for dye removal in Chap. 10.

The editors extend their thanks to all the authors who contributed to this book for their efforts in producing timely and high-quality chapters. The creation of this book would not have been possible without the assistance of several colleagues and friends deserving acknowledgment. They have helped by choosing contributors and reviewing chapters and in many other ways. Finally, the editors would like to thank the staff of Springer Nature for their highly professional editing of the publication.

Besançon, France — Grégorio Crini
Aix-en-Provence, France — Eric Lichtfouse

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The original version of this book was revised: The last name of one of the co-author in Chapter 9 was published with error which has been corrected now. The correction to this chapter is available at https://doi.org/10.1007/978-3-030-16581-9_11

About the Editors

Dr. Grégorio Crini 52, is researcher at University Bourgogne Franche-Comté, Besançon. His current interests focus on the design of novel polymer networks and the environmental aspects of polysaccharide chemistry. He published over 190 papers in international journals and books and is a highly cited researcher. The total citation of his publications is over 9000, h-index of 33. https://www.researchgate.net/profile/Crini_Gregorio

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