Chapter 7
Chitosan and Its Biomass Composites in Applications

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ABSTRACT

Biomass-based materials have been received a lot of attractive attentions due to their renewablity and low-carbon emmsion during processings. Chitosan is a deactylated product from chitin, which is the second most found bio-polymer in nature. Moreover, with the transformation of science and technology as well as the demand of society, chitosan-based composites have been extensively studied to adopt the changes towards sustainable development. Therefore, this chapter summarizes the existing researches of chitosan-based composites in different fields including biomedical applications, degradable food-packaging material and envrionmental remediation.

INTRODUCTION

In recent years, environmental issues such as climate change are one of the serious concerns caused by the increase in green-house-gas emission (Noohian & Mahmoudi, 2023). In particular, carbon dioxide, which is a significant contributor to global warming, has shown a dramatic increase over the past 20 years due to the demands of human consumption and the use of various materials (Kabir et al., 2023) Therefore, resilient efforts to create environmentally friendly materials based on green technologies and renewable sources are crucial for building sustainable development (Mikunda et al., 2021).

Regarding waste-based raw materials, the global consumption of seafood has been steadily increasing in response to the demands of each country (Boenish et al., 2022). It was reported that nearly 10 miliion tons of crustaceans, mostly shrimpt, prawns, crabs and crayfish are sold annually (Research, 2016). Consequently, the waste and by-products generated by this substantial industry can be considered as a significant source for chitin extraction, such as the shells of crustaceans. In the consumer market, the global

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consumption of chitin is growing at an average rate of 6.8%. Additionally, the worldwide chitin market is projected to increase from 45 million to 59 million US dollars between 2019 and 2024 (More, 2019).

Chitin, which is the second most abundant polysaccharide in nature, is found in crustacean shells, insects, and fungal cell walls (see Figure 1). As a biopolymer material, chitin possesses a wide range of functional properties (Hajji et al., 2015). However, its limited solubility in common solvents hampers its applications due to high crystallization and strong intra-/intermolecular hydrogen bonds (Gong et al., 2016), (Jardine & Sayed, 2018). Therefore, a conversion method called deacetylation has been employed to prepare chitosan from chitosan through chemical (Younes & Rinaudo, 2015) or biological processes (Schmitz et al., 2019). Chitosan is a cationic linear polysaccharide with multiple reactive amino and hydroxyl groups and consists of randomly distributed *N*-acetyl-D-glucosamine and β-(1–4)-linked D-glucosamine units (Sadiq et al., 2023). Due to its excellent properties such as biocompatibility, biodegradability, non-toxicity, and adsorption capabilities, chitosan has gained considerable attention for various applications, including food packaging, medical and pharmaceutical fields, drug delivery, and environmental remediation (Antonino et al., 2017) (Figure 1). Recently, the combination of polymer hydrogel networks with nanoparticles (metals, non-metals, metal oxides, and polymeric moieties) has shown promise in providing enhanced functionality to composite materials (Thoniyot et al., 2015). This chapter provide a summary of the preparation of chitosan composites and their utilization in various fields.

Figure 1. Flowing chitosan production process to its potential application from biomass sources through extraction process to chitin and extractionto of chitosan with deacetylation to chitosan