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RENEWABLE GREEN RESOURCES

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Abstract
This review will discuss the widespread use and economic attractiveness of chitin and chitosan. They can be extracted from crustacean waste, which is a stable source, and can be modified for specific applications. Valorization of crustacean waste has promising capabilities, chitin and chitosan have the potential to achieve the United Nations Sustainable Development Goals.

Keyword:
1. Log in
2. Production
3. The path to UN sustainable development goals
4. Summary
5. Available literature

Introduction

Chitosan is a semi-synthetic material obtained by the deacetylation of chitin and consists of glucosamine (deacetylated monomer) and N-acetyl-glucosamine (acetyl monomer) monomers, which are connected through the B-4 glycoside bonds. (Medically Imaged Nanobiomaterials, 2016.) Amino acids responsible for basic behaviors and cationic properties are crucial for polymer reactivity. Deatsetylation rate, molecular weight, crystallineity, and viscosity are some of the main parameters that affect the chemical and physical properties of chitosan and its final activity. The main difference between chitin and chitosan is that it dissolves in acidic solutions. The biological decomposition of chitin and chitosan, biological compatibility, non-toxicity, hemostatics, biodiversity, and immunostimulator activity are some beneficial properties of chitin and chitosan, which convert them into economically significant polymers. Chitin and chitosan are used in the food industry, agriculture, clearance of freshwater, tissue engineering, biotechnology, biotechnology, sanitation and cosmetics, as well as in the textile and paper industries.

Currently, the largest amount of chitin and chitosan is derived from fisheries industry waste, with a chitin content of 15-40%. Annual chitin industrial production from fishery waste is about 1 x 10^{11} tons. Based on the 2016 -2021 annual growth rate of 15,4%, the global chitin market is estimated to grow to over 155,000 tons by 2022. However, there are some limitations associated with the seasonal existence of this resource, mostly in coastal areas. In addition to waste crustaceans, which result in transportation costs and other areas being paid for, this polymer is also contained in the cell-containing wall of fungi and, in particular, insect exoskelette.

The United Nations Sustainable Development Goals (SDGs) have played an important role in promoting a sustainable seafood system since 2015. Since then, crustacean production has risen to 16,6 million metric tons per year. Asian countries such as China, Indonesia and India can be a clear example of this.

Although crustaceans contain about 40% meat, 60% are not consumed, raising questions about the scope of waste collection. At the same time, crustacean emissions include chitin, a biomoscient and biodegradable polymer, along with proteins and minerals, which is important in the production of high-tech products such as nerve conductors (e.g. Reaxon produced by Medovent).

PRODUCTION

The conventional deatsetilization process converts chitin into chitosan by removing the acetyl groups from amino acids in the chitin molecule, which affects the -NH2 groups. The percentage of N-acetyl-glucosamine units is called the acetylation rate (DA), and if the deacetylation process results in a polymer with units of >50% N-acetyl-glucosamine, it is called chitin; if lower, it is called chitosan. The deacetylation process influences the physical, chemical and mechanical properties of chitin/chitosan as well as their classification and suitability for specific applications. Alkali-deatsetilization using NaOH at high temperatures is widely used in industrial production of chitosan in the form of fragments, fine powders or fibers. However, this process can lead to chitosan, which has variable levels of deacetylation and a broad molecular weight distribution, which alters the structural properties of chitin. Therefore, satisfactory deasetilation is achieved with NaOH or KOH (40-50%) concentrated at temperatures above 100 ° C.

Typically, alkali consumes a large amount of energy for deacetilation; A large amount of alkali solution produces chitosan, which has different DDA and wide MW distribution.

Alternative green procedures. Mild extraction methods such as microwave ovens combined with combined steam blast and microwave ovens, as well as enzymatic deacetylation methods are also designed as promising and environmentally friendly processes for chitosan production. For example, the deacetylation of chitin in a microwave using sodium hydroxide increased the deacetylation efficiency by more than 3 hours to > by more than 90% compared to 21 hours during conventional alkali treatment. The explosion of steam has also been shown to facilitate the deacetilation of chitosan. Chitini can be deproteinized and deacetylated using various proteins and deacetylase. Chitin deacetylase mostly comes from bacteria, fungi and several insects and manifest themselves in a variety of ways.

Catalytic efficiency. Chitinolytic hydrolyzing enzymes are divided into endo- and exotchitinasis, which can fully hydrolyse chitin. Many bacterial chitosan deacethyles are preferably affected by low molecular weight chitosan. "Rhizobium spp" and "Vibrio cholerae" are known to produce chitosans effectively. Enzymes such as cellulose and lysosomes are also capable of hydrating chitosan. The enzymatic deatsetilation process seeks to form the same chitosan, but due to the high cost of enzymes it cannot be done in the industry right now. Chitin deacetilase is not effective in deacetilating insoluble chitin, so chitin should be treated in advance.

Adapt chitosan for special applications. Chitosan's reactive amino acid and hydroxyl groups make it a versatile material that can be modified and used for various applications. The broad literature contains various reactions to each functional group. These reactions include acidification, alkaline, carboxymetylization, and N-phosphometylation. Michael addition, quaternization, carboxialcilling, hydroxylation, phosphorus, sulphate and sopolymylation. For example, fourth ammonium replacement reactions targeted at amino acid groups result in excellent solubility, antibacterial, hemostatic, anticoagulant, hydrogel, film-forming, intensifying the absorption of fluid and hydrophilic chitosan yields with gene vector properties. The targeted reactions of the hydroxyl group require the initial protection of amino acids to produce antifungal activity, flexible film, high water solubility properties. Chitosan can also be modified by sulfonation, chitosan thyolation and phosphorylation to create cloves, hydrogels and nanoparticles for biotechnology and food applications. Although it may be difficult to change the C3-OH group, due to the steric barrier it can be chemically modified by methylation, accent and sulfurization. To adapt and expand the use of chitosan, welding sopolymerization is used in such ways as interconnection, radiation-influenced modification, and enzymatic modification. In these techniques, free radical initiators, interrelationship molecules and radiation are used to introduce functional molecules into the chitosan trunk or to create chitosan yields with unique characteristics. Overall, chitosan offers a wide range of opportunities for various industry applications, and researchers have developed many strategies to adapt it to specific needs.

Path to UN Sustainable Development Goals

Global seafood consumption is expected to grow by 36-74% over the next 30 years. However, progress towards achieving the SDG's 12,3 goal of food loss and waste is slow, with only 2022% of the success achieved. Therefore, it is necessary to accelerate progress in assessing the waste products of crustaceans, and this topic was considered generously. European and US-funded research projects, such as those focused on chitin and chitosan topics in Europe between 2000 and 2015, received grants of almost 15 million euros. After 2015, the value of grants increased, eventually reaching 55 million euros. While current chitosan manufacturing technologies are suffering from problems such as low cleanliness, reproduction, sustainability and high costs, the transition from first generation to second generation has opened up promising opportunities for crustacean emissions in various commodity markets, including agrochemicals and water treatment, which together cost more than $90 billion in market value. Revenue from these markets can be reinvested in research to address the challenges current chitosan manufacturing technologies face. In addition, the third generation of chitosan produced by biotechnology has the potential for advanced application in fields such as biotechnology and tissue engineering. Biotech engineering market alone - estimated at about USD 250 billion. Developed chitosan with a 5% acetylation rate can potentially increase peripheral nerve defects, affecting about 300,000 people in Europe each year. Nanotechnology-based chitosan and its derivatives also offer promising applications in areas such as self-employed nanosystems, bioacousmal electrical devices, and tumor-based nanoparticles. Research into the molecular level connections between the acetylation scheme and the different properties of chitosan is crucial for future studies in this area. If awareness of the industry and the population increases, the demand for products derived from chitin increases, provoking technological advances in the evaluation of crustacean emissions. However, mitigating allergic or viral contamination of chitosan from waste is critical for the production of complex biomaterials for use in the pharmaceutical and medical industries. It's time to rethink the dignity of crustacean emissions and support future food systems, as well as develop shell biorefiners to mitigate problems with stability and human health in accordance with the UN's SDGs.

Further research is needed to fully study the potential of chitin while achieving sustainable development goals (SDGs). While the widespread use of crustacean emissions for bulk products such as packaging and agrochemistry can affect the environment, quantitative detection of these effects on carbon and nitrogen cycles can help mitigate these effects. Currently, chemically obtained chitin or chitosan (the second generation) is the only commercial source used in mass products. The use of chitin-nanofibrils in food packaging was assessed in the n-CHITOPACK project (with 1 million euros in funding) which reported that replacing non-renewable materials with chitin-based plates could lead to a significant reduction in CO2 emissions. 12 million mt per year). Chitin is able to supply an agrochemical product containing nitrogen, which replaces petroleum-derived ammonia, which accounts for 0.5% of global ammonia demand.

However, the role of chitin in reducing carbon and nitrogen footprint does not encompass its sustainable value, especially given economic, environmental and social (health) factors. While allergy problems need to be solved, chile-based use of polypropylene from polypropylene in the food packaging industry can have a positive effect on cancer-causing effects, which leads to 72% less deaths than polypropylene. Commercialization of chitosan-based formulations can also prevent the release of large amounts of toxic pesticides into the ecosystem.

CONCLUSION

In conclusion, chitin and chitosan are manifold polymers with various characteristics that are economically attractive and make them useful in many industries, including food, agriculture, freshwater treatment, textile engineering, biotechnology, sanitation, cosmetics, textile and paper industries. Chitosan is obtained by deaceleting chitin and differs from it in solubility in acidic solutions. Currently, the largest source of chitin and chitosan comes from fishery industry waste, which has limitations related to seasonal availability, location and transportation costs. At the same time, crustacean waste contains chitin, a biomoscient and biodegradable polymer that can be used in high-tech products such as nerve conductors. The growing demand for sustainable seafood systems has contributed to the growth of the crustacean industry and the potential to produce chitin and chitosan.

The production of chitosan involves the deasetilation of chitin, which removes the acetyl groups and affects the amino acids. Acetylation rates affect the properties of chitin and chitosan. Alkali-deatsetylation is widely used in the industry, but can result in variable-grade deacetilation and a broad molecular weight distribution. Alternative, green procedures including extraction and enzymatic deacetylation methods have been developed using a microwave. Chitosan can be modification for specific applications via various reactions targeting the accent, alkaline, carboxymetylation and copolyderization, including the reactive amino acids and hydroxyl groups. These modifications result in chitosan derivatives with properties such as sociability, antibacterial and antifungal activity, as well as hydrogel and film-forming properties, making it a versatile material for various industrial applications.

Global seafood consumption is expected to increase significantly over the next 30 years. However, progress towards achieving the SDG goal of food loss and waste is slow. The assessment of crustacean emissions has been funded by large amounts by Europe and the United States. The transition from first generation to second-generation chitosan has opened up promising opportunities for crustacean emissions in various commodity markets. The third generation of chitosan produced by biotechnology has advanced application potential in fields such as biotech engineering and tissue engineering. Research is needed to fully study the potential of chitin in pursuit of SDG. Chitin is able to supply nitrogenous agrochemicals, replacing ammonia obtained by petroleum-chemical means. The use of chitin-based film in food packaging can significantly reduce CO2 emissions and have cancerous effects. Commercialization of chitosan-based formulations prevents the release of large amounts of toxic pesticides into the ecosystem. According to the latest advances, in my opinion, chitin and chitosan from 9 met the 6 criteria for doe-best chemicals:

1. Priority consideration (Funding by EU and US)
2. Broad technology (biochemistry, tissue engineering, nanomaterials, etc.)
3. Petrochemical substitutes (packaging of food, substituting for polypropylene)
4. Zoom scale (agrochemical and water treatment plants with a market value of $ 90 billion).
5. Renewable raw materials (fisheries industry waste)
6. Existing commercial product (agrochemical)

Therefore, further research is to be done to increase the volume that prevents the seasonal availability of raw materials and to increase its platform to the point that it can compete with existing gasoline. The importance of using crustacean emissions as a valuable resource to support future food systems through shell biorefineration to solve not only economic stability but also sustainability and human health problems needs to be re-considered. Focusing on this topic will ensure that this important waste product of the food system is transformed into a profitable resource in accordance with the objectives of the United Nations SDG.

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