利用深共熔溶劑從甲殼類廢棄物製備幾丁質及其性質分析

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摘要

幾丁質是世界上僅次於纖維素的生物聚合物，其具有許多優異的特性，可應用於生醫產業、食品加工、美妝產業、環保產業、農業等領域上。常見的製備幾丁質方法有化學法、生物法和溶劑法。深共熔溶劑(deep eutectic solvents, DES)是溶劑法的一種，其特性為成本低、低毒性、高可生物降解性及可持續性等。因此本文利用不同種類的 DESs，在不同莫耳數比、固液比、溫度、時間下，從甲殼類廢棄物中製備幾丁質，並對所得之幾丁質進行化學組成及物理化學性質分析，最後探討 DES 製備幾丁質之機制。結果顯示使用不同有機酸製備之 DES 均有明顯的去礦物質及蛋白質能力，且最佳之產率及純度分別可達到 48.85%及 87.73%。利用苄基三乙基氯化銨和乳酸形成之 DES 以莫耳數比 1:27、固液比 5%、溫度 120 ℃和時間 6 h 製備之幾丁質有最佳脫礦率及純度，分別為 97.36%和 91.15%，且物理化學性質均與商業幾丁質相似。在三元 DES 中，氯化膽鹼-乳酸-甘油(CCLaGly)表現出優異的萃取能力，相較於二元 DES 之氯化膽鹼-乳酸(CCLA)純度提升了 12%，且結晶度和分子量均與化學法幾丁質相當，此外，DES 組成分之間會形成龐大的氫鍵網絡，並分別與幾丁質、蛋白質和礦物質反應，將蛋白質及礦物質溶出去除，使幾丁質最後被分離出來。使用酸性二元 DES 或改良之三元 DES 可為製備 α-幾丁質產業上提供了環保永續且具成本效益的方法。

Preparation of chitin from crustacean waste using deep eutectic solvents and its property analysis

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Outline

1. Introduction
2. Preparation of chitin from crustacean waste using different types of deep eutectic solvents and reaction conditions
3. Exploration of the chemical composition and physicochemical properties of chitin preparation using deep eutectic solvents
4. Investigating the mechanism of chitin preparation using deep eutectic solvents
5. Conclusion

Abstract

Chitin is the second most abundant biopolymer in the world after cellulose, and it possesses many excellent properties that can be applied in various fields such as the biomedical industry, food processing, cosmetics, environmental protection, and agriculture. Common methods for preparing chitin are using chemical methods, biological methods, and solvent methods. Deep eutectic solvents (DES) are a type of solvent method characterized by low cost, low toxicity, high biodegradability and sustainability. Therefore, this study utilized different types of DESs to prepare chitin from crustacean waste under various molar ratios, solid-to-liquid ratios, temperatures, and times; and analyzes the chemical composition and physicochemical properties of the obtained chitin, also the mechanism of chitin preparation using DES was explored. The results showed that DESs prepared with different organic acids had significant demineralization and deproteinization capabilities, with the optimal yield and purity can reach 48.85% and 87.73%, respectively. The chitin prepared using a DES formed from benzyl triethyl ammonium chloride and lactic acid at a molar ratio of 1:27, a solid-to-liquid ratio of 5%, a temperature of 120°C, and a time of 6 hours exhibited the best demineralization rate and purity, which were 97.36% and 91.15%, respectively, and its physicochemical properties were similar to those of commercial chitin. Among the ternary DESs, choline chloride-lactic acid-glycerol (CCLaGly) demonstrated excellent extraction ability, with a purity increase of 12% compared to the binary DES of choline chloride-lactic acid (CCLA). The crystallinity and molecular weight were comparable to those of chitin prepared by chemical methods. Additionally, the components of the DES formed a large hydrogen bond network, which interacted with chitin, proteins, and minerals, effectively removing proteins and minerals and allowing for the separation of chitin. The use of acidic binary DES or modified ternary DES provides an environmentally sustainable and cost-effective method for the production of α-chitin.

參考文獻

Lei, J., Zhang, J., Li, K., Qin, H., Liu, H., Li, P., Liu, S., & Xu, J. (2024). Pretreatment of shrimp shells with an acidic deep eutectic solvent system for chitin extraction and its enhanced performance as a carrier for immobilized lipase. *International Journal of Biological Macromolecules*, *264*, 130774.

Ma, J., Yu, Y., Chu, D., Zhu, S., Liu, Q., & Yin, H. (2024). Efficient and eco-friendly chitin production from crab shells using novel deep eutectic solvents. *Journal of Polymers and the Environment*, https://doi.org/10.1007/s10924-024-03354-x.

Zhu, H., Chen, S., Yang, T., Hu, X., Cai, W., Wang, X., He, J., & Luo, Y. (2024). Comparative efficiency of different polyol-based deep eutectic solvents for chitin extraction from lobster shells. *International Journal of Biological Macromolecules*, *277*, 134425.