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ORIGINAL ARTICLE

Antioxidant and antimicrobial proprieties of chitin and chitosan extracted from *Parapenaeus Longirostris* shrimp shell waste

Propriétés antioxydantes et antimicrobiennes de chitine et du chitosane extraites à partir des déchets de crevettes Parapenaeus Longirostris

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Chitin;
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Summary
Introduction. — Chitosan, the linear polymer, is produced by alkali deacetylation of chitin (CHI). Recently chitin and chitosan were attracted marked interest due to their biocompatibility, biodegradability and non-toxicity.
Materials and methods. — In this study, chitin was extracted from shrimp shell (*Parapenaeus longirostris*) and chitosan was deacetylated by classical and ultrasound-assisted method. The identification of functional groups and the determination of degree of deacetylation of chitin (CHI), classical deacetylated chitosan (CDC) and ultrasound-assisted deacetylated chitosan (UDC) were carried through Fourier Transform—Infrared Spectroscopy. Their antimicrobial and antioxidant activity were also investigated.
Results. — The degree of deacetylation of CHI, CDC and UDC is 33.64%, 73.68% and 83.55%, respectively. Results showed that CHI, CDC and UDC exhibited a good antimicrobial activity against (*S. aureus, E. coli, P. aeruginosa, K. pneumonia*) and (*C. albicans and C. parapsilosis*). The scavenging ability of CHI, CDC and UDC on 1,1-diphenyl-2-picrylhydrazyl radicals

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is ranging from 4.71% to 21.25%, 11.45% to 32.78% and 18.27% to 44.17%, respectively, at the concentrations of 0.25 to 1 mg/mL. The inhibition of lipid peroxidation with thiobarbituric acid-reacting substances is ranging from 11.7% to 51.63%, 17.24% to 63.52% and 29.31% to 77.39%, respectively, at varying concentrations of 0.25 to 1 mg/mL.
Conclusion. — The effectiveness of CHI, CDC and UDC is correlated with their degree of deacetylation. The results indicate the possibility of exploiting chitin and chitosan as antimicrobial agent.

MOTS CLÉS
Chitine ;
Chitosane ;
Ultrason ;
Antimicrobien ;
Antioxydant

Résumé
Introduction. — Le chitosan est un polymère linéaire produit par désacétylation alcalin de la chitine (CHI), récemment la chitine et le chitosane ont suscité un intérêt marqué en raison de leur biocompatibilité, biodégradabilité et la non-toxicité.
Matériels et méthodes. — Dans cette étude, CHI a été extraite à partir de carapace des crevettes (*Parapenaeus longirostris*) et le chitosane a été désacétylé par la méthode classique et par la méthode assistée par ultrason. L'identification des groupes fonctionnels et la détermination du degré de désacétylation de la chitine (CHI), le chitosane désacétylé par méthode classique (CDC) et chitosane désacétylé par ultrasons (UDC) ont été réalisées par spectroscopie infrarouge à transformée de Fourier. Leur activité antimicrobienne et antioxydante a aussi été étudiée.
Résultats. — Le degré de désacétylation de la CHI, CDC et UDC est 33,64 %, 73,68 % et 83,55 %, respectivement. Les résultats ont montré que la CHI, CDC et UDC présentent une bonne activité antimicrobienne contre (*S. aureus*, *E. coli*, *P. aeruginosa*, *K. pneumonie*) et (*C. albicans et C. parapsilosis*). Leur capacité de piégeage des radicaux 1,1-diphényl-2-picrylhydrazyl est compris entre 4,71 % à 21,25 %, 11,45 % à 32,78 % et 18,27 % à 44,17 %, respectivement, à des concentrations allant de 0,25 à 1 mg/mL. L'inhibition de la peroxydation des lipides avec les substances réactives à l'acide thiobarbiturique est comprise entre 11,7 % à 51,63 %, 17,24 % à 63,52 % et 29,31 % à 77,39 %, respectivement, à des concentrations allant de 0,25 à 1 mg/mL.
Conclusion. — L'efficacité de la CHI, CDC et UDC est en corrélation avec leur degré de désacétylation. Les résultats indiquent la possibilité d'exploiter la chitine et le chitosane comme agent antimicrobien.

Introduction

Shrimps are very important products of aquaculture, and the shrimp processing industries generate each year a great amount of shellfish wastes. About 40% of the waste amount is chitin, which are abundantly dumped into the sea, and have become a major environmental concern due to their slow degradation. Therefore, it is a good opportunity to valorize the shrimp shells waste in the manufacture of value-added, like chitin and chitosan and its derivatives.

Chitin is a natural copolymer of D-glucosamine (GlcN) and *N*-acetyl-D-glucosamine (GlcNAc). Chitosan is produced by alkaline deacetylation of chitin, extracted from an abundant source of shellfish exoskeletons or the cell walls of some microorganisms and fungi [1]. It is insoluble at neutral and alkaline pH but it is soluble in acidic media. It has attracted marked interest as a biomedical material, because it is biodegradable, biocompatible, and non-toxic [2,3].

Because of the many beneficially biological properties of chitin and chitosan, such as antimicrobial, antioxidant, haemostatic activity and wound healing property [4], chitin and chitosan and their derivatives have been proposed for applications in biomedical, food, agriculture, biotechnology and pharmaceutical fields [2,5,6].

Currently, the natural compounds are the focus of biotechnological companies looking for new antioxidant and antimicrobial agents [7]. Therefore from a technological point of view, it would be quite profitable to recover the by-products released from seafood processing because of its richness in compounds of high value added, such as chitin and chitosan. In this study, chitin was extracted through chemical method from *Parapenaeus longirostris* shells which are not used and discarded as waste product in Tunisia, chitin has been transformed into more useful chitosan by classical deacetylation and ultrasound-assisted deacetylation, The Identification of functional groups and the determination of degree of deacetylation was carried through Fourier Transform—Infrared Spectroscopy. Their antimicrobial and antioxidant activity were compared despite their degree of deacetylation.