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Chitin and chitosan extraction from edible insects: characterization and comparison between different species and by-products

Mr. Pedro Navarro^{2,3,5}, Mr. José Carlos Ribeiro^{1,2}, Dr. Ofélia Anjos^{3,4}, Assoc. Prof. Fernanda Domingues^{5,6}, Assoc. Prof. Luís M. Cunha^{1,2}

¹Faculty of Sciences, University of Porto, Porto, Portugal, ²GreenUPorto-Sustainable Agrifood Production Research Centre, Porto, Portugal, ³Polytechnic Institute of Castelo Branco, Castelo Branco, Portugal, ⁴Forest Research Centre (CEF), Higher Institute of Agronomy, University of Lisbon, Lisboa, Portugal, ⁵Chemistry Department, Faculty of Sciences of the University of Beira Interior, Covilhã, Portugal, ⁶Health Sciences Research Centre (CICS-UBI), University of Beira Interior, Covilhã, Portugal

Aim

The main goals of this work were to extract chitin and synthesize chitosan from two different edible insect species - *Tenebrio molitor* larvae (TM) and *Acheta domesticus* (AD), as well as from by-products from *A. domesticus* processing (wings and legs – AD_WL).

Methods

Prior to chitin extraction, all sources were dried, ground and defatted. Chitin extraction consisted of a demineralization step (acid treatment) followed by deproteinization (alkaline treatment). The obtained chitin was dried and decolourized with sequential treatments with KMnO₄ and C₂H₂O₄. The decolourized chitin was dried and submitted to treatment with a strong alkaline solution in order to synthesize chitosan. The yield of the extractions was calculated and the obtained samples were characterized for colour (CIE-LAB system), molecular weight (viscosimetric method), surface morphology (SEM), functional groups characterization (ATR-FTIR, FT-Raman) and crystallographic structure (XRD). Furthermore, the antioxidant activity of chitosan was assessed.

Results

The highest chitin extraction yield was observed for AD_WL (14.98 ± 0.16%) followed by TM (9.01 ± 0.10%) and AD (8.70 ± 0.36%). For chitosan, the yields relative to the chitin were very similar (ca. 73%) for all sources. Regarding colour, all the samples had a very similar whiteness index and the discolouration step increased its value from ca. 37 to ca. 68. Insect samples presented the characteristic peaks of the α-chitin form, while also showing similarities to the commercial samples in XRD, ATR-FTIR and FT-Raman. Surface morphology showed some differences between samples with insect chitin and chitosan presenting pores which were not present in commercial samples. Concerning the molecular weight of the synthesized chitosan, the lowest value was obtained for AD_WL (309 kDa) which was lower than the MW of commercial shrimp chitosan (324 kDa). Neither the insect nor the commercial chitosan demonstrated DPPH inhibition, while for the β-carotene assay the insects' chitosan demonstrated lower antioxidant activity than commercial chitosan.

Conclusion

It was possible to extract chitin and synthesize chitosan from different edible insect species. The wings and legs of *A. domesticus* are promising since they presented the highest yield and similar behaviours to commercial products and can increase the economic value of edible insect rearing.