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Optimization of extraction conditions for astaxanthin from shrimp waste and investigation of antioxidant activity

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Astaxanthin is a xanthophyll carotenoid, which exhibits many important biological activities including a high degree of antioxidant capacity (AOC), hence has a significant applicability in food, pharmaceutical and cosmetic industries. An attempt was made towards optimization of astaxanthin extraction conditions from uncooked, cooked and acid-treated shrimp waste using different extraction methods (maceration, sonication and soxhlet extraction) and five different solvents (acetone, ethyl acetate, acetone:ethyl acetate (1:1), hexane and methanol). Further studies were carried out to investigate the antioxidant capacities of extracted astaxanthin. The percentage yield of crude astaxanthin was calculated for each trial and the UV-visible absorbance spectra were compared with a standard astaxanthin spectrum. All extracts showed a comparable UV-visible spectrum, confirming the presence of the pigment. Presence of astaxanthin and its esters in the extracts were confirmed by running thin layer chromatograms against anastaxanthin standard. Furthermore, the percentage of astaxanthin in each crude sample was calculated using the Beer-Lambert law. The best astaxanthin percentage of 68% has been observed through the use of acetone: ethyl acetate (1:1) solvent system facilitated by maceration of cooked and acid treated shrimp, whereas the best crude yield was found to be in the acetone extract of the acid-treated shrimp sample. Folin-Ciocalteu reagent was used to investigate the AOC of astaxanthin extracted by each method. The highest AOC of 65 µg pyrogallol equivalents (PGE)/mg of the crude was observed for the macerated ethyl acetate extract of the acid-treated shrimp sample and an AOC of 56 µg PGE/mg was calculated for the macerated ethyl acetate extract of the uncooked sample. The highest AOC by sonication and soxhlet extraction methods were also obtained with ethyl acetate. Concluding, it is reasonable to state that the highest amount of astaxanthin can be extracted by maceration with either acid treatment or cooking, when acetone: ethyl acetate solvent system is used. The highest AOC retention was found to be in the extract obtained by macerating the acid washed shrimp waste in ethyl acetate.

Keywords: Antioxidant capacity, astaxanthin, Folin-Ciocalteu