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The direct isolation of chitin nanowhiskers on assimilation of crustacean shell waste and crude extract from pineapple fruit waste

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Statement of the Problem: Chitin is the second most abundant biopolymer. It is found in crustacean shell waste as one of the major components (15-40 %) along with protein (20-40 %) and $CaCO_3$ (20-50 %). Isolation of high purity chitin is challenging and strictly recommended for biomedical applications. Chitin nanowhisker (CNW) is an important derivative of chitin produced by hydrolysis of amorphous domain of chitin. They find various applications due to its low density, high surface area, greater strength and biological activity. Here, we have demonstrated a facile, direct isolation of CNW using two waste materials namely, prawn shell waste and crude extract from pineapple fruit waste (PWE). The crude PWE is a rich source of water, sugars, lactic acid bacteria (*Lactobacillus plantarum*), bromelain (proteolytic enzyme) and chitinase. It contains the mixture of appropriate ingredients that are specifically required for direct isolation of CNW. The crude PWE serves as a reaction medium as well as a multifunctional reagent mixture for simultaneous deproteinization, demineralization, and depolymerization in a single-pot. The quality of CNW was evaluated by removal of protein and minerals. The absence of residual protein in CNW was confirmed by solid-state NMR, UV-Visible and, FT-IR spectroscopies. Additionally, the qualitative tests were also performed to confirm the elimination of proteins. Interestingly, very low residual mineral contents were observed (0.005 % Ca^{2+} and 0.026 % Mg^{2+}) as evaluated by AAS. The microscopic analysis using HR-SEM and TEM demonstrated the nanocrystalline structure of CNW isolated by the current method. The pH during the process was observed to fluctuate within acidic range (4.05 to 4.83) that aided the dissolution of minerals and fibrillation of chitin nanowhiskers. The high quality of CNW prepared by the current method was consistently proved by various analytical techniques. Hence, the current methodology would be promising for sustainable production of CNW.

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