Chitin Recrystallization and Nanocrystals Synthesis

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Introduction

Squid pens and crustacean shells are rich in chitin, a polysaccharide with versatile applications. Chitin is extracted through the removal of minerals and proteins, and its derivative, chitosan, offers enhanced physicochemical properties due to amino groups, enabling diverse uses. The hierarchical structure of chitin includes α-chitin nanofibers, enveloped by proteins and calcite crystals, contributing to its crystalline organization [1, 2].

Chitin nanocrystals (CNCs), synthesized via acid hydrolysis, possess exceptional mechanical, thermal, and optical properties, along with biodegradability and biocompatibility, making them ideal for various scientific and industrial domains [3, 4].

This study explores optimal aging conditions to enhance chitin crystallinity and synthesizes CNCs using acid reflux combined with mechanochemistry—a green, solvent-free method offering energy-efficient, high-productivity synthesis pathways.

Methodology

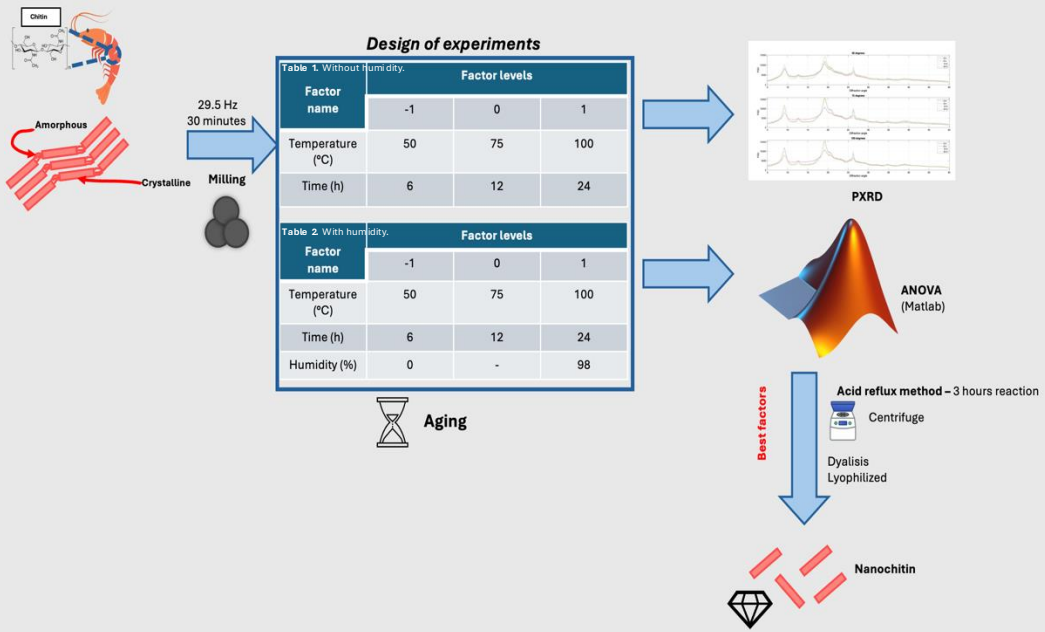

Fig. 1. Methodology used for the chitin recrystallization; design of experiments detailed in the**Table 1 and 2**.

Results

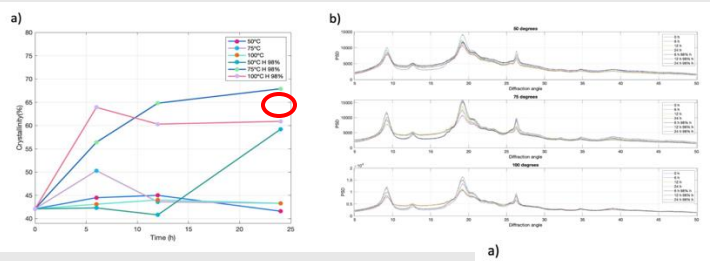

Fig. 2 . a) Crystallinity at different times, temperatures, and humidity. **b)** Crystallinity index at different times and temperatures; At 50ºC (T0, T6, T12, T24), 75ºC (T0, T6, T12, T24), and 100ºC (T0, T6, T12, T24) is observable that there is an increase in the peaks in comparison with the control. The best condition set is aging with humidity at 75° for 24 hours.

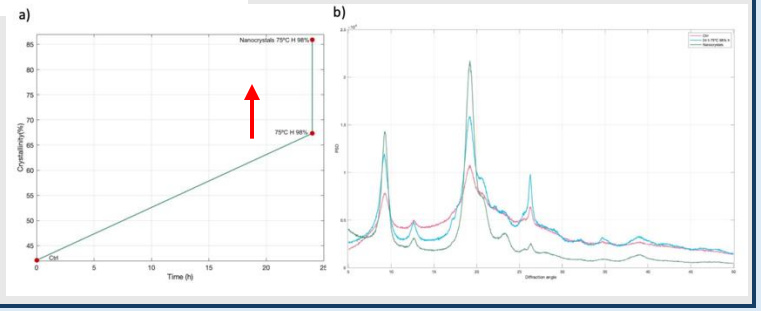

Fig. 3. a) Crystallinity variation between aged chitin and chitin nanoparticles subjected to identical conditions. **b)** Crystallinity Index: Aging at 75ºC for 24 hours (98% RH) vs. Aging followed by Nanocrystal Synthesis.

Conclusion

In conclusion, following the execution of two experiments employing distinct experimental designs, optimal interactions among variables have been identified to yield a substantial enhancement in the crystallinity of chitin. As depicted, in **Figure 2. a)** and **b)**, samples subjected to high humidity conditions exhibited the most pronounced increase in crystallinity.

Those exposed to a humidity-free environment demonstrated minimal improvements in crystallinity. **Figure 2. b)** illustrates a noticeable distinction in peak characteristics between the two experimental conditions. Upon comprehensive evaluation of all treatments, the most efficacious interaction for augmenting crystallinity involves the application of high humidity at 75°C, allowing the system to age for a duration of one day.

References

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