Cellulose and chitin synthases: same same but different

Filipe Natalio*

Plant Biodesign Lab
Department of Plant and Environmental Sciences
Weizmann Institute of Science, Israel

*Correspondence: filipe.natalio@weizmann.ac.il

Glycosyltransferases (GTs) play essential roles in various biological processes and exhibit promiscuity in substrate specificity, allowing the synthesis of diverse glycoconjugates crucial for the adaptation and survival of organisms. Cellulose and chitin synthases are transmembranar proteins involved in cellulose and chitin biosynthesis, respectively, and belong to the family of inverting processive GTs. Both biopolymers share high chemical and structural similarities. Yet, organisms that produce chitin do not produce cellulose and vice-versa. This is apparently supported by the low homology between the amino acid sequence. Recently, we discovered that the active site residues of cellulose and chitin synthases from bacteria are highly conserved between them and spatially, implying a catalytic promiscuity derived from broad specificity substrate common ancestor [1]. This hypothesis was experimentally confirmed in vitro using recombinant bacterial cellulose synthase and chitin precursors, leading to the formation of chitin (unpublished data). In a further step, we demonstrated the formation of co-polymers of chitin in cellulose-producing organisms such as bacteria and cotton in vitro cultures.
These findings underscores the potential of leveraging cellulose and chitin synthases' catalytic promiscuity for the synthesis of novel biopolymers with distinct and desirable properties for a range of applications toward fabrication chimeric organisms.

Reference

[1] Shamshoum, M. and F. Natalio, *Conserved active site architecture between bacterial cellulose and chitin synthases.* ChemBioChem, 2023. **n/a**(n/a): p. e202300388.