Exploring the potential of marine fungal enzymes for environmentally-friendly antifouling

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Environmentally-friendly antifouling has been introduced since the application of metal-based antifouling, such as tributyltin (TBT), banned the International Maritime Organization in 2005. In response, marine natural products exhibiting antimicrobial, cytotoxic, and antifouling activities have been proposed to replace the metal-based coating. Marine organisms including corals, bacteria, and algae can produce chemical compounds that have been tested effectively inhibiting the microbial growth including sulfur-containing, phenolic compound, indole, polyether, and terpenoid, demonstrating the immense potential of marine organisms as reservoirs of bioactive agents. The number of antifouling natural products extracted from marine organisms is increasing since 2009. Among these, enzymes offer specific advantages, including targeted activity, environmental stability, and biodegradability in disrupting biofilm, degrading adhesive layer, and interfering quorum sensing. Key enzymes such as protease, lipase, and chitinases target essential components of biofouling organisms, effectively inhibiting their settlement and growth. A review of Web of Science database reveals 420 articles on antifouling enzymes, with only 14 focusing on fungal enzymes, compared to 92 articles on bacterial enzymes and 23 articles on algal enzymes. This highlights a significant research gas and the untapped potential of marine fungal-derived enzymes as sustainable antifouling agents.

Keywords
Environmentally-friendly Antifouling; Marine Natural Products; Marine Fungal-derived Enzymes