Unveiling the Biotechnological Potential of the Marine Polychaete *Halla parthenopeia*: the Antimicrobial Properties of Hallachrome and Identification of Novel Toxins

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Driven by the prospects of harnessing the vastness of marine biodiversity as a source of novel bioproducts, marine biotechnology is attracting increasing attention. Drug discovery, in particular, has been focusing on organisms bearing chemical defenses with specific ligand-binding abilities, such as toxins. Among toxin-secreting animals, marine polychaetes, which form a polyphyletic, highly diversified, and widespread group of invertebrates, are promising but largely unexplored. The burrowing polychaete *Halla parthenopeia* is a specialized predator of bivalves that secretes a 'feeding' mucus to facilitate predation on clams. Additionally, it produces a 'defensive' mucus containing hallachrome, a toxic anthraquinone that may serve as an antiseptic to aid wound healing in case of autotomy. This study aimed to explore the antimicrobial properties of hallachrome and to identify putative toxins responsible for the activity of the feeding mucus. Hallachrome exhibits potent antimicrobial activity against gram-positive bacteria and fungi, including *Staphylococcus aureus* and *Candida albicans*, even inhibiting the growth of bacterial biofilm at lower concentrations comparatively to other natural anthraquinones. *De novo* transcriptome assembly and analysis yielded differential gene expression patterns between the body wall and the feeding apparatus, altogether identifying over 300 overexpressed transcripts in the feeding apparatus, including eight putative toxins. The biological activities observed in vitro or predicted *in silico* for the defensive and the feeding mucus, respectively, suggest potential applications as antimicrobial or cytotoxic agents. These findings underscore the substantial biotechnological potential of *H. parthenopeia*, and the marine polychaete in general, warranting further investigation for their exploitation in future biopharmacological applications.