

Toxicity of two marine algal toxins to blue mussel and brine shrimp larvae

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To meet the present and future global protein demand, aquaculture production is growing rapidly. Simultaneously, the occurrence of harmful algal blooms (HABs) is steadily increasing in frequency, intensity and geographical scale because of overfishing, pollution, climate change and the introduction of alien species. Over the past decades, numerous reports of disease outbreaks following the consumption of cultured organisms which were contaminated with toxins have clearly underlined the co-occurrence of HABs and the aquaculture industry. As the aquaculture sector continues to expand, it increasingly requires the availability of high quality larvae for fish feed or shellfish production. However, to date, knowledge concerning the possible effects of HAB derived toxins on larviculture is limited. This research therefore aims to investigate the effects of two well-known phycotoxins, i.e. domoic acid and okadaic acid, on larvae of two key aquaculture species: the blue mussel *Mytilus edulis* and the brine shrimp *Artemia franciscana*. Larvae were exposed to concentration series of either toxin as well as bloom concentrations of their respective producers *Pseudo-nitzschia multiseries* and *Prorocentrum lima*. Mortality of *A. franciscana* nauplii and larval development of *M. edulis* larvae were carefully monitored after 48 hours of exposure. In addition, effects on the innate immune response of both species were assessed by measuring the phenoloxidase activity. Our results show that the currently reported natural levels of these marine toxins do not detrimentally influence the larvae of either aquaculture species. Concentrations of live harmful algae exceeding reported bloom densities were not found to affect the development of *M. edulis* either. However, even at the lowest applied concentration of 50 cells.ml⁻¹ of the dinoflagellate *Prorocentrum lima*, nauplii of the brine shrimp *A. franciscana* exhibited $85.6 \pm 5.5\%$ mortality after 48 hours of exposure. Additionally, the phenoloxidase innate immune response of *A. franciscana* nauplii appeared to be affected by domoic acid. This last observation may imply that the nauplii are more susceptible to bacterial infections which have typically plagued the aquaculture industry for decades. Using *Vibrio campbellii* as a model species, this last hypothesis was tested.