Accumulation, transformation and breakdown of DSP toxins from the toxic dinoflagellate Dinophysis acuta in blue mussels, Mytilus edulis

Okadaic acid (OA), dinophysistoxins (DTX) and pectenotoxins (PTX) produced by the dinoflagellates Dinophysis spp. can accumulate in shellfish and cause diarrhetic shellfish poisoning upon human consumption. Shellfish toxicity is a result of algal abundance and toxicity as well as accumulation and depuration kinetics in mussels. We mass-cultured Dinophysis acuta containing OA, DTX-1b and PTX-2 and fed it to the blue mussel, Mytilus edulis under controlled laboratory conditions for a week to study toxin accumulation and transformation. Contents of OA and DTX-1b in mussels increased linearly with incubation time, and the net toxin accumulation was 66% and 71% for OA and DTX-1b, respectively. Large proportions (~50%) of both these toxins were transformed to fatty acid esters. Most PTX-2 was transformed to PTX-2 seco-acid and net accumulation was initially high, but decreased progressively throughout the experiment, likely due to esterification and loss of detectability. We also quantified depuration during the subsequent four days and found half-life times of 5-6 days for OA and DTX-1b. Measurements of dissolved toxins revealed that depuration was achieved through excreting rather than metabolizing toxins. This is the first study to construct a full mass balance of DSP toxins during both accumulation and depuration, and we demonstrate rapid toxin accumulation in mussels at realistic in situ levels of Dinophysis. Applying the observed accumulation and depuration kinetics, we model mussel toxicity, and demonstrate that a concentration of only 75 Dinophysis cells l-1 is enough to make 60 mm long mussels exceed the regulatory threshold for OA equivalents.