

PHHS BLOCK GRANT SUCCESS STORY 2016

RECEPTOR BINDING ASSAY FOR PARALYTIC SHELLFISH POISONING CONTROL

THE QUEST FOR SAFE SHELLFISH IS AIDED BY MOLECULAR ASSAY.

Issue: (1) The Mouse Bioassay (MBA) used to detect Paralytic Shellfish Poisoning (PSP) toxins in shellfish (a) is labor intensive, (b) has inadequate sensitivity, and (c) is subject to matrix effects. Specifically, the MBA has low sample throughput. (2) The public safety or regulatory limit (80 µg/100 g) is only slightly above the MBA detection limit (~30 µg/100 g). (3) The MBA is potentially unsafe for surveillance of shellfish containing high concentrations of metal ions (e.g., zinc or manganese).¹

Intervention: PSP is a food-borne illness caused by ingestion of contaminated shellfish. The PSP toxin, (saxitoxin [STX]), and its analogs are potent neurotoxins responsible for PSP illness. STX is extremely toxic (human lethal dose 1-4 mg). Marine dinoflagellates (ocean-dwelling, single-celled organisms) produce STX and related toxins that can accumulate to toxic levels in filter-feeding bivalves such as oysters and mussels.

The California Department of Public Health (CDPH) and California Department of Fish and Wildlife maintain a quarantine on sport harvesting of mussels between May 1 and October 31, when algal blooms typically flourish and shellfish accumulate toxins. Throughout the year and for commercially harvested shellfish the CDPH Environmental Management Branch (EMB) conducts surveillance of PSP toxins in shellfish relying on the MBA.

An alternative detection method approved by the Interstate Shellfish Sanitation Conference (ISSC) for regulatory testing of mussels is a receptor binding assay (RBA). In the RBA, toxicity is estimated by measuring the binding of toxins to their toxicologic receptor

(sodium channels). The RBA is a competitive binding assay in which toxins in the sample compete with [3H]-STX bound to the sodium-channel receptor--toxins are estimated from [3H]-STX displaced.

The RBA is an effective alternative to the MBA for PSP surveillance and may be suitable for regulatory monitoring.

- The RBA allows for simultaneous testing of multiple samples.
- The RBA is more sensitive to PSP toxins (detection limit = 6.4 µg/100 g), detecting toxins at much lower concentration than the MBA and well below the regulatory limit.
- Porcine brain tissue, a waste product from food production and commercially-available, can be substituted for rat brains in preparation of synaptosomes needed for assay binding.
- The RBA is safer for surveillance of shellfish containing high concentrations of metal ions.

Impact: Commercial and sport-caught shellfish in California will be safer for human consumption with the substitution of the RBA for the established MBA in the State's Preharvest Shellfish monitoring program. The RBA (1) allows for simultaneous testing of multiple samples; (2) detects PSP toxins at lower concentrations [1/12th of the regulatory limit], informing producers of rapidly developing dinoflagellate blooms, and anticipating needed commercial bed closures; (3) appears to be more accurate at low toxin concentrations, and is not subject to matrix effects of high salt; (4) is an effective and humane alternative that avoids sacrifice of experimental animals in this important public health laboratory program.