Preventive Health and Health Services Block Grant
SUCCESS STORY 2017

Receptor Binding Assay for Paralytic Shellfish Poisoning Control
A Molecular Assay to Measure Shellfish Poison Add Title of Success Story

Issue: Paralytic Shellfish Poisoning (PSP) is a foodborne illness caused by ingestion of shellfish contaminated with the potent neurotoxins, saxitoxin (STX) and its analogs. These toxins are produced by marine dinoflagellates (e.g. algae, Alexandrium spp), and accumulation can occur in bivalves such as oysters, clams, scallops, and mussels. STX, is extremely toxic, with a human lethal dose of 1-4 mg. The Mouse Bioassay (MBA) has been used for decades as the detection tool for surveillance and protection of shellfish consumers; however, this test is labor-intensive, and accuracy can be compromised by salts (e.g., zinc, manganese) [1] sometimes naturally present in samples. The MBA has a relatively high detection limit of ~40 µg/100 g, while the public safety alert limit is only slightly higher, at 80 µg/100 g. Additionally, the MBA sacrifices of 3 to 5 mice per sample.

Intervention: The California Department of Public Health (CDPH) uses the MBA to conduct surveillance of PSP toxins in commercially harvested shellfish through its Environmental Management Branch throughout the year. However, there exists a receptor binding assay (RBA) which is more effective, and which is approved by the Interstate Shellfish Sanitation Conference (ISSC) for regulatory testing of mussels. The RBA quantifies PSP toxins by measuring the amount of labeled saxitoxin (3H-STX) displaced in a competitive binding reaction using the toxicologic receptor, a sodium channel protein.

New findings of this research at CDPH, have demonstrated that the RBA is an effective alternative to the MBA for PSP surveillance, and it may be suitable for regulatory monitoring of all shellfish species harvested from California waters. Our studies demonstrate the following:

A year of side-by-side comparisons of RBA and MBA demonstrate strong agreement between the two methods for higher-concentration samples (e.g. > 60 µg/100 g tissue)

- The RBA provides a greater margin of safety for surveillance in shellfish containing high concentrations of metal ions and PSP toxin concentrations below 40 µg/100g
- RBA is a higher-throughput method because it offers simultaneous testing of multiple samples and shorter turnaround
- With its 6.4 µg/100 g detection limit, RBA is nearly 5-fold more sensitive to PSP toxins than the MBA, detecting toxins well below the regulatory limit. This means RBA can provide earlier warning of PSP toxin events
- Porcine brain tissue, a commercially available waste product from food production, can be substituted for rat brains in preparation of synaptosomes needed for assay binding. Use of porcine tissue will eliminate the need for experimental animals raised in the lab

Impact: Commercial and sport-caught shellfish in California will be safer for human consumption if RBA replaces MBA in the State's Preharvest Shellfish monitoring program. The ability of the RBA to simultaneously test multiple samples and its lower detection limit will inform producers and regulators of rapidly developing dinoflagellate blooms and anticipate needed closures in growing areas.

1. Turner, A.D., Dhanji-Rapkova, M., Algoet, M. et al. Investigations into matrix components affecting the performance of the official bioassay reference method for quantitation of paralytic shellfish poisoning toxins in oysters. Toxicon 2011; 59(2): 2015-30.