Toxicity of Emamectin Benzoate in Commercial Fish Feed to Adults of the Spot Prawn and Dungeness Crab

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Introduction

Sea lice infestations of net-penned Atlantic salmon can result in significant economic losses to the salmon aquaculture industry in Canada. As a means to control the deleterious effects of the sea lice infestations prophylactic drug treatments are prescribed to control the problem. Use and application in Canada of these drugs is regulated in order to protect indigenous species and the aquatic environment in general. To-date limited toxicological studies with these drugs have been conducted on non-targeted benthic organisms or opportunistic feeders. Even fewer toxicological studies have been conducted using geographically relevant species.

Emamectin benzoate is a drug that has proven successful in the control of sea lice infestations in net-penned salmon. Other than toxicological studies from the United Kingdom and Scandinavia there are limited relevant studies that are applicable to Canadian waters or species. Until the work detailed here, the only other toxicological data available was from the East Coast of Canada. The St. Andrew's Marine laboratory of the Canadian Department of Fisheries and Oceans (DFO) had been the sole laboratory to study the acute toxicological effects of emamectin benzoate in Canada. In this joint Schering-Plough\DFO- St. Andrew's Marine Laboratory study the Atlantic lobster was the targeted organism for toxicological testing.

Study Outline

On the West Coast of Canada, studies to determine toxicological effects on the resident and commercially important spot prawn, *Pandalus platyceros*, and the Dungeness crab, *Cancer magister*, were undertaken at Environment Canada's Pacific Environmental Science Centre, located in North Vancouver, British Columbia, to evaluate the licicide Slice® (active ingredient emamectin benzoate MK-244) developed by the Schering-Plough Animal Health Corporation. Test material used in the studies was identified as Slice®, 0.2% emamectin benzoate aquaculture premix and technical grade emamectin benzoate. Product was supplied by Schering-Plough to the analytical laboratory (Xenos Laboratories Ottawa, Ontario) for chemical analysis and test mixture preparation.

Xenos laboratories prepared the test diets by mixing Slice® premix with appropriately sized commercial fish feed pellets (5 mm for prawns; 8.5 mm for crabs) at the chosen concentrations, and then coating with fish oil. This method would be same procedure with which a fish farmer would administer their veterinary prescribed prescription for a sea lice outbreak to their net-penned fish stocks.

Methods

Test organisms were obtained from Department of Fisheries & Oceans staff at the Pacific Biological Station Nanaimo, who collected the prawns in August 2001 and the crabs in May 2002 from waters located off Vancouver Island, British Columbia. Collection sites have no known record of emamectin use.

For each species, bioassay studies consisted of a range finder and a definitive test. All exposures used on-demand, sand filtered, natural sea water. Both species were pre-conditioned to pellets and starved 24 hours (T: -1) prior to introduction into testing aquarium.

Prawns and crabs, one per 38-litre flow through aquarium, filled with 10ºC temperature controlled, constantly flowing seawater, were offered a feed ration at 1.5-2.5% of their body weight. Range finding bioassays for emamectin benzoate were at concentrations of 0, 1, 10, 100 and 500 ppm. Medicated pellets were administered for six hours per day for seven days. (T=0-6 days). The definitive bioassay concentrations for both species included 0,1,10 and 100 ppm emamectin benzoate and followed the same regime.
Seven days following the emamectin benzoate exposure, prawns and crabs were offered (for six hours daily) a preferred diet of filets of either underyearling rainbow trout or squid (at 5% body weight). T=7-14 days
Behavior and food consumption was observed several times per day, and the amount of food consumed in the six hours was measured and recorded.

Conclusions

The average amounts of medicated pellets consumed by prawns ranged from 0.001 to 0.023 grams (~0.006-0.2% body weight). For crabs this ranged from 0.01 to 1.68 grams (~0.001-0.3% body weight).

Average amounts of preferred diet consumed by prawns ranged from 0.27 to 0.75 grams (~1.5-6.1% body weight). For crabs this ranged from 8.2 to 15.2 grams (~1.0-2.7% body weight). Overall test organisms consumed 10 to almost 1000 times the amount of preferred diet over medicated pellets during any one test.

As a general observation of the bioassays the numbers of test organisms eating, once the food ration was switched to their preferred diet of fish or squid filets after a week of the medicated pellets, increased significantly across the treatment groups. This was most dramatic for the treatments having received higher levels of emamectin benzoate, and remained high for the entire week of being offered the preferred diet.

The average proportions of replicate prawns consuming preferred diet ranged from 88 to 96%. The average proportions for crabs ranged from 66 to 100%.

Post definitive test exposures, both prawns and crabs were found to have consumed significantly less of the medicated pellets, except for the second definitive test using crabs, where there was no significant difference between the control and 100 ppm treatment.

In summary both the prawns and crabs displayed a dislike for fish feed pellets, even more so when these were medicated with the licicide Slice® (active ingredient emamectin benzoate). The test organisms either completely ignored, quickly dismissed (after some initial interest), or consumed extremely little of the medicated pellets offered, even after a period of starvation. Based on our studies there were no acute toxicological effects to the either of the test species from fish pellets treated with the licicide Slice® (active ingredient emamectin benzoate). Tissue chemistry for both test organisms, at the highest dosage of medicated feed administered in both the range finder and definitive bioassays, was on non-detectable. There were no significant control mortalities in any of the trials.

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