Fluoride Toxicity in Crayfish

Stephanie Nguyen, Jasmine Singh, Jenny Tan
Biology Department, Baylor University, Waco, TX

Abstract

The objective of the experiment is to determine at what level does fluoride begin affect crayfish mortality. Fluoride was studied because it is a common chemical additive in water. Initially, the crayfish were placed in fluoride concentrations between 0 ppm and 50 ppm in increments of 10 ppm. However, because the entire sample perished within 72 hours, the experiment was refined to concentrations between 0ppm and 20 ppm at increments of 3ppm, and the crayfish were observed for a longer duration. During which time, the percentage of crayfish dead was recorded at each 24 period for 5 days. It was found that fluoride became lethal at 7ppm after a 72 hour exposure. Pass this concentration and time, mortality increased exponentially.

Introduction

Fluoride is routinely added into municipal water to promote dental health and is not filtered out (Miller-Ihli, 2003). High concentrations of fluoride are known to kill invertebrates by affecting organisms' growth. Mortality depends on exposure length and water temperatures (Camargo, 2003). The limits of fluoride toxicity in crayfish were studied in order to determine the concentration at which the fluoride becomes toxic to the crayfish.

Materials and Methods

•In the first trial, six 6.0" x 11.6" x 5.5" plastic containers with five crayfish were placed in each concentration of fluoride (0, 10, 20, 30, 40, 50 ppm). After standard measurements (dissolved oxygen, pH, temperature, weight and length of each crayfish) were recorded, observations took place over a 120 hour period (Fornstrom, 1997).

•A second and third trial were created with new concentrations (0, 3, 7, 10, 13, 17, 20 ppm). Same measurements were taken every 24 hours for 120 hours, recording any deaths, missing limbs, change in coloration, and molting in the crayfish.

•Analysis of dissolved oxygen, pH, and temperature were taken following the directions of the LaMotte Precision pH testing kit and Veriner dissolved oxygen reading probes.

Results

Figure 1 – Trial 1: Percentage of Crayfish Dead After 48 Hours of Flouride Exposure

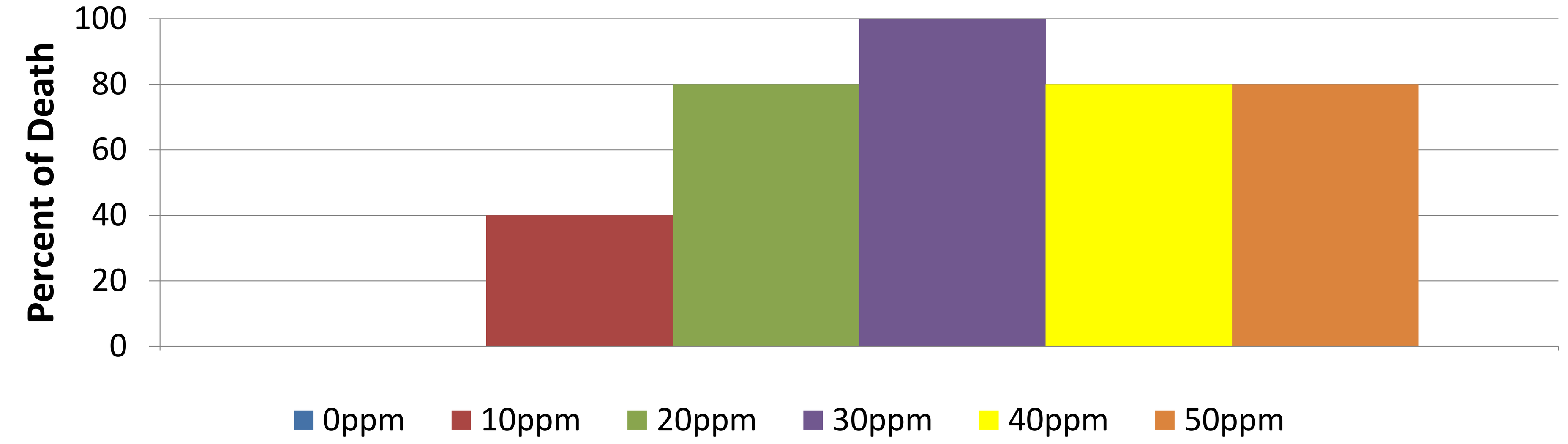
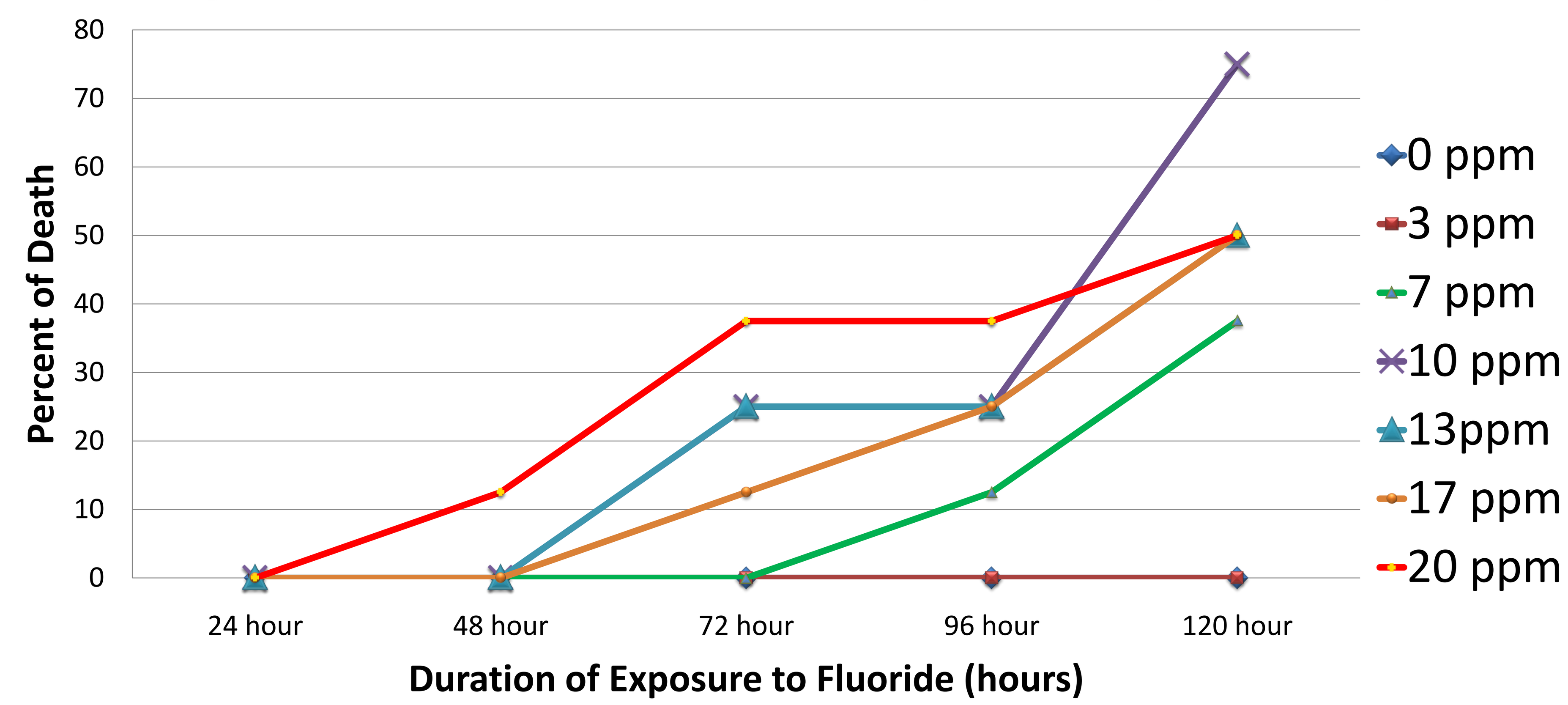


Figure 2 – Trial 2 and 3: Effects of Fluoride Exposure on Crayfish Mortality



In the first trial, all the crayfish within the 20, 30, 40, and 50ppm died within 48 hours (*Figure 1*). These concentrations were too high so they were lowered for trials 2 and 3 to more accurately measure fluoride toxicity.

When the crayfish were separated into different concentrations and observed over a 120 hour period for trials 2 and 3, it was noted that the crayfish in the 0ppm and 3 ppm concentrations stayed alive and had no visible changes. Death was not observed until the 72 hour mark at the 7 ppm concentration. The 10ppm concentration showed the highest death rate; it reached LD50 by the 100 hour mark. The 13ppm, 17ppm, and 20ppm reached LD50 by the 120 hour mark (*Figure 2*).

It was observed that as the fluoride concentration increased, the crayfish often became more pink in color similar to cooked shrimp. This was often followed by death before which crayfish showed limited movement. Signs of molting were also observed from the 7 ppm onwards that was not observed in 3 ppm and 0 ppm.

Discussion and Conclusion

As the fluoride concentration increased, the mortality also increased (*Figures 1 and 2*). The 10 ppm concentration's high mortality rate is an abnormality to the trend. A number of crustaceans die during or shortly after molting (Bowser, 1980). One crayfish in 10 ppm molted at 96 hours and, consequently, could have contributed to the high death count at 120 hour, resulting in a sharp peak in the curve. The addition of fluoride could have caused too much stress on it during its vulnerable state. Fluoride also seems to have an effect on the crayfish exoskeleton . At lower concentrations, fluoride facilitates molting, however, high concentrations result in death.
Also, the longer the crayfish is placed in high concentrations of 7 ppm and above, the greater chance of death.

In conclusion, there is a correlation between the concentration of fluoride and crayfish death. Mortality is also dependent on length of exposure, which is supported by Camargo's study. As a result of the experiment, one can see that the fluoride becomes toxic at 7 ppm , and lethal dosages that kill 50% are reached at 10 ppm.

Literature Cited

Bowser, Paul R., Renée Rosemark (1980) Mortalities of cultured lobsters, *Homarus*, associated with a molt death syndrome. Aquaculture, 23: 11 – 18.

Camargo, Julio A. (2003) Fluoride toxicity to aquatic organisms: a review. Chemosphere, 50: 251-264 .

Fornstrom, Cynthia B. , Peter F. Landrum, Carol P. Weisskopf, Thomas W. La Point (1997) Effects of terbufos on juvenile red swamp crayfish (Procambarus clarkii): Differential routes of exposure. Environmental Toxicology and Chemistry, 16: 2514–2520.

Miller-Ihli, Nancy J., Pamela R. Pehrsson, Rena L. Cutrifelli, Joanne M. Holden (2003) Fluoride content of municipal water in the United States. Journal of Food Composition and Analysis, 16: 621–628.

Acknowledgements

A special thanks to:
Dr. Marty Harvill, Nora Schell, Dr. Robert Doyle, Baoqing Ding, The College of Arts and Sciences , Baylor Department of Biology, Lake Waco Wetlands