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The Effects of Selenium on the Death Rate of Brine Shrimp

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ABSTRACT

In small quantities, selenium can be beneficial to most organisms. At higher concentrations, however selenium almost always becomes toxic. In recent years, this problem has manifested itself in the form of agricultural run-off in farmlands in the west. This research sought to quantify at what concentration selenium began to have a lethal effect and the maximum concentration in which any brine shrimp could remain alive. Experimentation began with hatching brine shrimp and letting them grow for about eight days. They were then divided into groups with two or three hundred in each. A measured amount of sodium selenate was added to each group with the exception of the control group. After eight days, the number of live shrimp was counted. It was found that a general negative linear relationship existed between the number of remaining live shrimp and the concentration of selenium. The best estimate of the concentration at which no shrimp can live is between 15mg/liter and 16mg/liter.

Keywords: *Selenium, Brine shrimp*

INTRODUCTION

Scientists know that selenium is an important micronutrient for most organisms. A selenium deficiency can cause a shortened life span and premature cuticle deterioration in Daphnia (Keating and Dagbusan, 1984). In humans, a deficiency can cause Keshan disease, a cardiac disorder, and in rats, alters the glutathione level in plasma (Whanger, 1996). Selenium may also help prevent certain types of cancer such as prostrate cancer (Clark et al 1998). Psychologists have also found that in humans, selenium can decrease some mood disorders (Psychology Today 1996).

The concentration at which selenium is beneficial is small, however. A high concentration of selenium is toxic to most organisms. In the early eighties, we learned how high levels of selenium can directly harm the environment. Increased irrigation leached naturally occurring selenium from the soil into reservoirs and rivers. The buildup caused negative effects in the fish and waterfowl (Banuelos, et al, 1997). In a freshwater reservoir after two years of an increased selenium level, there were no longer many species of fish living. Of those species that remained, most experienced physiological disorders such as sterility (Lemly, 1985). A study was done on the effects of selenium in marine fish by directly injecting selenium into the fish. The results were the same as in fresh water fish with the lethal dose being at a low concentration (Yaunxun and Moro, 1996). Research is still being preformed to find the best way to reduce selenium in the soil.

My research looks at how a marine organism, Artemia (brine shrimp), is able to survive living in an environment that has increased levels of selenium. Brine shrimp can be found in great numbers in lakes with high salt content such as the Great Salt Lake in Utah. Adult female shrimp can either reproduce by laying cysts in which the embryo can exist indefinitely, or they can lay eggs in which the nauplius larvae hatch a few hours later. The nauplii can molt up to 15 times as they mature to adult brine shrimp. They reach adult size in about 12 days, and their life span after that is about three months under good conditions. Females can hatch as many as 300 nauplii every four days. Their main food source is algae although they can feed on diatoms and other small particles. Populations of brine shrimp can survive in harsh conditions. If their environment becomes too harsh such as in the winter when the water temperature drops, females will start producing cysts. The cysts will stay dormant and will not hatch until conditions are right again such as in the spring. The goal of this research is to determine at what concentration selenium becomes toxic for brine shrimp, and if it will completely kill off a population.

MATERIALS AND METHODS

Brine shrimp eggs were obtained from Carolina Biological Supply Co.(Burlington, NC). The eggs came with a premeasured amount of salt for one liter of water. The eggs were hatched in a one-liter beaker with an aerator and a fluorescent light shining on the beaker continuously for the first 24 hours. After they hatched, the florescent light was removed, and they were exposed to normal room light during the day and no light at night. The aerator was in use at all times except for periods of time when they were being counted. At most, the aerator was not used for two hours at a time. The shrimp were fed once every day with special brine shrimp food, consisting mostly of algae, from the Carolina Company. After eight days, the hatched nauplii, immature shrimp, were separated into five different containers. The number of shrimp in each container was in order as follows: 306, 311, 314, 304, and 312. The salinity of each container was 30 ppt. Nine days after hatching, sodium selenate was added to the containers in the following order of concentrations: 0mg/l, 1mg/l, 2mg/l, 4mg/l, and 8mg/l. Eight days after the selenium was added, the number of live shrimp was counted. The method for counting shrimp was as follows. Approximately 10 ml of water

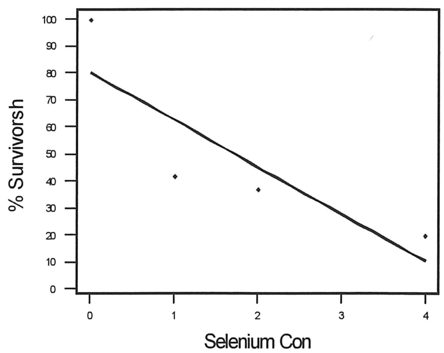

Figure 3 Regression line of first trial

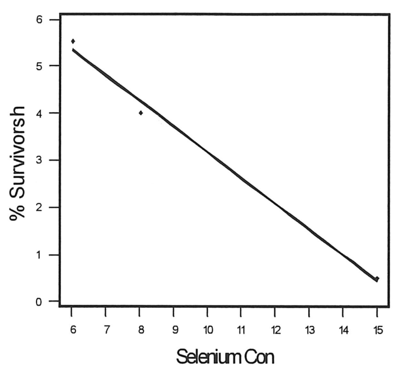

Figure 4 Linear regression in second trial

Using both trials and averaging the overlapping concentrations, we get a graph that looks like Figure 5. The correlation is –0.766. It would be predicted that the maximum amount is 12.78 mg/l. We have also seen that this cannot be correct because of the results from trial 2. According to the data, it seems like the prediction of just under 16 mg/l is the most accurate estimate. The correlation is strongest with this graph, and it made a prediction that the results cannot contradict. Further testing would be needed to verify this estimation.

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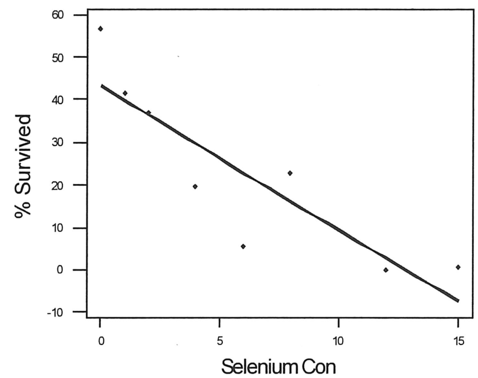

Figure 5 Linear regression of combined trials

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