Tenebrio molitor as a Model Organism for the Impact of Different Metal Salts on Humans

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Introduction

The *Tenebrio molitor* or the yellow mealworm is a small wormlike creature that lives in under logs, rocks, or animal burrows. (DYM, 2016) The yellow mealworms are a big part of the ecosystem feeding, beetles, spiders, lizards, and birds.(DBMBI, 2010) So we investigated, what is the reaction of the yellow mealworm to different concentrations of metal salts? We hypothesized, if we test yellow mealworms with different concentration of metal salts, then we predict that the yellow mealworms will be more sensitive to iron chloride than copper chloride, because the yellow mealworms is more likely to find iron chloride in its environment because it is less rare and since yellow mealworms live in human populated areas such as industrial parks and iron chloride is used more frequently in industrial areas then they will need to be able to stay away of the chemical to survive. To test this we exposed the mealworms to different concentrations of copper and iron chloride. First we did a stimulus test to make sure they reacted to the copper and iron chloride. Second we encircled the mealworms with the different concentrations. Third we did our raceway test where let them crawl across soil.

Methods

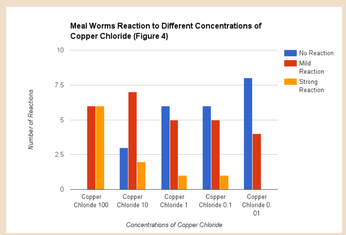
The first test that we started out with for yellow mealworms is the stimulus test. We tested 12 different yellow mealworms. This was to find out if the yellow mealworms reacted to light, ethanol, and touch. We first started out with poking their body with a probe. We would then record their reaction strong, mild, or no, a strong reaction is one where the yellow mealworms starts to thrash around, a mild reaction is one backs away from the chemical, and no reaction is one in which the worm does not react. After completing the probe test we moved on to a light stimulus. We would shine a flashlight on the yellow mealworms's head and see their reaction again. Then we would do the same for their back side.The last stimulus test we did was ethanol. We would fill a dropper with ethanol and put one drop on the yellow mealworms's head. We would record their reaction. We tested yellow mealworms by encircling the worms with the two metal salt we used previously copper chloride (II), iron chloride (III). We did this so we can find the right concentrations of metal salt to test on the yellow mealworms in later tests. Then we started our real experiment to find out how the yellow mealworms reacted to the metal salts in a race way experiment. We did this by putting two worms on a track, and filling the raceway with soil up to 16 centimeter mark and moistening the soil with one of the concentrations of metal salts we used. Then we let the yellow mealworms crawl for ten minutes. We then measured how far they crawled in centimeters and recorded it in our data sheet. We measured our dependent variable in many ways, with the circle test we used the reactions as our dependent variable in which we gathered our information from. When we did the raceway test we used the distance the yellow mealworms moved as our dependent variable which we measured.
Once we were done with all of our experiments we took our control data and treated data and compared them using a T-Test. The T-Test is a way to compare two different data sets and see if they are the significant or not. We then graphed our results.

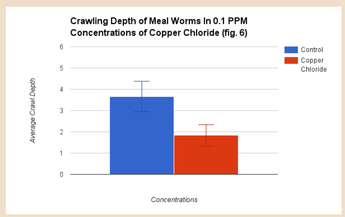
Abstract

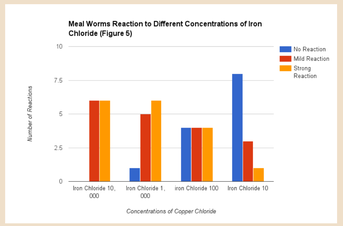
We researched and investigated, what is the reaction of yellow mealworms (*Tenebrio molitor*) to different concentrations of metal salts? We did this experiment because we know that exposure to metal salt can be harmful to worms and we wanted to see what mealworms would do if we expose them to it. For our experiments we exposed yellow mealworms to different concentrations of metal salts(copper and iron chloride) We first did a stimulus test to see if the mealworms reacted to light, ethanol, and touch. After we did this we did a circle test. For this we encircled the mealworms in different concentrations of copper and iron chloride. The last test we did was a crawl test, in which we soil into a raceway then put different concentrations of copper and iron chloride on the soil. Then we would put the mealworms on the soil and see how far they crawled. Our most important result was that mealworms reacted to 0.01 ppm concentrations of copper chloride which supported our most important conclusion which is that mealworms react more to copper chloride then iron chloride. This matters to human health exposure to copper in our bodies can harm us for example, we can get symptoms such as nausea, vomiting, diarrhea, liver damage, kidney damage, and death. (DOC, 2013)

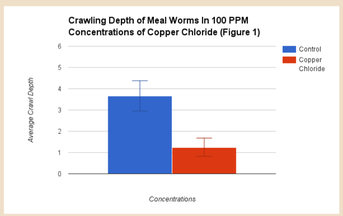
Results

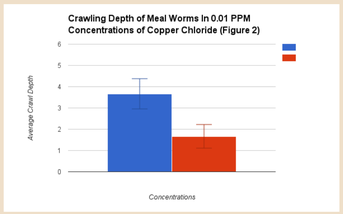
We first tested how much the *tenebrio molitor* would react to light, touch and ethanol to gather a large understanding of the species. We recorded how strong the reaction was and reporting it within our tables. Once we had tested their sensitivity to touch, we discovered that the *tenebrio molitor* demonstrated violent thrashing behavior when touched by our testing probe. While testing how they react when ethanol is poured upon them, we learned that 58.3% of the *tenebrio molitor* had a strong reaction. While 33.3% of the *tenebrio molitor* had no reaction at all. The *tenebrio molitor* showed little to no reaction to light or darkness. These findings were not surprising. Once we were done with our stimulus tests we began to begin our circle and raceway tests. Our circle tests showed that the *tenebrio molitor* would have strong to mild reactions when forced they come in contact with serial dilutions of copper and iron chloride. The dilutions of our metal salts were our independent variables. We also had a control in which we used dechlorinated tap water to use as our control. The worms reaction was our dependent variable change as we change our dilution of metal salt. We found that when using the different concentrations of iron mealworms still had multiple mild reactions during 10 PPM(33.33%). after that they gave no significant reactions throughout the tests. Whereas when testing copper we found that they react mildly down to 0.01 PPM. 33% of our sample set (12 worms) reacted mildly to the 0.01 PPM. When we measured how far the *tenebrio molitor* would crawl on soil with different dilutions of our metal salts poured on top. We then took these distances and compared them to how far the *tenebrio molitor* traveled with dechlorinated tap water poured atop instead. When we gathered our information on the copper chloride and were able to compare it to our control we found astonishing results. The worms crawling within Copper chloride 100 PPM. The average worm only crawled 2.25 inches more than an inch less than our control and when observed by our T-Test comparing the two it showed that they are in fact not similar. This represented tread existed through our entire test when we learned that they began to crawl less in a copper chloride concentration of 0.01PPM. The worms here averaged at crawling 2 inches less than the control. Although the Iron was the same the entire time when compared to the control thought a T-Test. As seen in our figures below:

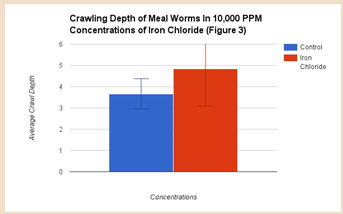












Discussion

After completing our experiments we can conclude that *Tenebrio molitor* or mealworms are more sensitive to copper chloride than iron chloride. When the mealworms were in 100 PPM of copper chloride the T-Test value was less than 0.05 meaning there was a significant difference in how far the mealworms crawled in the control and how far they crawled in 100 PPM of copper chloride. The average crawl length for the control was 3.7 and the average crawl length for 100 PPM of copper chloride was 1.25. This shows how the worms were more sensitive to the copper chloride and were more hesitant to go farther in the raceway. We found this same pattern occur in 0.01 PPM of copper chloride. As we looked at the data for how far the mealworms crawled in the concentrations of iron chloride the t-test showed that the iron chloride did not affect the mealworms at all and there was no significant difference between how they reacted in the control and how they reacted in iron chloride. This shows how the worms were more sensitive to the copper chloride because there was no significant reaction in 10,000 PPM of iron chloride but there was a significant reaction in 100 PPM, 0.1 PPM, and 0.01 PPM of copper chloride, which are all smaller concentrations than iron chloride yet there was a higher reaction. When we were doing the circle test to see the mealworms reaction we found that even in a concentration of 0.01 PPM, 33% of the mealworms had a mild reaction.

The patterns that appeared throughout our data were that mealworms have a higher reaction to concentrations of copper chloride than iron chloride. The mealworms did not show a significant reaction in iron chloride but they did in copper chloride. This pattern shows how copper chloride is more dangerous to mealworms than iron chloride. Copper chloride is also dangerous to humans. The body needs certain amounts of copper to function properly, but too much exposure to copper can cause many health problems. For example, just breathing in copper can cause irritation to the nose and throat. Ingesting copper orally can cause nausea, vomiting, diarrhea, liver damage, kidney damage, and death (Dangers of Copper). Iron is also essential for our bodies to function but an overdose can also cause health problems. An overdose of iron can potentially cause iron poisoning which is usually from pure iron supplements. However children's supplements with iron only include so little iron that even a full jar won't cause harm (Toxicity, Mechanism and Health Effects of Some Heavy Metals).

Works Cited

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