CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
J1713

Project Title
Tachycardia, Intoxication, and Coma: The Physiological Effects of Caffeine on Daphnia magna and Humans

Abstract

Objectives/Goals
This project was developed to discover how caffeine would affect the physiology and heart rate of organisms. A survey made by Johns Hopkins University shows that 80% of adults in North America regularly use caffeine. If such a common drug has unsafe side effects, many people will be affected.

Methods/Materials
To execute my experiment, I made 6 solutions of caffeine and water: 2%, 1%, 0.5%, 0.1%, 0.05%, and 0.01% concentrations, in addition to a 0% control solution. I tested 3 Daphnia per caffeine concentration, and for each Daphnia, I held 3 trials of normal heart rate to act as the control and 4 trials of caffeinated heart rate. I then took the average beats per minute(BPM)of the trials and calculated the percentage BPM increase. Changes in physiology and behavior were noted.

Results
In the 0.01% caffeine solution, the percent increase in BPM was 7.89%. The 0.05% solution caused BPM to increase by 15.03%. In the 0.1% caffeine solution, the BPM percent increase was 28.75%, and the heart rate began to level off. The 0.5% solution increased heart rate by 31.98%. The 1% solution increased heart rate by 34.94%, and the 2% solution increased heart rate by 39.39%. The coma stage appeared in the 1% solution after the Daphnia was soaked in caffeine for 30 seconds, while intoxication occurred at 0.01%. In the coma state, the Daphnia appeared to be quite unresponsive and motionless, in contrast to the intoxication state, where the Daphnia was agitated and disoriented.

Conclusions/Discussion
My hypothesis about increasing heart rate and 2 stages of caffeine development was true. I learned that caffeine does increase the heart rate, and that heart rate levels off when caffeine intoxication is reached. After caffeine intoxication, organisms will become very active, confused and disoriented. The caffeine coma stage that comes after caffeine intoxication causes organisms to stop moving except for the heart and to be completely unresponsive to stimuli. Seizures also occur.
From this experiment, I was able to find out how much caffeine it would take for a human being to enter the state of a coma. According to the DSM-IV manual, 250 mg of caffeine will put a human in the caffeine intoxication stage. In my experiment, 10x the amount of caffeine required for caffeine intoxication made the Daphnia go in a coma state. Multiplying 250 mg by 10, I can conclude that 2.5 grams of caffeine is sufficient for a human to enter a coma.

Summary Statement
In this project, I use Daphnia Magna as a model to determine the physiological effects of caffeine on humans, including the caffeine intoxication stage mentioned in the DSM-IV manual criteria book and the caffeine coma stage.

Help Received
Borrowed graduated cylinders and beakers and received advice from my teacher Mrs. Iyer. Thanks to my mom for purchasing powdered caffeine and Daphnia Magna.