CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

35570

Project Title

Shedding Light on the Hormone of Darkness: Investigating the Effect of Exogenous Melatonin on the Heart Rate of Daphnia

Abstract

Objectives/Goals

The National Sleep Foundation's 2014 Sleep in America poll "reveals that kids are falling short on the amount of time they should be sleeping each night." Exogenous melatonin is increasing in popular use as a sleep aid for children. Known as the "hormone of darkness," melatonin, a hormone secreted by the pineal gland, regulates circadian rhythms. While melatonin naturally occurs in the body, supplemental melatonin has not been medically endorsed for use in children. Since the effects of melatonin, both individually and in combination with O.T.C. drugs, on cardiac activity are not well known, this project investigated the effect of exogenous melatonin on the heart rate of Daphnia magna. It was hypothesized that melatonin, individually and combined with O.T.C. drugs, would lower the heart rate (HR). Three O.T.C. drugs - diphenhydramine, ibuprofen, and acetaminophen - were selected.

Methods/Materials

The base HR was calculated by counting the heartbeats of 25 Daphnia magna in DI water under a microscope. Time tests were conducted by exposing the Daphnia magna to the test agent for 2, 4, 6, 8, and 10 minutes. Using the optimal exposure time, three concentrations (mg/100 mL) of melatonin (1, 3, and 5), diphenhydramine (12.5, 25, and 50), ibuprofen (100, 200, and 400), and acetaminophen (160, 320, and 640) were tested. Combination tests were conducted with the optimal time and concentrations of melatonin and each O.T.C. drug. Five measurements were recorded for each Daphnia magna tested, and five trials were conducted. A total of 120 Daphnia magna were tested.

Results

The base HR was 210 bpm. Melatonin and diphenhydramine lowered the HR of Daphnia magna to 138 bpm and 151 bpm, respectively. Ibuprofen and acetaminophen did not dramatically alter HR. The combination of melatonin and diphenhydramine lowered the HR the most - to 97 bpm, a decrease of 54%. The change in HR increased as both exposure time and concentration increased.

Conclusions/Discussion

The hypothesis was supported. Experimental data showed that melatonin can significantly decrease HR and that combining melatonin with other drugs, especially diphenhydramine, can be potentially unsafe. Melatonin decreased the HR of Daphnia magna most probably by increasing the release of ACh (Acetylcholine), a neurotransmitter that slows the HR. Sleep aids can be habit-forming, so making lifestyle changes that can improve healthy sleep would be a better alternative.

Summary Statement

My novel project investigates the effect of exogenous melatonin, individually and combined with O.T.C. drugs, on the heart rate of Daphnia magna to help individuals make informed decisions about using supplemental melatonin as a sleep aid.

Help Received

Mom helped keep time for measuring heart rate; Mrs. Nguyen provided guidance.