CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

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22433

Project Title
The Effect of Arsenic Trioxide on the Endocrine System of Tenebrio molitor Beetle Larvae

Abstract

Objectives/Goals
The objective of this study is to determine the effect of arsenic trioxide, an abundant form of arsenic in our environment, on the endocrine system of tenebrio molitor beetle larvae. The hypothesis states that the arsenic trioxide will inhibit the endocrine system of the tenebrio larvae by suppressing the prothoracicotropic hormone responsible for releasing ecdysteroids which control molting, thus delaying or preventing the hormonal process of metamorphosis.

Methods/Materials
The endocrine system of tenebrio larvae was tested by observing colonies for molting. Arsenic trioxide was dissolved in distilled water to create concentrations of 0.5, 10, 30, 60, and 120 parts per million. Three petri dish colonies were created per concentration by soaking the bran meal in individual solutions. Twenty tenebrio larvae were placed in each petri dish and fed the bran meal. Observations for viability and metamorphosis were noted every 24 hours for a 10-day period.

Results
The results show a positive dose-related response of the rate of pupation of tenebrio larvae to the concentration of arsenic. The exception was the 10 part per million concentration, possibly due to experimental error. The concentration of 60 parts per million provided the highest rate of pupation,x followed by 30 ppm and 0.5 ppm. Arsenic trioxide toxicity showed a threshold effect, as there were relatively constant mortality rates up to 60 ppm concentrations, with a 95 percent mortality rate in the 120€ ppm solution after the ten-day period.

Conclusions/Discussion
The results of this study suggest a strong correlation between the concentration of arsenic and disruption of the endocrine system. Medium to high doses accelerated pupation, implying one of two theories. Thx arsenic may have stimulated the prothoracicotropic hormone, or inhibited its antagonistic pair, juvenile hormone, responsible for maintaining the larval stage. In either case, arsenic may alter the steroidx hormone-receptor complex thereby disrupting the modulation mechanism for certain gene activity. In ax species, steroid hormones, including glucocorticoids, have widespread effect and are responsible forx modulating genes that may suppress cancer and regulate blood pressure. Thus, the effect of arsenic trioxide, an ever-present chemical in our environment, on the endocrine system is of great significance, and it is imperative we research further, possibly with mammalian subjects.

Summary Statement
This study establishes a possible correlation between arsenic and disruption of the endocrine system of tenebrio molitor beetle larvae.

Help Received
Mr. Garabedian assisted in creating the arsenic trioxide solutions in the laboratory. Mr. Mirigian and Mr. Hunter provided the incubator and magnetic stirrer for the experiment.