

Effects of Nicotine on the Development of Zebrafish Embryos

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Abstract

The objective of this study was to conduct additional research to compare the effect of nicotine on zebrafish embryos to the effect on a human fetus. The experiment was conducted by testing three different concentrations of nicotine. The embryos were observed over a course of three days, and pictures were taken. After the experiment, the results show that the development rate of the zebrafish embryos decreased as the concentration of nicotine increased.

Introduction

- Nicotine has a negative effect on development rate of fetuses, traveling through the bloodstream directly to the fetus (O'Brien 2012).
- The more cigarettes smoked in a day, the higher chances of the baby having difficulties growing in the womb (Wickström 2007).
- Result seen found in human fetuses:
 - Low birth weights; delayed growth
 - Premature delivery
 - Death (Candelaria 2010).
- Hypothesis:** Higher concentrations of nicotine will slow down the development rate of the zebra fish embryos.

Materials

- Zebrafish embryos (4-6 per condition)
- Incubator (constant 28° C)
- 1.0 mg/mL stock nicotine solution (diluted to 20%, 10%, 1%, 0%)
- 0.06 g/L Instant Ocean solution
- Falcon dish
- Cell phone camera
- Dissecting microscope at 30x

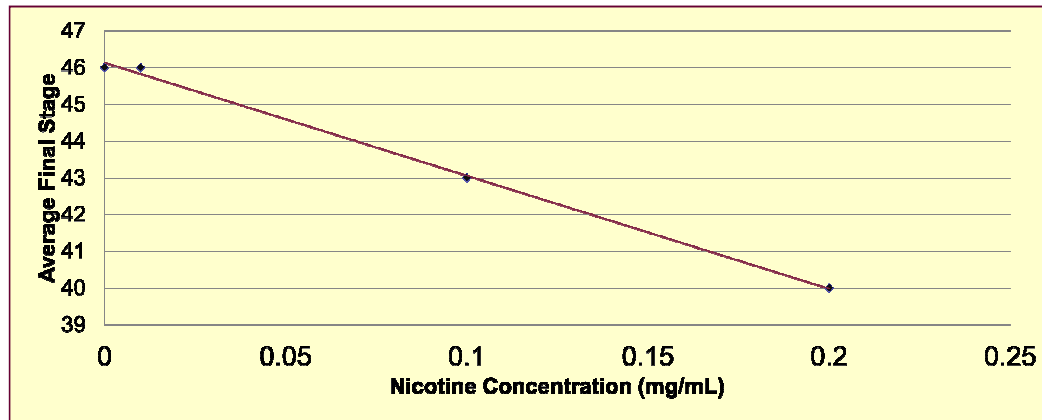
Methods

- Experimental procedure is based on "Zebrafish as Models: Studying the Effects of Environmental Agents on Human Health" (Petering et al., 2011).
- 3 mL of each experimental solution was placed in a separate section of falcon dish.
- 4-6 embryos per concentration
- Development observed over the next 3 days using microscope images taken with a cell phone camera.
- Images compared to development diagrams provided by Exploratorium (exploratorium.edu).
- Average stage of development for each condition was recorded, as well as any dead embryos.
- Solutions for each condition changed daily to prevent bacterial growth.
- All hatched zebrafish released into aquarium after experiment.

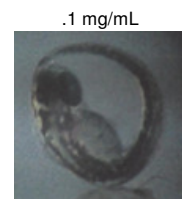
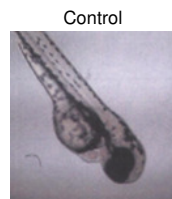
Results

- Day 0:** All embryos placed in solutions were stage 0
- Day 1:** All embryos around the same stage of development (stage 29)
- Day 2:** Control and 1% solution yielded hatchlings, while the 10% and 20% did not
- Day 3:** Development of 10% and 20% stalled around stage 40; ½ died in each of these solutions, 1% and control completely hatched, all survived.
- The zebrafish within the higher nicotine concentrations displayed slowed development.
- Fish at the highest concentration (.2 mg/mL) had a 50% survival rate.
- All zebrafish in the control and .01 mg/mL reached the final stage of development.

Average Final Stage (Day 3) vs. Nicotine Concentration



**Day 3:
Pictures
of
average
embryo in
each
solution**



Discussion

Through this experiment, we found that nicotine concentration and embryo development of Zebrafish is negatively correlated. The average final stage of development was lower in the higher concentrations of nicotine. This data supports the initial hypothesis which predicted the negative correlation between the independent and dependent variables.

This experiment yielded results that are consistent with current scientific findings regarding embryonic development. Wickström presented that nicotine effects birthing weights. Within our findings, weight was not recorded but growth rate was. The embryos with the growth defect would then hatch prematurely causing them to be smaller. Also, Beatrice Parker and Victoria P. Connaughton found that high concentrations of nicotine increased chances of embryo death. The increased amounts of deaths in high concentrations in our experiment are similar to the results of Parker and Connaughton's experiment.

This experiment raises other questions regarding the development of Zebrafish. How is behavior affected in the embryos that do hatch? What are the long-term effects on the living fish? These questions could be answered in a long-term study of Zebrafish in lower concentrations of nicotine.

References

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