Sucralose on Zebrafish Embryo Development

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Abstract

Artificial sugar is a highly controversial substance. Although it is approved by the Federal Drug Administration, studies have found its consumption can have negative effects on development and overall health. This experiment aimed to determine how exposure to artificial sugar impacts the embryological survival and development of *Danio rerio*. When pregnant, women do not consciously avoid artificial sugar consumption. The results of this lab can be used to further understand the consequences of artificial sugar on human embryos and the health of humans in general, as well as warn women about any harmful effects it may cause to their baby. Zebrafish embryos were exposed to Instant Ocean solution (control), sugar solution, and artificial sugar solution at around 28 hours post fertilization and were observed until 172 hours post fertilization. The results displayed slight differences in developmental rates among the three groups and a lower survival rate of the embryos in the artificial sugar solution. Approximately 77.5% of the zebrafish in the control survived, while only 47.5% of the zebrafish exposed to artificial sugar survived. The survival rates between embryos in sugar and artificial sugar environments did not greatly differ, however the results were still significant. With a larger sample size and a variety of concentrations, the results and accuracy of this lab would augment. The results of this investigation support that the survival rate of zebrafish embryos is lower when exposed to artificial sugar solution in comparison to sugar solution. The research question that aims to be answered through this experiment is the following: how does artificial sugar affect the embryonic development and survival of zebrafish?

Introduction

Zebrafish are important model organisms for the study of how certain chemicals can impact embryological development and survival. Zebrafish rapidly develop, grow outside of the mother's body, are produced in ample amounts, and have a transparent appearance. These characteristics allow researchers to investigate the effects of diseases and chemicals on development with ease. Furthermore, according to Your Genome, "70 percent of protein-coding human genes are related to genes found in zebrafish" (paragraph 2). The results of zebrafish experimentation can be extended and related to humans, as the zebrafish genome yields significant similarities to the human genome.

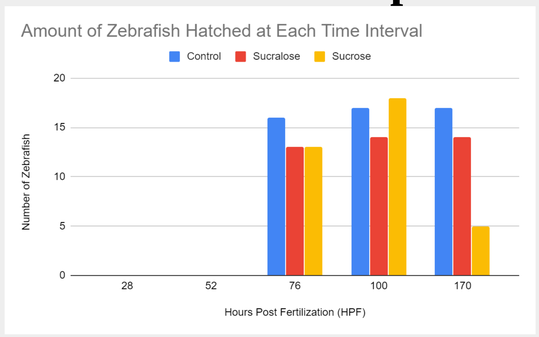
The purpose of this experiment is to determine how artificial sugar, or sucralose, affects the development and survival of zebrafish embryos in comparison to real sugar, or sucrose. Although it is approved by the Federal Drug Administration, consumption of sucralose and the consequences it has on the human body is highly controversial. As stated on Healthline, "if sucralose is not regularly consumed, it can change blood sugar and insulin levels" (paragraph 3). Because zebrafish are not initially exposed to sucralose, the artificial sweetener can have an early impact on the blood flow and health of the embryos. To continue, Healthline found from animal studies that "sucralose has negative effects on the bacterial environment in the gut" (paragraph 5). Having healthy, functioning bodily systems is imperative to the growth and development of the embryos. While pregnant women are allowed to moderately consume sucralose, negative effects on the embryological development and health have been found.

This investigation aims to determine how artificial sweetener affects the rate of development and survival of *Danio rerio* embryos. The hypothesis is as follows: in an environment of sucralose, there will be a lower survival rate of the zebrafish embryos than in an environment of sucrose, as their development will be hindered.

Methods and Materials

The following materials must be gathered in order to perform this experiment : 300mL of instant ocean, seven pipettes, a sharpie to be used to labeling beakers and wells, small 50mL beaker for waste, three 150 mL beakers, an incubator to store the embryos at 28.5 degrees celsius, a multi well plate to put embryos in, a dissecting and compound microscope to examine the embryos, sucrose 0.1 gram, aspartame 0.1 gram, a stir stick, a scale, and a sale tray. When all listed materials are gathered the experiment can begin by obtaining all the embryos at 4 hours of post fertilization(HPF). Unfortunately due to an error the embryos were not able to be placed in the experimental environment until 28 HPF. Next 9-12 live embryos were counted and placed into each well of the multi-well plate. Then any left over concentration in the well from transporting the embryos was removed and discarded. Next the solutions were made by measuring 100 mL of Instant ocean out into a 150mL beaker. Then 0.1 grams of sucrose and sucralose were weighed out on scale and put into the beaker and dissolved using a stir stick. To prepare the control solution 100mL of Instant Ocean was used. 1 mL of each solution was pipetted into the corresponding well. Be sure to use a different pipette when handling each substance to ensure no contamination. The wells are labeled and separated by row and that each row is a different substance. Now all the embryos have been put in the appropriate solution, the plate can be placed in the incubator for 24 hours. After those 24 hours remove the plate from the incubator and record how many dead and hatched embryos are seen. The dead embryos are placed into the waste beaker. Examine embryos under microscopes and record observations of the embryos. When all data is recorded use a fresh pipette to empty the wells and refill them with 1mL of each solution. Continue changing solutions in the well until 170 hour is hit. Continue and observe and record the number dead, hatched, and unhatched embryos in the data table.

Data and Graphs



The graph examines the number of hatched embryos in each solution. With the highest number of hatched total being 18 in the sucrose solution at 100 HPF, that number dropped significantly after being left in the solution for another 70 hours. This means that many of the hatched embryos died within that time, bringing the number of hatched embryos down to 5 after the whole 170 hours passed. One can infer that within those 70 hours the fish had been exposed to the sucrose solution to a point where it was toxic and caused many of the fish to die. Technically speaking the sucrose group had the most total hatched embryos at the end of the 170 hour interval with 14. It shows how the sucrose solution provides the best environment for the fish to develop in, allowing for 14 of the 40 total embryos placed to be hatched and fully developed. Continuing to support the hypothesis, the sucralose solution proved to be a toxic environment from the start, as the early embryos struggled to develop and mature onto the next stage and only 5 embryos survived to adulthood. The inference of sucralose being the most harmful to embryonic development can be made according to the graph.

Analysis

Overall, the zebrafish that were exposed to the artificial sugar solution had the lowest rate of survival in comparison to those exposed to the sugar and regular Instant Ocean solutions from 28 hpf to 172 hpf. In addition to survival, the phenotypical development of each experimental group showed acute but important differences in terms of how artificial sugar impacts development rates. While the developmental comparisons are notable pieces of data, the rate of survival demonstrates a greater impact. The survival rates of the zebrafish in sugar and the zebrafish in artificial sugar solutions did not greatly differ, however the results are still significant, as they display that artificial sugar exposure has a more negative effect on the embryos.

Discussion

The data results and analysis support the hypothesis that in an environment of sucralose, there will be a lower survival rate of the zebrafish embryos than in an environment of sucrose, as their development will be hindered.

Zebrafish investigations and their results play an important role in discovering how specific diseases and chemical exposure can influence embryonic development, and humans as a whole, because they have a similar genome and possess characteristics that make them great model organisms.

The results of this lab indicate that sucralose, or artificial sugar, has a negative impact on embryological development.

Works Cited

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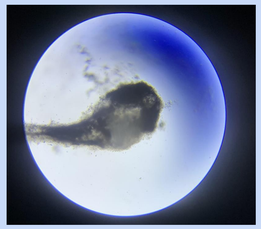
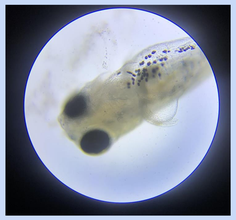
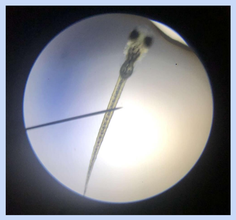


Sucralose 170 HPF



Sucrose 170 HPF



Control 170 HPF