Differences Between Caffeine and 5 Hour Energy on Zebrafish

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Abstract

The research conducted in this experiment shows significance in relation to human health. The data and research will help humans understand the difference between energy shots and straight caffeine in relation to human development. We thought that if we increased concentrations of energy shots the survival and hatching rate of the zebrafish. Our data actually proved to accept the hypothesis, but on another level, showing that energy shots do way more damage than caffeine.

Introduction

Zebrafish are a fast developing freshwater dwelling fish. We use these fish as a model for looking at the development of embryos. Zebrafish develop extremely fast compared to other animals and are transparent in development. I will be comparing the effects of caffeine compared to 5 hour energy, and why 5 hour energy is much more dangerous. Caffeine is naturally found in some plants and flowers but we mainly find it in your morning coffee. 5 hour energy is not naturally found and is synthetically made. It is a concoction of a lot of different proteins and stimulants. Caffeine and 5 hour energy generally have negative effects on development on human and zebrafish embryos. Caffeine must be extremely regulated when pregnant and 5 hour energy is just not recommended. This research investigates how caffeine and 5 hour energy affects the survival and hatching of zebrafish. If we increase the concentrations of 5 hour energy and caffeine, then the embryos affected with 5 hour energy will be affected a lot more. This is because it appears 5 hour has more ppm of stuff within one particle of the energy shot. Opposed to caffeine, within a ppm of caffeine, only caffeine is found and it is less concentrated. If we increase the concentrations of 5 hour energy and caffeine, then the hatching and survival of zebrafish will not be affected. This research is significant because there is not a lot of research done on development in relation to these chemicals. I want to show people how different these two substances are.

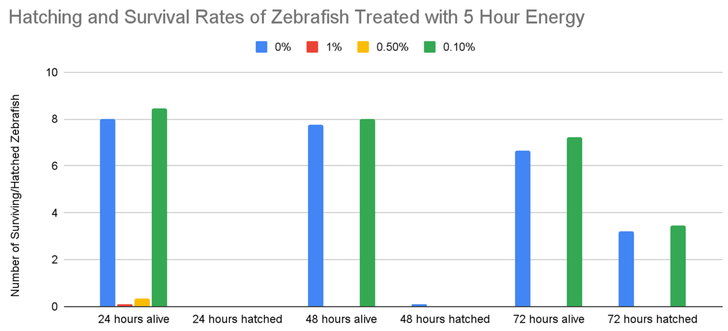
Methods

Materials and Methods are adapted from the WInSTEP/SEPA modules

- Zebrafish Embryo dishes (caffeine and 5 hour energy)
- Microscope
- 5 hour energy and caffeine concentrations

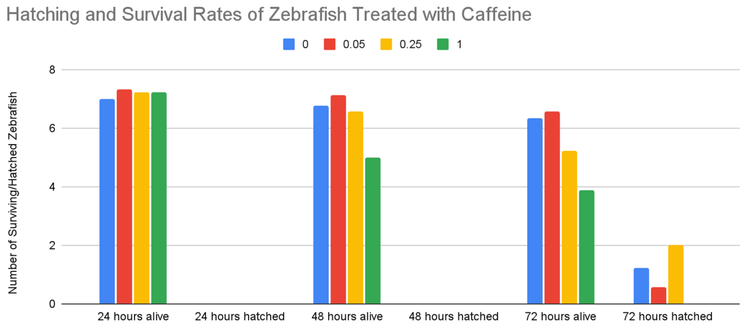
1. Obtain labeled embryos from teacher
2. Observe each section carefully
3. Look for dead, living and hatched embryos
4. Record exact number of living and hatched embryos in provided google sheet(dead hatched don't count)
   a. Place under white paper if you need to see better
   b. Use t-test to compare
5. Repeat the steps above for every 24 hours

Graphs and Data



T-Test Results for 5 Hour Energy:

Concentration (%)	24 hours alive	24 hours hatched	48 hours alive	48 hours hatched	72 hours alive	72 hours hatched
0 vs 1	0	1	0	0.3321949847	0.00000002746857471	0.00427360876
0 vs 0.5	0	1	0	0.3321949847	0.00000002746857471	0.00427360876
0 vs 0.1	0	1	0	0.3321949847	0	0



T-Test Results For Caffeine:

Concentration (mg/mL)	24 hours alive	24 hours hatched	48 hours alive	48 hours hatched	72 hours alive	72 hours hatched
0 vs 0.05	0.6238815553	1	0.6031662724	1	0.7175282605	0.1470287768
0 vs 0.25	0.7027564996	1	0.7566505701	1	0.1021000109	0.1927480354
0 vs 1.0	0.733228334	1	0.0222935866	1	0.005975670944	0.004024899347

References: Wolfenden, Elizabeth. "Can You Drink a 5 Hour Energy Drink While You Are Pregnant?" *Healthfully*, 11 Jan. 2021, https://healthfully.com/402381-can-you-drink-a-5-hour-energy-drink-while-you-are-pregnant.html.
"Caffeine in Pregnancy." *Home*, https://www.marchofdimes.org/pregnancy/caffeine-in-pregnancy.aspx.

Results

We used a t-test because we wanted to see if there were significant differences between the concentrations in caffeine and 5 hour energy. A lot of our significant data was found in the data of 5 hour energy. Nearly every other comparison was significant. The t-test results with 1 shows that the fish in each trial were not significant at all. The t-test results with 0 shows a complete significant difference. This is a very strong representation of how strong of a difference the concentrations have between one another. Specifically, the p-values for 5 hour energy are 0.00000002746857471 shown twice, 0.004273608706 shown twice, and 0 being shown five times. The p-values for caffeine are 0.0222935866 shown once, 0.005975670944 shown once, 0.004024899347 shown once.

Discussion

We wanted to figure out to what extent the different concentrations of caffeine and 5 hour energy differ. If we increase these concentrations the more severe the effects of these two chemicals will be. We will also see extreme effects in the 5 hour energy concentrations. This is because there is a concoction of different vitamins and chemicals in 5 hour energy opposed to just caffeine. That concoction might have just been too much for the fish to handle at that stage of their lives and could be why we saw an extreme cut off to survival and hatching rate. it is safe to say that we reject our null hypothesis that these concentrations will have no effect on the zebrafish. We can clearly see in the graphs and the data tables that these two chemicals seriously affected the fish. Especially 5 hour energy. The p-values for 5 hour energy comparisons showed up more, a total of nine times, and we more significant than caffeine. The total number of p-values for caffeine was three. This means that there were only three significant comparisons. Looking at how significant 5 hour energy compared to caffeine we can definitely say 5 hour energy has a more significant effect on zebrafish than caffeine. Some limitations to this study was that the fish weren't put in natural conditions. As always, we can always increase the size of our study to get more reliable and precise results. Finally, if there could have been more precise ways to measure heart rate and blood circulation I feel this would have been significant data to collect. The whole reason we conducted this research was to come to a conclusion on these chemicals affecting child development in humans. I think this is important knowledge to consider because people should know what to put and not put in their bodies while going through pregnancy. Something new I learned in this study was mainly regarding 5 hour energy. Still to this day, little is known about the effects of the supplement, though we can come to a conclusion with this study that it is not safe for child development.

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