

What Coca-Cola Product Has The
Most Effect On An Earthworm's
Burrowing Time?

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2021

Abstract

Coca-Cola products are drinks often consumed by humans. These drinks were created by Dr. John Pemberton and his company. This leads to our question, what Coca-Cola product has the most effect on an earthworm's (*Lumbricus terrestris*) burrowing time? We wanted to know which product would increase the amount of time it took for an earthworm to burrow. We thought that Cherry Coke, the one with the most sugar, would have the largest impact. We gathered our materials and tested the worms. After treating the worms in the soda, we put them in the dirt and waited for them to burrow. This was repeated for each worm. We found that Cherry Coke had the most effect. This is important because Cherry Coke is often consumed, and it's important to know that it can be harmful. Humans can see that Cherry Coke impacted the worm, so it's possible that this can translate to harm humans.

Introduction

Our research question is what Coca-Cola product has the most effect on an earthworm's burrowing time? Humans use Coca-Cola as a refreshing drink throughout the year. It can also be used as a toilet bowl cleaner, flower and plant fertilizer, and a soothing remedy for jellyfish stings (The Mad Scientists, 2015). It is important to study this chemical because it can be damaging to humans if they drink it in large amounts too often. This topic was chosen because we wanted to see how the different types of Coca-Cola would differ when they're tested on worms.

Coca-cola was created by Dr. John Pemberton in Atlanta, Georgia in 1886 (Coca-Cola, 2021). Carbonated water was melded with syrup to create this fizzy soda. In 1982, the company introduced "Diet Coke," the new sugar-free low-calorie version of Coca-Cola. Cherry Coke, the cherry-flavored version of Coca-Cola, was released in 1985. The zero-calorie soft drink, Coke

Zero, was released in 2017 (Editors of Encyclopedia Britannica, 2021). The chemical formula of Coca-Cola is $C_{30}H_{38}N_8O_{10}$. Cherry Coke follows this formula, but with the addition of cherry flavoring, $C_4H_6O_5$. Diet Coke's formula for the syrup is $C_{18}H_9N Na_2O_8S_2$, and Coke Zero is the same (Pubchem, 2021). Health risks such as an increased heart rate, heart disease, diabetes, and obesity can occur when Coca-Cola is consumed in large amounts (Felman, 2019). The largest difference in these liquids is the sugar levels.

The chemicals in Coca-Cola products can affect humans. By drinking Coca-Cola products, the duration of a person's sleep cycle may change. This can also interfere with brain activity, increasing the risk of a stroke and dementia. We are studying worms instead of humans because worms are more affected by other substances, especially ones that they are not used to. Earthworms and humans are similar in how their nervous systems work. The human nervous system consists of two parts, the central nervous system, and the peripheral nervous system. The central nervous system has the brain and the spinal cord. Our brain interprets a signal received from our nerves and sends out more signals to our spinal cord (LAL, 2018). The worm's nervous system is controlled by its cerebral ganglion which functions as a simple brain. The ventral nerve cord is attached to the ganglion. Earthworms and humans are different because earthworms have brains that are simpler than human brains (Marengo, 2019).

One way Coca-Cola products can get into the soil is by purposely putting them into the ground. Some people put Coca-Cola in their gardens to help get rid of slugs and other insects (Grant, 2021). Another way Coca-Cola products can get into the soil is by a person being irresponsible and dumping the liquid out wherever they want. The health of the soil is very important because healthy soil is made up of little organisms that turn dead matter and minerals into plant nutrients (Honeyager, 2015). Healthy soil is also important because it is used to protect

against drought (Honeyager, 2015). One reason Coca-Cola products would be bad in the soil is that the insects and other creatures wouldn't be used to the liquid and they could react differently. They might feel endangered and not know what to do.

We hypothesize that earthworms treated with Cherry Coke for 30 seconds will have the slowest burrowing time. We think this because the soda has more sugar in it rather than the other Coca-Cola products.

Methods

We began by gathering our materials for the experiment. We needed four Coca-Cola products, Coca-Cola, Diet Coke, Coke Zero, Cherry Coke, and Water. We also needed a jar and dirt to test the burrowing time of the worm. We then needed paper towels to use as a treatment vessel for the worms. Four earthworms were needed. Finally, we needed a stopwatch, a tray, a pen, and a recording sheet. To begin, we soaked the liquids in a paper towel and laid the worm in a paper towel for 30 seconds. Then the worm was transferred into the soil and we started the stopwatch. Once the worm began to burrow, we stopped the stopwatch and recorded the time. Then we repeated these two more times and then switched worms. We did this three times with the new worm and then switched again. We continued doing this until all worms had been tested three times in each liquid. We went on Google Sheets and typed the data we got from the experiments that took place, including the averages and a T-Test. We created a bar graph to demonstrate our data.

Results

Our independent variables in this experiment were the different Coca-Cola products we treated our worms with. The dependent variables in this experiment were the burrowing time of the worms. We controlled the soil, the tray, and the environment we experimented in. Our worms

reacted reasonably well, except the ones tested in Cherry Coke.

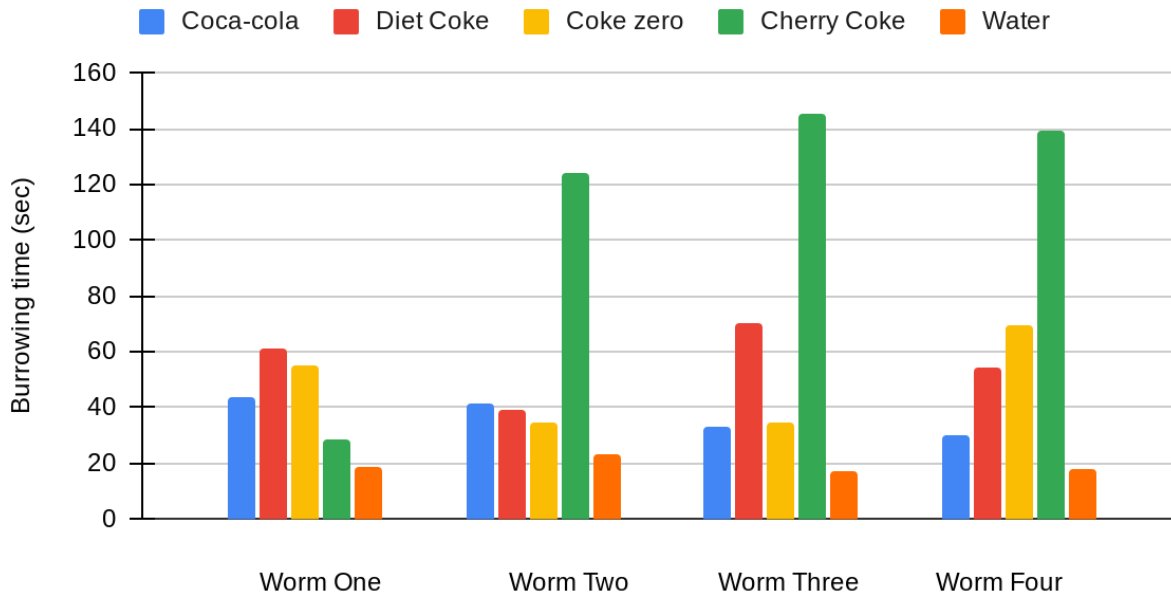
This is our data table. We averaged the three trials of each worm to find the times. Then we averaged the worms altogether.

Data Table #1

	Coca-Cola	Diet Coke	Coke Zero	Cherry Coke	Water
Worm 1	43.67	61.33	55.33	28.67	19
Worm 2	41.67	39.3	34.33	124	23.3
Worm 3	33.33	70.67	34.3	145.33	17.3
Worm 4	30	54	69.67	139	17.6
Average	37.17	56.33	48.41	109.25	14.98

Graph #1

Burrowing time effected by different variations of Coca-Cola products



This is our graph. It demonstrates that worms burrowed the slowest after being treated in Cherry Coke. Across the board, they burrowed the fastest in water.

After our data was collected, we graphed it and created statistical tests. This helped us figure out if our results were significant or not. None of our results were significant because they were all above .05.

Conclusion

Our hypothesis was correct because Cherry Coke had the slowest time. It had an average of 109.25 seconds. We hypothesized that earthworms treated with Cherry Coke for 30 seconds will have the slowest burrowing time. The Coca-Cola products and the water statistics were significant because they were all lower than 0.05. The Coca-Cola products against one another were not significant because they were all above 0.06.

This can be related to the world because many people drink Coca-Cola products every day. If someone looks at our data they'd find that Cherry Coke is worse for you because of the high sugar amounts. The worms had a slower time in the Cherry Coke which means the worms reacted differently with the higher amounts of sugar. The water, on the other hand, had the fastest burrowing time which shows water is a better alternative. People care about this because they most likely want what is better for them and what would be healthier.

One limitation was that we did not get enough time to test the liquids during class. We had to find extra time to complete our research and data analysis. If we were to do future research we would want to try using different soda brands such as Pepsi and Dr. Pepper. We want to see if the different types of sodas affect the worms burrowing.

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