

# How Do Energy Drinks Affect the Burrowing Time of an Earthworm?

Trainer Rolfs

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## **Abstract**

This paper mainly focuses on the effects of energy drinks on earthworms and potentially on humans nervous systems. The paper also breaks apart the ingredients of energy drinks and tells why energy drinks were the chosen contaminant for the experiments the scientists conducted. The scientists chose energy drinks as their contaminant because they are very widely used and can affect the nervous system and an organism's muscles. Also they are widely advertised and if people feel like other people are drinking them and saying it gives you energy then they will want to drink them too. The main takeaway from the experiments and the essay are that energy drinks mostly negatively affect humans and earthworms but can also have positive effects on humans if they are used in small amounts. For example, if you drink small amounts of caffeine or some of the other stimulants in these drinks it can give you energy with little or no side effects because most of the ingredients are natural stimulants. The experiments the scientists conducted were intended to find out if energy drinks will affect an earthworm's nervous system and the time it takes it to burrow. The procedure of the experiments was to expose the earthworm to the contaminant in an exposure chamber and then after 20 minutes place the worm on moist soil to record how long it takes for the worm to fully burrow. The findings of the scientists did surprise them because Red Bull, which has a "better reputation" than Monster, affected the earthworm more than Monster did. The contaminant with the greatest negative effect however was 5-hour energy 0 sugar. The scientists concluded that caffeine and other ingredients in energy drinks can affect the time it takes for an earthworm to burrow.

## **Introduction**

The contaminant that the scientists experimented with was energy drinks. The energy drinks that the scientists experimented with were; Monster Energy, Red Bull, and 5-hour energy. According to "How Do Energy Drinks Work? | HowStuffWorks - Science, some common chemicals between these energy drinks are; caffeine, B-vitamins which are vitamins that convert sugar to energy, Taurine, which is a natural amino acid made by the body that helps regulate muscle contractions and heartbeat, guarana seed which is a stimulant that comes from a shrub, carnitine which is just an amino acid, creatine which is an organic acid that helps supply energy for muscle contractions, and Ginkgo biloba which is made from seeds of a Ginkgo Biloba tree and is thought to enhance memory<sup>1</sup>. The circumstances in which these are used is on a daily basis because people drink them to boost their energy and because they are addicting. Athletes drink energy drinks for different reasons. Some think it will help them perform better in their sport or activity some have sponsorships and drink them so the company pays them and for some, it's both of those reasons. How it works is the chemicals in the drink will go into a person's blood flow and depending on the chemical affect your body in different ways. One example of one of these chemicals is taurine which according to "Jessica Caporuscio, Pharm.D. - Medical News Today." enters your circulation and travels through the body<sup>2</sup>. It crosses the blood-brain barrier and enters neurons. These energy drinks are used very much all around the nation in fact

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<sup>1</sup> "How Do Energy Drinks Work? | HowStuffWorks - Science ...."  
<https://science.howstuffworks.com/innovation/edible-innovations/energy-drink.htm>.  
Accessed 29 Jan. 2020.

<sup>2</sup> "Jessica Caporuscio, Pharm.D. - Medical News Today."  
<https://www.medicalnewstoday.com/authors/jessica-caporuscio-pharmd>. Accessed 29 Jan. 2020.

according to Natural Products Insider, about 61% of Millennials consume energy Drinks<sup>3</sup>. Energy drinks are used because people want to have more energy and the things in energy drinks make your body feel like it has more energy like caffeine. But that is not the only reason that people drink energy drinks. Also they taste good so people like the way that they taste and they get the extra energy from them, however they can have negative side effects too. That is also the reason the scientists decided to conduct the experiments but they did not have a good way to experiment on humans so they chose earthworms. The companies that make the drinks want the people to drink them more too so they make advertisements on television also they sponsor people like professional athletes to drink their drinks when they are in big events. The sponsored people also wear the logos from the drinks and tell reporters that are filming them for the television because then when people watching the television at their homes or watching the big sporting event see the logos or the athletes drinking the drink, they want to be like the athletes. So if the athlete drinks the drink and they are good at sports than if the people drink the drink they will be good at sports also. In the case that they already use the advertised product they will feel better about using it because it is used so much by athletes then they will want to buy more of that product. That is part of the reason that energy drinks are used everywhere. People drink energy drinks in their homes when they are doing physical activities, and under many other circumstances, some people even drink energy drinks in the morning when they wake up.

Humans come in contact with energy drinks every day because they willingly drink them thinking that they will give them energy or they just taste good. But not all

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<sup>3</sup> "Naturalproductsinsider Website Analysis ...."  
<http://naturalproductsinsider.com.curl.wiki/>. Accessed 29 Jan. 2020.

people are exposed to energy drinks because the people who are it is their choice to drink the drinks. In one can of Monster Energy, there is 16 ounces of liquid therefore people are exposed to 16 fluid ounces of the soda that contains those chemicals per can that they drink and many people drink 1 to 2 cans every day. In one can of Red Bull, there are about 8.4 ounces of the soda, and people usually drink 2 to 3 cans a day. In one can of 5-hour energy, there are 2 ounces of liquid and people are not recommended to drink more than 2 cans a day. Some of the possible short term effects of monster energy are headaches, irritated skin, loss of appetite, dizziness, and mood change and the long term effects may include heartburn, heart attacks, and seizures. Some of the possible short term effects of 5-hour Energy are nausea, dizziness, headaches, anxiety, and sleepiness. Some of the possible long term effects of 5-hour energy include low/high blood pressure, seizures, and blood clots. Some of the possible short term effects of Red Bull can include irritated skin, trouble breathing, restlessness, headaches, nausea, and restlessness. The long term effects of drinking Red Bull can include, seizures, heart attacks, and high/low blood pressure. Energy drinks are not very harmful if you rarely drink them but if you drink too much they can be really bad for you.

Because of these effects of energy drinks, three scientists decided to complete an experiment on energy drinks and how the chemicals inside of them affect earthworm burrowing time. They did this by creating an exposure chamber with a percentage of water and a percentage energy drink that they recorded. They then placed the earthworm into the chamber for 20 minutes. When they removed the earthworm from the chamber they placed it on fresh burrowing dirt and documented how long it took for

the earthworm to burrow and the difference between that time and the control time. After the earthworm finished burrowing they sprayed it off with clean water and repeated the process.

If scientists expose an earthworm to energy drinks such as Monster energy, 5-hour Energy, and Red Bull then it will take longer for the earthworm to burrow or possibly even kill the worm in the case of monster because according to "Health | Energy drinks 'make you sleepy' - BBC NEWS. Some of the ingredients in energy drinks like sugar can actually make you have slower reactions and make it harder to concentrate over time.<sup>4</sup>

### **Materials and Methods**

For the experiment the following items were purchased and used,

- 1 2oz can of orange flavor 0 sugar 5-hour energy
- 1 16oz can of regular Monster Energy
- 1 8.4oz can of regular Red Bull
- 1 milligram per milliliter caffeine solution
- 27 red 18oz solo cup
- 18 BUNN coffee filters
- Safety goggles
- Spray bottle with water
- 1 timer
- 1 plastic container
- 9 adult redworms

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<sup>4</sup> "Health | Energy drinks 'make you sleepy' - BBC NEWS." 21 Jul. 2006, <http://news.bbc.co.uk/2/hi/health/5202278.stm>. Accessed 29 Jan. 2020.

- dropper

The way the scientists tested was in a step process they,

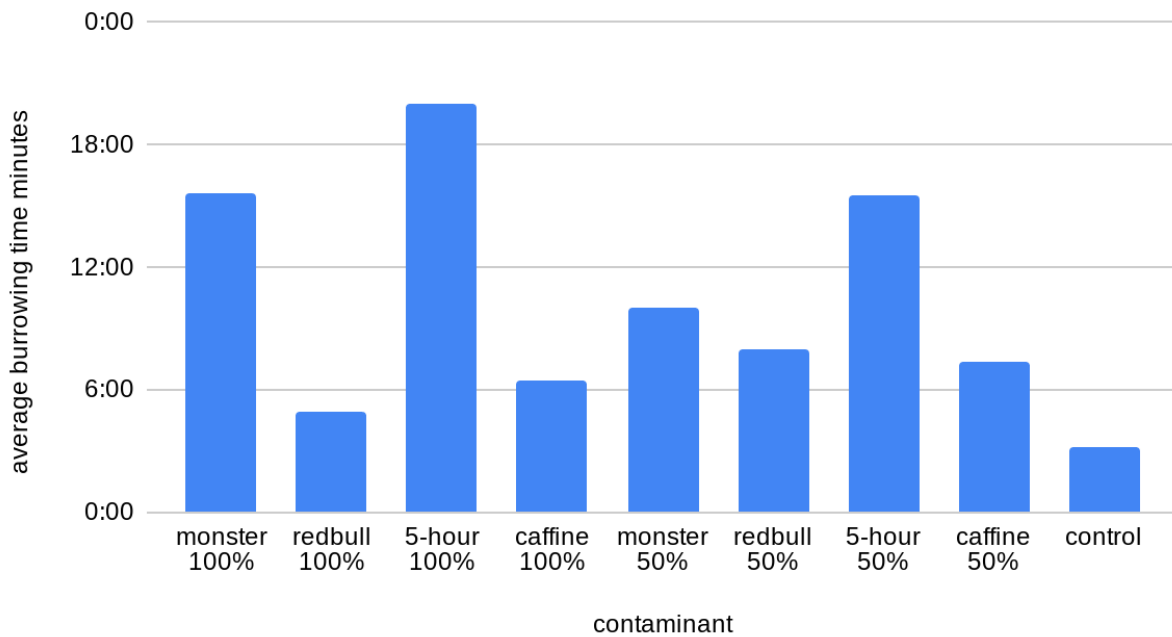
1. Acquired an adult redworm.
2. (if making 50% or 25% or other percent of contaminant.) get dropper and drop however many drops of water for every drop of contaminant depending on percent of contaminants.
3. Took a 18oz solo cup and filled it with the contaminant just above the center bottom of the cup.
4. Took another 18oz solo cup and filled with 15oz of dirt.
5. Took first cup and put one BUNN coffee filter on top of the solution.
6. Put redworm on the coffee filter.
7. Place one more BUNN coffee filter on the worm.
8. Take one more empty 18oz solo cup and place it on top of the second coffee filter.
9. Leave the chamber for 20 minutes.
10. Take redworm out and place it in fresh dirt in another 18oz solo cup.
11. Record the time it took to burrow.
12. Spray off worm with water

Some safety concerns the scientists had where they had to wear goggles so the contaminant didn't get in their eye and they had to handle the worm with care because it is a living thing too.

## Results

To conduct the experiments the scientists put the worm in an exposure chamber with the contaminant and recorded how long it took to burrow. The scientists conducted their experiment because they felt that teens on average were drinking too much energy drinks and they wanted to figure out the health concerns and effects on the body due to energy drinks. What the scientists thought would come out of the experiment was that, an earthworm when exposed to caffeine and energy drinks will take longer to burrow than an earthworm exposed to just water. All of the worms experimented on where in the exposure chamber for 20 minutes. Their results can be shown in a graph as,

average burrowing time minutes vs. contaminant





and in a table as,

	trial one	trial two	trial three	average
monster 100%	3:45 minutes	13:03 minutes	13:80 minutes	15:4 minutes
red bull 100%	5:48 minutes	4:59 minutes	4:08 minutes	4:58 minutes
5-hour 100%	20 minutes	20 minutes	20 minutes	20 minutes
caffeine 100%	2:54 minutes	7:56 minutes	8:34 minutes	6:28 minutes
monster 50%	3:45 minutes	13:05 minutes	13:18 minutes	10:02 minutes
red bull 50%	15:10 minutes	5:08 minutes	3:36 minutes	7:58 minutes
5-hour 50%	11:54 minutes	20 minutes	14:37 minutes	15:30 minutes
caffeine 50%	11:09 minutes	4:27 minutes	6:27 minutes	7:24 minutes
control	3:50 minutes	3:38 minutes	2:04 minutes	3:11 minutes

Mostly what happened was when the earthworms were taken out of the exposure chamber they were distorted and took time to get used to being back into an open space. After they got used to being out of the chamber they looked like they had forgotten how to burrow, some would circle the outside of the cup before trying to burrow some would start burrowing but then they would come back out of the dirt again. When they eventually figured it out they would slowly start to make their way into the dirt. The statistical analysis the scientists completed showed that their hypothesis was correct. Their hypothesis was, an earthworm when exposed to caffeine and energy drinks will take longer to burrow than an earthworm exposed to just water. Their hypothesis was proven correct because all of the burrowing times of earthworms exposed to the contaminant were longer than the times of the worms exposed to water in the exposure chamber.

## **Discussion**

The results of the scientists experiment show that some of the chemicals in energy drinks and just caffeine alone can affect the time it takes for an earthworm to burrow. This could mean that earthworms and possibly humans nervous system or muscles can be negatively affected by things humans drink on a daily basis. (Some mistakes the scientists might have made in testing where that they had to rush some of the last trials and did not complete the experiment as efficiently as earlier in the process.) For example not taking the worm out of the chamber at exactly 20 minutes or not putting together the exposure chamber as smooth as earlier in the process. The reasons the energy drinks and caffeine had an effect on the time it takes for an earthworm to burrow is because there are lots of different ingredients in the energy drinks that can hurt the nervous system and muscle reaction time or efficiency. One of the most common ingredients in these energy drinks is taurine which can cause nausea, headaches, and difficulty walking or moving. One other common ingredient in these three energy drinks is carnitine which can cause symptoms like nausea, stomach pain, headaches, and high blood pressure. One other final ingredient in all of the energy drinks is caffeine. Caffeine can cause symptoms like, increased blood pressure, anxiety, dizziness, nervousness, nausea, irritated skin, and many other side effects<sup>5</sup>. Almost all of those things could cause your muscles and nerves to be distorted and not work right or as fast as usual. The scientists investigations into these things have opened a gateway to further research now that we know that these things can affect the

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<sup>5</sup> "Heat Island Effect US EPA - Newsletter October 17th 2019 Combat ...."  
<https://vganews.com/anti/newsletter-october-17th-2019-combat-anti-0824842>. Accessed 12 Feb. 2020.

body and how they can be harmful to us. The next experiment that could be done is to further research other energy drinks and test all of them on other organisms.