The Effects of Perchlorate and Turmeric on the Heart Rate of *Daphnia magna*

PURPOSE

To examine if turmeric helps reverse the effects of the chemical perchlorate on the heart rate of *Daphnia magna.*

INTRODUCTION

Daphnia magna are water fleas that are found in ponds, freshwater lakes and swamps. They eat algae, yeast, and bacteria and are the prey of tadpoles, salamanders, newts, aquatic insects, and many types of small fish. Since *Daphnia magna* is a food source for many aquatic organisms, if *Daphnia magna* contain toxins then these toxins will affect the organism that ends up eating the *Daphnia magna.* This is known as biomagnification and can result in catastrophic effects on the aquatic ecosystem, if left unchecked. *Daphnia magna* are good to use in experiments because they are sensitive to changes in water and it is easy to see the specific effects of a certain chemical. They are also commonly used in aquatic toxicology because they are transparent, making it easy to see their heart. Toxicology is the branch of science that is concerned with nature or the effects of poisons. Of all Daphnids, *Daphnia magna* are the largest and easy to handle.

Turmeric is a natural home remedy, and it helps the human body in many ways. It has powerful anti - inflammatory effects and is a strong antioxidant. It can also keep blood sugar levels steady and prevent diabetes. The antioxidant properties of Turmeric can be used to reverse the toxic effects of Perchlorate on *Daphnia magna*.

Perchlorate is a harmful chemical that is found in airbag initiators for vehicles, fireworks, fertilizers, pool chlorination chemicals, etc, and results in pollution. Perchlorate is found in high concentrations in soil, water, and plants. Rivers that have perchlorate are dangerous because it can affect organisms in the river while also affecting humans who consume those organisms or drink from the water. Drinking liquids and eating food that is contaminated with perchlorate can affect thyroid glands, which is the main target, produce tumors, and effects normal development and growth in infants. So, if the perchlorate increases the heart rate of *Daphnia magna*, then it will affect other organisms as well. Major rivers have been contaminated with perchlorate in the past. For example, a river in Michigan that has been polluted with perchlorate is the Muskegon river. Another river that has been contaminated is the Colorado river, which supplies drinking water for approximately 20,000,000 people.

HYPOTHESIS

0.1 M Perchlorate will have the strongest effect on the heart rate and turmeric will help reverse the effects of perchlorate on the heart rate of *Daphnia magna.*

RESULTS

Figure 1

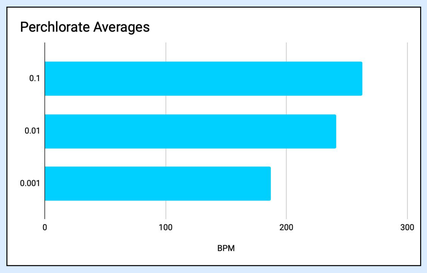


Figure 2

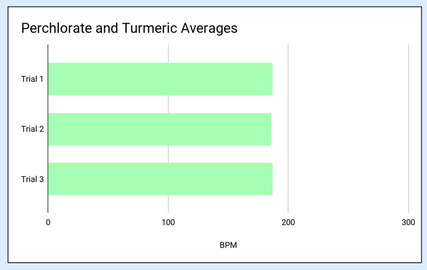
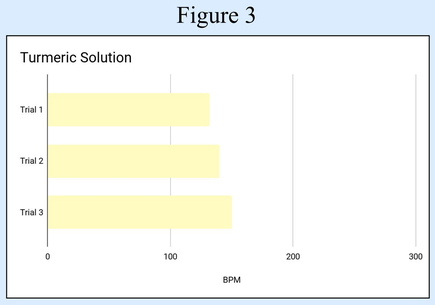


Figure 3



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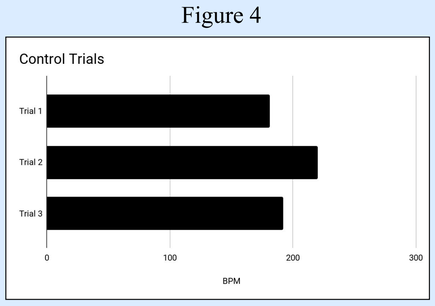

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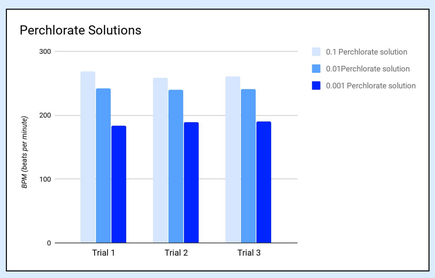

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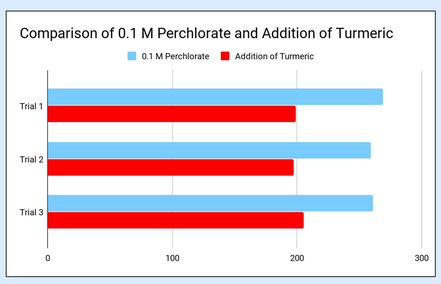

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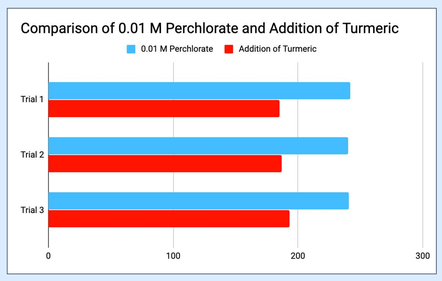
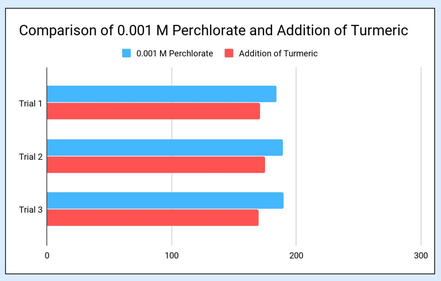


Figure 8



ANOVA for Turmeric + Perchlorate concentrations

Figure 9

Data Summary

	Samples					
	1	2	3	4	5	Total
N	3	3	3	3	3	15
ΣX	603	565	516	422	593	2699
Mean	201	188.3333	172	140.6667	197.6667	179.9333
ΣX^2	121229	106443	88766	59524	118025	493987
Variance	13	17.3333	7	81.3333	404.3333	596.2095
Std.Dev.	3.6056	4.1633	2.6458	9.0185	20.108	24.4174
Std.Err.	2.0817	2.4037	1.5275	5.2068	11.6094	6.3045

standard weighted-means analysis

ANOVA Summary Independent Samples k=5

Source	SS	df	MS	F	P
Treatment [between groups]	7300.9333	4	1825.2333	17.45	0.000166
Error	1046	10	104.6		

ANOVA for Perchlorate and Control

Figure 10

Data Summary

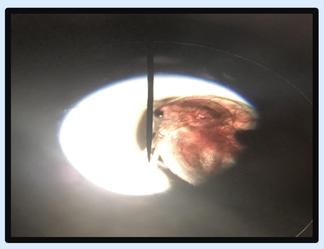
	Samples					
	1	2	3	4	5	Total
N	3	3	3	3		12
ΣX	789	723	563	593		2668
Mean	263	241	187.6667	197.6667		222.3333
ΣX^2	207563	174245	105677	118025		605510
Variance	28	1	10.3333	404.3333		1120.4242
Std.Dev.	5.2915	1	3.2146	20.108	20.108	33.4727
Std.Err.	3.0551	0.5774	1.8559	11.6094	11.6094	9.6627

standard weighted-means analysis

ANOVA Summary Independent Samples k=4

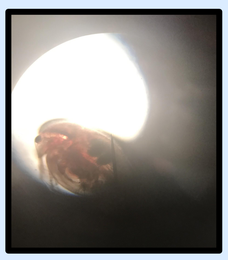
Source	SS	df	MS	F	P
Treatment [between groups]	11437.3333	3	3812.4444	34.37	<.0001
Error	887.3333	8	110.9167		

Figure 11



Daphnia magna
Photo Credits: Sharmitha Bandla

Figure 12

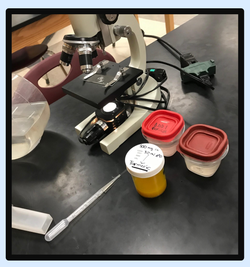


Daphnia magna
Photo Credits: Sharmitha Bandla

MATERIALS

1) *Daphnia magna*
2) Perchlorate
3) Turmeric
4) Spring water
5) Depression slide
6) Light microscope
7) Pipette
8) Thermometer
9) Stopwatch

Figure 13



Set up of Experiment
Photo Credits: Akshanth Bandla

PROCEDURE

1. Make Perchlorate and Turmeric solutions.
2. Mix 117.5 mg of perchlorate with 10 ml spring water to make 0.1 M perchlorate.
3. Mix 1 ml of 0.1 perchlorate solution with 9 ml spring water to make 0.01 perchlorate solution.
4. Mix 1 ml of 0.01 perchlorate solution with 9 ml of spring water to make 0.001 perchlorate solution.
5. Mix 50 mg of Turmeric with 3 ml spring water to make Turmeric solution.
6. Draw *Daphnia* from water and transfer to slide.
7. Place slide correctly under the microscope.
8. Measure the bpm with a stopwatch for the control, spring water. Do this three times. Use different *Daphnia* for every trial.
9. Measure the bpm with the three different concentrations of perchlorate. Do three trials for each concentration.
10. Measure the bpm with turmeric solution. Do three trials.
11. Count the bpm with turmeric and different concentrations of perchlorate solutions.
12. Record data throughout processes.

CONCLUSION

The hypothesis was supported. Turmeric did help in reducing the heart rate of *Daphnia magna* after it was exposed to different concentrations of perchlorate. Perchlorate increased the heart rate of *Daphnia magna* past the normal heart rate and Turmeric reduced the heart rate of *Daphnia magna* in all three trials. Looking at the Anova graphs, the P value was less than 0.5, so the results were significant. Based on these results, turmeric can be used as part of a treatment for perchlorate contamination in humans and possibly reduce or reverse the negative health effects.