Using Leaf Worms as a Model Organism to Determine Human Reactions to a Variety of Essential Oils

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Introduction

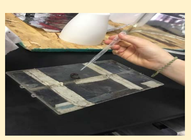
Essential oils can harm humans by the way people use them on their skin. Worms, our model organism, have very sensitive skin making them able to react to different stimuluses much like us humans would if those stimuluses came into contact with our skin's sensitive areas, such as the inside of our mouths or other areas (Osmon, 2018). Our testable question is as follows: How do Earth Vibes essential oils (orange, lavender, peppermint, and tea tree), affect the amount of time it takes the model organism, worms, to burrow after they've been exposed directly and indirectly at different concentrations to the essential oils?

If we test the model organism, worms, to record for any behavioral changes of indirectly (diffuser) and directly exposing worms to essential oils, then the worms will have a mild reaction when we expose them to essential oils, compared to the control. However, when we directly expose the worms to essential oils, they will have a bigger behavioral change compared to indirectly. This effect may decrease as the concentration lowers. This is because many school districts have banned essential oils, after learning exposure can cause asthma attacks, migraines, and allergic reactions. (Balatsos, 2015) Additionally, even governments have warned its citizens about the dangers of essential oils. The Government of Australia stated in their public health warning, that ingesting essential oils can cause seizures, nausea, vomiting, diarrhea and more. And for large doses, it can put the victim into a coma. (Government of Western Australia) Also, because the oils have a pH around 5 and are therefore acidic (Ahuja, Biju, Chaudhry and Khar, 2005). Additionally, for the second part of the test, if we put the worms in a cup with dirt to see how long it takes for them to burrow after being exposed to the variety of oils, then the worms will take longer to burrow after being exposed to more concentrated % of the oils, because according to our past studies. it takes around 89 seconds more for them to burrow after being exposed to acidic substances. All in all, when we test the worms they will have a behavioral reaction to the exposure of essential oils. And applying the essential oils directly to the worms will have a bigger behavioral change compared to indirectly.

Materials and Methods

We exposed the worms to the oils directly by putting the oils directly on the worms, and we exposed them indirectly by using the diffuser. This is so that we can see if they are affected differently, since people use them in both of these ways. After we exposed them to the oils at different concentrations, we put them in cup of dirt to see if the oils affect how they burrow.

Our Independent Variables for our direct tests were the different concentrations of essential oils, (1%, 10%, 100%) and the different essential oil scents (lavender, peppermint, tea tree, orange) . For our second experiment (with the diffuser/ diluted) our independent variables are also the different concentrations (0.5%, 1%, 2%) and the different scents of the essential oils (lavender, peppermint, tea tree, orange). Also, we changed our experiment by changing the one concentration for the diffuser/ indirectly, initially 0.5%. We planned to test concentrations of 1%, 2% and 5%. Additionally, our constants for this experiment was the number of worms, what essential oil scents we used, what brand of essential oils we used, and the same testing process for all the directly tests and all the indirectly tests.



Direct Testing

Burrowing Testing

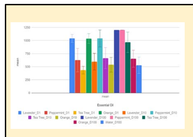
Indirect Testing

Abstracts

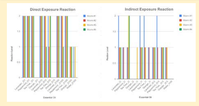
Comparing the data, we noticed that ⅔ of the lavender concentrations have two different p-values compared to water. Which means one concentration has a different p-value of the control. For the indirect testing, we noticed that for two of the scents (peppermint and orange) have two p - values that have a significant difference from the water testing. While one test has a similar p - value to water. While the other two scents (peppermint and tea tree) have two significantly different p-values. They relate to human health because the worms replicate human skin and the effects of what could happen.

The materials that we used include our essential oils, water, a diffuser, a glass chamber, raceway test trays, worms, safety goggles, eye dropper, stopwatch, paper towel, plastic cups, tupperware bowl, and potting soil. Using these materials, we ran multiple experiments to test our testable question. When researching the oils, we found that essential oils are used in many different things. They are commonly used in soaps and perfumes, but they are used in different things for different reasons.

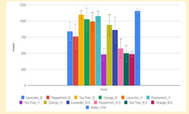
Data Presentation



Essential Oil Means v.s. Water Mean (Direct)



Essential Oil Means v.s. Water Mean (Indirect)



For direct the highest results were of peppermint and lavender 100% concentration . The lowest results were tea tree. For the standard error, tea tree 1% concentration had the highest and lavender and peppermint 100% concentration had the lowest.

For indirect, the highest result was of water. The lowest result was of tea tree 1% concentration. For standard error, lavender 0.5% concentration was the highest and Water was the lowest.

Data Analysis

We also noticed that out of three direct testings of lavender, two different concentrations have two different p-values compared to water. This is also true for Peppermint as well. With tea tree and orange, two out of the three concentrations have approximately, if not the same, p-value to water. For the indirect testing, we noticed that for two of the scents (peppermint and orange) have two p - values that are significantly different from the water testing, while one test has a similar p - value to control. The other two scents (peppermint and tea tree) have two significantly different p-values. The evenness of the data means that essential oils are neither really bad for you or really good for you. The two statistical test that we did were the ANOVA test and the t-test. We decided to use the ANOVA test to get the p-value because we wanted to analyze if there are differences in the entire data set. Additionally, we decided to conduct multiple t-tests in order to tell which pairs of data are the same or different.

Results

Our independent variables are different for each test. While both have the same amounts of time to burrow and to be exposed to the oils which are the same set of scents, our direct tests used 1%, 10%, and 100% concentrations of essential oil while our indirect tests used 1%, 2%, and 5% concentrations of essential oil. We noticed that lavender had the most extreme results, then tea tree, peppermint and orange.

Also, our experimental design consists of testing on worms with different essential oils at different concentrations in order to see how it affects them when burrowing and when exposed to the oils.

In our table for both directly and indirectly, there's six p-values that don't reject the null hypothesis (meaning they're the same), and there are six p-values that do reject the null hypothesis (meaning they're different).

Discussion

When the model organism, leaf worms, are directly and indirectly exposed to 4 Earth Vibes Essential Oils they will have significant behavioral change and cellular change directly opposed to indirectly, which simulates what may happen when humans are exposed to essential oils.

The first piece of evidence is that most of the tests have a larger burrowing mean compared to the control. This connects to the claim is because most of the means for directly are larger than the mean of the control, while indirectly means are all smaller than the control. The fact that the means were different from water shows that when the leaf worms had a behavioral change, therefore a cellular change. However, direct had more extreme reactions compared to indirect. This is relevant for humans because leaf worms have very sensitive skin, leaf worms model humans may reaction in sensitive skin areas, such as the lungs. Therefore, exposure to essential oils could cause humans to have behavioral change.

The second piece of evidence is that 33 out of 52 has a extreme reaction to different essential oil concentrations. This connects to the claim because when we directly exposed worms to essential oils 33 out of 52 had a extreme reaction, and when we exposed then to the control all of the worms had a none to mild reaction. This shows that essential oils, caused the leaf worms to have a change in their cells Furthermore, in 2012 an aromatherapy experiment using essential oils including lavender, peppermint and tea tree. However, 71patients had adverse effects from the exposure of essential oils, including one fatality. (Posadzki, Alotaibi, and Ernst, 2012)

The third piece evidence is only 6 out of 52 had extreme reaction when we exposed them indirectly. This connects to the claim because when the worms are exposed to essential oils (indirect and direct) still have a behavioral change. However direct exposure has more worms that had extreme reaction. This still shows that exposure to essential oils can cause behavioral and cellular changes, to leaf worms and humans. Furthermore, a study found that lavender oil may simulate prepubertal gynecomastia in boys. (National Institute of Environmental Health Sciences, 2018) This connects to the means because when the worms burrowed faster when being exposed to essential oils, and how boys might simulate prepubertal gynecomastia. This shows that exposure to essential oils caused leaf worms and humans to have a change in cells.

In conclusion, when leaf worms are directly and indirectly exposed to essential oils have significant behavioral change and cellular change. Which translates to what may happen when humans are overexposed to the essential oils.

Some limitations of this project is the different amounts of moisture in the cup, the amount of drops due to the drops coming out quickly, etc.

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