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**BIOS-1108L**

**November 8, 2023**

Sensory ecology, Chemoreception, and Preferences in Scent in *Drosophila melanogaster*

**Abstract:**

The purpose of this lab was to test chemoreception in fruit flies, which was done by determining which scents the fruit flies were more attracted to using straight and Y-tube test and which scents they ingested at a greater degree using a gustatory test. Our hypothesis was that the majority of the fruit flies would be more attracted to the perfume in the straight tube tests as well as prefer perfume over cologne in the Y-tube test. For the gustatory test, we believed that the fruit flies would be more attracted to the vanilla scent. Our alternate hypothesis is that the fruit flies will be more attracted to the cologne in both the straight tube and Y-tube test. During the experiment, we tested and compared cologne, perfume, honey, vanilla, ethanol, and D.I. water. We created a straight tube test divided into 3 sections for each scent, section 3 being closes to the scent and section 1, the farthest. The Y-tube test was used to compare the perfume and cologne, and included a Y-maze with three sections, one as a starting chamber and two for the scents being tested. The gustatory test was carried out using 4 different color dyes, 4 different scents (honey, vanilla, ethanol, and water) and a petri dish in 4 sections. We observed the colors in the stomachs of the flies to determine which scent they preferred to ingest. Our results supported most of our hypothesis, as 65% of the flies were in the 2 sections closes to the scent in the perfume straight tube test compared to 64% in the cologne straight test tube and >50% in all the other straight test tube. In the Y-tube test 57% of the flies were in the perfume scent chamber and 34% remained in the starting chamber. The results of the gustatory test disproved some of our hypothesis, as the flies preferred the honey scent over the others. We determined our experiment is statistically significant as it got a p-value lower than 0.05 alpha value on the One-Way ANOVA test. This experiment is relevant and important for understanding the concept of sensory ecology and how chemoreception in animals is processed and reacted to, specifically in fruit flies. Chemoreception is important in animals as it allows for the organisms to sense their environment and determine the presence of potential dangers, as well as factors helpful for their survival, such as food and a safe environment.

**Methods:**

In this experiment we hoped to determine and compare the reactions the fruit flies had when placed in environments with different scents, in order to better understand what controls certain behaviors. The aim of this experiment is to test chemoreception in fruit flies. For the multiple tests carried out, we measured how attracted the flies were to a scent by how close they were to it after a certain period of time.

For the straight tube tests, we tested 6 different scents, perfume, cologne, water, ethanol. Vanilla, and honey. We used 6 different tubes, one for each scent. We placed 15-25 flies in a tube that was sectioned into three sections. The third section is the closest to the scent while the first is the farthest. We then dipped a cotton swab into the scent and placed it in the tube, with the scent near the cap of the tube. We then counted how many flies were in each section after 5 minutes. If the majority were in the third section, that means they are attracted to the scent, and if many were in the first section, that means they were not attracted to the scent. We repeated this process for each scent.

For the Y-tube test we used around 30 flies, which were initially placed in the starting chamber. The 2 scents being tested and compared (the perfume and cologne) were placed in the other 2 chambers. The flies were given a week to choose which scent they preferred, by moving to 1 of the 2 scents chambers from the starting chamber. The number of flies in each chamber were counted and recorded.

The gustatory test was done using a petri dish that was sectioned off into 4 sections. The scents being tested were mixed with one of the 4 color dyes, in the process, diluting them slightly. The honey scent was dyed with dark yellow, the vanilla with green, the distilled water with blue, and the ethanol with red. The fruit flies were then placed in the petri dish and covered and were allowed to eat from all 4 scents for 10 minutes. After the 10-minute period, the fruit flies were viewed under a microscope to determine what colors their stomachs turned.

We later also conducted another round of straight tube experiments using the honey and vanilla scents in order to determine if the strength of the scents has an effect on how attracted the flies are to the scent. We diluted the scents using a micropipette, mixing 5 uL of the scent with 10 uL of water, which diluted it to half its concentration. We then repeated the same process as in the original round of straight tube tests.

After collecting all the data and making all our observations, we ran a one-way ANOVA statistical test to determine the significance of our results. The p-value found was compared to the alpha value of 0.05, a p-value of 0.05 or less means the results are statistically significant.

**Results**

Our data was found to support most of our hypothesis, and the statistical test run (ANOVA) confirmed that our results are statistically significant, as the p-value was found to be 0.0264 which is less than the alpha value of 0.05. For the straight tube tests, we found that 65% of the fruit flies remained in the two sections closest to the perfume smell, demonstrating that the fruit flies did not have an aversion to the smell and even preferred it. We also found that 64% of the fruit flies remained in the two sections closest to the cologne smell. For the rest of the straight tube tests, more than 50% of the fruit flies remained in the third section of the tube, showing an aversion to smells like honey, vanilla, ethanol, and water. This data successfully supports our hypothesis, which stated the flies would be more attracted to the perfume than anything else.

For the Y-maze tube tests, the fruit flies displayed a strong preference for the perfume compared to the cologne. After a time period of a week, 57% of the fruit flies were found in the perfume chamber, while 34% of the fruit flies remained in the starting chamber. This provides further support for our hypothesis. The results from the gustatory test were harder to quantify, as it was difficult to precisely determine which fly ingested which of the scents. Overall, we can conclude that the flies mostly preferred the perfume scent over all other scents. Among the scents tested in the gustatory test, the honey seemed to be the most attractive to the flies and from the flies that did ingest a scent, the honey seemed to be the color seen in their stomach.

For the later straight tube tests, done with a diluted concentration of the honey and vanilla scent, we could determine that the flies preferred the vanilla over the honey, as more were found in section three of the test tube.

**Discussion:**

The results and data show that generally, the fruit flies preferred the perfume scent over all other scents. This data supports our hypothesis. In the straight tube test, the flies preferred the perfume the most and then the cologne second. This was further supported and proven with the Y-tube test. 65% of the flies were found to be in section 2 or 3 in the perfume tube and 64% were in section 2 or 3 in the cologne tube. In the Y-tube test, 57% of the flies preferred the perfume over the cologne. The only other scent the flies liked, was the vanilla at 50% concentration. The ANOVA test proved our data to be statistically significant. A possible source of error would the strength of the scents, as we found diluting the scent made the flies more attracted to it. If a scent is too strong, this may repel the flies instead of attracting them. Another possible source of error may be the number of flies used in each test, which varied as some flies escaped or were killed during the process of the experiments. For the gustatory test, an important source of error would be the colors used to dye the scents as some were too similar to the natural colors of the fruit flies’ stomachs.

The implications of the results of this experiment are many as understanding the biology of chemoreception in fruit flies is important for several important issues, specifically food waste and agriculture. The issue of food waste due to insect infestation is a common one around the world and is difficult to combat. Understanding how and why fruit flies are attracted to things like fruits, allows for a better understanding of the issue in general. This understanding may open up new avenues to combat and prevent against this issue.

**Figures and Tables:**

**Number of flies in the straight tube test**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Honey 100% concentration** | **Honey 50%**  **concentration** | **Vanilla 50%**  **concentration** | **Vanilla 100% concentration** | **Perfume** | **Cologne** | **Ethanol** | **Water** |
| **Section 1 of tube** | **20** | **9** | **13** | **4** | **6** | **9** | **14** | **12** |
| **Section 2 of tube** | **3** | **0** | **0** | **3** | **5** | **8** | **2** | **11** |
| **Section 3 of tube** | **0** | **1** | **1** | **7** | **6** | **8** | **1** | **2** |

**Number of flies in the Y-tube test**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Perfume** | **Cologne** | **Starting chamber** |
| **Number of flies** | **20** | **3** | **12** |

**A table with numbers and a number

Description automatically generatedResults of ANOVA test**

Having read the Georgia Institute of Technology Academic Honor Code, I understand and accept  
my responsibility as a member of the Georgia Tech community to uphold the Academic Honor  
Code at all times. In addition, I understand my options for reporting honor violations as detailed  
in the code.  
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