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The effect of developmental environment on choice of egg deposition in *Drosophila melanogaster*

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ABSTRACT

There are many factors that affect behaviors and important decisions made by organisms, such as reproduction and the location of egg deposition. Factors like genetics and developmental environment influence how an organism responds to different circumstances. The model organism used was *Drosophila melanogaster*, due to their rapid life cycle. This organism has a short lifespan and is relatively easy to work with. The decision and selection of food can be altered by offering certain types of diet to the *Drosophila melanogaster*. Behavioral studies show how fruit flies can be influenced by their habitat and surrounding as much as their genetics and nature. The *Drosophila* were paired for reproduction and studied the distribution of the offspring among the two fruits we used. Pear and banana are the two fruits used because they are both natural sugar. The fruit flies were nurtured on one of the food types and were put in trials to pick a specific fruit they wanted their offspring to be raised in. The flies significantly preferred pear over banana, but the developmental environment of *Drosophila melanogaster* doesn't affect the habitat they chose to lay eggs on. This experiment shows how certain types of food have more benefits and survival rates for the development of *Drosophila melanogaster*. Understanding the type of fruit the organisms are the most attracted to will improve the durability and reproduction of *Drosophila* in future studies.

INTRODUCTION

An organism's phenotype is affected by both their genes and their environment. The body inherits information that codes for the phenotype in the form of DNA that comes from the parents' gametes. For example, wing shape, eye color, and body-color have all been found to be heritable in *Drosophila melanogaster* (Hamby 2016). But in many cases, the environment can play as big or greater role in determining the phenotype of organisms. Experience can influence behavioral phenotypes, which makes the offspring of a certain generation practice the same lifestyle (Daniel et al. 2013).

Behavior is a complex trait that is known to be influenced by both genetics and the environment. The behavioral traits observed in *Drosophila* are aggressiveness, mating, courtship, and feeding. These traits could be influenced by a variety of environmental factors, such as temperature, light, climate and even host restrictions.

A study was done on biotic and abiotic factors that impact the behavior of *Drosophila suzukii*. It showed that the habitat factors that influence behavior are host type, host quality, temperature, and humidity. An organism would have a higher tendency of preferring a warm environment if the organism was in a high-temperature climate area all their lives (Hamby et al. 2016). The temperature the organism is in can also affect its movement and how actively they interact with each other. Too hot or too cold habitat can limit the reproduction levels of fruit flies. (Markow 2008).

Food preferences are exhibited through behavioral choices made during all stages of life. One would expect the expression of this trait to be potentially influenced by both what the previous generation was able to successfully feed on as well as what is currently available in the environment (Beck 2006). Food preference can be directly related to survival and this is completely dependent on the environment a fly is found in (White et al. 2013). The objective of this experimental research is to explore the effect of the developmental environment on the choice of egg deposition in *Drosophila melanogaster*? The choice of diet in *Drosophila* might be based on the habitat they grew up in and are familiar with. The intent of this experiment is to see the connection between behavior, and ecology.

MATERIALS AND METHODS

The main purpose of this experiment is to identify what effects the developmental environment has on the choice of egg deposition. Glass vials were prepared to provide an environment in which the *Drosophila* can multiply. Two different fruits, banana, and pear were placed in two separate empty vials to start the experiment. A few male and female fruit flies (*Drosophila* cultures from Carolina Biological Supply) were added to each vial to create the parent generation that experienced different food developmental environments. The two diet options provided for the *Drosophila* were bananas and pears which contain adequate carbohydrates and protein nutrients to enhance survival rates.

After the parent flies had matured, their preference of food media for egg deposition was examined. I brought a male and a female *Drosophila* from the

same parent vial and put them in the test container. The container consisted of a fresh pear and banana vial. The *Drosophila* were able to fly around, reproduce, and lay eggs in the vial they chose. This was repeated for multiple pairs (N=20 pear parent pairs, N=13 banana parent pairs). After the offspring started developing and were able to be transferred. I counted the number of offspring that hatched from each of the food media options for each pair. The data gathered in the experiment was analyzed using a chi-square test.

RESULTS

Both banana and pear vials from the parent choice experiment had offspring develop in them. Some vials had higher amounts of offspring than others.

Table 1. The total amount and the percentage of offspring found in each vital after the trials

Parent Fruit	Pear Offspring # (%)	Banana Offspring # (%)	Total number of Offsprings
Pear	245 (67.49%)	118 (32.51%)	363
Banana	93 (75.61%)	30 (24.39%)	123

The choice to deposit eggs was not influenced by the *Drosophila* developmental environment (chi-square= 2.39, P=0.15). However, there was an overall difference in the number of offspring that developed in each food type (chi-square = 6.76, P=0.01). The result indicates that pear fruit is the preferred habitat in *Drosophila* regardless of the environment the offspring were raised in.

DISCUSION

The overall result indicates that the offspring selected pear fruit more than banana despite the fruit they were raised on. We had more pear parents than banana parents from the original generation, this could affect the outcome numbers of the two different populations. The development of *Drosophila* depends on various fruit hosts. The fruit type and the ripeness can impact the growth of the organism (Lee et al. 2015). Thus, the difference observed could be explained by the survival rate of fruit flies being higher in pear fruit because of the nutrition content. The nature of the pears might have an influence on the choice of the *Drosophila*. *Drosophila* needs sugar, alcohol and other nutrients to develop (Colombani et al. 2003). A medium-sized pear contains 0.6 g protein, 27 g carbohydrates, 17 g sugar, 6 g of fiber,0.6 g of fat, and has 101 calories. A medium-sized banana contains 1.1 g protein, 22.8 g carbohydrates, 12.2 g sugar, 2.6 g fiber, 0.3 g fat and has 89 calories. Pears have a high amount of nutrients that *Drosophila melanogaster* needs to survive.

Since the number of eggs the parents laid weren't counted but focused on the offspring that hatched to become an adult, there is no specific way of telling how many eggs were laid in each vitals originally. The counting system displays the number of *Drosophila* that survived to become an adult. The natural nutrients in pear could simply be a good hatching environment for *Drosophila*. This should be explored further in future experiments.

Microbial activities in the vials can be another factor that affected the collection of the data. The role of microorganisms and their impact on larval survival and their reproduction is the biotic factor that impacts the development of *Drosophila* (Hamby et al. 2016). The fruits were getting rotten in a few days but the *Drosophila* were kept in the containers until the larva is in an adult stage to be transported and counted, which took about two weeks. When this situation was observed after a few trials the decision was made to autoclave the fruits and the equipment used to have a better chance of development of the organism.There was a better chance of offsprings developing into adults in banana but had way fewer offsprings from the pear fruit.

Distinguishing the type of fruit *Drosophila* has a high chance of surviving in is beneficial for future studies. The study of organismal behavior can be done by controlling several variables while nurturing the organism with a specific fruit we want them to lay eggs on. Fertility issues can be addressed and resolved through expanded studies similar to this experiment.

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