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### Introduction

Hydrogen peroxide has proven antimicrobial benefits and is created in honey when honey bees add glucose oxidase.



Honey bees are self-medicating and have been found to use the antimicrobial properties found in hydrogen peroxide.

### Research Questions

Do honey bees have a preference toward specific hydrogen peroxide concentrations?

What are honey bees toxicity threshold for hydrogen peroxide?

### Methods

Honey bees were collected from the University of Georgia's Honey Bee Lab.

Sucrose was used as it is the sugar found in nectar. Glucose was used as it is the most prevalent sugar in honey.



We designed two major choice trials for both glucose and sucrose.

We made two mortality trials- the first one saw minimal mortality prompting the second trial with significantly higher concentrations of hydrogen peroxide.

We analyzed for statistical significance using R studio.

Meet the Author!



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I would like to thank the NSF for the opportunity to conduct these experiments. I would also like to thank all the support I have received from my fellow REU students.



### Conclusion

**HONEY BEES SHOWED AN AVOIDANCE OF HYDROGEN PEROXIDE IN GLUCOSE AND SUCROSE SOLUTIONS WITH THE EFFECT SIZE STRONGER IN GLUCOSE. BOTH THE TYPE OF SUGAR AND THE CONCENTRATION WERE FOUND TO STATISTICALLY SIGNIFICANT IN THEIR PREFERENCE.**

**THERE WAS A PROPORTIONAL INCREASE OF HONEY BEE DEATHS AS THE CONCENTRATION INCREASED. ON AVERAGE LESS THAN HALF OF THE HONEY BEES DIED AT 4% H<sub>2</sub>O<sub>2</sub> AND LOWER.**

### Bee Mortality

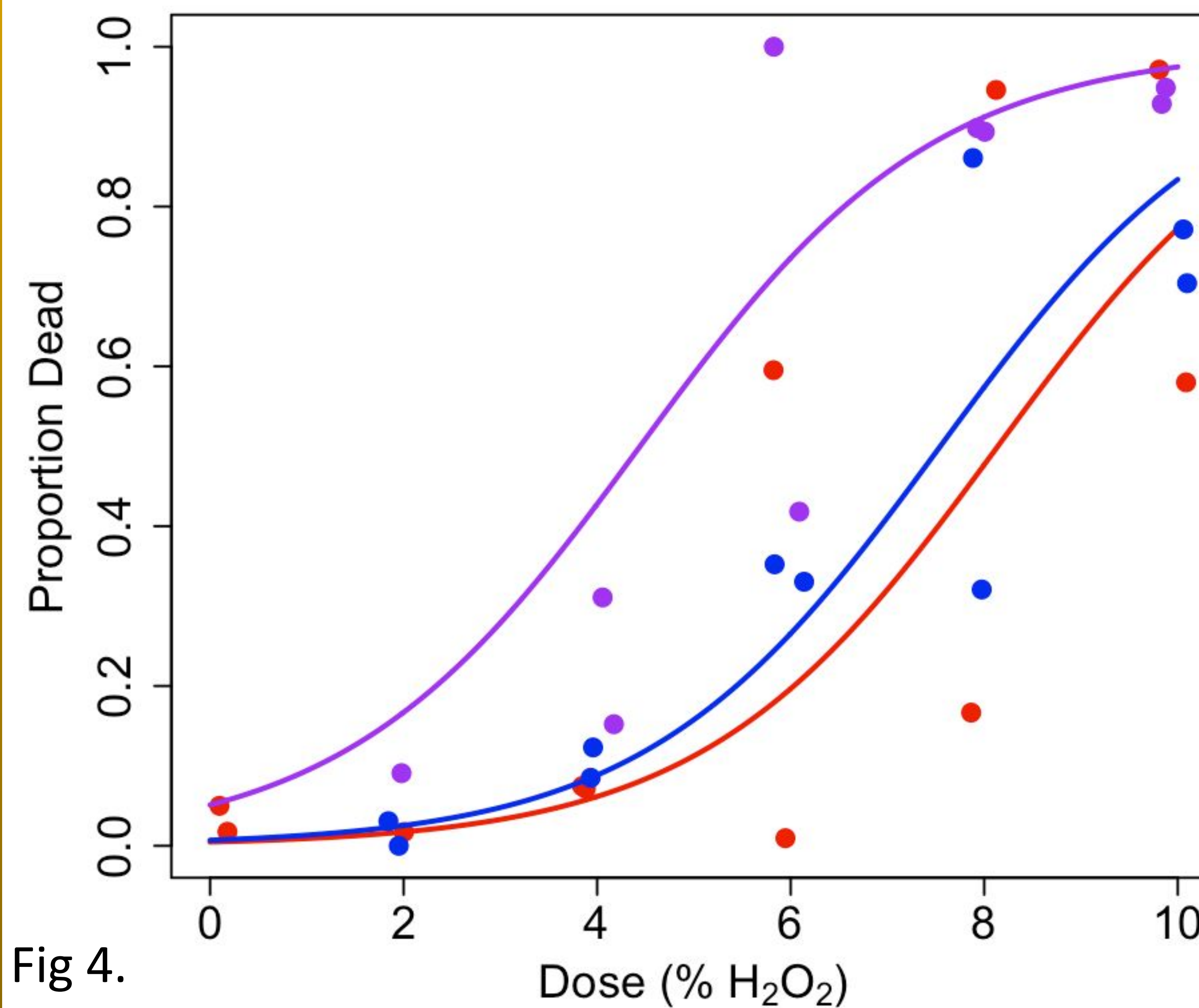


Fig 4.

- As the concentration increased from 0%-10%, more proportional honey bee deaths occurred ( $F=23.53$ ,  $p=0.001$ ).

### Key Findings

H<sub>2</sub>O<sub>2</sub> Concentration vs. Proportional Sugar Consumption

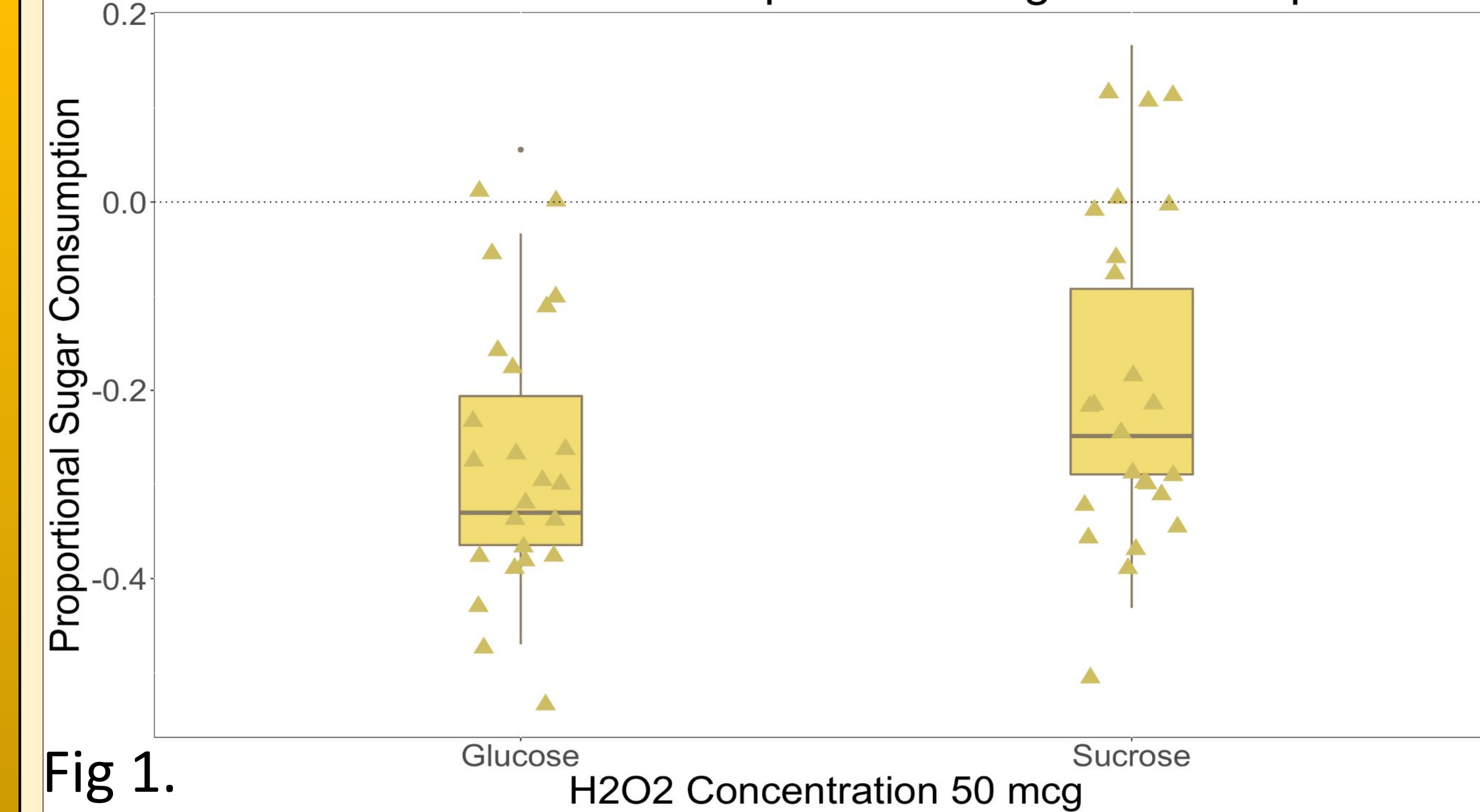


Fig 1.

Fig 1. showed an avoidance to the test solution when compared to that of the control solution ( $F_2=4.88$ ,  $p=0.002$ ). The glucose trial saw an avoidance with an average of 0.28 mL more of the control solution consumed over the test solution, standard error=0.0459. The sucrose trial saw an avoidance with an effect size much stronger than that of the glucose trial. An average of 0.19 mL more of the control solution consumed over the test solution, standard error=0.0424.

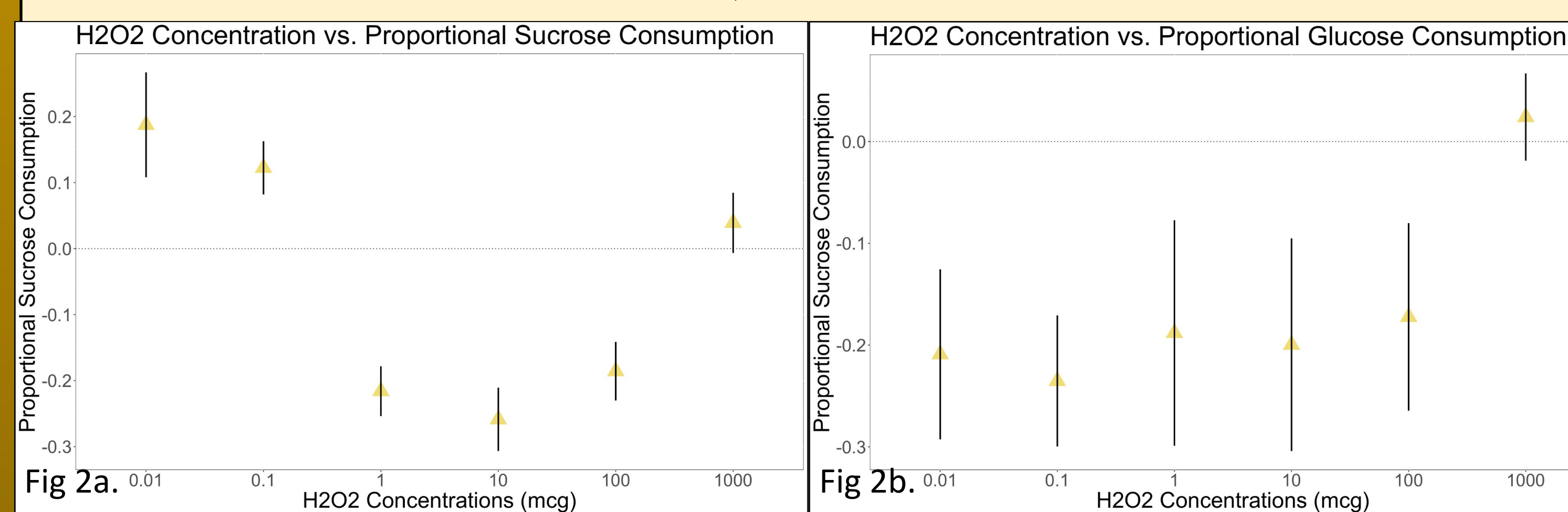


Fig 2a.

Fig 2b.

Fig 2a. showcases a preference for H<sub>2</sub>O<sub>2</sub> at the lowest concentrations and slightly at 1000 mcg/mL ( $F_1=34.62$ ,  $p=0.854$ ). Fig 2b. showed an avoidance of the test solution in all concentrations except 1000 mcg/mL ( $F_1=32.58$ ,  $p=0.005$ ). Both the type of sugar ( $F_2=7.47$ ,  $p=0.019$ ) and the concentration ( $F=2, 61.11$ ,  $p=0.020$ ) were found to be statistically significant in preference.

### Acknowledgments

Trial	Type of Experiment	Sugar Used	Concentration	# Colonies	# Cages
Trial 1	Choice Experiment	Sucrose	0.01, 0.1, 1, 10, 100, 1,000 mcg/mL H <sub>2</sub> O <sub>2</sub>	6	36
Trial 2	Choice Experiment	Sucrose	0.1, 10, 1,000 mcg/mL H <sub>2</sub> O <sub>2</sub>	3	36
Trial 3	Mortality Trial	Sucrose	0, 100, 500, 1,000, 5,000, 10,000 mcg/mL	3	36
Trial 4	Choice Experiment	Glucose	50 mcg/mL H <sub>2</sub> O <sub>2</sub>	4	24
Trial 5	Choice Experiment	Glucose	0.01, 0.1, 1, 10, 100, 1,000 mcg/mL H <sub>2</sub> O <sub>2</sub>	3	36
Trial 6	Choice Experiment	Sucrose	50 mcg/mL H <sub>2</sub> O <sub>2</sub>	3	24
Trial 7	Mortality Trial	Sucrose	0%, 2%, 4%, 6%, 8%, 10% H <sub>2</sub> O <sub>2</sub>	3	36

Table 1. Choice trials (24 hr wait) were given the 1mL of control and one of the 6 H<sub>2</sub>O<sub>2</sub> concentrations. Mortality trials (48 hr wait) had 3mL of H<sub>2</sub>O<sub>2</sub> concentrations.