

Introduction

- 300 million people around the world deal with depression ("Depressive disorder (depression)", 2023).
- Prebiotics and probiotics have been shown to be effective at treating depression (Bistas & Tabet, 2023).
- The Gut-Brain axis is a major factor in causing depression (Chaiyasut et. al, 2023).
- Prebiotics and probiotics are very accessible and pose no major health concerns.
- Depression is also the most untreated in developing countries where access to antidepressants and other medications is very limited. ("Mental health in developed vs developing countries", 2021).

Background

- Levodopa has been shown to be effective at causing drosophila to be depressed (Moulin et. al).
- Many developing countries do not have access to the treatment that developed countries do for depression treatments such as antidepressants.
- Prebiotics and Probiotics are very accessible.
- Drosophila are a very common organism used for testing in biology.
- DNA sequencing can determine gut health and this method has been used successfully in previous studies (Jiang et al, 2020).

Contribution to Field

- Previous studies in the field have worked with both prebiotics and probiotics (Bistas et al., 2023).
- However, no study has yet to do this same strategy and test it on drosophilae with many different kinds of gut health as well as measuring the synergy of the two treatments.
- This study will add to previous studies by concluding whether these two treatments are better for individuals with better or worse gut health.
- This study will also determine if the two different treatments have a synergetic effect on certain gut health types.

Depression Rates

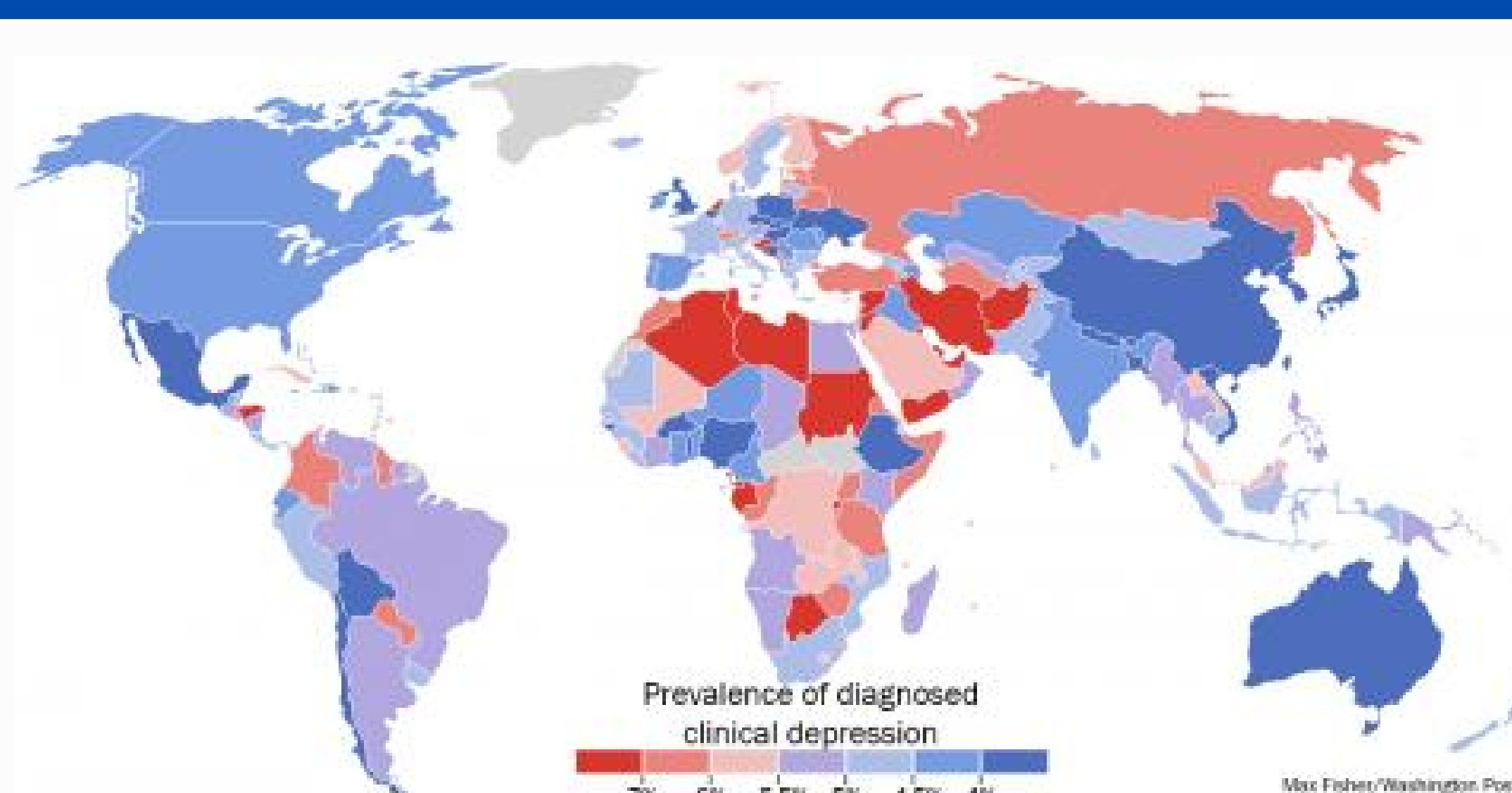


Figure 1. The prevalence of depression across the world. This map clearly shows that developing countries tend to have much higher levels of depression that developed countries.

The Synergy of Probiotics and Prebiotics Based on Gut Health: A Novel Approach on Depression



By Vatsal Patel

Purpose

How does the use of prebiotics and probiotics affect depression levels in individuals with healthier gut condition and worsened gut condition, when used together and separately?

Hypothesis

The use of prebiotics and probiotics to treat depression will be more effective in individuals with worsened gut health, especially when used together.

Result #1

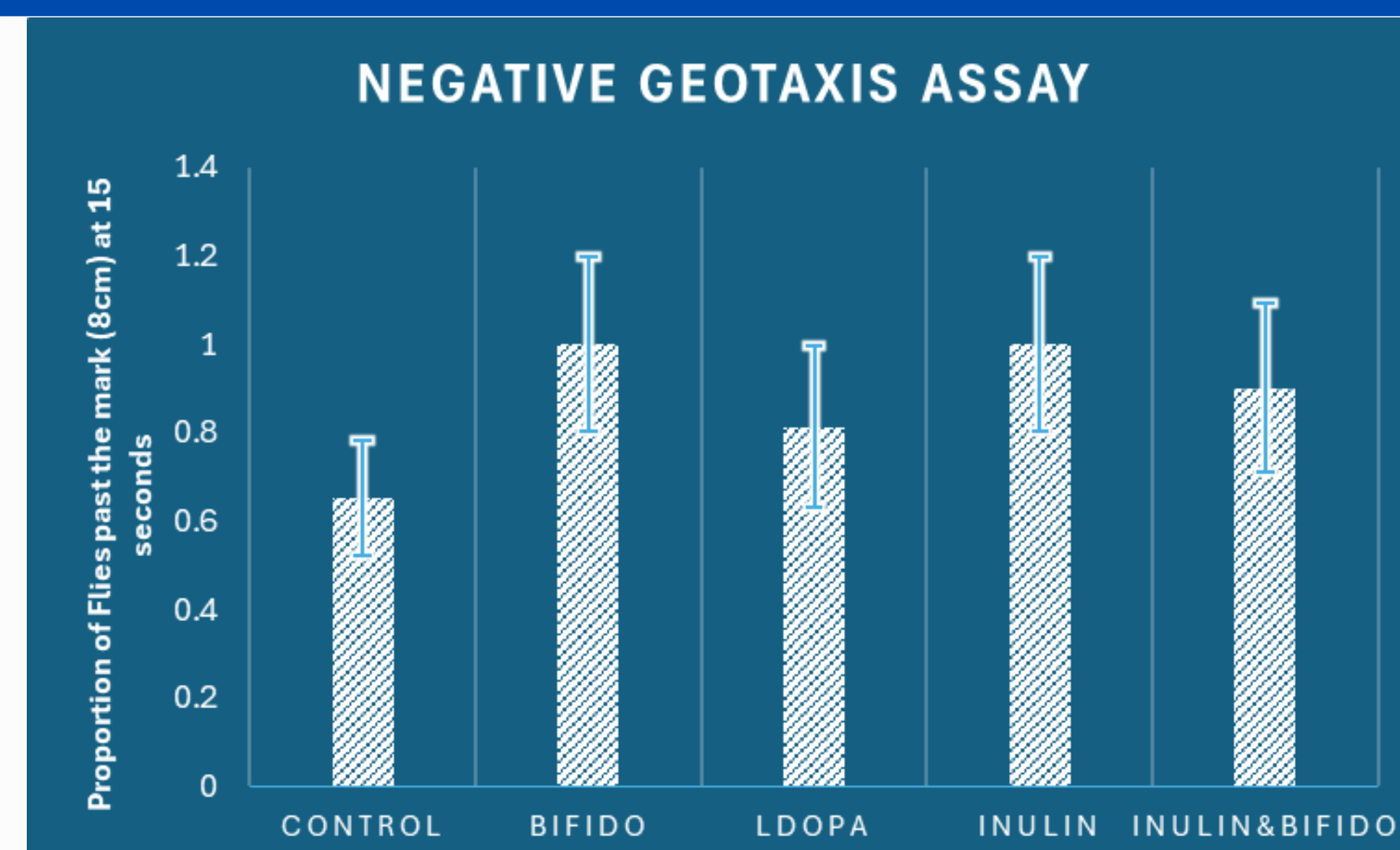


Figure 2. Results of Negative Geotaxis Assay. The bar chart shows the proportion of flies past the Scantimeter mark at the 15 second mark. Error bars use confidence interval, to visually show the T-tests performed on the data.

Analysis

- The data gathered from the negative geotaxis assays and the forced swim tests was put through the according T-tests.
- The negative geotaxis assay T-tests did not show any significant difference between the individual treatments and the combination treatment. It also showed that there was no significant difference in depression levels in the LDOPA and Control group. It also indicated that only inulin alone was able to significantly lower depression levels ($p=0.0029^*$).
- The forced swim test T-tests showed much more more significant results with the combination treatment being more effective that the two individual treatments ($p=0.00000851$ and $p=0.000869^{***}$). It also showed that there was no statistical difference between the two individual treatments, and that all treatments were effective at lowering depression levels, as well as that LDOPA was effective at increasing depression levels.

Result #2

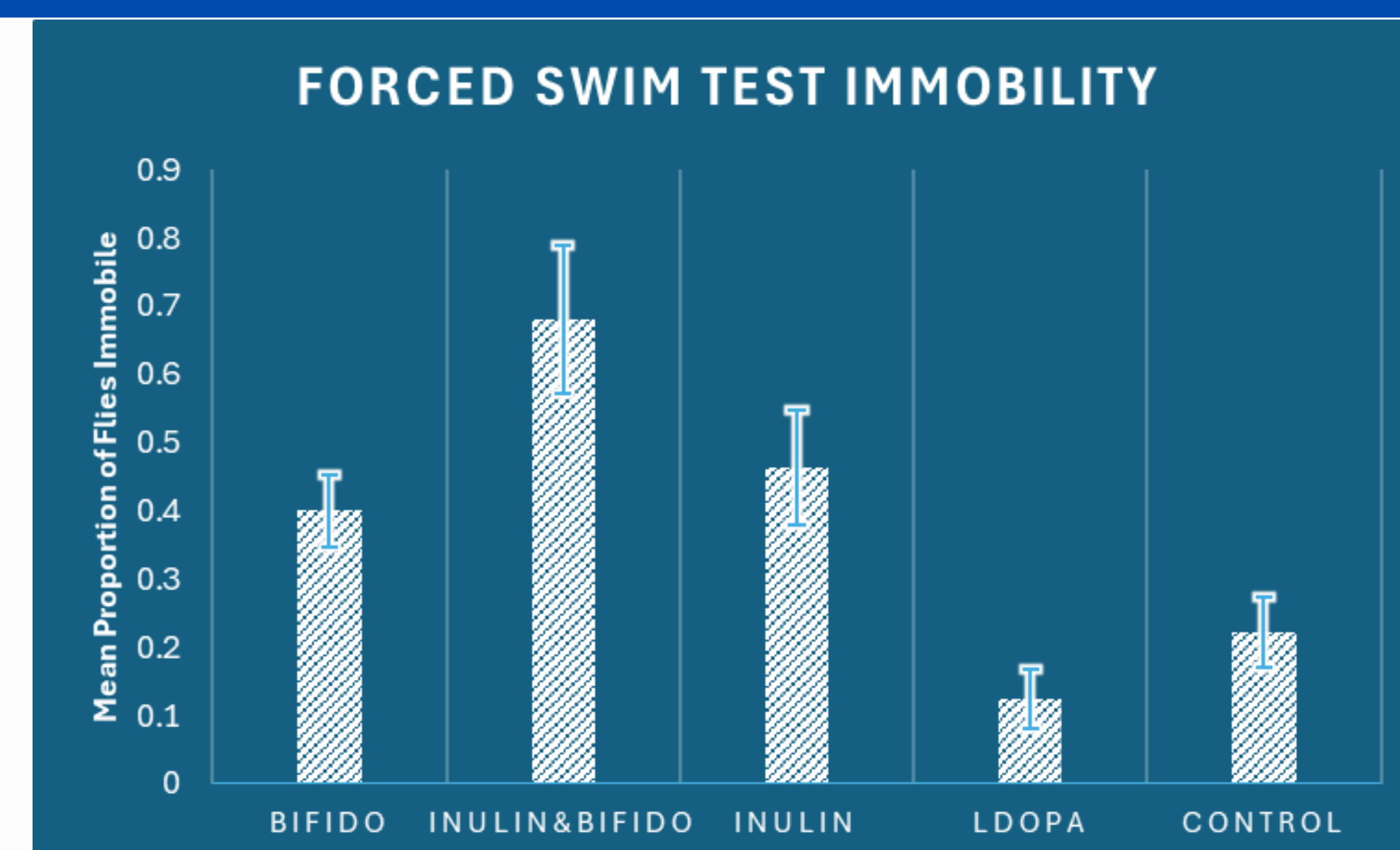


Figure 3. Results of Forced Swim Test. The bar chart shows the mean proportion of flies immobile throughout the 5 minutes of the tests. The error bars show confidence intervals of 95%, to visually display the t-tests conducted.

Future Steps

- As a result, for future steps it would be beneficial to test multiple different prebiotics and probiotics on the drosophila.
- More assays could also be used for in the future, as only two were used in this study (Forced Swim Test and Negative Geotaxis Assay).
- Unfortunately, due to time constraints, especially due to issues regarding materials, this study was unable to measure the gut health of the flies, however, I plan to do that as a future step, using DNA-sequencing.
- Comparing these results to those of flies which have been treated with anti-depressants.

Graphical Abstract

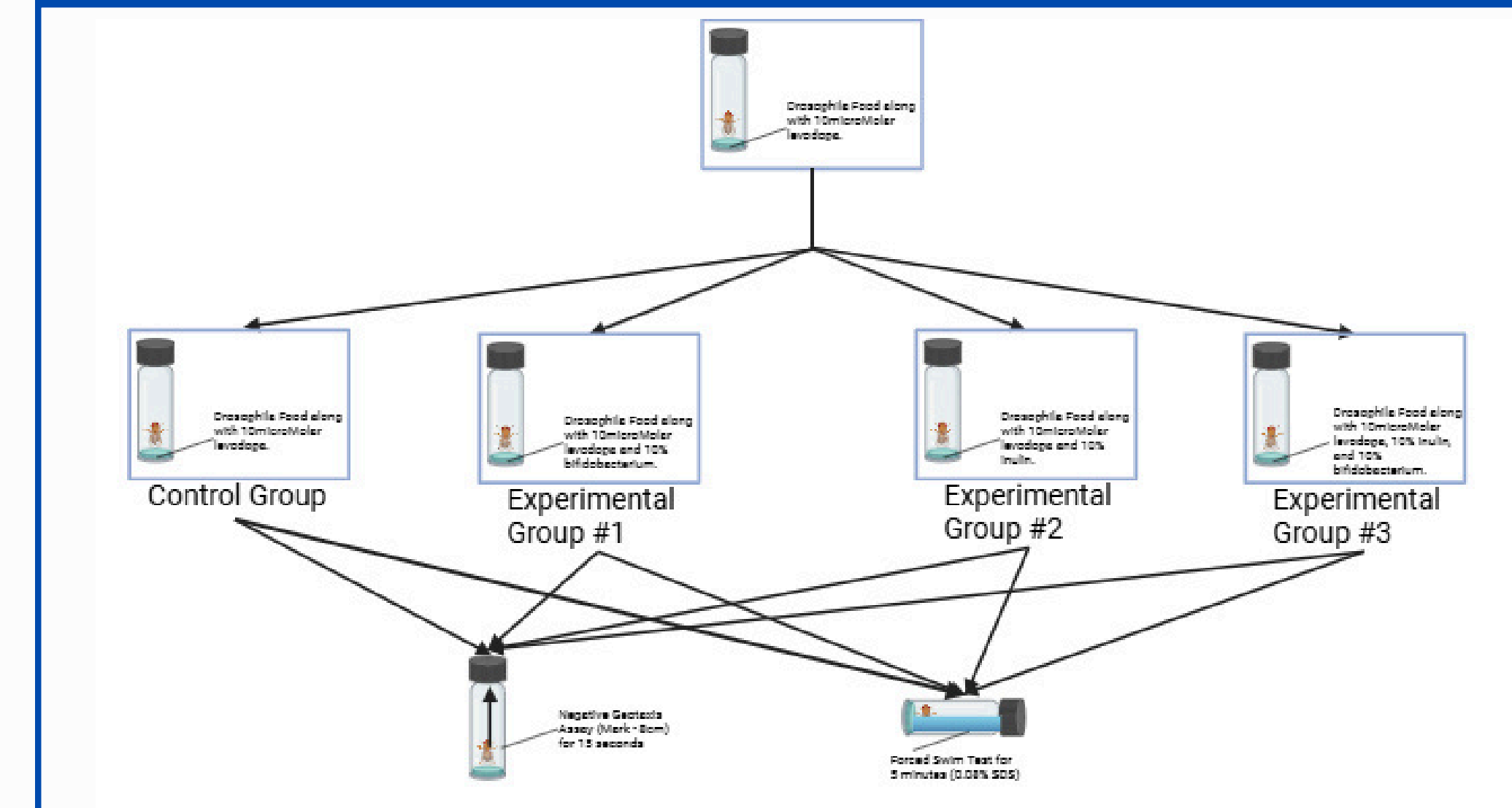


Figure 4. Results of Forced Swim Test. The bar chart shows the mean proportion of flies immobile throughout the 5 minutes of the tests. The error bars show confidence intervals of 95%, to visually display the t-tests conducted.

Materials

- Drosophila
- Clear containers
- Sodium dodecyl sulfate (SDS)
- Water
- Levodopa
- Bifidobacterium
- Inulin
- Pipettes

Methodology

- Study Methodology
 - Drosophila were divided into five groups of which four were induced with depression using levodopa (10μM) while one remained wild type
 - These drosophila were then allowed to mate and the offspring were transferred to new containers of which three contained treatments, and two remained control.
 - Treatments: Bifidobacterium, Inulin, and both
 - Controls: Wild Type and Levodopa only
 - These drosophila were also then allowed to mate, and their offspring were used for the subsequent assays.
 - To measure depression levels, each group was put through a negative geotaxis assay and forced swim test.

Conclusions

- The conclusions that can be drawn from this data follow:
 - Due to a difference in the results of the data analysis all data must be used for conclusions with caution.
 - Bifidobacterium and inulin are both equally effective at treating depression.
 - Combination treatment may be more effective than the individual treatments.
 - All three treatments are effective at lower depression levels.
 - For the purpose of this study, it would be beneficial to rely much more on the analysis from the forced swim tests as they prove the hypothesis and are used widely to test anti depressant effectiveness in the pharmaceutical industry.