

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

Currently around 3.8% of the entire world's population suffers from a common yet often severe mental disorder, depression ("Depressive disorder (depression)", 2023). This equates to around 304,000,000 people out of the 8 billion people on Earth. That is a staggering amount of people who face such a mental disorder which can lead to obesity, physical illness, alcohol or drug misuse, anxiety, social isolation, suicide, alongside a plethora of other social, physical, and mental issues. ("Depression (Major Depressive Disorder) - Symptoms and Causes", 2022). Currently around 2.4 to 3.1 million people in the United States have Inflammatory Bowel Disease ("IBD Facts and Stats, 2024). In recent years, studies have shown that mental health and gut health are related to each other through the gut-brain axis (Kumar et. al, 2023). This means that a potential decline in condition for either of these parts of these bodies could lead to the other's condition also deteriorating.

Probiotics are one potential treatment for depression as probiotics are beneficial bacteria that enhance gut health. These probiotics also often contain microorganisms which allow for the maintenance of these beneficial bacteria (Zeratsky, 2022). As a result of this, probiotics have been consistently shown by a plethora of studies to alter and improve the condition of the gut microbiota (Hemarajata & Versalovic, 2012). As a result of this, probiotics can have many additional benefits such as treating acne, cavities, and gum disease ("What Are Probiotics & What Do They Do?", 2023). One of these many additional benefits that probiotics have been shown to provide is the ability to decrease depression levels (Bistas et al., 2023). As a result of this, probiotics are currently being viewed as potential treatments for depression.

In addition to this, prebiotics are also a potential treatment for depression as prebiotics enhance the gut microbiota. These prebiotics are made up of fiber that can be found in everyday food and in a similar manner to probiotics, do not pose any major safety concerns ("What Are Prebiotics and What Do They Do?", 2022). Prebiotics also have a plethora of other benefits including decreasing inflammation,

regulating blood pressure levels, reducing risk of allergy, strengthening the immune system, and reducing the risk of cardiovascular disease (“The Importance of Prebiotics | Brown University Health”, 2022). As a result of both probiotics and prebiotics having such similar effects in regard to depression, they have also both been used in combination to treat depression. These studies have shown that in combination they are also very effective at treating depression (Bistas & Tabet, 2023).

However, the reason these applications of probiotics and prebiotics to neurological disorders can be traced to a recently discovered founding: the gut-brain Axis. The gut-brain axis is the network of neurons which send signals between the brain and gut (“What Is the Gut-Brain Connection?”, 2023). In recent studies, the gut-brain axis has been shown to be a major factor in depression (Chaiyasut et. al, 2023). However, there has yet to be a study which incorporates prebiotics, probiotics, and gut health alongside depression. As a result, this is a major connection which needs to be made in order to improve the treatment methods for depression. This is also even more necessitated by the fact that the main current mode of depression treatment are antidepressants, which can have many different side effects including: nausea, weight gain, and sleep problems (“Antidepressants: Get tips to cope with side effects”, 2019). As previously mentioned, the use of prebiotics and probiotics can easily bypass all of these side effects. Prebiotics and probiotics are also much more accessible than antidepressants as they can be found in food often eaten daily such as yogurt, fruit, vegetables, and whole grains.

For this study, *Drosophila* will be the model organism used due to two main reasons. The first of these being that *Drosophila* are very easy to maintain in a lab and are a model organism which is commonly used to conduct research experiments. The second reason is that *Drosophila* can easily be depressed using levodopa (Moulin et al., 2021). As a result, due to the *Drosophila* also having a digestive system, this experiment would be optimal to conduct in *Drosophila* as they are fairly easy to work with. Levodopa is a drug that is used to treat Parkinson’s disease, however, it also causes depression in flies (Moulin et al., 2021). Another reason for the difficulty level of using flies for this experiment being

relatively low is due to the many different assays that can be used to easily measure depression levels (Moulin et. al, 2021). The two that this study will employ are the negative geotaxis assay and the forced swim test due to their accuracy in measurement of depression and low difficulty to conduct. The negative geotaxis assay involves measuring the number of flies that can fly up to a certain height in a specific amount of time. The lower this number is, the more depressed the flies are. The forced swim test involves forcing flies to float in water containing SDS. In this test the number of flies that remain mobile after an amount of time is measured. Due to the erratic behavior of the flies in the water being associated with depression, a higher number of flies remaining mobile would indicated higher levels of depression (Hibicke et. Nichols, 2022).