Analysis of the Interaction Between Bacterium Nissle 1917 and L-Dopa to Improve Treatment of Parkinson's Disease

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Parkinson's disease (PD) patients primarily receive the drug L-Dopa to replenish the natural stores of dopamine in the body to reduce PD symptoms (Nagatsu 2009). L-Dopa is structurally similar to dopamine (Hadjiconstantinou 2008), a catecholamine, which can alter gene expression in bacteria, resulting in increased bacterial growth and pathogenicity (Barandouzi et. al 2022). The host catecholamines have been shown to bind to a bacterial protein QseC, a sensor protein found in many bacteria like Escherichia coli that regulates virulence and biofilm formation (Curtis et. al 2014). In my previous project, I treated E. coli Nissle 1917 with L-Dopa, a probiotic bacterium highly homologous to that of intestinal E. coli (Conway and Cohen 2015). I found that L-Dopa increases its biofilm formation, but I did not examine the pathways by which L-Dopa affects Nissle 1917 and its impact on PD treatments. I hypothesize that LED209, a known QseC chemical inhibitor, should reduce biofilm formation of Nissle 1917 treated with L-Dopa and the adverse effects of biofilms on a C. elegans Parkinson's disease model. The L-Dopa-stimulated biofilm formation of BW25113, in which the QseC gene or its downstream genes is deleted or knocked out, should also be reduced. I found that blocking the QseC pathway, either through LED209 or gene knockouts, prevented bacteria from responding to L-Dopa to form increased biofilms. I also found that administering L-Dopa could exacerbate PD symptoms if the gut bacteria respond to L-Dopa to form increased biofilms, and blocking the QseC pathway alleviated this adverse outcome.

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