CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
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Project Number
S2309

Project Title
Effects of Gut Microbiota on Drosophila Models of Parkinson's Disease

Abstract

Objectives/Goals
Parkinson#s Disease (PD) is a locomotor disease characterized by toxic aggregation of the protein a-syn in neurons. Recent research: mice with a PD-causing mutation failed to exhibit symptoms of the disease when digestive-tract microbes were removed. Familial PD research is often performed in Drosophila melanogaster fruit flies, which share many PD genes with humans. To see if the fly model concurs with results from mice, I investigated locomotor activity in these flies both with and without their gut microbiota, then used this to understand the pathways underlying the disease.

Methods/Materials
Flies w/ PD mutations parkin and LRRK2 obtained from Bloomington Drosophila Stock Center with wild-type controls. Fly eggs collected and soaked in bleach solution, then added to sterile food, creating flies without gut microbiota. Flies were sorted by sex and then placed in a cylindrical vial to determine percentage that climbed up more than 8 cm, in 10 seconds. Low climbing ability indicates PD-related neurodegeneration.

Results
Nineteen percent of microbe-free, LRRK2-mutant Drosophila climbed over 8 cm, compared to only 4.6% of mutant flies with normal gut microbiota ($P < 0.0001$). However, within parkin mutants, 13% of microbe-free flies climbed over 8 cm, compared to 18% of flies with normal gut microbiota ($P=0.0245$). Data from female flies; males followed this pattern.

Conclusions/Discussion
LRRK2-mutant flies followed the pattern found in the mice study, with gut microbiota causing the locomotor activity to increase (a drop in PD symptoms) - on the other hand, this is the opposite in parkin-mutant flies. Loss of either LRRK2 and parkin causes a-syn aggregation (and thus loss of locomotion) as both are needed to lyse a-syn. However, parkin also is necessary to keep up mitochondrial health, causing debate over which way it more strongly impacts locomotor activity. Due to LRRK2 results, my experiment proves agreement between fly and mice models; however, we can also see that the mitochondrial activity of parkin is more crucial to its impact on locomotor activity than its breaking of a-syn, because parkin-mutant flies with no microbiota still had lower levels of locomotion.

Summary Statement
I showed that appearance of Parkinson#s Disease symptoms in fruit flies is dependent on presence of gut microbes and examined the effects of this on different Parkinson's mutations.

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