CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Rujuta S. Sathe

Project Number

S2315

Project Title

Using PQQ Mitochondrial Biogenesis as a Therapeutic Approach towards the Treatment for Neurodegenerative Disease (ALS)

Abstract

Objectives/Goals

Amyotrophic Lateral Sclerosis (ALS) is a neurodegenerative disease caused by the reactive oxygen species released by neurons mitochondria when they are damaged by a high Ca2+ influx. This high influx leads to glutamate aggregation in the neurons which contributes to motor neuron death and muscular paralysis. Today, there is no effective treatment for ALS and current therapies simply reduce symptoms and slow disease progression. My approach towards treating ALS involves using PQQ mitochondrial biogenesis to generate new mitochondria which the neurons can use to repair any damage done to the cell and to prevent further degeneration.

Methods/Materials

My experimentation involved infecting C.elegans with Sodium Selenite in order to model ALS. I created 15.5, 30, and 45 microMolar solutions of PQQ chemical and each dosage was then pipetted onto separate Petri dishes containing C.elegans induced with the ALS disease. Data was recorded over a period of 5 days of treatment using DinoLite microscope and WormLab software.

Results

The ALS induced C.elegan locomotion was analyzed after treatment with PQQ in order to determine effectiveness of PQQ treatment on ALS. Center points, Speed, Reversals, and Omega Bends were measured. As concentration of PQQ increased from 15.5 to 45 microMolar, speed increased to 135 um/sec, which was close to the 142 um/sec speed of healthy C.elegans. Reversals decreased successively from 26 to 5 reversals, Omega Bends increased from 0 to 5 omega bends, and Center Point scattering increased from 25 to 85 units along x-axis. The increase in Speed, Center Points, Omega Bends and the decrease in Reversals indicates improvement in mobility and reversed paralysis.

Conclusions/Discussion

The experimental results support my hypothesis as the C.elegans induced with the ALS disease, when treated with PQQ, had an improvement in locomotion and decreased paralysis. Treatment with the most effective concentration of 45 microMolar PQQ , led to a percent recovery of 89.6 which proves that PQQ treatment is successful at reversing the effects induced by ALS, unlike current treatment options which just slow disease progression. Overall, this research shows that mitochondrial biogenesis is a feasible and effective treatment option for ALS and that future therapies should target the same signal transduction pathway as PQQ in order to activate mitochondrial biogenesis in degenerated neurons of an ALS patient.

Summary Statement

This project has demonstrated the effectiveness of PQQ mitochondrial biogenesis as a treatment for ALS.

Help Received

My mentor, Mrs.Fallon, provided laboratory space, equipment, and guidance. I independently conducted research, formulated a novel approach, and gathered and analyzed the data.