CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

35791

Project Title

Modeling the Effect of High Molecular Mass Hyaluronic Acid on Formation of Amyloid Beta Plaques in Alzheimer's Disease

Abstract

Objectives/Goals

The goal is to see if the high molecular mass hyaluronic acid (HMM-HA) can prevent the aggregation of beta-amyloid plaques, which play an important role in the progression of Alzheimer's disease. Naked mole rats have HMM-HA in extra-cellular matrixes including synapses, they also do not get Alzheimer's. Because HMM-HA acts as a space filler in the synapses, the hypothesis is that HMM-HA can prevent or slow down the amyloid plaques from aggregating.

Methods/Materials

Beta-amyloids fibrils were obtained by fully reducing hen egg white lysozyme (HEWL). HEWL was separated from hen egg white through ion exchange chromatography and then reduced to beta-amyloid fibrils using 90% EtOH. Beta-amyloid fibrils were then mixed with different concentrations of HMM-HA (2.8 MDa), low molecular mass hyaluronic acid (LMM-HA, 50 KDa) (negative control), and deionized water (control).

The plaque aggregation in different concentrations of HMM-HA and LMM-HA was quantified by the following four methods. 1. Measuring the absorbency of aggregate at 280nm wavelength using spectrophotometer. 2. Filter retardation assay: Using ImageJ software, measuring the intensity of Congo red stained aggregated plaques filtered using vactum filter. 3. Measuring the weight of the plaques after filtering plaques using Amicon centrifugal filters. 4. Electrophoresis Method: Performing Native PAGE, SDS PAGE, Native Agarose, and SDS Agarose Gel Electrophoresis to determine the aggregations. The farther the beta-amyloid plaques move, the smaller they are. Experiment repeated five times.

Results

The spectrophotometer showed that the plaques with higher concentrations of HMM-HA had lower absorbance of light at 280nm 75% of the time. In the filter retardation assay, the stains of the amyloid plaques with higher concentrations of HMM-HA were less intensive 73% of the time. In the Amicon centrifugal filter method, the weight of plaques in higher concentrations of HMM-HA was lower 84% of the time. Gel electrophoresis results were inconclusive because the size of the plaques was too big and protein barely moved from the well.

Conclusions/Discussion

Three of the four tests were conclusive proving that HMM-HA is effective in preventing the aggregation of beta-amyloid plaques. Further research includes trying to find a way to get the HMM-HA past the blood-brain barrier. HMM-HA could eventually become a treatment for Alzheimer's.

Summary Statement

My project aims to identify if high molecular mass hyaluronic acid can potentially prevent beta-amyloid plaques, a characteristic of Alzheimer's disease, from forming.

Help Received

Guidance was received from Dr. Hannon, science teacher, and Johan Sosa. Used lab equipment at Biocurious, a community lab.

Preliminary