Protein Quality Control and Fat Metabolism: A Key to Understanding Aging?

Age-related diseases, such as neurodegenerative disorders and diabetes, are often linked to problems with the removal of damaged or unnecessary proteins from cells and disruptions in fat metabolism. Cells have quality control systems that ensure proteins are correctly built and removed when they are no longer needed or are damaged. Our project investigates how these two crucial processes – the protein quality control system and fat metabolism – are interconnected. We want to understand how this relationship, particularly in the context of communication between the intestine and germ cells, affects the aging process. In worms, germ cells (the germline) not only influence offspring but also affect the aging rate and health of the adult organism's other cells. We are exploring how this two-way communication impacts the entire organism.

We use the nematode worm Caenorhabditis elegans as a model organism. This tiny, transparent worm, while seemingly simple, possesses many genes and biological mechanisms similar to those found in humans, including those responsible for protein quality control, fat metabolism, and aging processes. Furthermore, its short, approximately three-week lifespan, and the ease with which it can be grown in the laboratory, allow us to quickly and efficiently study aging processes under controlled conditions. Additionally, in this worm, we can precisely manipulate genes, turning off or modifying the function of specific proteins to understand their roles. We are focusing on the communication between the intestine and the germ cells. The worm's intestine, like in humans, is a crucial organ where digestion and nutrient absorption occur, as well as many other metabolic processes, including those related to fat metabolism. The germ cells (germline) are responsible for passing genetic material to the next generation, and their condition has a significant impact on the lifespan and health of the entire organism.

We want to answer the question: How do problems with the protein quality control system in the intestine affect how the body manages fats, and how do these changes impact germ cells and the aging process? We are investigating whether changes in fats are a warning signal that the intestine sends to other tissues, including the germ cells, informing them of problems. In other words, does the gut "tell" other cells that it has a problem with removing damaged proteins, using fats as the "mail carrier" with this message?

Research Plan:

1. We will identify which types of fats change in the body when the protein quality control system in the intestine is disrupted.

2. We will investigate how these fat changes affect the protein quality control system in different parts of the body, including the germ cells.

3. We will determine how the intestine and germ cells communicate using fat-based signals, and how this two-way communication impacts the aging process of the entire organism.

Expected Outcomes: We will learn how disruptions in the protein quality control system in the intestine affect the entire organism, including the germ cells, through changes in fat metabolism. We will discover how the intestine and germ cells "talk" to each other, using fats as messengers, and how this two-way communication influences the rate of aging. Understanding these mechanisms may help in developing new strategies for treating age-related diseases, including neurodegenerative diseases. Our research will deepen our understanding of the fundamental processes of aging and maintaining cell health.