TIME FLIES WHEN YOU'RE HAVING FUN: A FRUIT FLY STUDY ON AGING

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Research Question

Do regions of condensed DNA impact the rate at which we age?

Abstract

In many species, females live longer than males and one of the biological differences between these two sexes is two pieces of DNA that they possess. These two pieces are called sex chromosomes. Typically, females have two X sex chromosomes and males have one X and one Y. The Y chromosome is composed of condensed DNA, while the X is not. In this study, male fruit flies with normal X and Y chromosomes, and abnormal male fruit flies with one X and no Y were used. The level of expression of genes in the two fly groups was determined and compared to see how aging was affected.

Why Fruit Flies

The common fruit fly (*Drosophila melanogaster*) has been used for over a century as a model organism. Benefits of using fruit flies are:

- It has a fully sequenced genome
- It contains at least 75% of the genes that are found in the human genome.
- Like humans, it also has:
  - X and Y sex chromosomes
  - Condensed DNA
- Shorter lifespan allows for multigenerational studies in a short timeframe

Figure 1. Close-up view of a male *Drosophila melanogaster*.

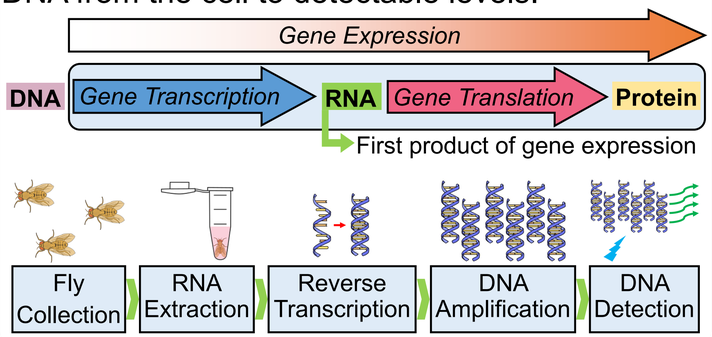
Methods

Fly Types

Normal male flies with both X and Y chromosomes and abnormal male flies with one X and no Y chromosomes were used.

Reverse Transcription Polymerase Chain Reaction (RT-PCR)

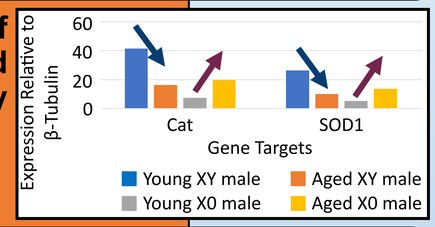
To determine the level of gene expression, a technique called reverse transcription polymerase chain reaction was used. This technique is used to exponentially amplify the gene-specific DNA from the cell to detectable levels.



Results

In XY males, it was seen that gene expression of seven genes decreased as they aged. However, in X0 males which lack a Y chromosome, it was seen that gene expression of the same seven genes increased as they aged. The genes, which showed differential expression with age and the amount of condensed DNA present, are all involved in the process of removing the toxic by-products created by the process of cellular energy production which is believed to advance aging. In other words, flies with less condensed DNA were able to more effectively get rid of toxic cellular substances which would have otherwise lead to the accelerated aging of the cell.

Figure 2. Graph of two genes and their expression by XY and X0 males.



Discussion

The X0 males, which do not have a Y chromosome, were seen to express key genes required for the removal of toxic cellular by-products of energy production at a level higher than XY males, which have a Y chromosome. The Y chromosome is largely composed of condensed DNA. Additionally, females across many different species (including humans), are observed to live longer than males and do not have a Y chromosome, and therefore, possess less condensed DNA. From this, it can be concluded that the condensed form of DNA, such as that found in the Y chromosome, leads to accelerated aging.