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What can we learn about aging from naked mole-rats?

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Abstract

LOWER READING LEVEL

Have you ever heard of a naked mole-rat? This rodent is interesting to scientists. That's because their bodies don't age like the bodies of humans or other mammals. They also don't get age-related diseases, such as heart disease or cancer. That's why they can live over 30 years! Scientists are trying to understand how aging works in naked mole-rats. This will help them better understand aging in humans. We conducted an analysis of naked mole-rat DNA. We wanted to find out if the DNA changed with age. We found that naked mole-rats do age on a DNA level like other mammals. We then analyzed the places where the DNA changed. This analysis helped us predict how these changes might affect the body. We also found that the naked mole-rat queens age more slowly than the rest of the naked mole-rats in a community.

Introduction

Naked mole-rats are a special mammal. Unlike other mammals, they are **eusocial**. That means they live in colonies like bees and ants. Most of the naked mole-rats in a colony are workers. They work to support the colony. A queen runs the colony. She is the only female of the colony that has babies. Naked mole-rats are also interesting because they live long lives. They can live up to 37 years. That is 33 years longer than mice! Their bodies don't show signs of aging either. And they don't get age-related diseases, such as heart disease and cancer. That's why naked mole-rats are so interesting to scientists who study aging.

Naked mole-rats, like all organisms, have **DNA**. DNA is the special code that carries information about an individual. Researchers have found that DNA changes with aging. They also know that these changes happen at specific locations along the DNA code.

Scientists can use changes in DNA to create a type of clock. This clock can tell us an individual's age based on DNA rather

Fun fact: Naked mole-rats don't drink water! Instead, they get all the hydration they need from their plant-based diet.

Photo: Lorna Faulkes Photography

than changes to the body. We call this an **epigenetic clock**. These clocks are very accurate for mammals, including humans. We created epigenetic clocks for naked mole-rats. We then used these clocks to see what happens to naked mole-rats as they **age**. We also looked at how the aging of a typical naked mole-rat compares to the queen's.

Methods

We collected 11 different **tissue** samples from naked mole-rats, giving us 382 DNA samples in total (Figure 1). These naked mole-rats were between 0 and 26 years old. We analyzed these DNA samples for changes. Then we made the epigenetic clocks. We made these clocks by matching the age of the naked mole-rat with the amount of DNA changes it had.

We designed an epigenetic clock for four different kinds of tissue. These parts of the body were the blood, kidney, liver, and skin. We created another epigenetic clock that works for the entire naked mole-rat body.

Once we had naked mole-rat epigenetic clocks, we created two new clocks. These clocks linked aging in naked mole-rats to humans. Then we found the places on the DNA code where changes occurred.

Finally, we analyzed DNA from different naked mole-rat queens. We also analyzed samples from worker naked mole-rats. Then we used our epigenetic clocks to compare how fast queens and workers age.

The scientists made four specific clocks from the tissue types that had the highest number of DNA samples. Which four tissues did they use?

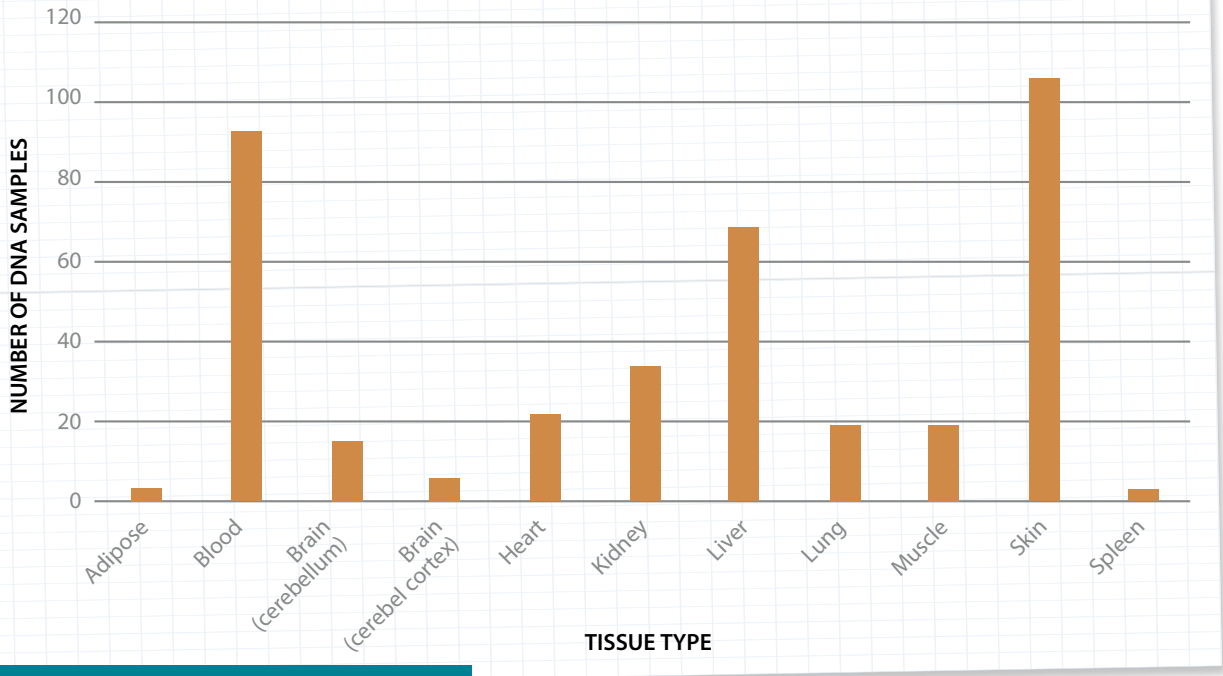

Figure 1: The number of DNA samples obtained from each tissue type.

Results

We created 5 epigenetic clocks for naked mole-rats. These clocks showed that naked mole-rats experience DNA changes with age.

We also compared the DNA changes for queens and worker naked mole-rats. We found 237 DNA changes that were different. The difference in DNA changes told us that naked mole-rat queens age more slowly than worker naked mole-rats.

Discussion

We learned that naked mole-rats do age on a DNA level like other mammals. That's important because certain health conditions occur when there is fast DNA aging. But the bodies of naked mole-rats don't appear to age. That means they aren't getting these health conditions. Why? It is possible that naked mole-rats' bodies have figured out ways to prevent these health conditions. We need to do more research to figure out why the two types of aging don't match.

The location of the DNA changes in the naked mole-rats was also important. It helped us predict how these changes might affect what happens inside the body of a naked mole-rat. The comparison of the DNA from queens and workers was also helpful. It told us that the queens age more slowly. It also helped us **hypothesize** why they age at a slower rate. But we need to do more research to figure out how the job of a naked mole-rat affects their aging.

Studying aging in naked mole-rats is an important way to understand aging in humans. We hope other scientists can take what we learned about naked mole-rats and apply it to humans.

Conclusion

Scientists like us will continue looking for ways to keep humans healthy even into old age. In the meantime, you can stay healthy by eating nutritious foods. Make sure to include pulses, fruit, and vegetables in your diet. These foods provide your body with vitamins and minerals. You need vitamins and minerals to stay healthy. You also want to be active and get plenty of rest. And don't forget to keep a positive attitude whenever you can. Taking good care of your mind and body can help you stay healthy as you age.

Glossary of Key Terms

Age – to get older and to show signs of getting older.

DNA – a complex code in living organisms that carries information about the organism. This information can be passed onto their children.

Epigenetic clock – a model that matches the amount of DNA changes to the age of the organism.

Eusocial – a social structure common in ants and bees.There is a queen that produces offspring and a community of working individuals.

Hypothesize – to give a possible but not yet proven explanation for something (a hypothesis).

Tissue – groups of cells that have similar properties and work together.

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Check your understanding

1. Why do we study naked mole-rats to better understand aging?

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2. What happens to a mammal's DNA as it ages?

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3. We identified two areas about naked mole-rats and aging that will require more research. Which area do you think we should research next? Explain your choice.

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4. What signs of aging can you think of? For example, how can you tell that one person is older than another person or that one dog is older than another dog?

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5. With a partner or small group, brainstorm how better understanding aging in naked mole-rats affects humans in the future.

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We dedicate this article to the memory of Dr. Steve Le Comber.