# Bioengineers uncover lipid metabolic dynamics in Drosophila brain during aging

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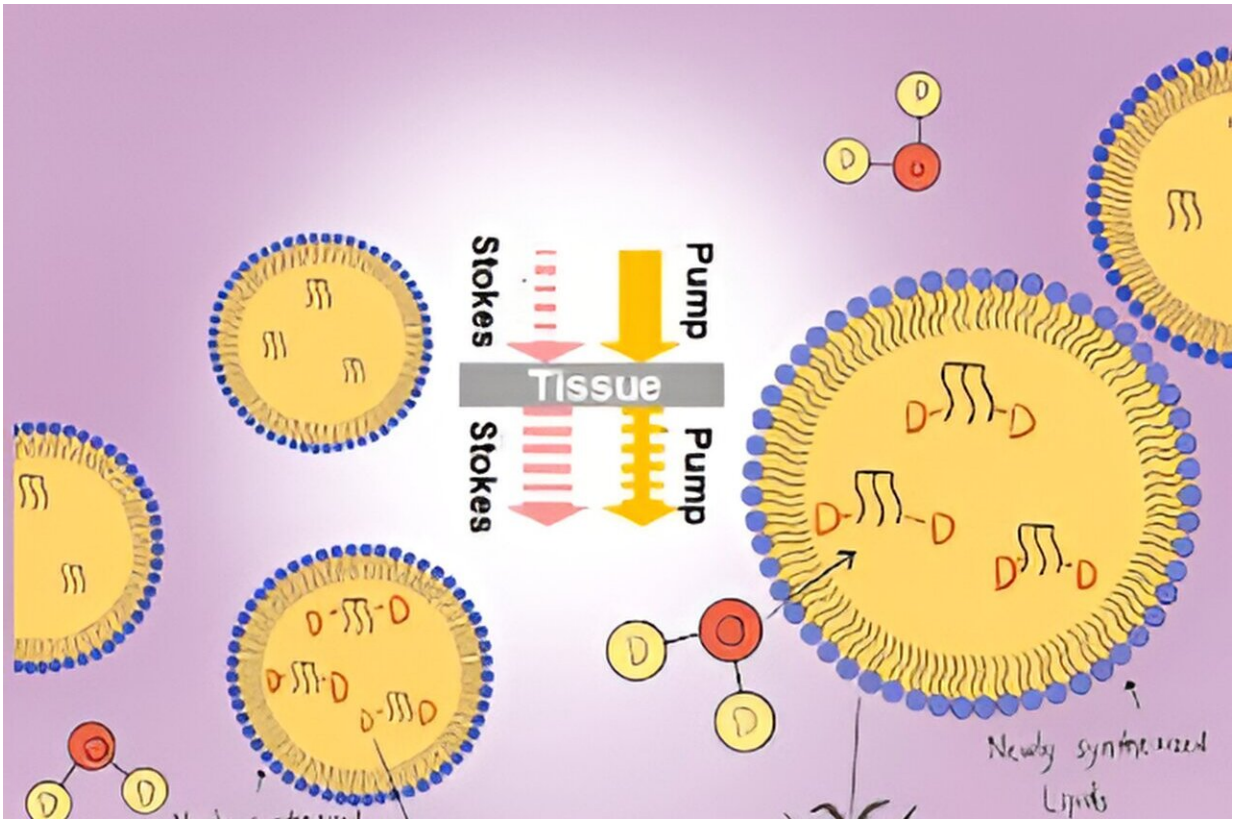


Conceptual illustration considering the interplay between lipid drop storage and consumption, diet and aging. Credit: University of California - San Diego

Aging is an inevitable phenomenon in the process of life, accompanied by the deterioration of physiological functions and increased

susceptibility to diseases.

Studies have found a connection between lipid metabolism and aging as well as age-related diseases. Lipid droplets, organelles that store fat, are closely linked to lipid metabolism in terms of their size and number.

In recent years, researchers have gained a deeper understanding of the important functions of lipid droplets in cellular metabolism and the optimal functioning of organisms more generally. However, the changes in lipid metabolism with age and how nutrient and metabolic pathways regulate lipid metabolism are still under investigation.

Recently, a study on the dynamic changes in lipid droplet metabolism in the Drosophila brain during aging has made significant progress. The research team is led by Lingyan Shi from the Shu Chien-Gene Lay Department of Bioengineering at the University of California San Diego. The team published its study, "Bioorthogonal Stimulated Raman Scattering Imaging Uncovers Lipid Metabolic Dynamics in Drosophila Brain During Aging," in the journal *GEN Biotechnology*.

The researchers employed a novel microscopy imaging technique called deuterium oxide ($D_2O$)-stimulated Raman scattering (DO-SRS) to observe in situ the dynamic changes in lipid droplet metabolism in the Drosophila brain with respect to age, gender, and dietary restriction. The study revealed the density, size, membrane, and distribution of lipid droplets in different cell types.

The study found that the brains of young flies contain metabolically active small lipid droplets with lipid-rich membranes. However, as flies age, the lipid droplets gradually increase in size and become less metabolically active, resulting in a decrease in the lipid composition of the brain. This finding reveals the interplay between lipid droplet storage and consumption, indicating the presence of functional impairments in

the aging brain.

Further research showed that downregulation of the insulin/IGF-1 signaling pathway can reverse altered lipid metabolism, highlighting the crucial role of lipid droplet homeostasis in brain health. Maintaining a balance between lipid synthesis and breakdown is essential for lipid transport between glial cells and neurons. Dietary restriction significantly enhances lipid exchange in the aging fly brain and downregulates the insulin/IGF-1 signaling pathway, thereby extending lifespan.

In the study of different genders of flies, it was found that the abundance and size of lipid droplets in the female fly brain are consistently higher than those in the male fly brain during the aging process. This finding reflects the possibility of higher detoxification capacity in females, partially explaining the phenomenon of females having longer lifespans than males. It provides clues for further research on the gender-dependent regulation of lipid droplet mechanisms.

The first author-Yajuan Li, MD, Ph.D.-a postdoctoral researcher in Shi Lab in the UC San Diego Jacobs School of Engineering, and the corresponding author—bioengineering professor Lingyan Shi—the Principal Investigator, stated that their high-resolution in situ imaging method established for the first time directly observed and quantified lipid metabolism in the Drosophila brain.

This technique is not only limited to brain imaging but can also be more widely applied within organisms, providing a reliable platform for future research on lipid droplet metabolism.

**More information:** Yajuan Li et al, Bioorthogonal Stimulated Raman Scattering Imaging Uncovers Lipid Metabolic Dynamics in Drosophila Brain During Aging, *GEN Biotechnology* (2023). DOI: 10.1089/genbio.2023.0017

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