Organ-Specific Rapamycin Metabolic Remodeling

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Abstract

Rapamycin-mediated inhibition of mTORC1 extends lifespan in Drosophila, but its organelle-level metabolic effects across tissues and aging remain poorly understood. In this study, we used spontaneous Raman spectroscopy combined with deuterium labeling to map lipid droplet remodeling in the gut epithelium, stage-8 ovarian oocytes, and fat body of young and aged flies under rapamycin treatment. Flies were exposed to heavy water (D_2O) for five days before imaging to enable de novo metabolic labeling, and multiple biomarkers were extracted. Quantitative Raman analysis revealed tissue- and age-dependent responses to rapamycin, with aged fat body showing reduced biosynthetic activity, gut epithelium exhibiting altered lipid synthesis/turnover and increased cytochrome/pigment-associated signal, and stage-8 ovarian oocytes showing limited significant changes. More broadly, this work establishes a Raman-based framework for subcellular metabolic profiling of pharmacologic interventions in aging biology.