Dietary nutrition and lifespan of Drosophila melanogaster

王蓉、张豫宁、陈江涛

2021.10.29

报告主题 ：**Dietary nutrition and lifespan of Drosophila**

报告内容：

Relationship between Dietary nutrition and Lifespan　　12:00-12:30 王蓉

Protein diet and Lifespan　　12:30-13:00 张豫宁

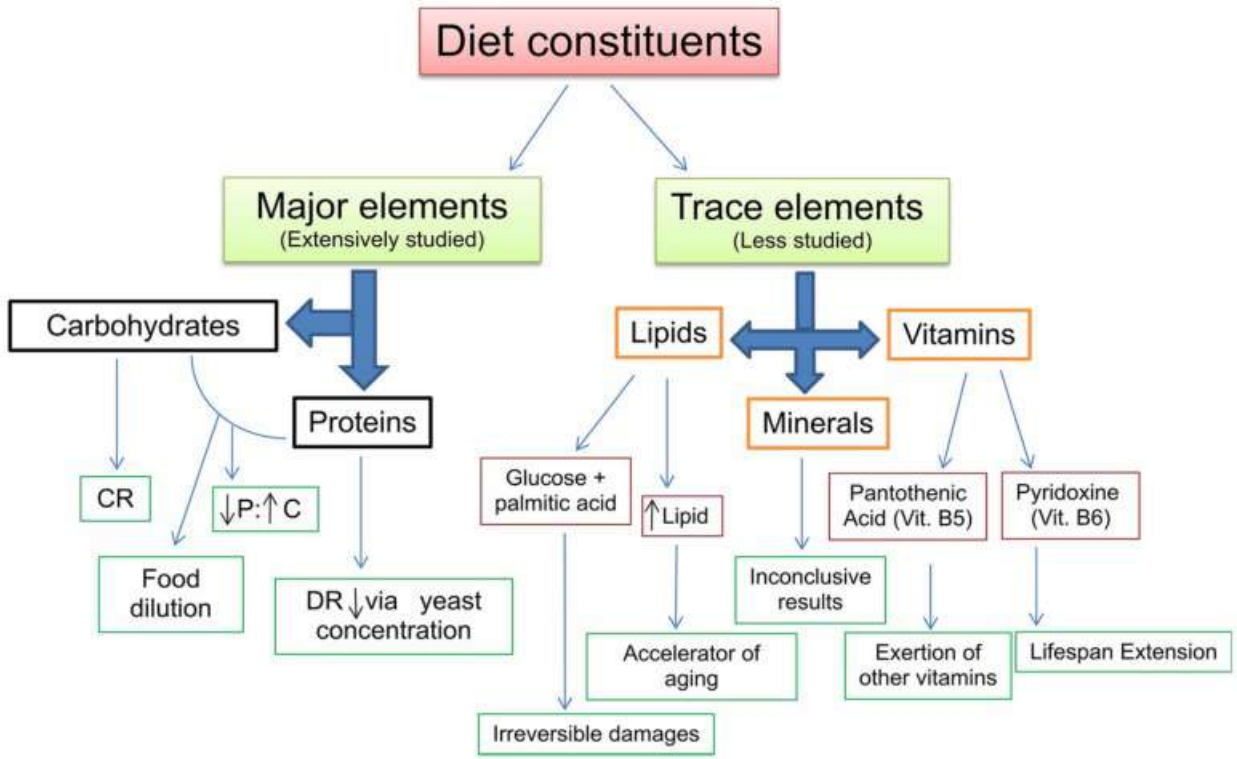
Carbohydrate-lipid and Lifespan　　13:00-13:30 陈江涛

13:30- 讨论 ~


要想身体好
吃饭七分饱

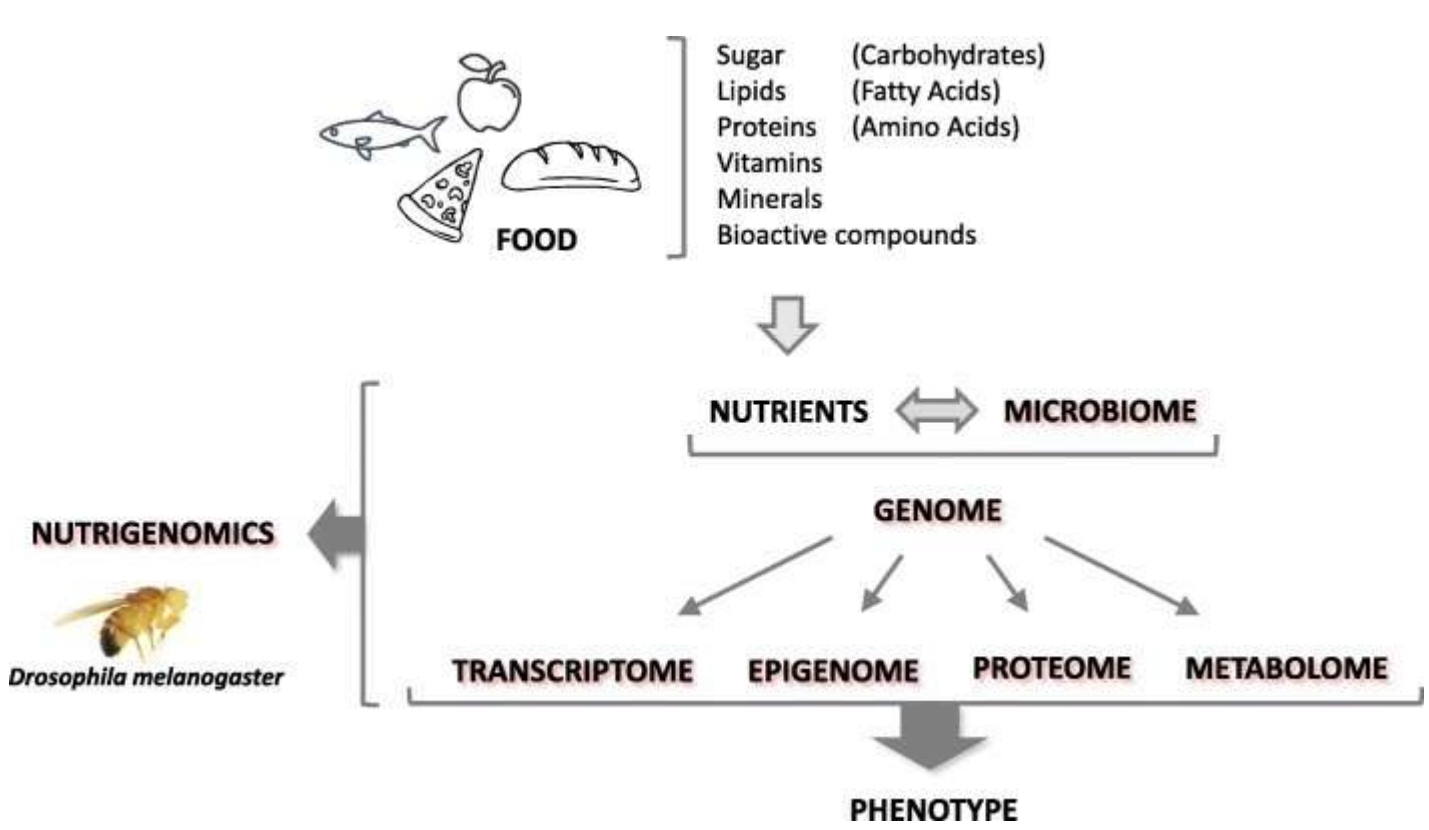
- **Relationship between diet and longevity in Drosophila**
- **Mechanisms of diet regulating longevity in Drosophila**

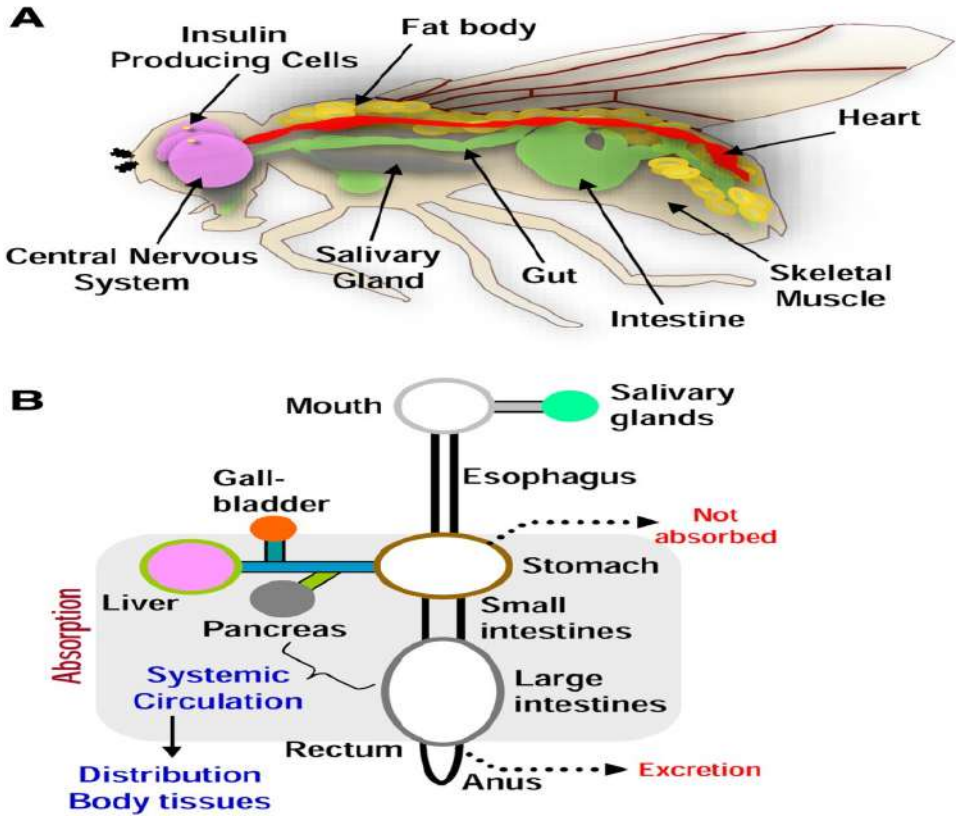
Relationship between dietary nutrition and drosophila lifespan



(Sudhakar Krittika and Pankaj Yadav.*Biogerontology*.2019)

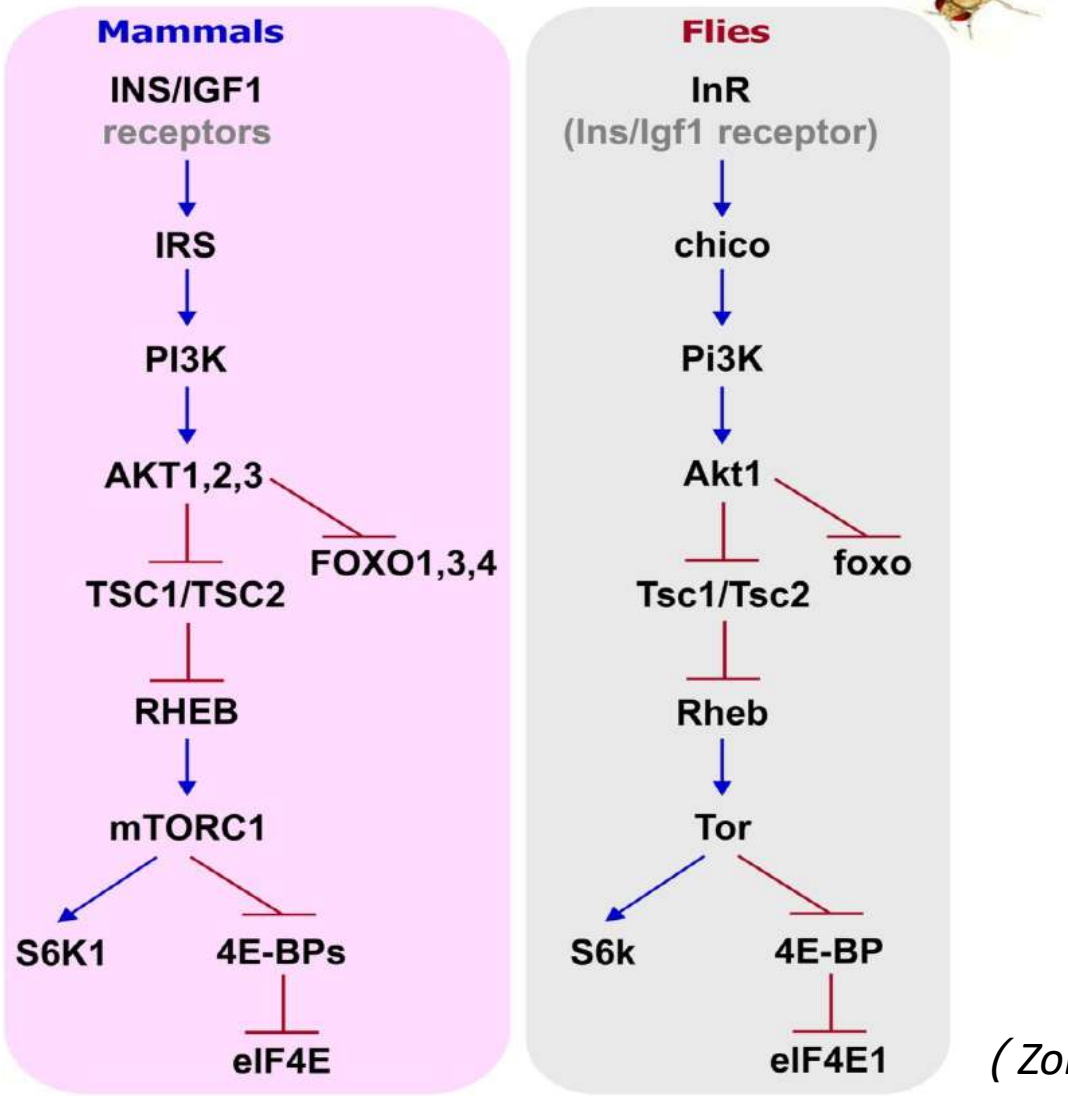
Model organisms for nutrition and longevity—Drosophila





(Nieves Baenas and Anika E. Wagner.*Genes &nutrition*.2019) *(Zoi Evangelakou, Maria Manola*et al.*Genes &nutrition*.2019)

Molecular links between nutrition and longevity in Drosophila—TOR /IIS pathway



*(Zoi Evangelakou, Maria Manola*et al,*Genes &nutrition*,2019)

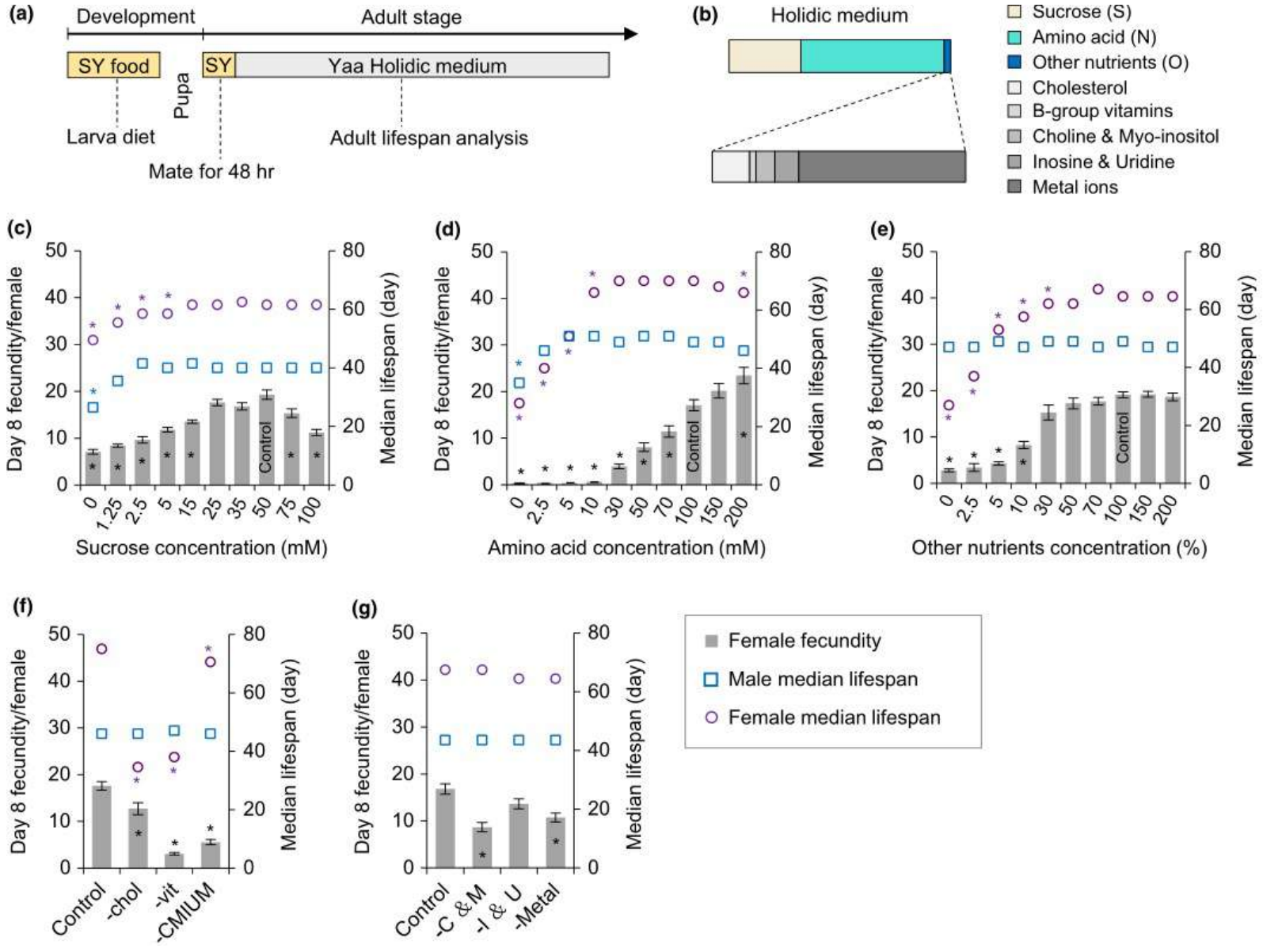
Summary:

- There are two main nutrient perception signaling pathways in drosophila——TOR pathway and IIS pathway.

- These two pathways coordinate and regulate each other and play a crucial role in influencing longevity.

How diet modifies lifespan of Drosophila

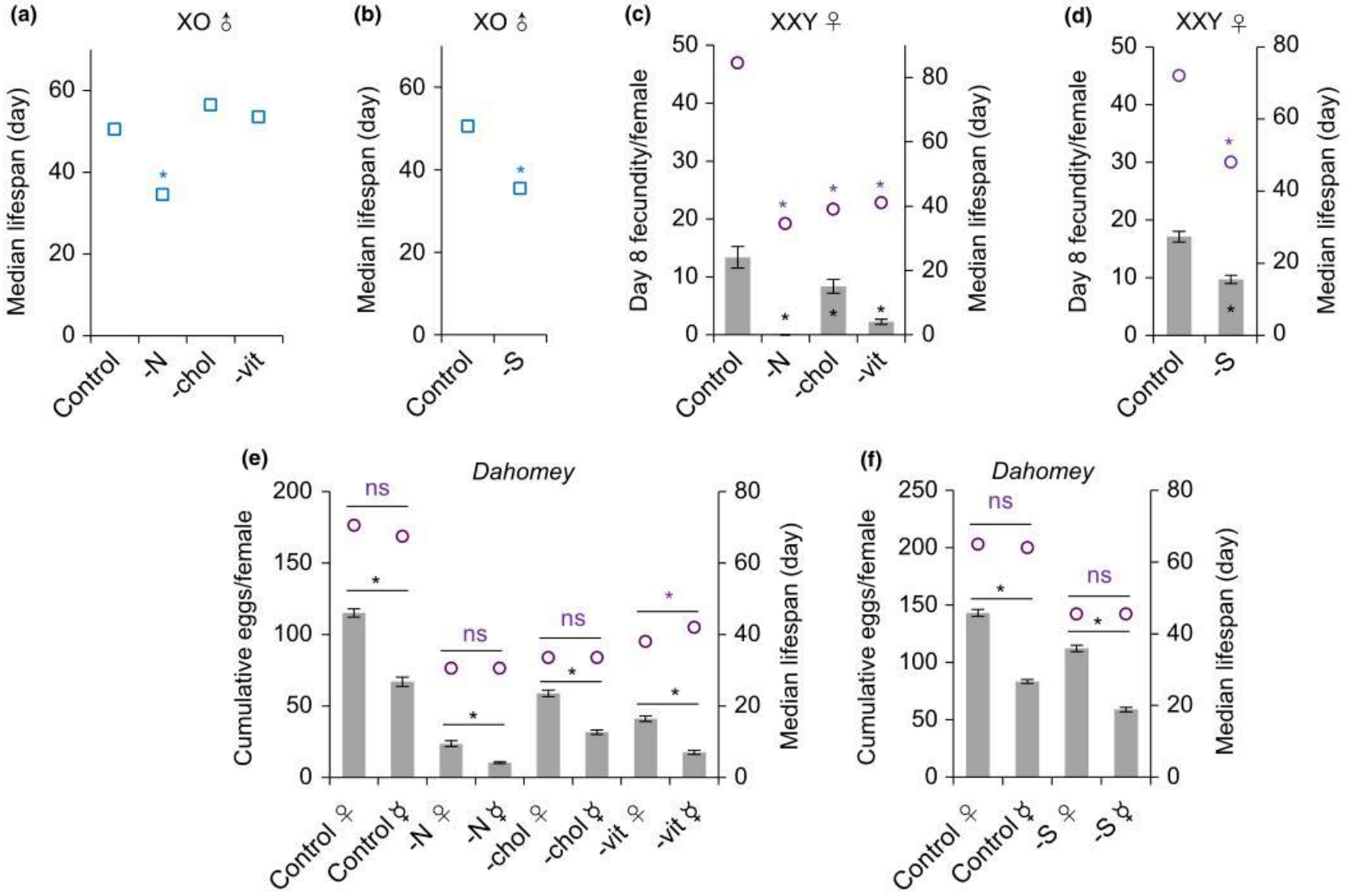
Sexual dimorphism in the nutritional requirement for adult lifespan in Drosophila



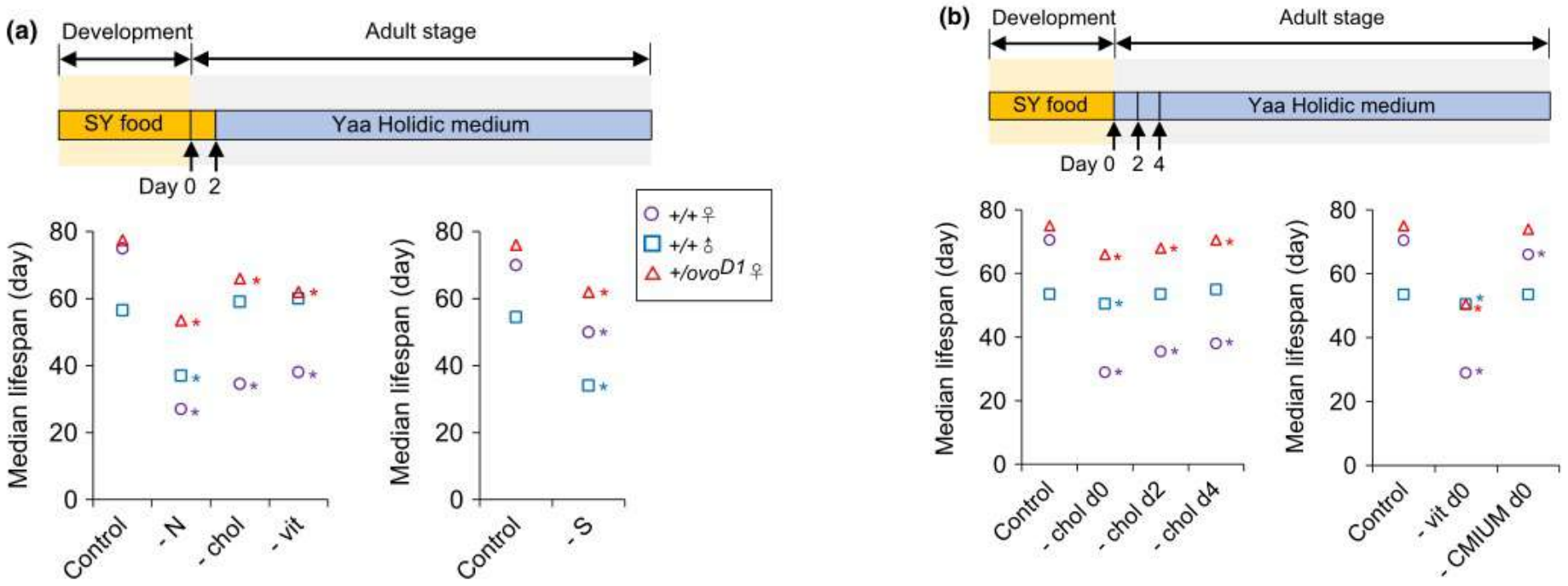
Nutritional requirements for sustaining life are much lower in males than in females

(Ting Lian, Qi Wu et al.*Aging Cell*.2020)

Sex chromosome complement and mating status do not explain the sexual dimorphism of adult nutritional requirement

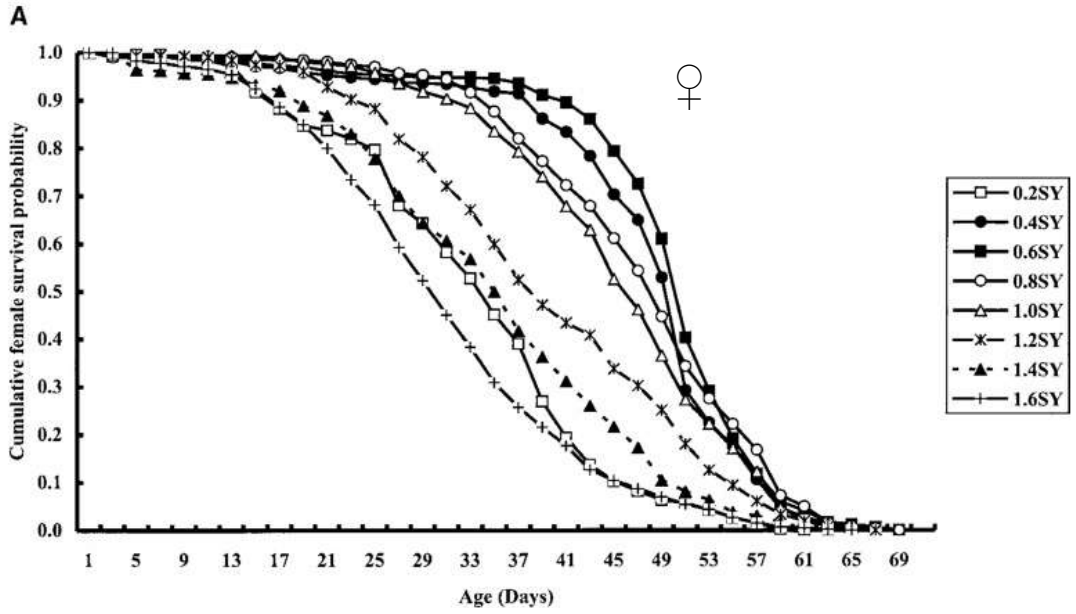


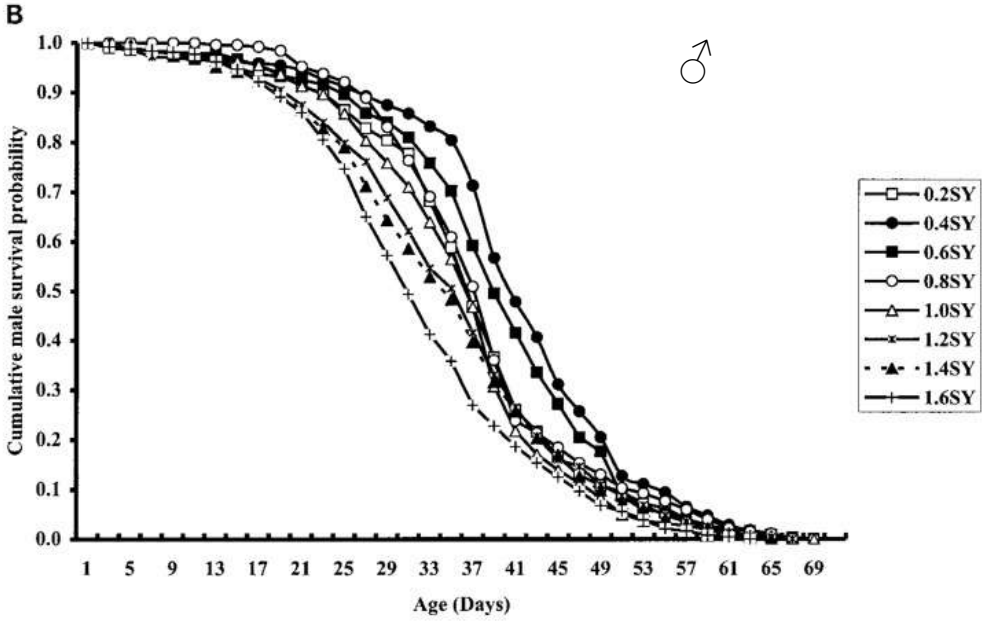
Female oogenesis is the key cause of the gender difference in life-sustaining nutritional requirements



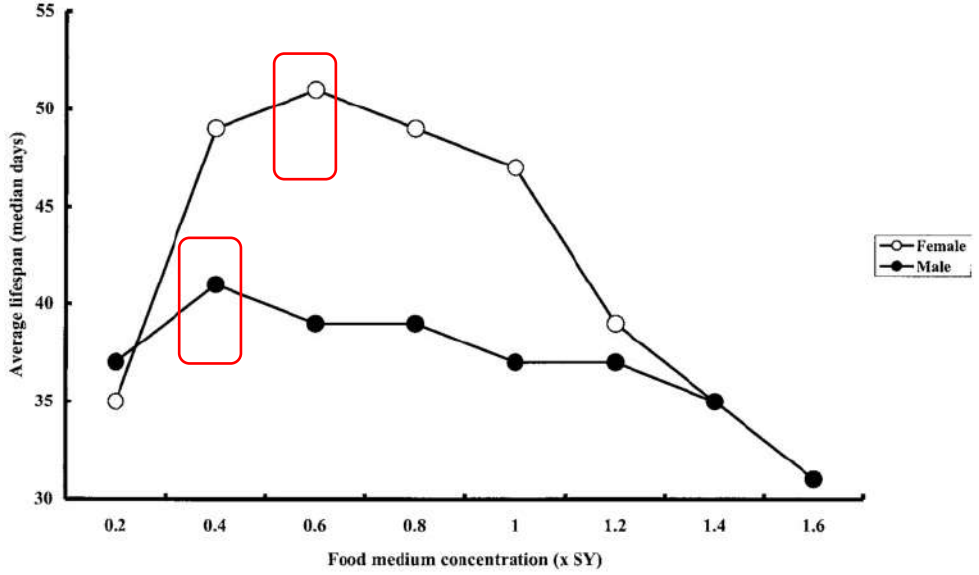
Males only need a constant source of sugars and amino acids, while females have a strong additional reliance on dietary cholesterol and vitamins throughout their lives

Sex Differences in the Effect of Dietary Restriction on Life Span in Female and Male Drosophila





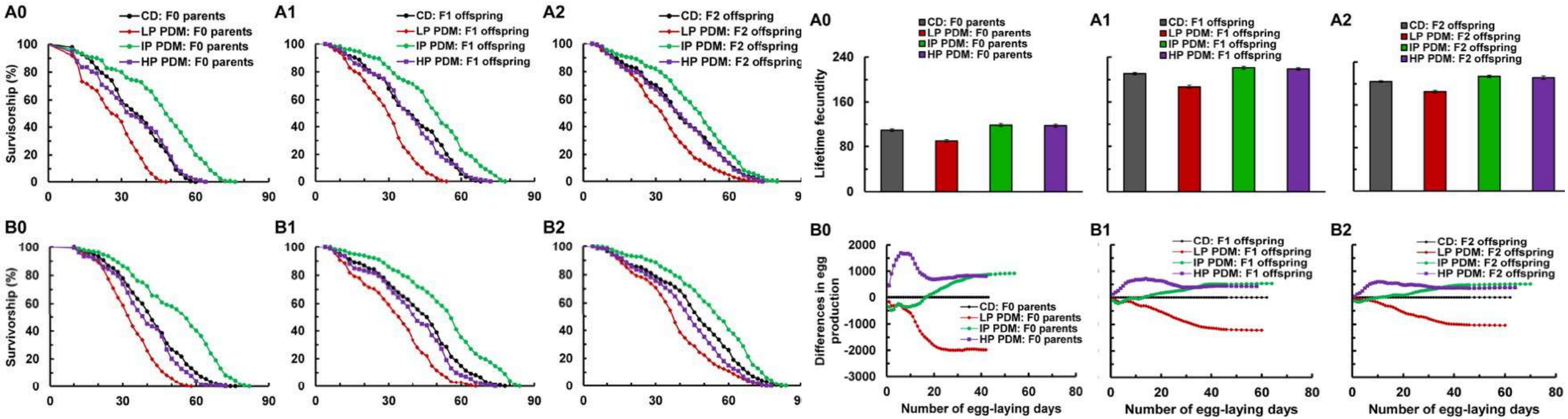
Effect of Food Concentration on life span



Tapiwanashe Magwere, Tracey Chapman et al.*BIOLOGICAL SCIENCES*.2004

Transgenerational programming of longevity and reproduction by post-eclosion dietary manipulation in Drosophila

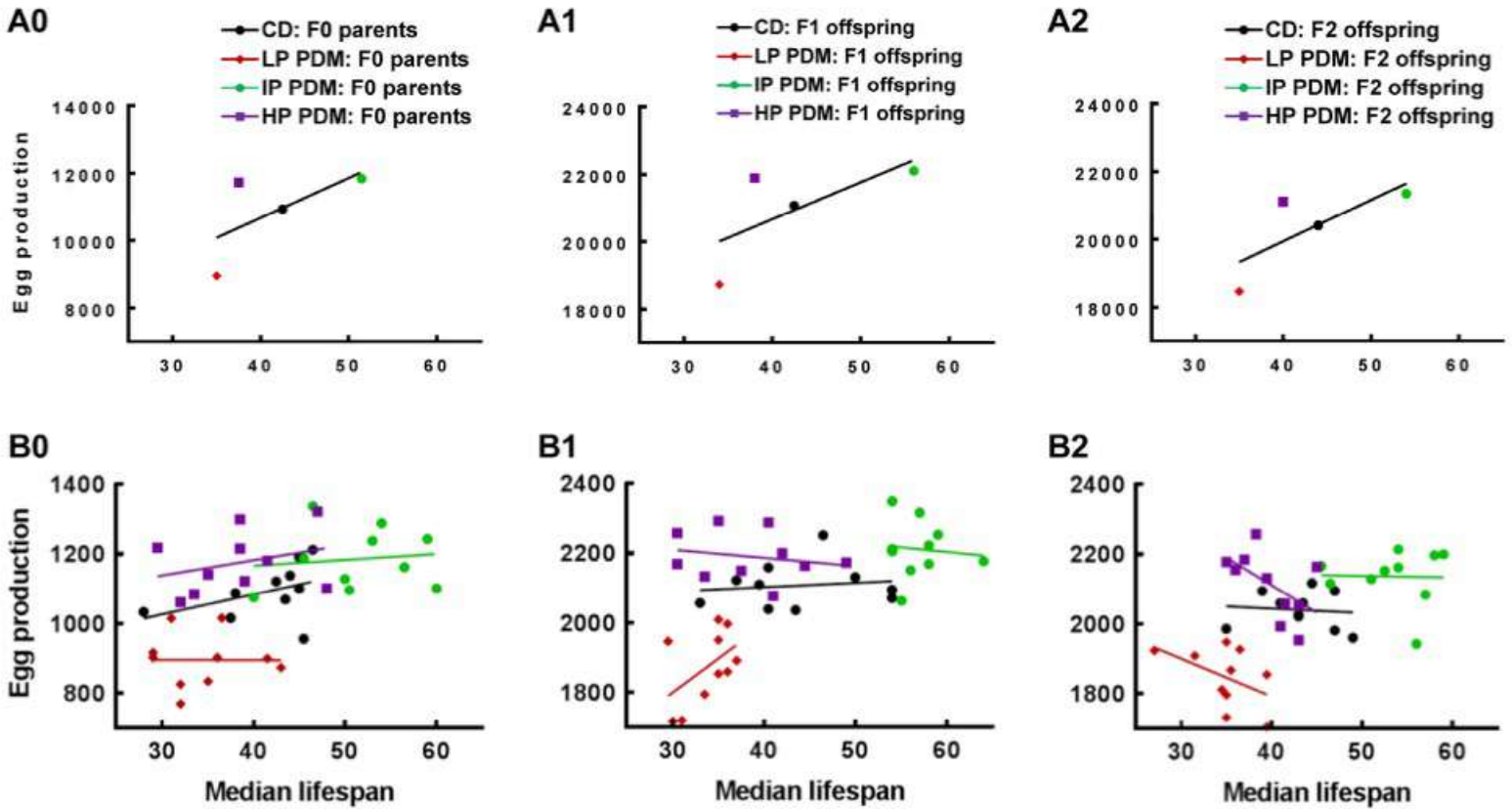
Unmated males



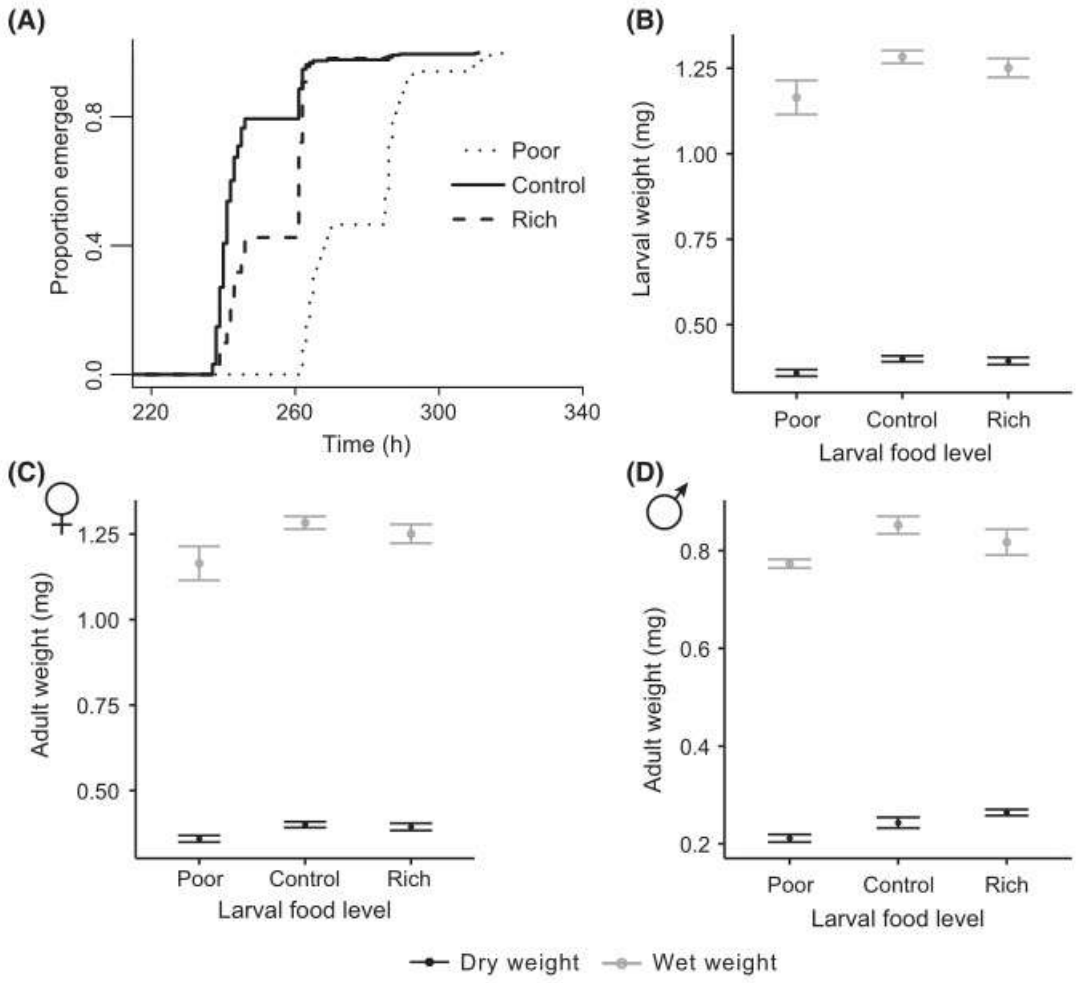
Unmated females

(Brian Xia and Steven de Belle.*Aging*.2016)

No evidence for trade-off between longevity and reproduction

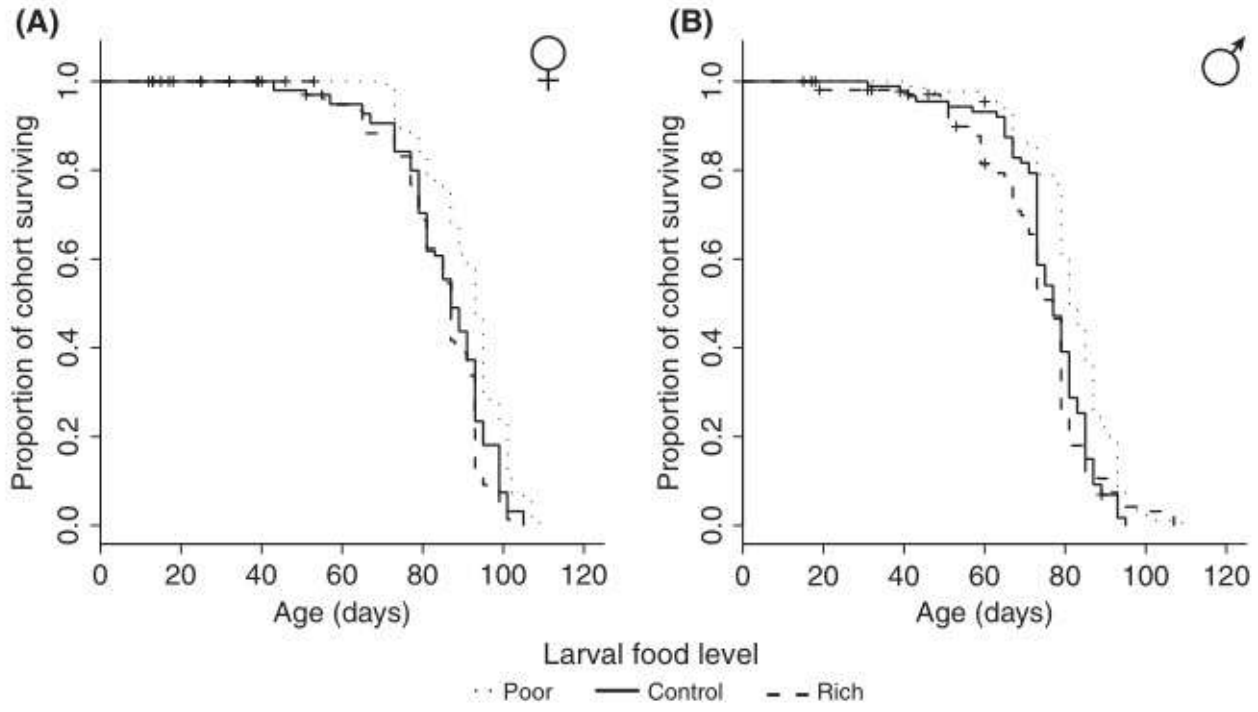


Effects of larval nutrition on larvae and young adults

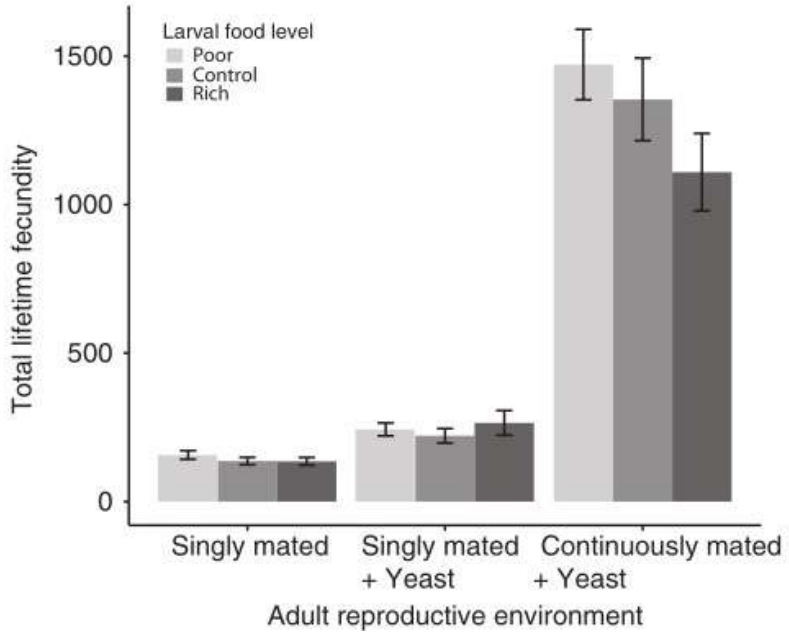


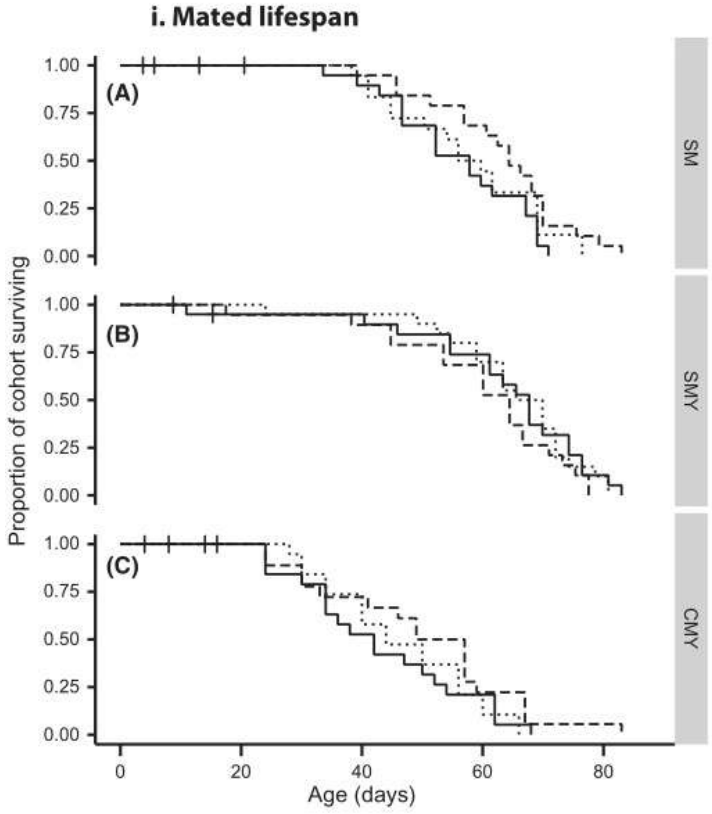
（Christina M. May, Agnieszka Doroszuk et al.*Ecology and Evolution*.2015）

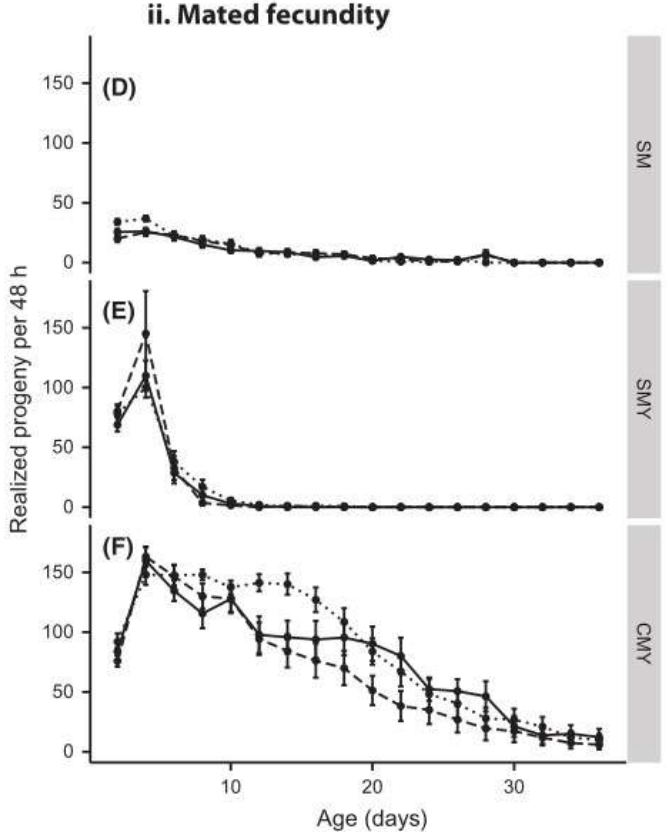
Effects of larval nutrition on virgin longevity



Effects of larval nutrition and reproductive environment on mated longevity





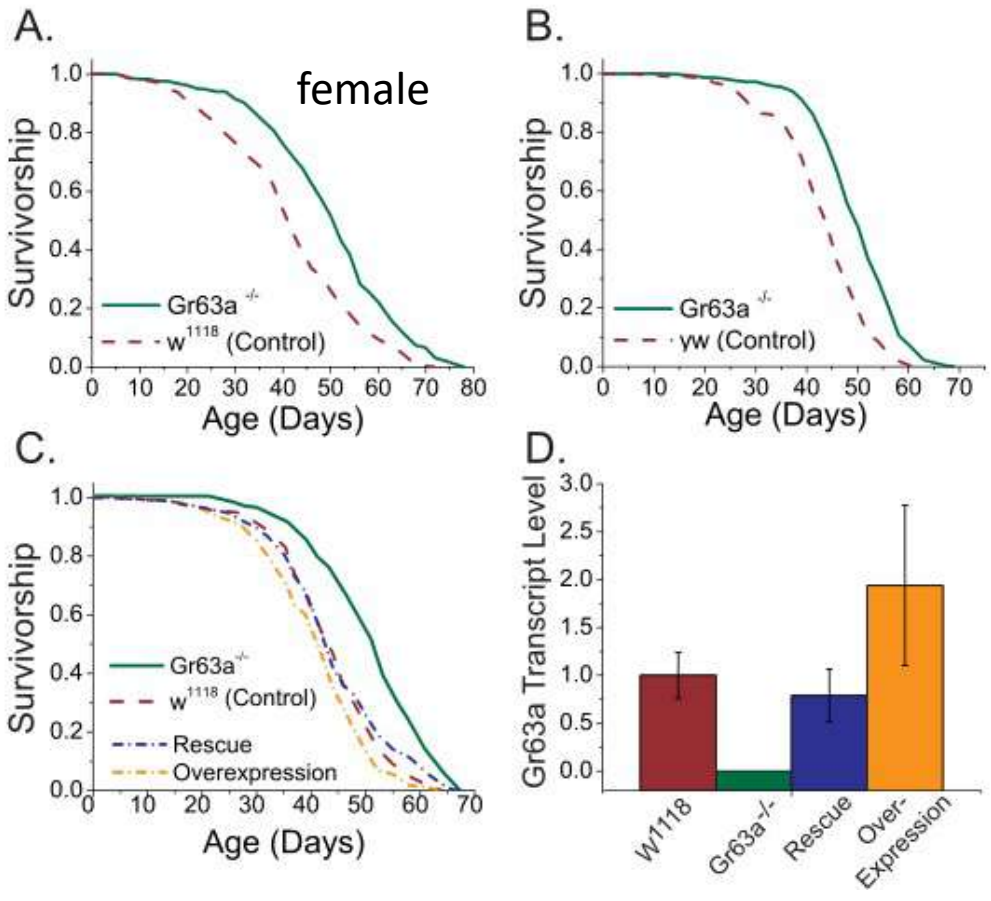


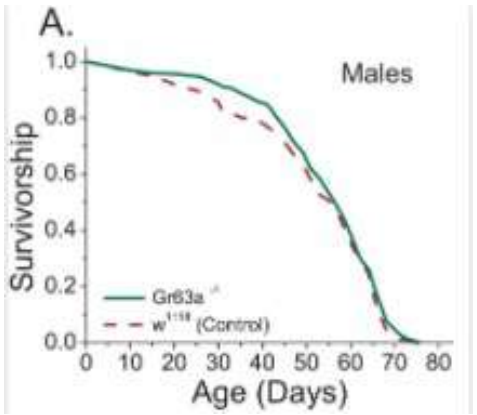
Summary:

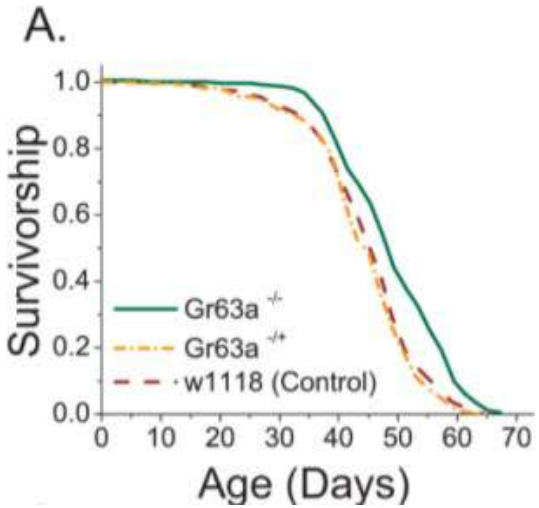
- Drosophila has sexual dimorphism in adult nutritional requirements and DR also showed gender differences in flies' longevity.
- The effect of diet on lifespan is Transgenerational，from F0 to F2-F3 generations by transgenerational inheritance.
- The nutritional level of the larvae also affects the fly's lifespan.

What is the mechanism by which diet regulates drosophila lifespan

Carbon Dioxide Sensing Modulates Lifespan in Drosophila

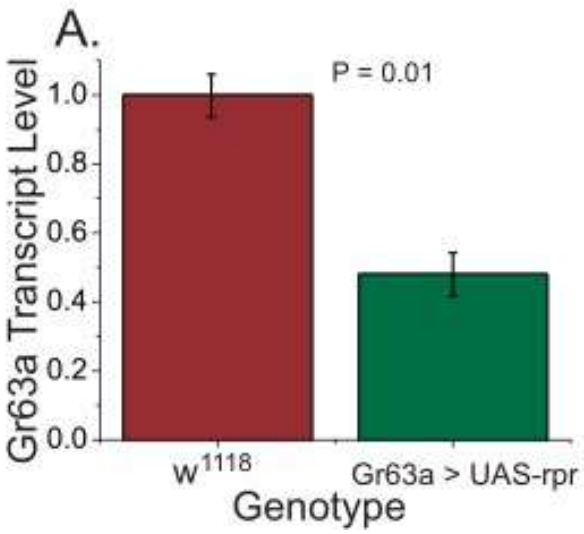


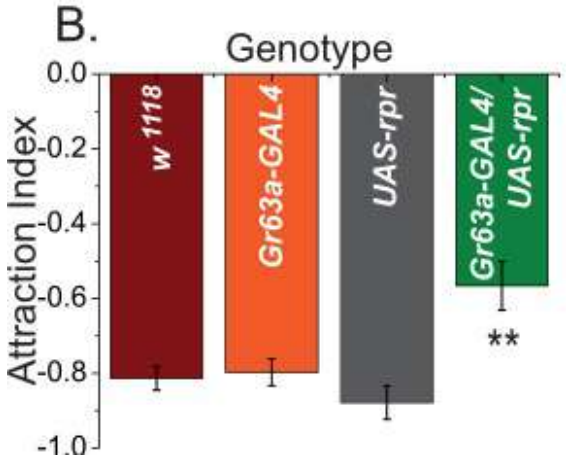


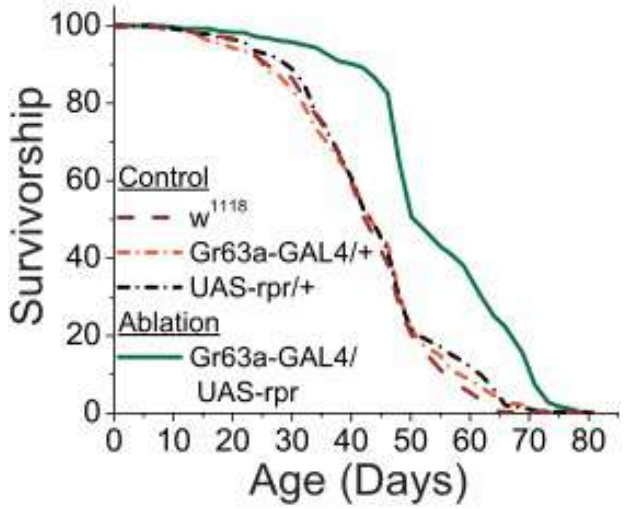


(Peter C. Poon, Tsung-Han Kuo et al.*PLoS Biology*.2010)

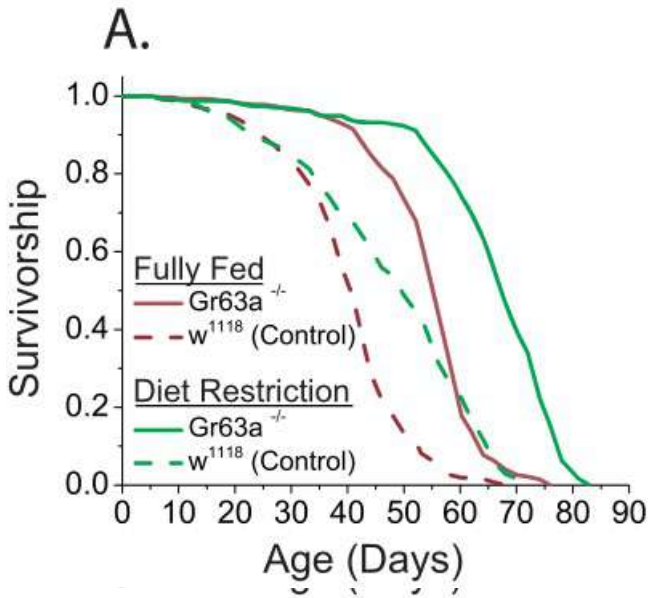
Genetic Ablation of ab1C Neurons Phenocopies the Longevity Extension of a Gr63a Loss-of-Function Mutation

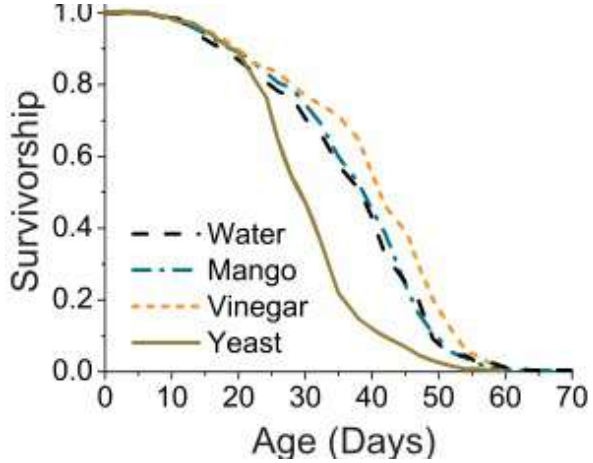


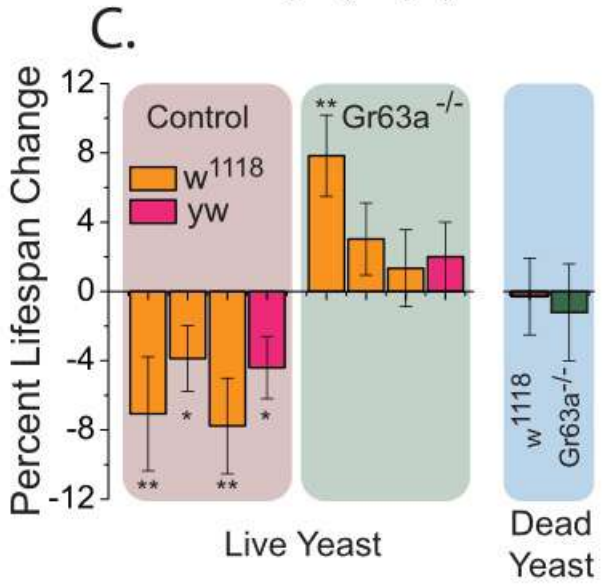




Gr63a Acts through Mechanisms Distinct from DR to Modulate Lifespan

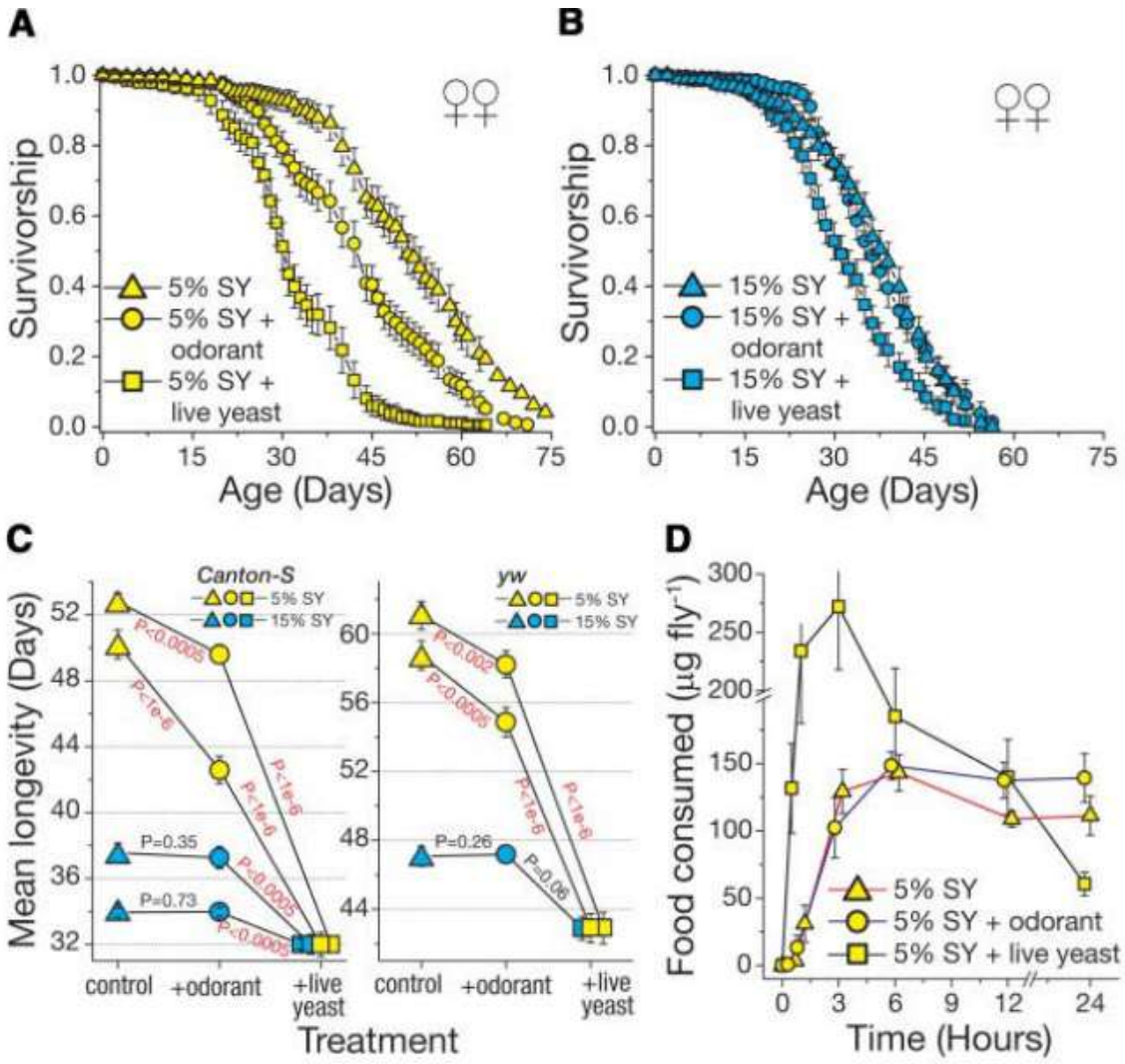


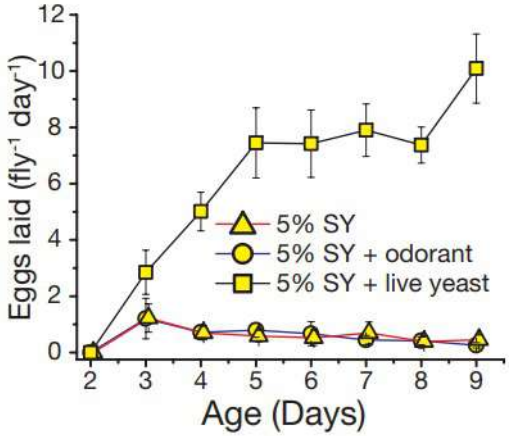




Gr63a Is Required for Live Yeast Odorants to Modulate Lifespan

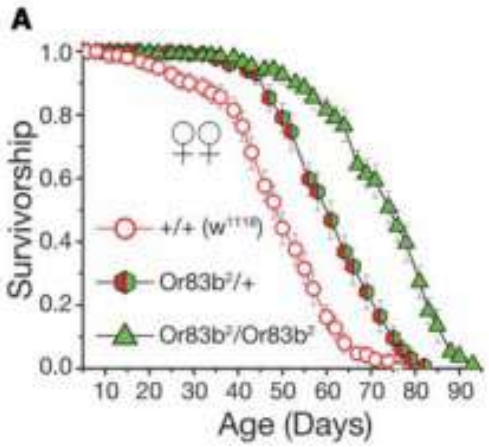
Regulation of Drosophila Life Span by Olfaction and Food-Derived Odors

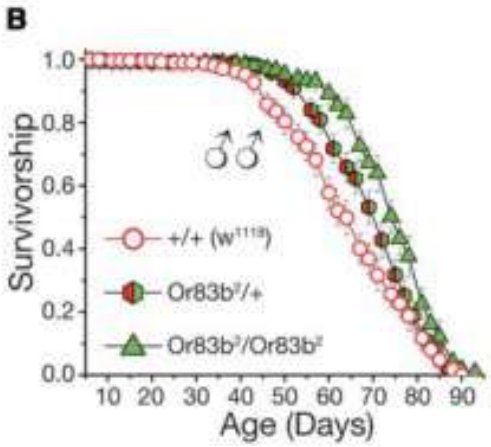


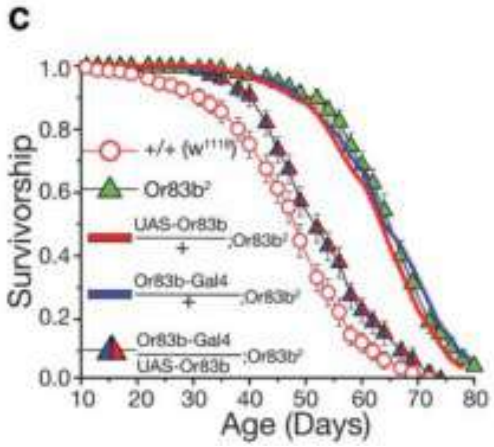


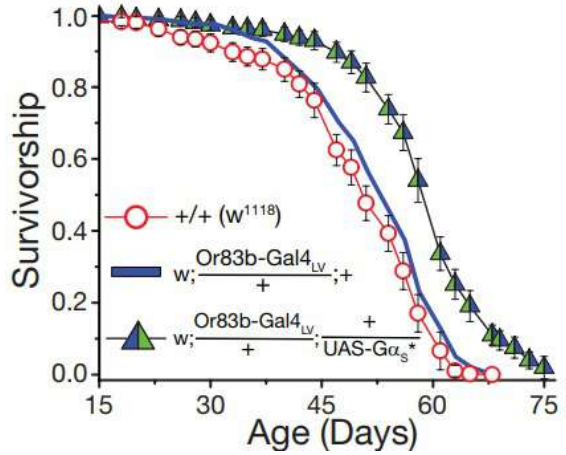
(Sergiy Libert,Jessica Zwiener et al.*Science*.2007)

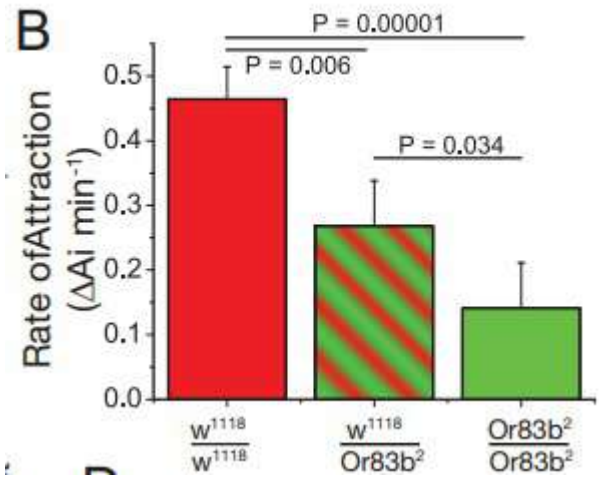
whether the loss of olfactory function is sufficient to increase life span

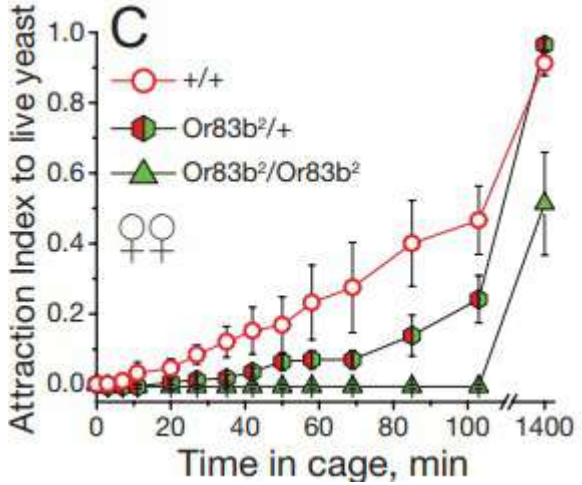


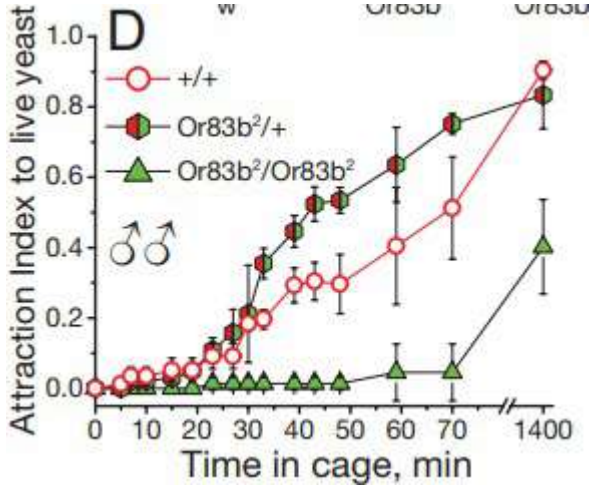






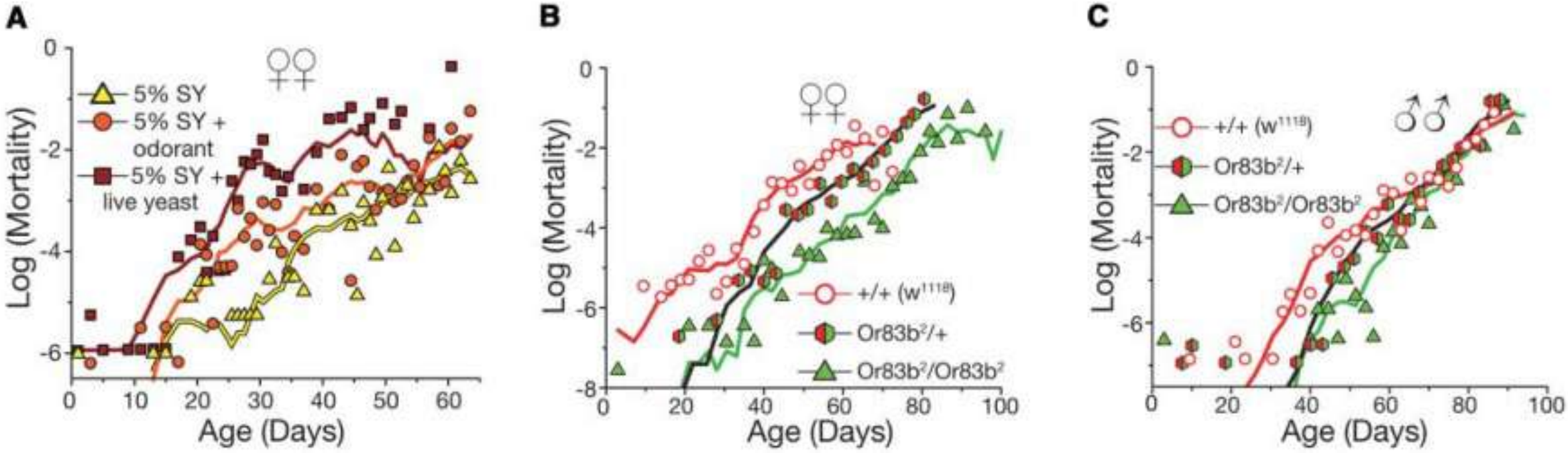






Or83b is the cause of increased life span in these animals.

Olfactory signaling modulates life span primarily by altering the onset of demographic senescence



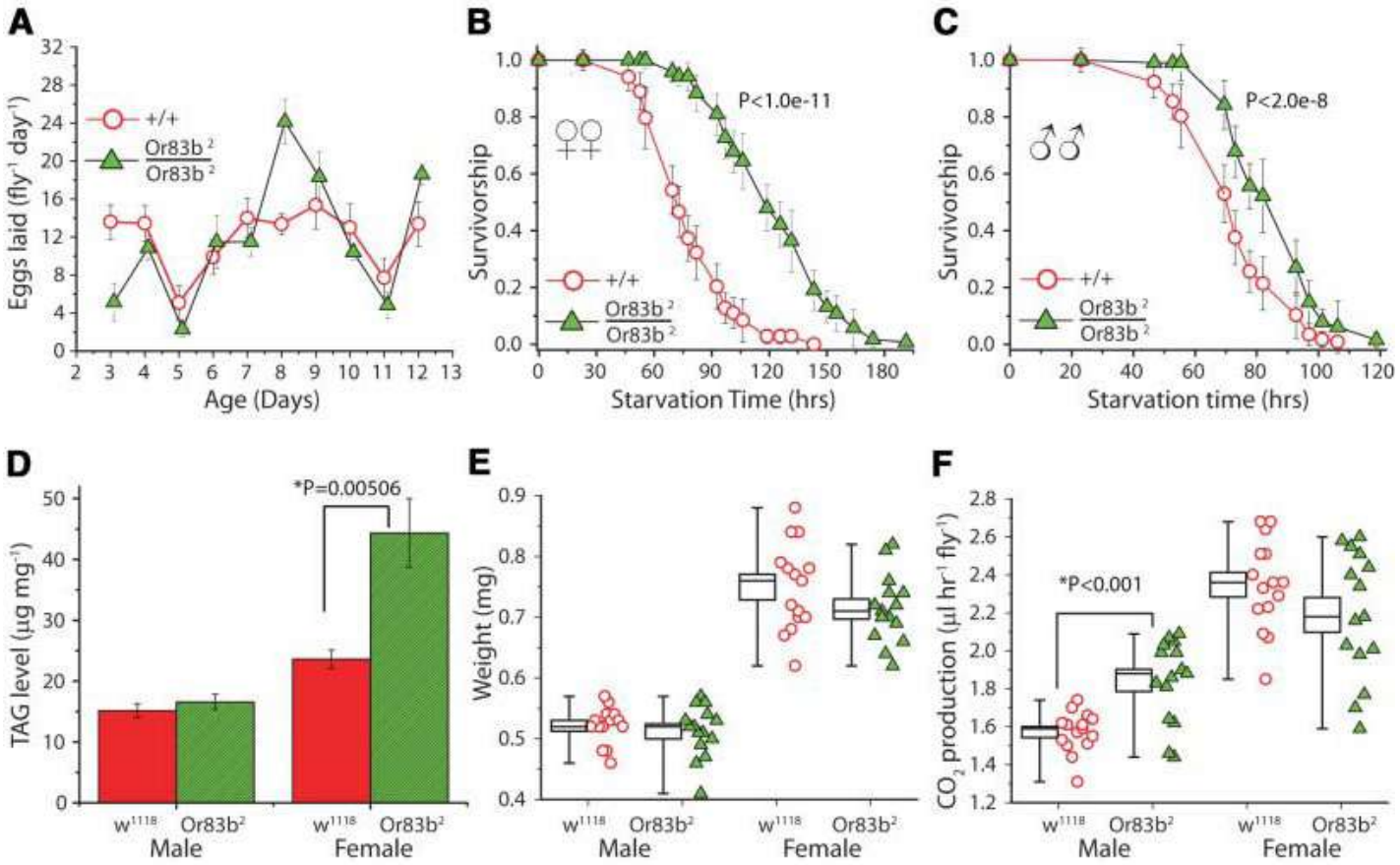
The interaction between the olfactory and diet pathways

Genetic background	Nutrient level (% SY)	Control longevity			*Or83b* longevity			Absolute change	% Increase
		n	Mean	(SE)	*n*	Mean	(SE)		
Canton-S									
	3%	319	50.1	(0.77)	311	61.6	(0.86)	11.5	23.0%
	5%	319	50.1	(0.81)	304	62.5	(0.78)	12.3	24.6%
	7.5%	324	43.9	(0.80)	315	58.9	(0.83)	15.0	34.1%
	10%	313	44.8	(0.82)	318	58.6	(0.92)	13.8	30.7%
	15%	314	41.6	(0.69)	329	55.6	(0.76)	14.0	33.7%
yw									
	3%	249	58.0	(0.85)	234	76.1	(0.63)	18.1	31.2%
	5%	244	60.0	(0.83)	239	76.5	(0.60)	16.5	27.6%
	7.5%	254	62.0	(0.74)	236	76.0	(0.76)	14.0	22.6%
	10%	241	61.9	(0.74)	238	75.6	(0.81)	13.7	22.1%
	15%	242	50.5	(0.57)	246	69.4	(0.60)	18.9	37.4%
	YP*	237	42.9	(0.84)	243	65.7	(0.73)	22.8	53.1%
w^{1118}									
	3%	315	51.9	(0.89)	318	75.6	(0.86)	23.7	45.6%
	5%	326	53.2	(0.90)	320	76.0	(0.81)	22.8	43.0%
	7.5%	333	49.6	(0.83)	319	78.0	(0.77)	28.4	57.3%
	10%	316	51.1	(0.79)	317	77.6	(0.84)	26.5	51.9%
	15%	314	49.3	(0.79)	319	72.7	(0.78)	23.4	47.3%

Genetic background	Nutrient level (% SY)	Control longevity			*Or83b* longevity			Absolute change	% Increase
		n	Mean	(SE)	*n*	Mean	(SE)		
Canton-S									
	3%	322	52.1	(0.83)	317	66.8	(0.75)	14.7	28.2%
	5%	315	53.2	(0.67)	282	66.3	(0.80)	13.1	24.6%
	7.5%	331	52.3	(0.71)	313	68.7	(0.77)	16.4	31.3%
	10%	330	52.0	(0.76)	296	67.5	(0.82)	15.6	30.0%
	15%	325	47.2	(0.74)	301	67.1	(0.85)	19.9	42.1%
yw									
	3%	257	63.6	(0.81)	238	73.8	(0.57)	10.3	16.2%
	5%	242	63.9	(0.89)	243	75.2	(0.57)	11.4	17.8%
	7.5%	251	64.4	(0.75)	240	74.3	(0.72)	9.9	15.4%
	10%	246	65.3	(0.92)	246	75.8	(0.67)	10.5	16.0%
	15%	244	60.1	(0.73)	222	70.3	(0.69)	10.1	16.8%
w^{1118}									
	3%	317	63.2	(0.80)	328	69.1	(0.72)	6.0	9.5%
	5%	314	63.9	(0.77)	322	69.5	(0.77)	5.6	8.7%
	7.5%	322	63.6	(0.80)	324	73.6	(0.74)	10.0	15.7%
	10%	317	65.2	(0.77)	310	74.6	(0.77)	9.4	14.5%
	15%	317	64.4	(0.80)	305	73.8	(0.71)	9.4	14.5%

the Or83b mutation extends longevity largely, but not exclusively, through a diet-independent pathway.

Or83b2 flies exhibited altered physiology and enhanced stress resistance.



Reduced early reproductive output is not required for extended longevity in Or83b2 mutants.

Summary:

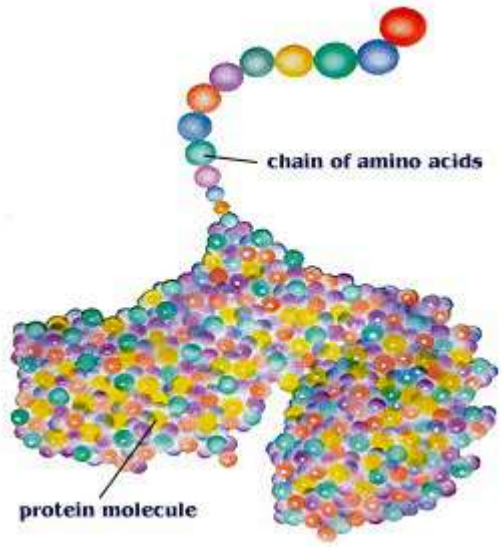
- Drosophila perceives nutrition mainly through IIS and TOR pathways, which play an important role in regulating longevity.
- Drosophila has sexual dimorphism in adult nutritional requirements and DR also showed gender differences in flies' longevity.
- The effect of diet on longevity is transgenerational programming, from F0 generation to F2-F3 generation through intergenerational inheritance, and the nutrition level of larva also influences the longevity of drosophila.
- Olfactory regulation is one of the mechanisms affecting drosophila lifespan.

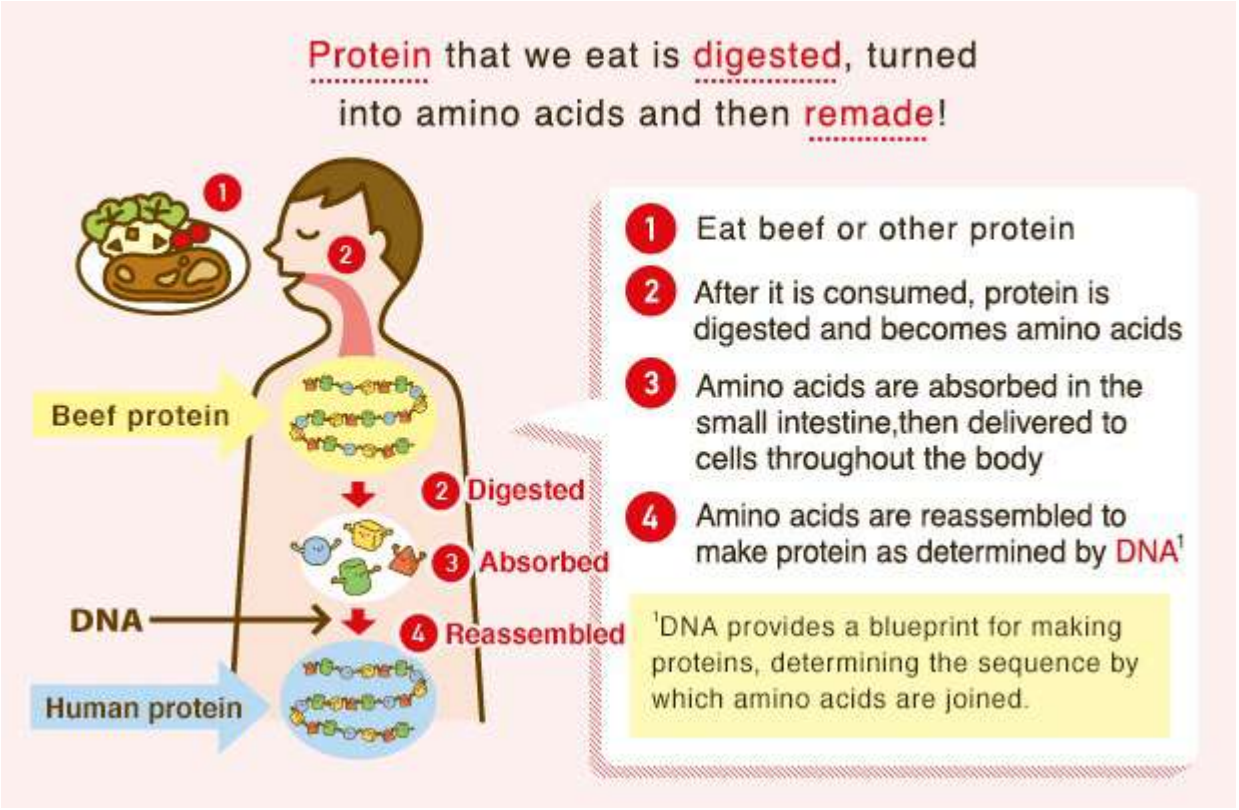
THANKS

Effects of Dietary Proteins and Amino Acids on lifespan in Drosophila

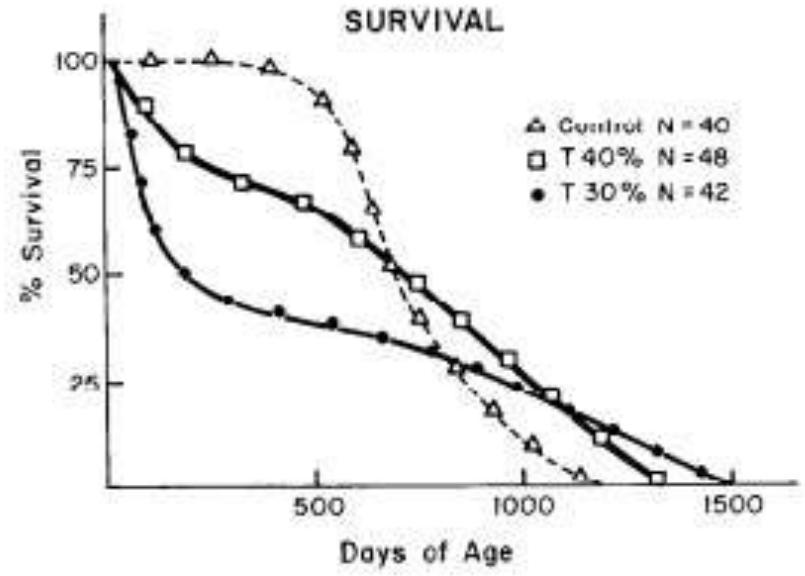
张豫宁 2021-10-29

Background

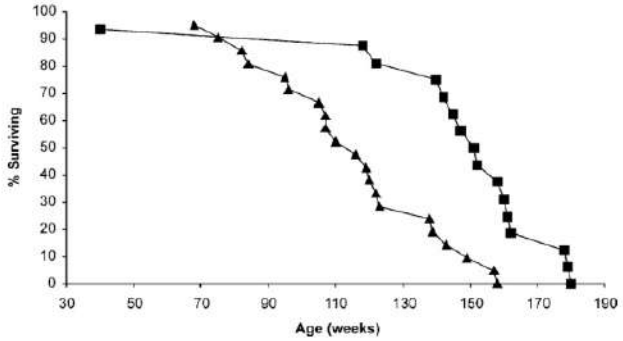

chain of amino acids
protein molecule

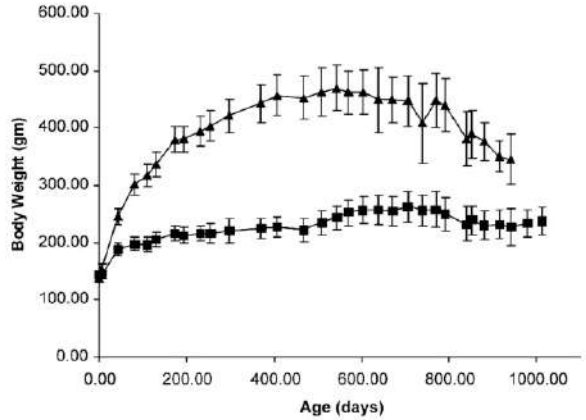

Protein that we eat is digested, turned into amino acids and then remade!
1
2
Beef protein
2 Digested
3 Absorbed
DNA
4 Reassembled
Human protein
1 Eat beef or other protein
2 After it is consumed, protein is digested and becomes amino acids
3 Amino acids are absorbed in the small intestine,then delivered to cells throughout the body
4 Amino acids are reassembled to make protein as determined by DNA[1]
[1]DNA provides a blueprint for making proteins, determining the sequence by which amino acids are joined.

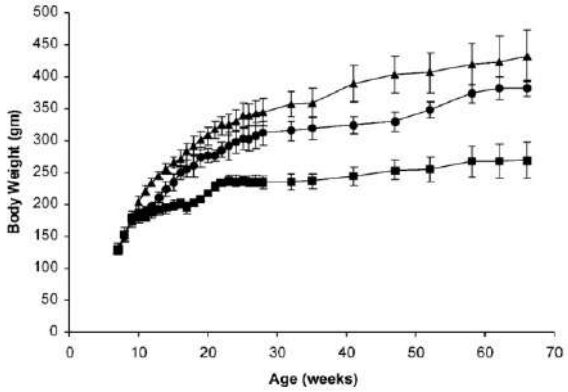
Background

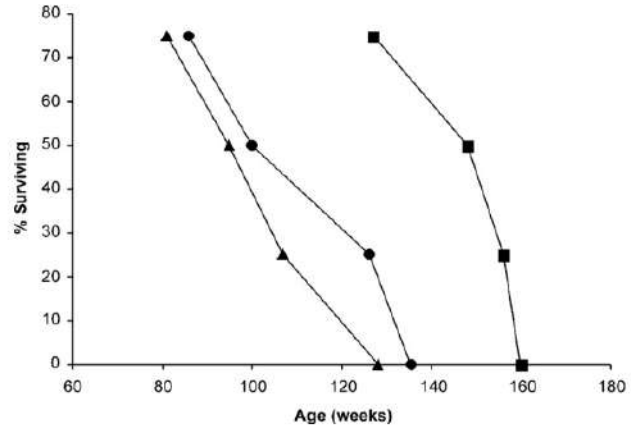


Hiroshi Ooka. *Mechanisms of Ageing and Development*







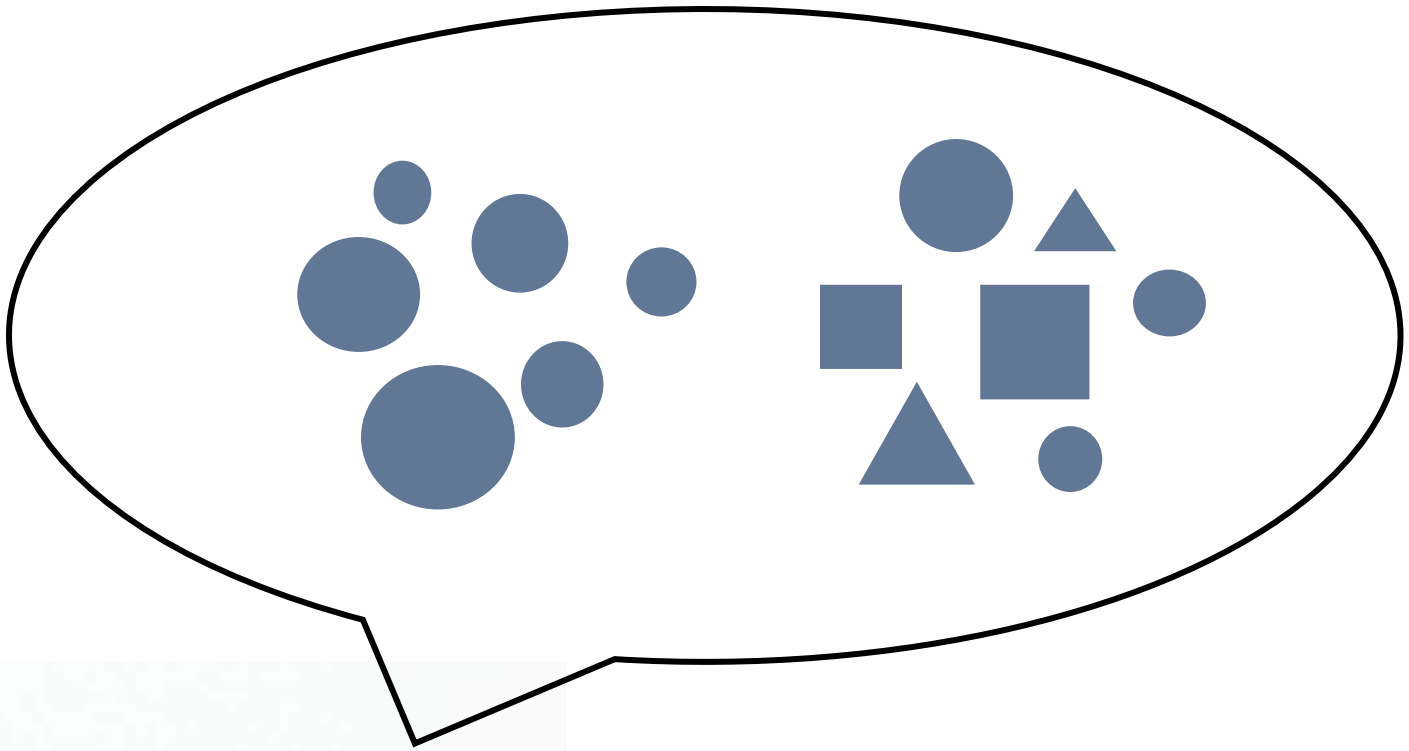


J.A. Zimmerman et al. *Experimental Gerontology*

Whether dietary protein and amino acid affect Drosophila lifespan ?

- **Contribution of dietary proteins to aging**
- **Role of specific amino acids in longevity**

➢ Contribution of dietary proteins to aging



PNAS

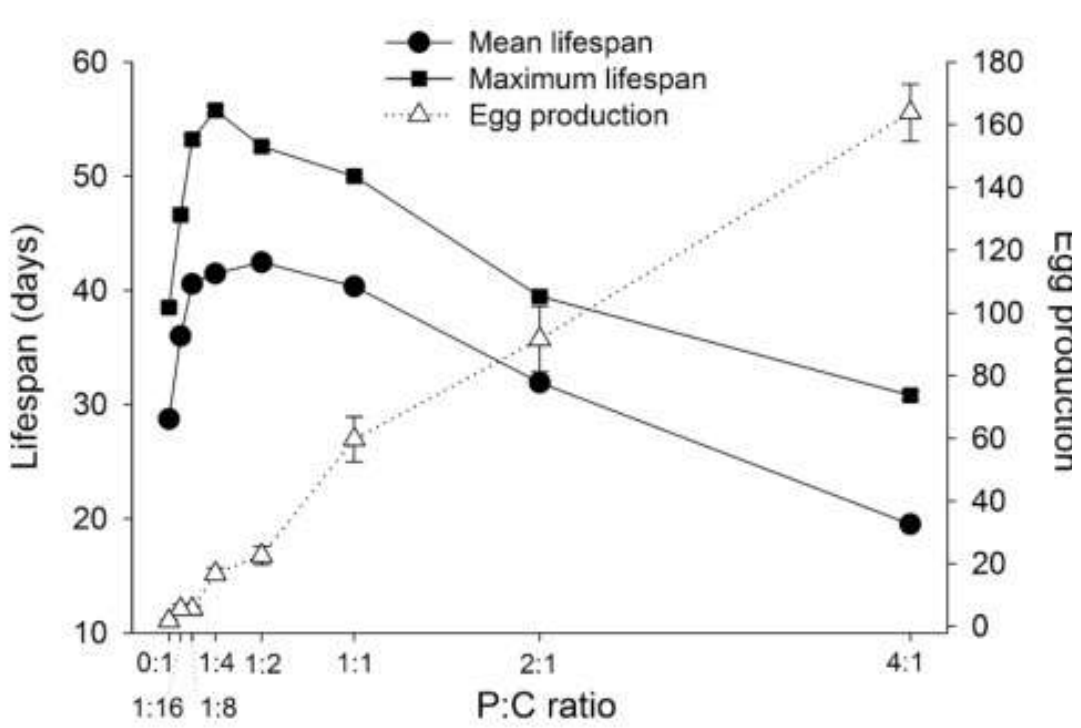
Lifespan and reproduction in *Drosophila*: New insights from nutritional geometry

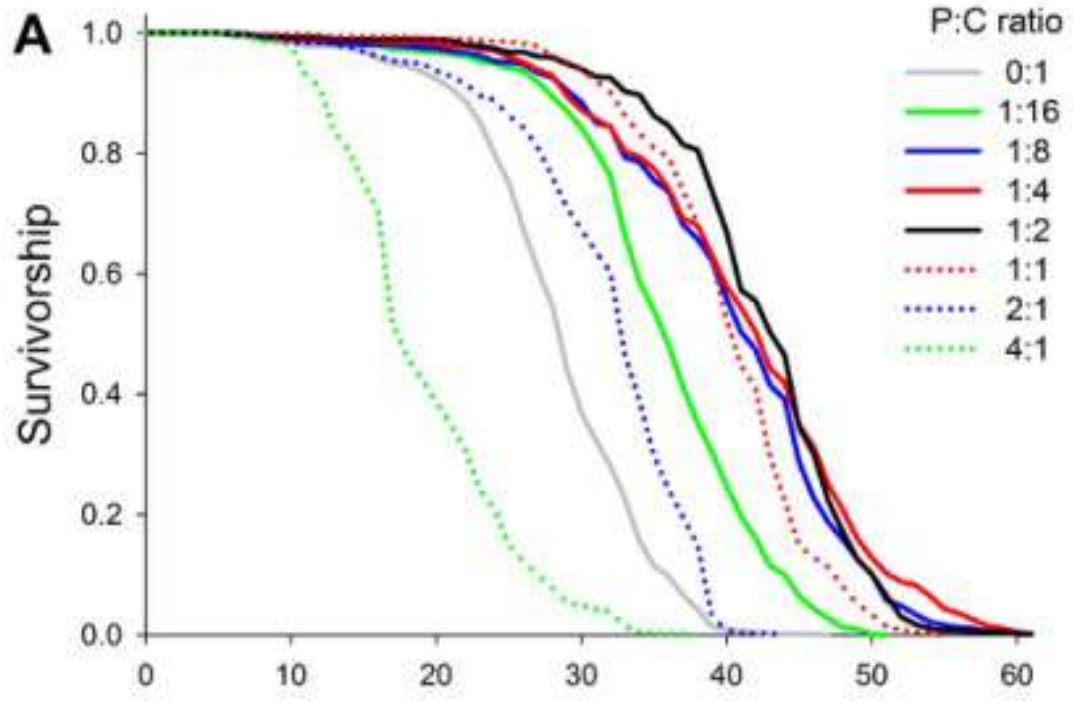
Kwang Pum Lee*†, Stephen J. Simpson*‡, Fiona J. Clissold*, Robert Brooks§¶, J. William O. Ballard§‖, Phil W. Taylor**, Nazaneen Soran*, and David Raubenheimer††

*School of Biological Sciences and Centre for Mathematical Biology, University of Sydney, Sydney NSW 2006, Australia; †Department of Agricultural Biotechnology, Seoul National University, Seoul 151-921, Korea; §Evolution and Ecology Research Centre, ¶School of Biological, Earth and Environmental Sciences, and ‖School of Biotechnology and Biomolecular Sciences, University of New South Wales, Sydney NSW 2052, Australia; **Centre for the Integrative Study of Animal Behaviour, Macquarie University, Sydney NSW 2109, Australia; and ††Liggins Institute and National Research Centre for Growth and Development, University of Auckland, Auckland, New Zealand

Edited by David L. Denlinger, Ohio State University, Columbus, OH, and approved December 27, 2007 (received for review November 13, 2007)

Drosophila fed low protein and high carbohydrate lived longer.

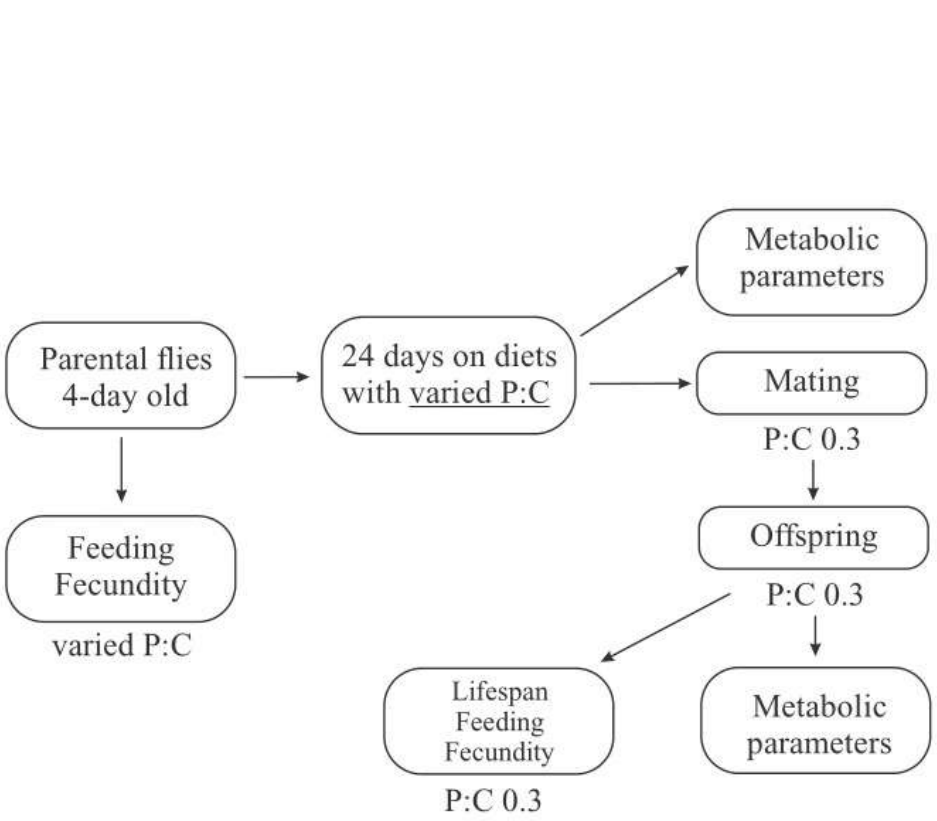


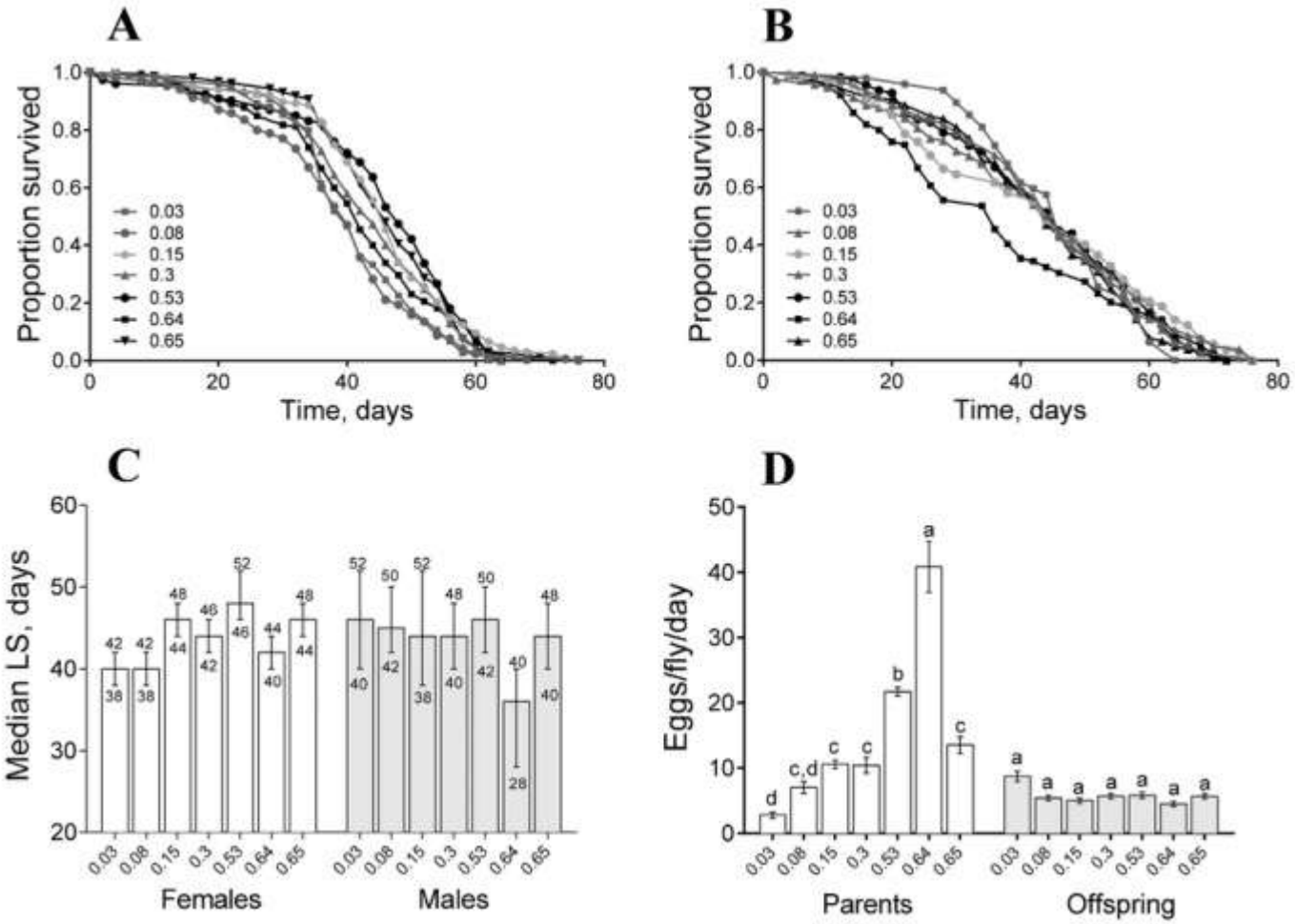


Effects of dietary P:C ratio on lifespan (mean and maximum) and egg production in female D. melanogaster.

Kwang Pum Lee.*Journal of Insect Physiology.2015*

Changes in maternal longevity caused by nutritionalfactors can be passed down to offspring.





Olha Strilbytska et al. *Comparative Biochemistry and Physiology*.2020

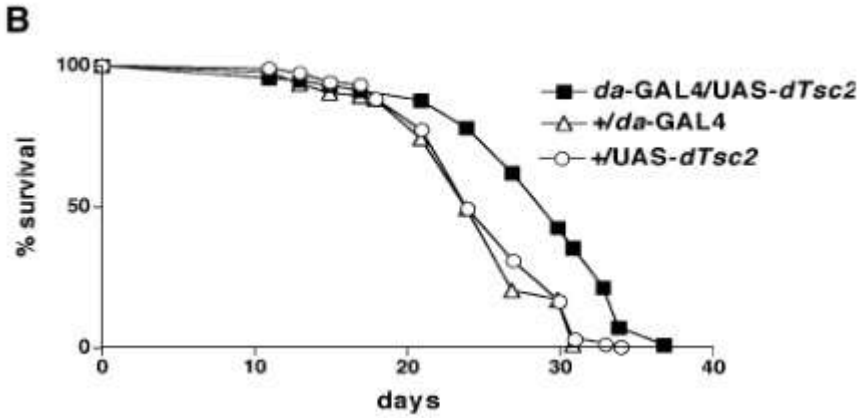
Reduced protein intake appears to extend lifespan by inhibiting TOR signaling pathways .

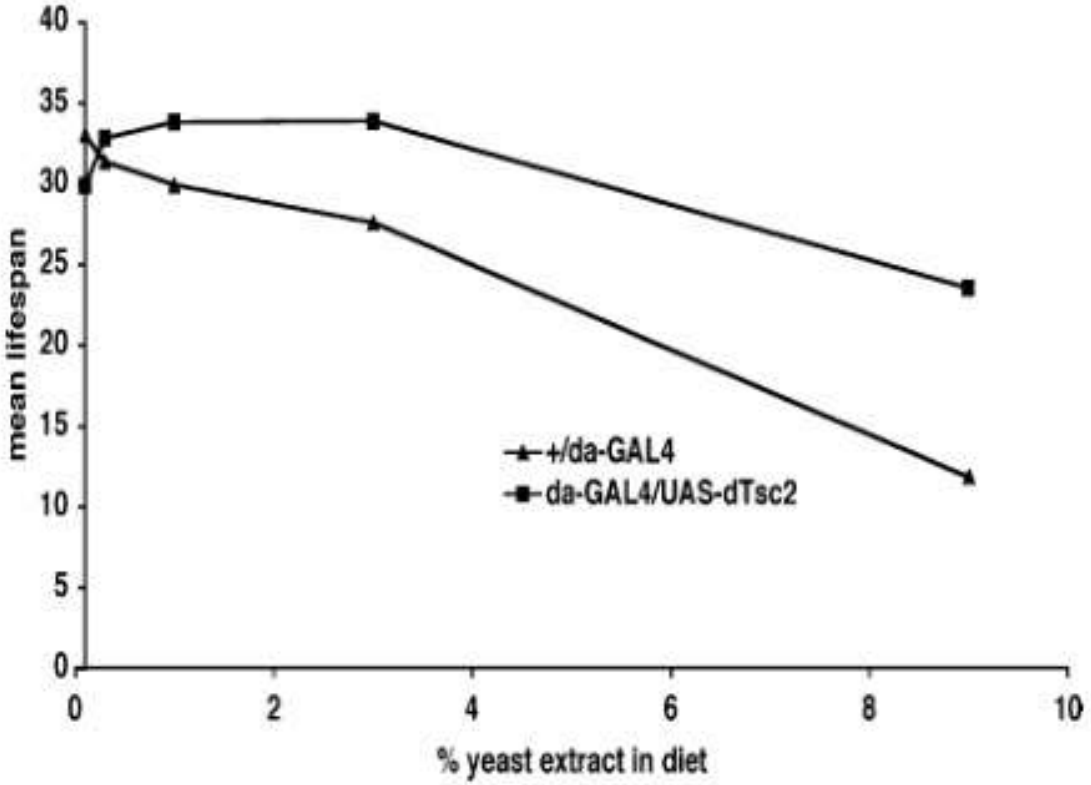
Current Biology
Volume 14, Issue 10, 25 May 2004, Pages 885-890

Report

Regulation of Lifespan in *Drosophila* by Modulation of Genes in the TOR Signaling Pathway

Pankaj Kapahi, Brian M Zid, Tony Harper, Daniel Koslover, Viveca Sapin, Seymour Benzer



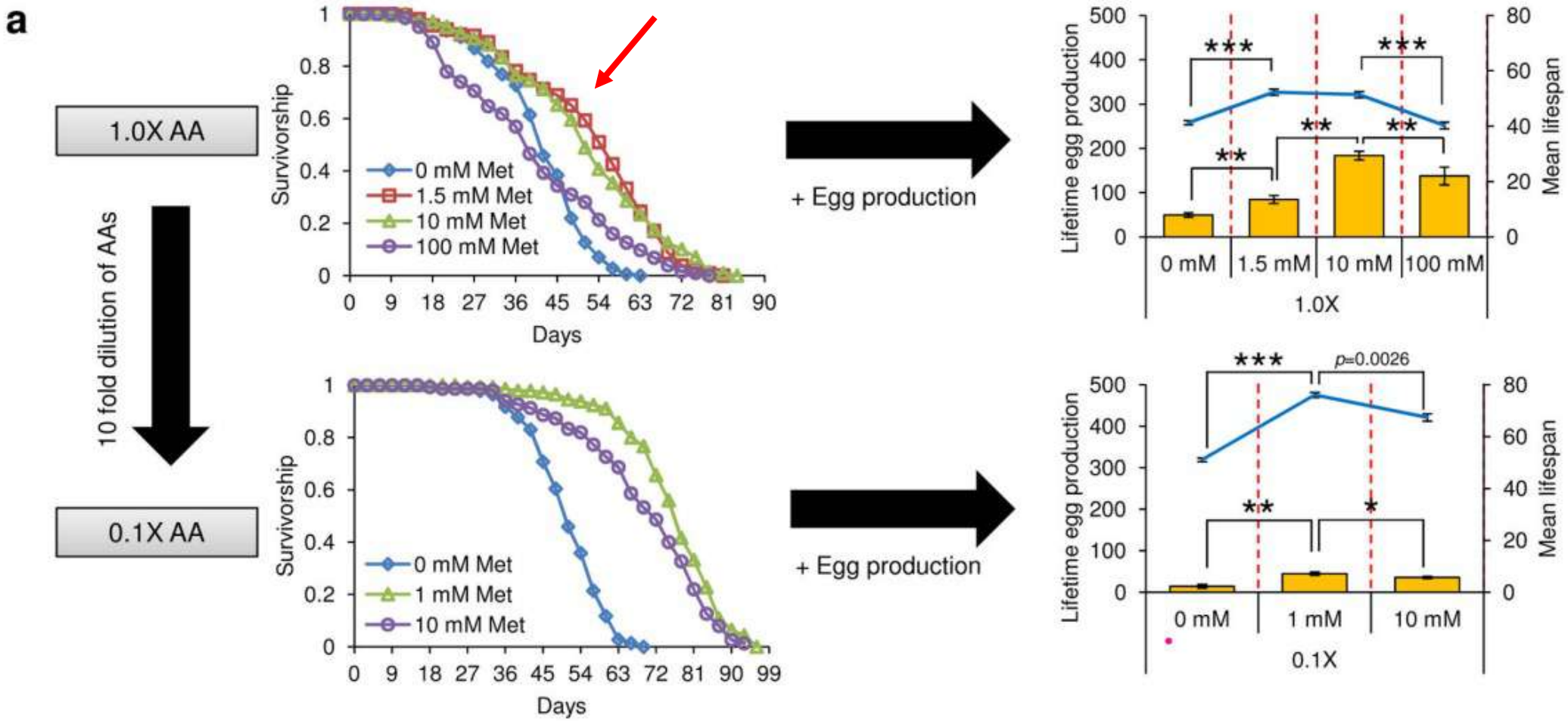


Summary

1.P :C ratio is a major determinant of lifespan, and the mechanism may be mediated by reducing protein intake may affect lifespan through inhibition of TOR signaling pathways, and this phenotype can effect offspring lifespan.

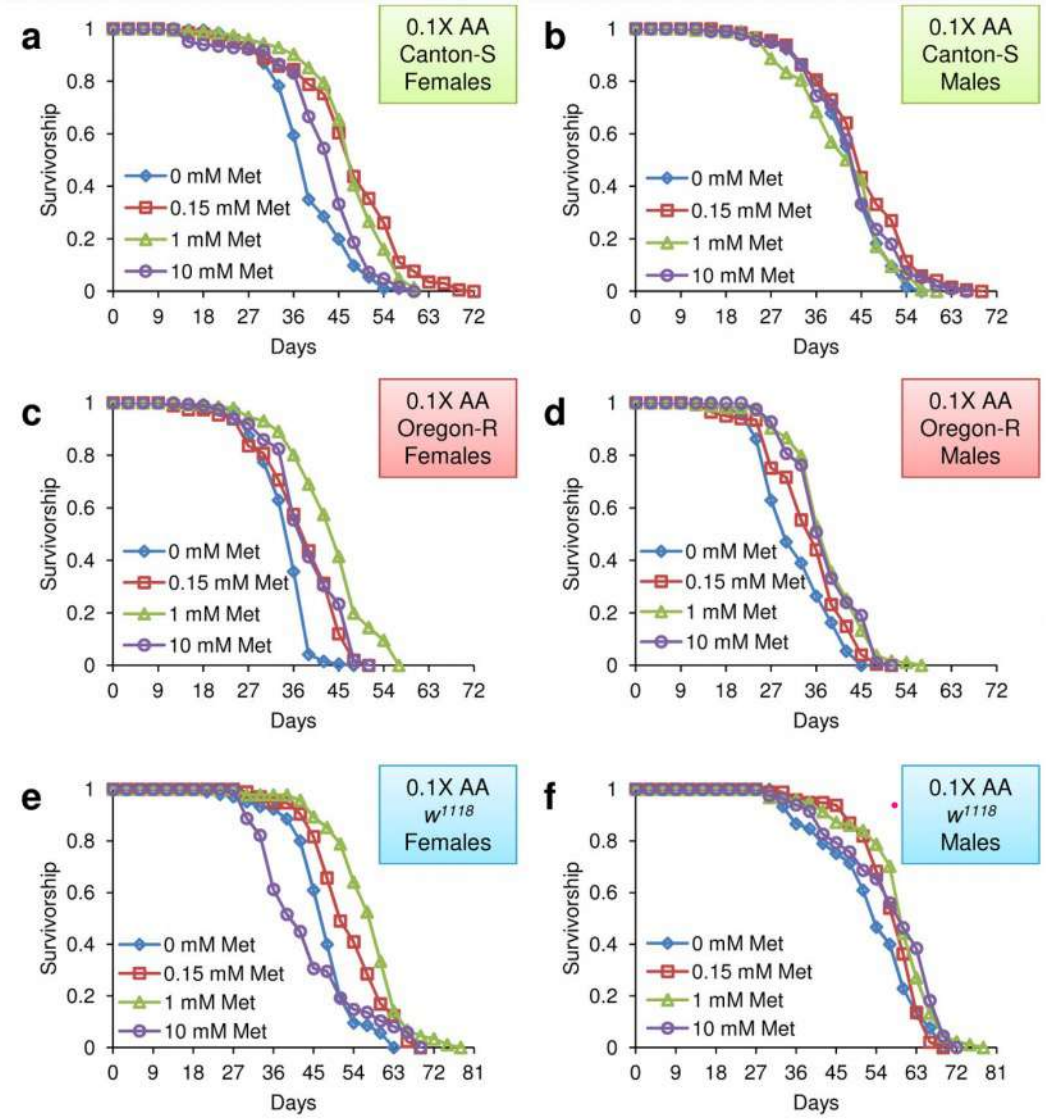
➢ Role of specific amino acids in longevity

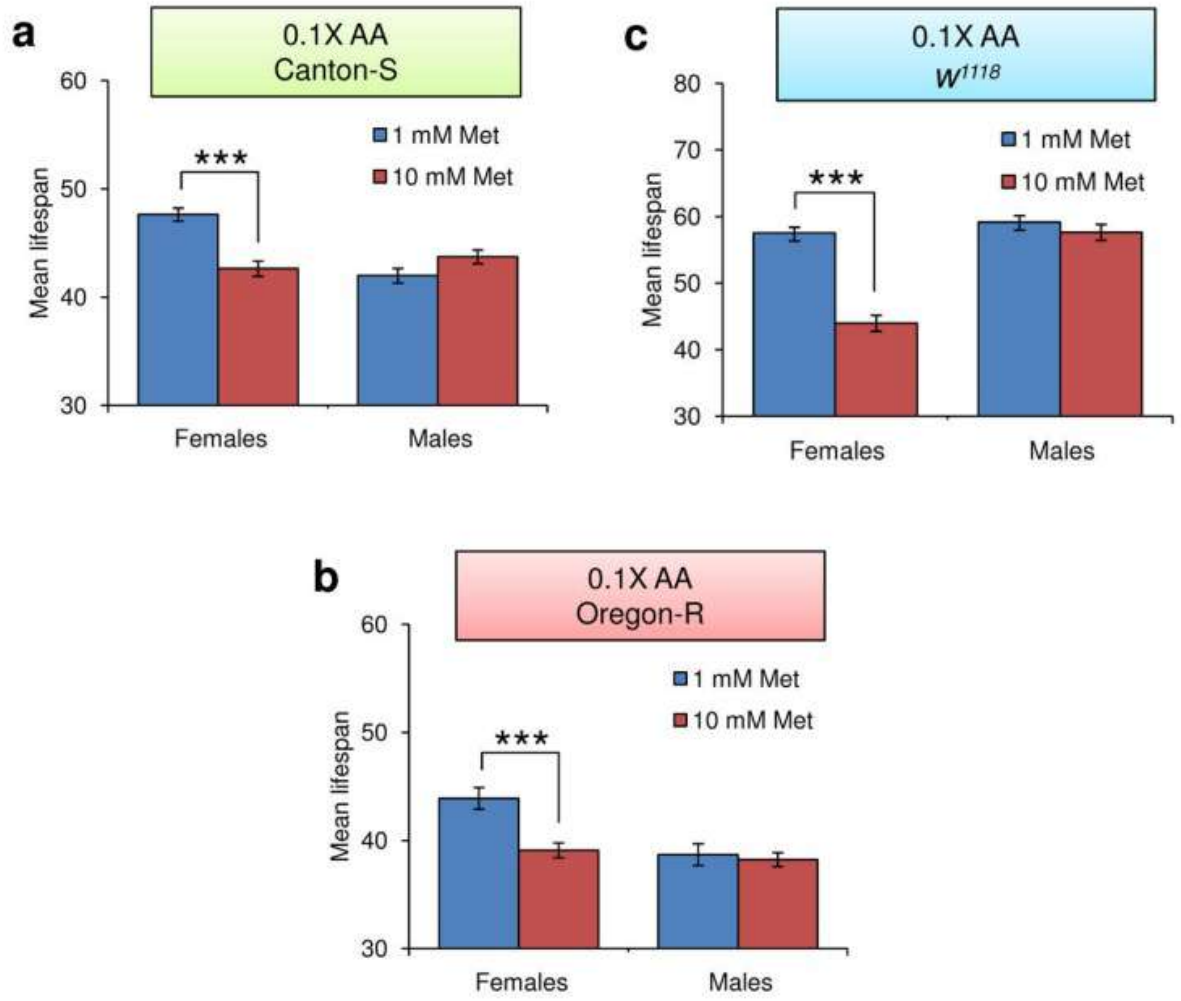
Imbalance of amino acids and high levels of Met decrease lifespan and reproduction.



Byung Cheon Lee et al. *Nat Commun*

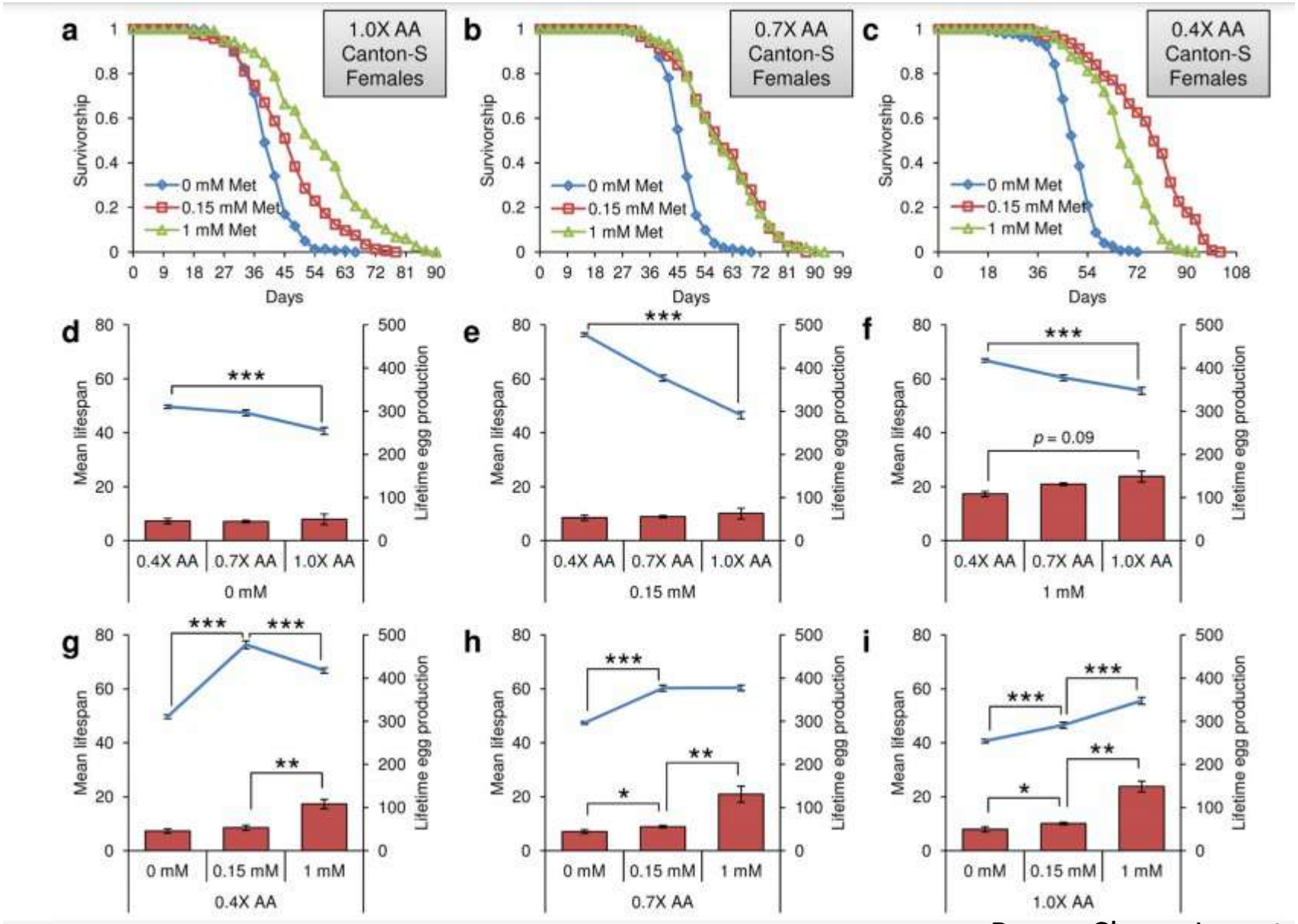
Sex-specific decrease of lifespan by imbalance of amino acids and high levels of Met.





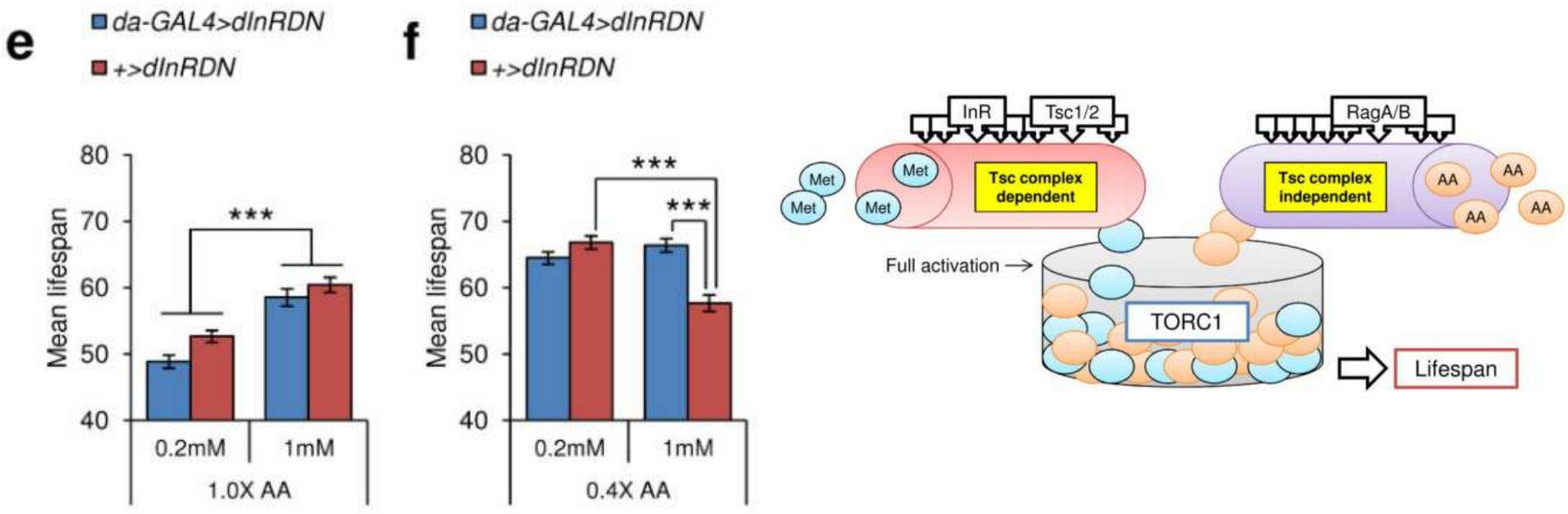
Byung Cheon Lee et al. *Nat Commun*

Lifespan extension by Met restriction was accompanied by decreased reproduction.



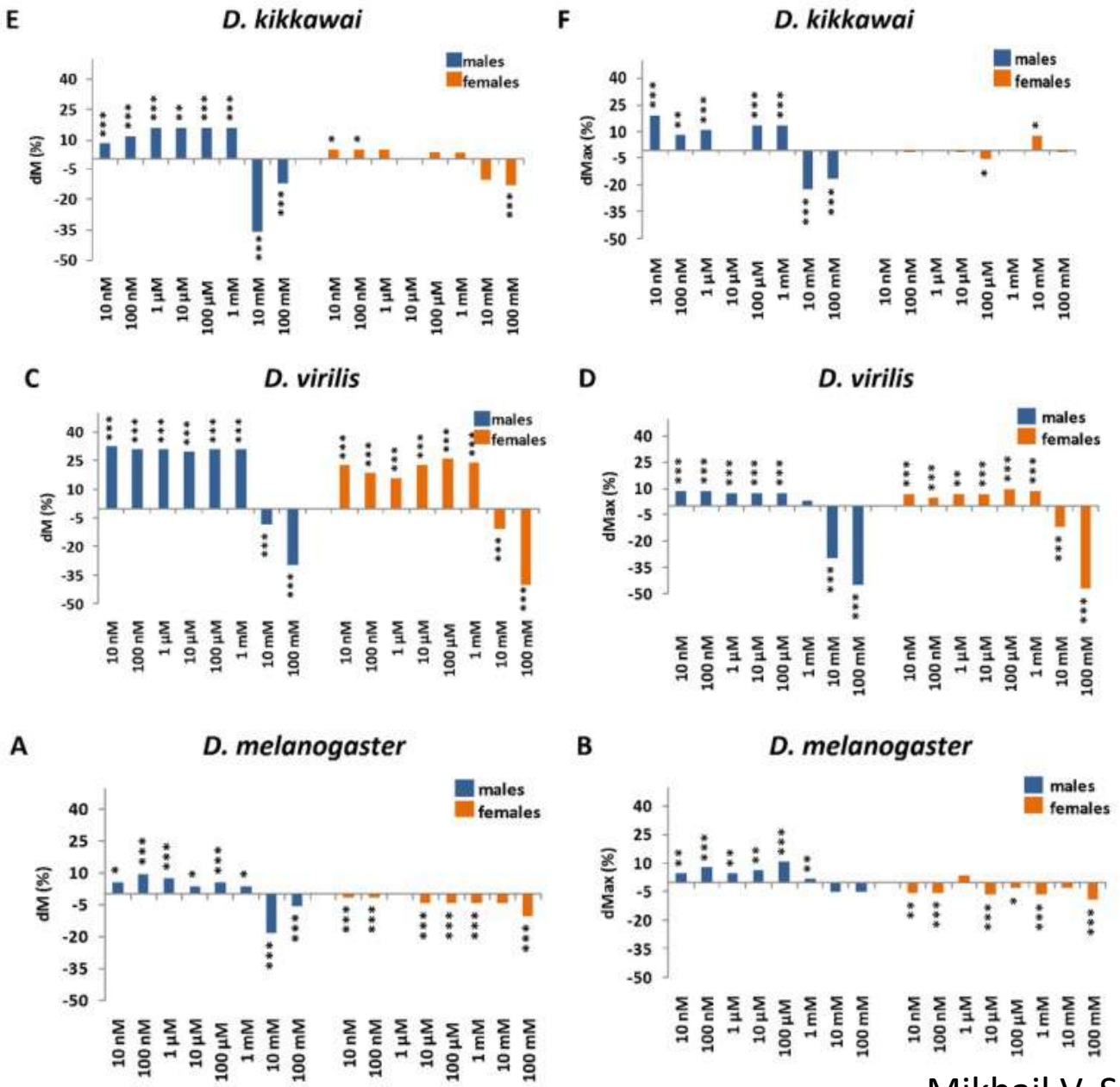
Byung Cheon Lee et al. *Nat Commun*

Under low amino acid status, particularly methionine restriction, lifespan increases lifespan in Drosophila by down regulating TOR signaling.



Byung Cheon Lee et al. *Nat Commun*

The effects of NAC supplementation on 3 Drosophila species

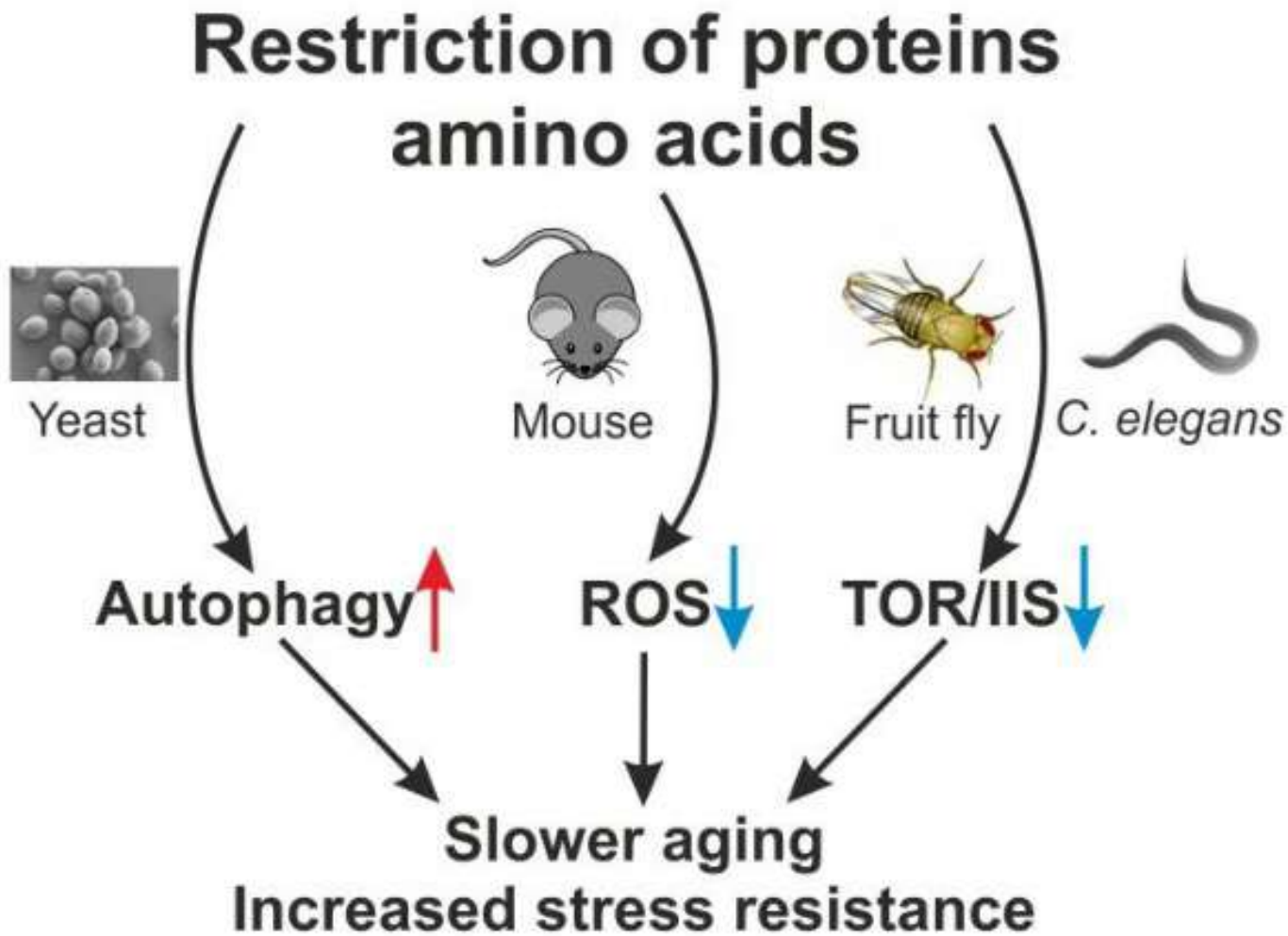


Mikhail V. Shaposhnikov et al.*AGING*.2018

Summary

1.P :C ratio is a major determinant of lifespan, and the mechanism may be mediated by reducing protein intake may affect lifespan through inhibition of TOR signaling pathways, and this phenotype can effect offspring lifespan.

2. Drosophila lifespan extension by Met restriction requires low amino acid status.


Restriction of proteins
amino acids
Yeast
Mouse
Fruit fly
C. elegans
Autophagy
ROS
TOR/IIS
Slower aging
Increased stress resistance

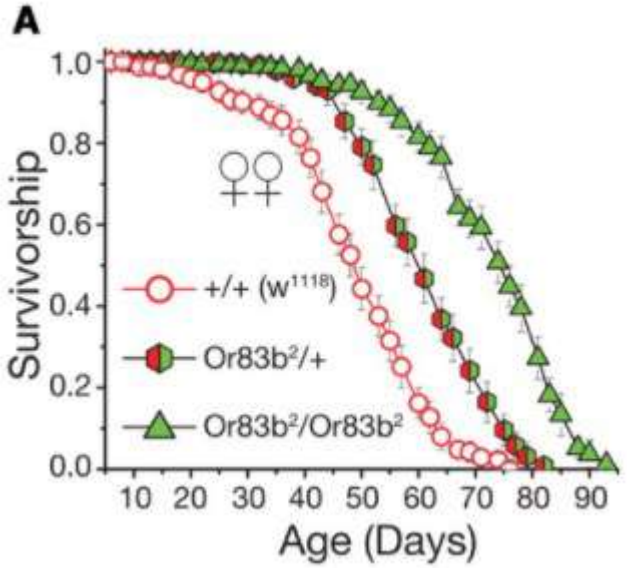
Sensory modulation of lifespan

Science

Regulation of *Drosophila* Life Span by Olfaction and Food-Derived Odors

SERGIY LIBERT, JESSICA ZWIENER, XIAOWEN CHU, WAYNE VANVOORHIES, GREGG ROMAN, AND , SCOTT D. PLETCHER Authors Info & Affiliations

SCIENCE • 23 Feb 2007 • Vol 315, Issue 5815 • pp. 1133-1137 • DOI: 10.1126/science.1136610



Cell

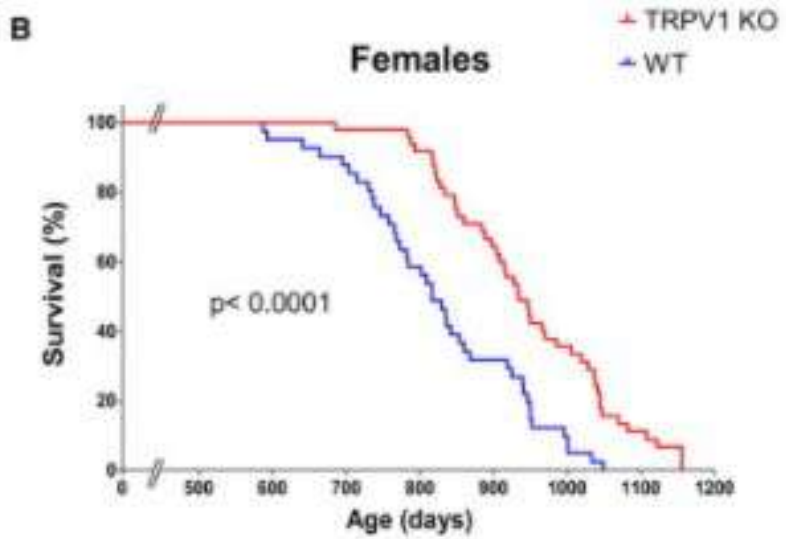
Volume 157, Issue 5, 22 May 2014, Pages 1023-1036

CellPress

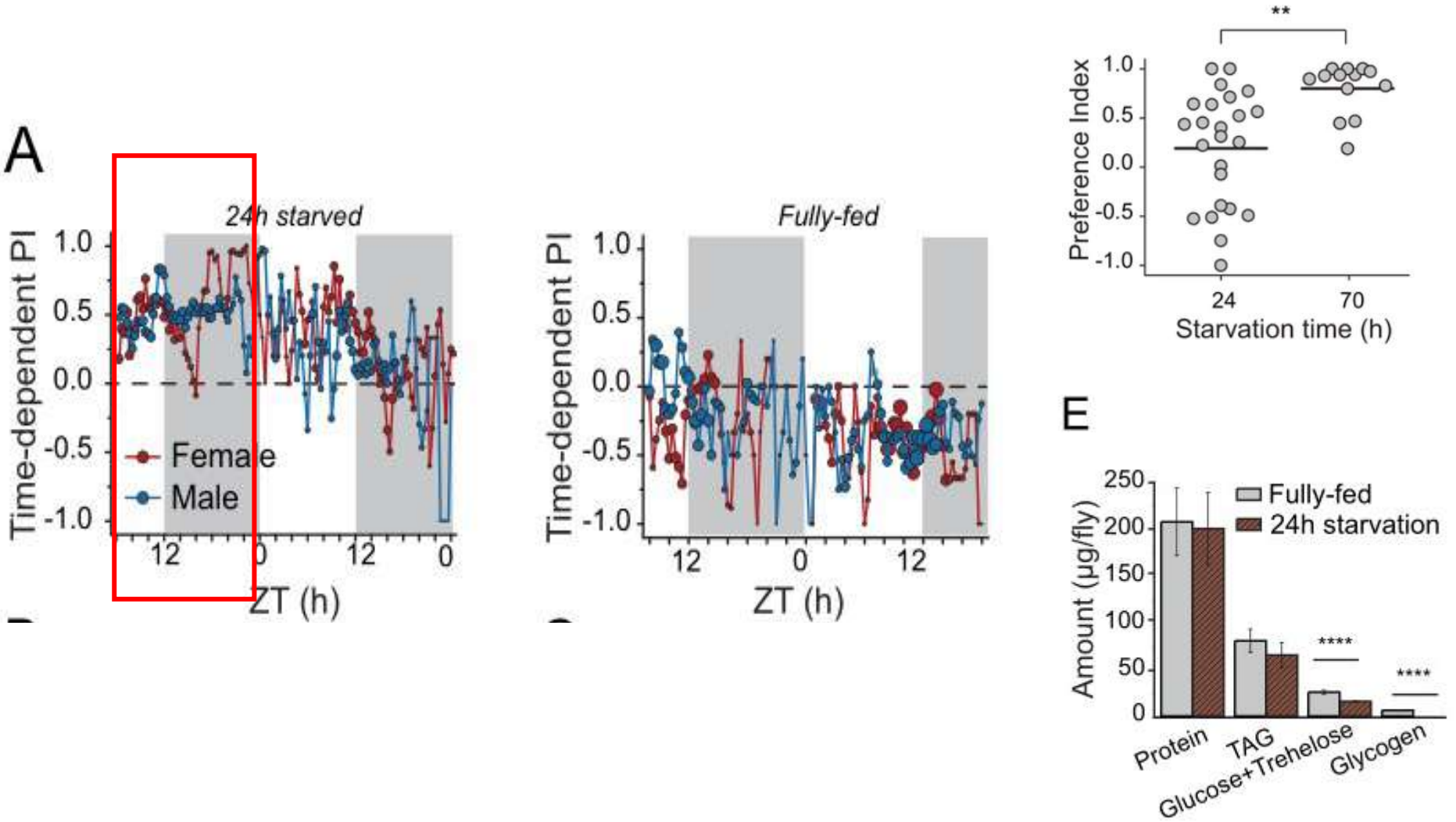
Article

TRPV1 Pain Receptors Regulate Longevity and Metabolism by Neuropeptide Signaling

Céline E. Riera [1, 2, 3], Mark O. Huising [4], Patricia Follett [2, 3], Mathias Leblanc [3], Jonathan Halloran [1], Roger Van Andel [1], Carlos Daniel de Magalhaes Filho [3], Carsten Merkwirth [3], Andrew Dillin [1, 2, 3]

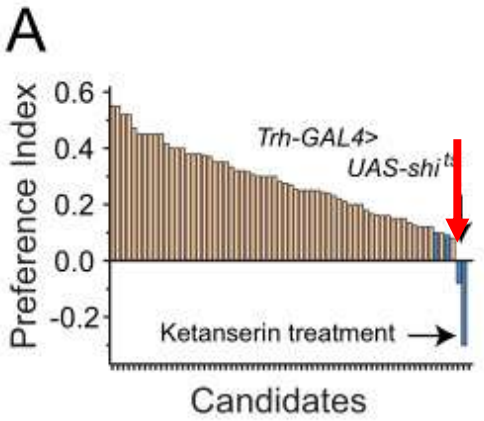


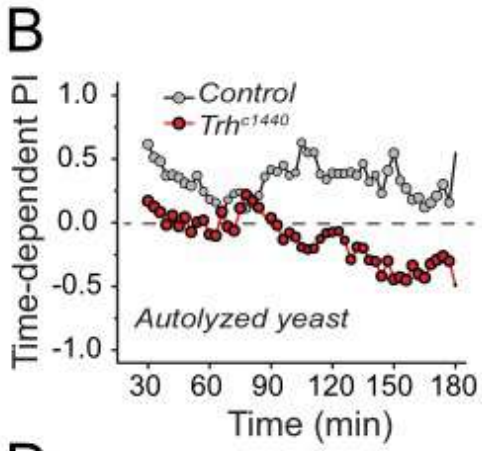
Drosophila develop a preference for protein under starvation.

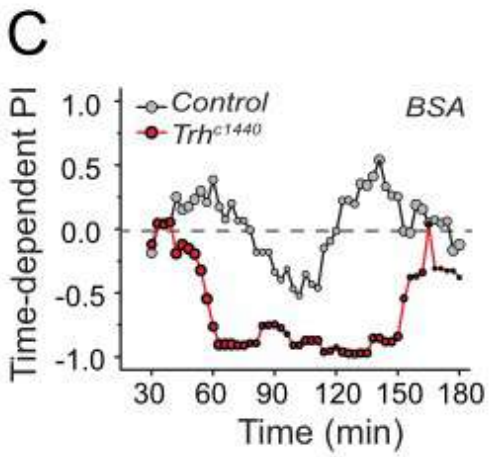


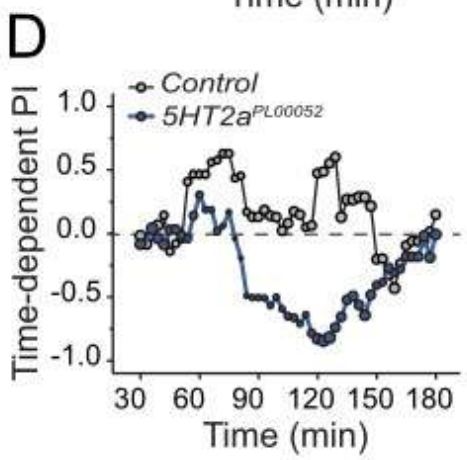
Jennifer Ro et al. *eLife*

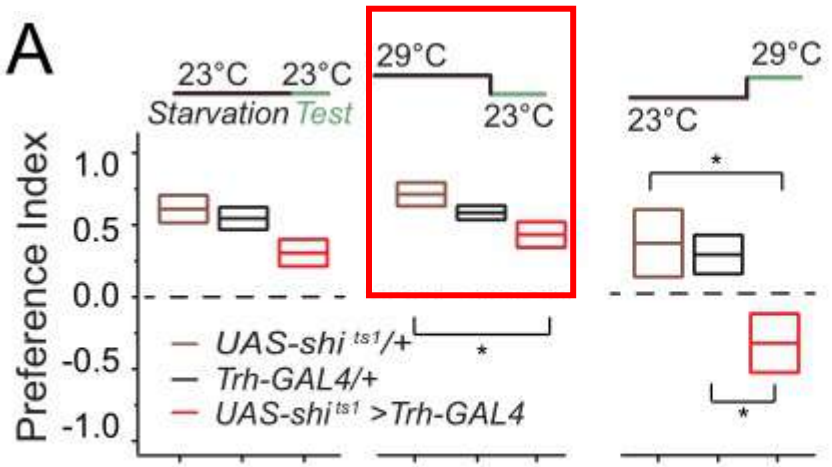
Serotonin signaling through receptor 2a modulates protein preference.

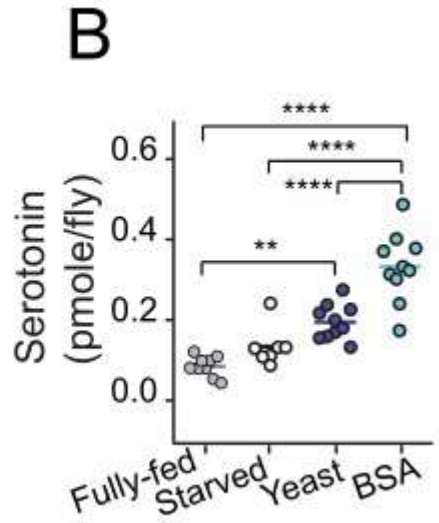


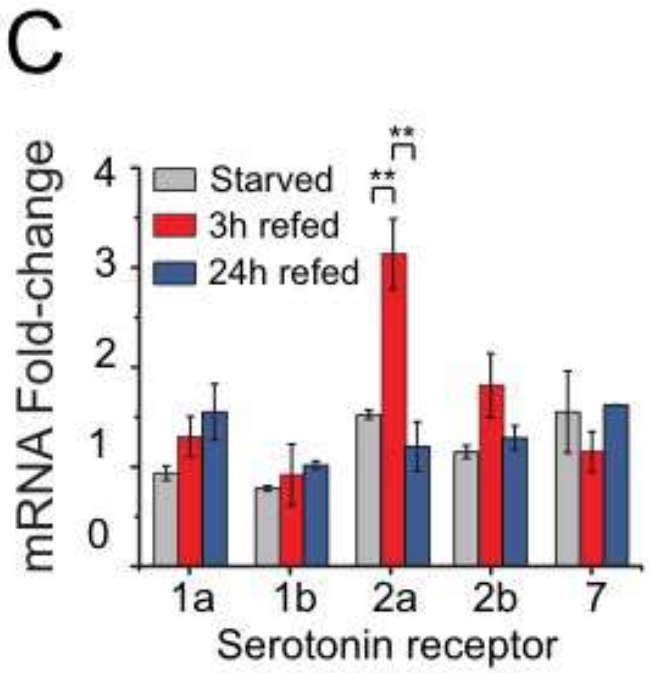






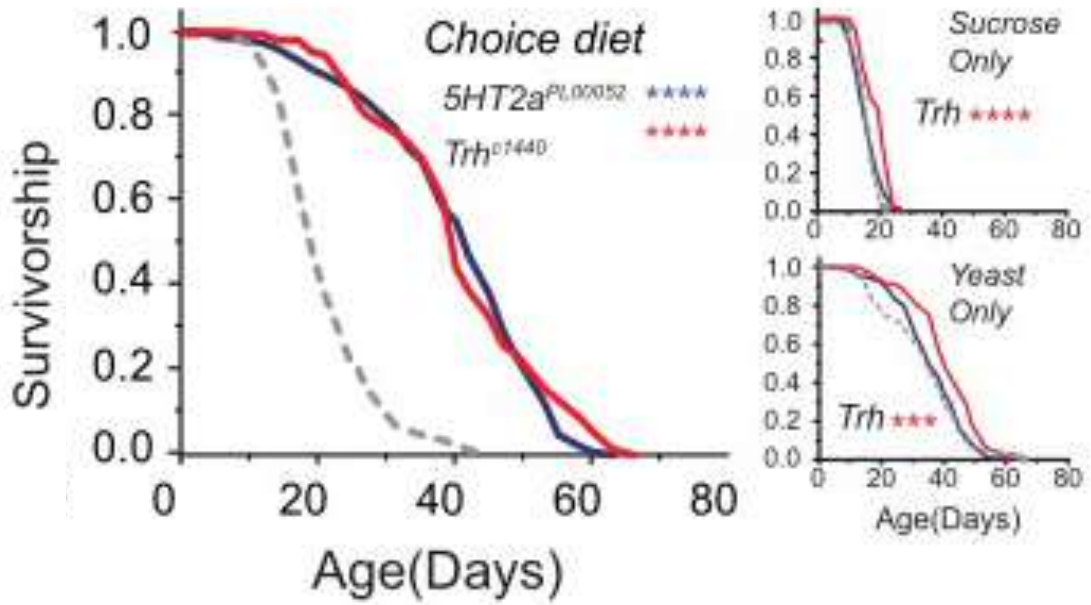






Jennifer Ro et al. *eLife*

The perceived value of dietary protein modulates lifespan via serotonin signaling



Jennifer Ro et al. *eLife*

Summary

1.P :C ratio is a major determinant of lifespan, and the mechanism may be mediated by reducing protein intake may affect lifespan through inhibition of TOR signaling pathways, and this phenotype can effect offspring lifespan.

2. Drosophila lifespan extension by Met restriction requires low amino acid status.

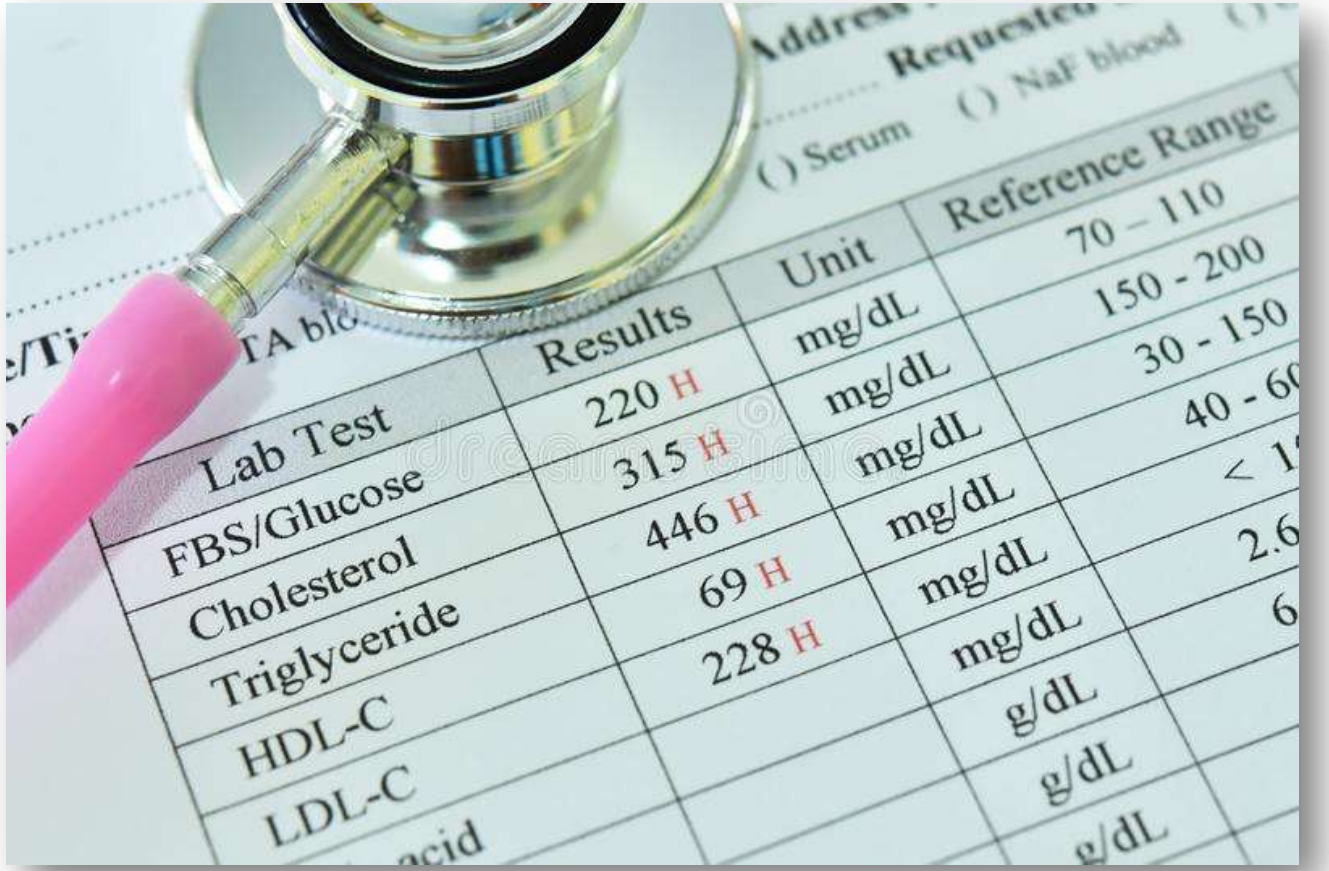
3. Serotonin signaling mediates protein valuation and aging

Effects of Dietary Proteins and Amino Acids on lifespan in Drosophila

THANKS

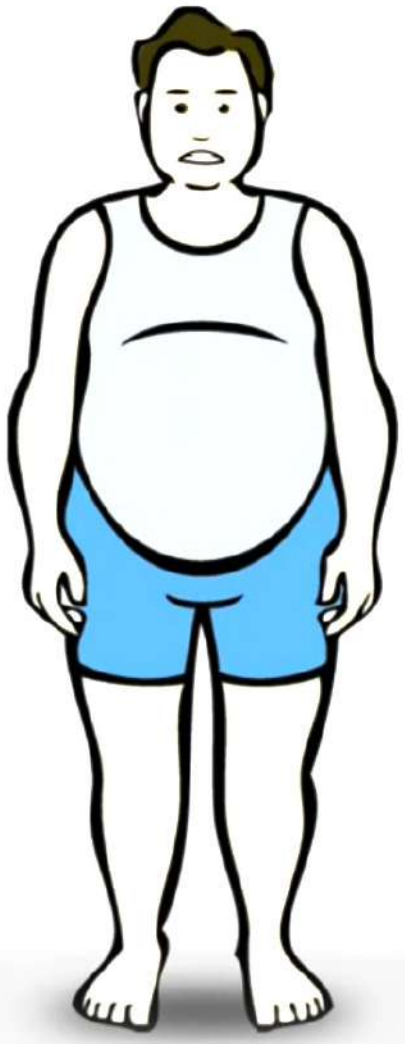
PROTEIN

Carbohydrate-lipid and Lifespan



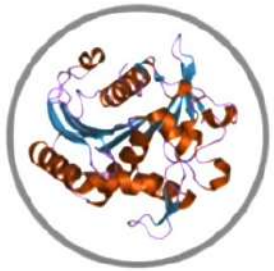
--Chen Jiangtao

2021/10/29



THE METABOLIC SYNDROME

HEART DISEASE

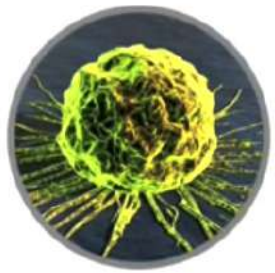


LIPID PROBLEMS

HYPERTENSION

TYPE 2 DIABETES

DEMENTIA



CANCER

POLYSYSTIC OVARIAN SYNDROME

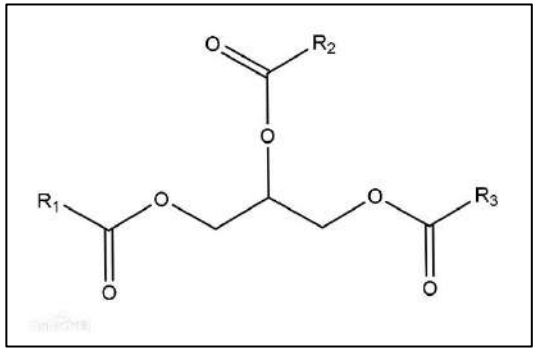
NON-ALCOHOLIC FATTY LIVER DISEASE

- How does lipid metabolism influence aging?
- How does sugar metabolism influence aging?

- **How does lipid metabolism influence aging?**

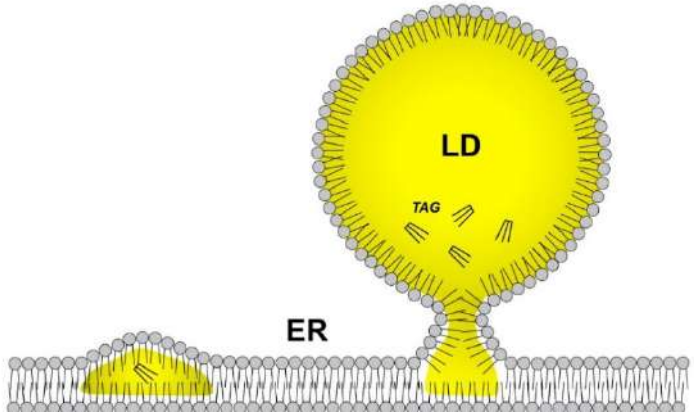
1.1 How do cells store and organize their fat in *Drosophila*?

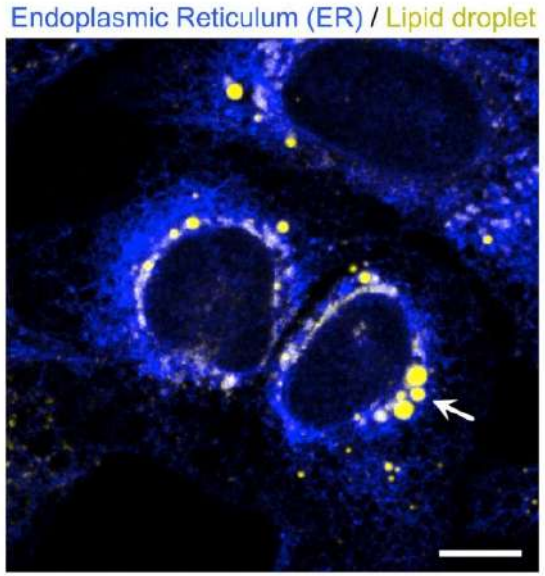
植物性三酰甘油

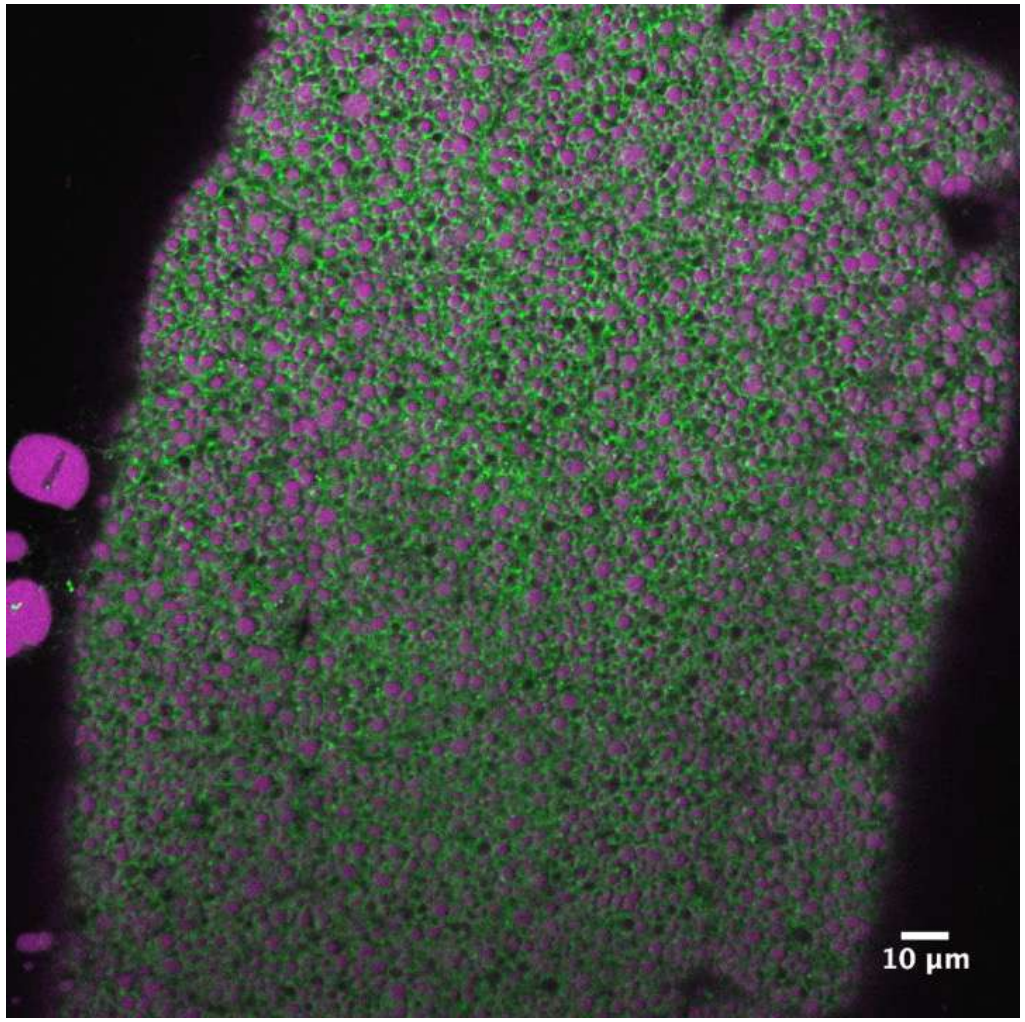


triglyceride

LD：Lipid droplet



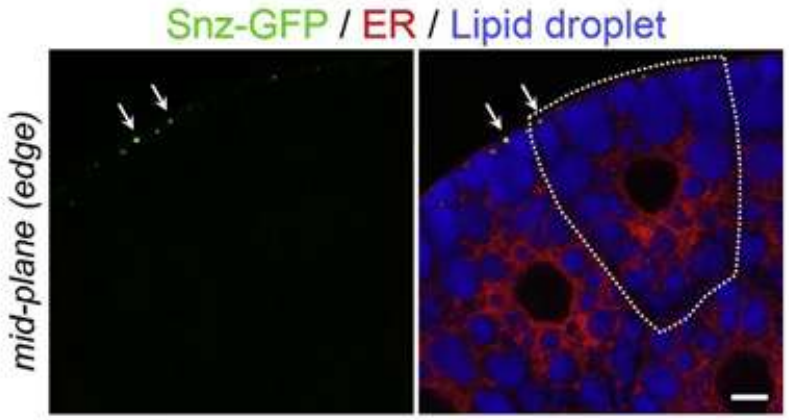


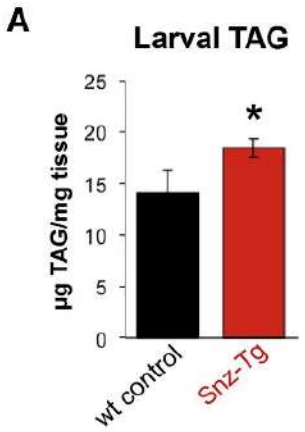


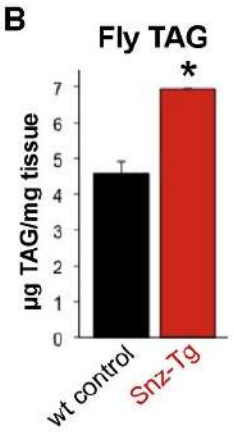
Lipid droplets in fat body

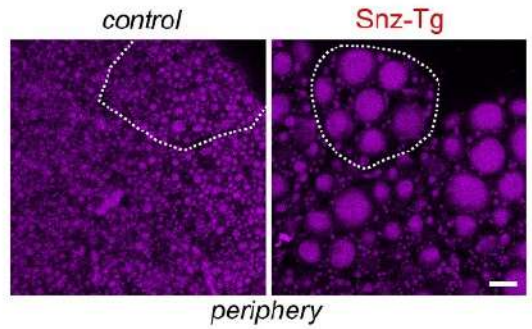
Rupali Ugrankar et al. *Developmental Cell* .2019

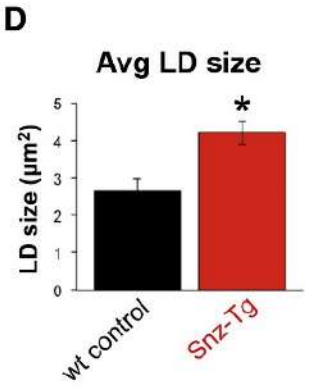
1.2 How does triglyceride storage in lipid droplets affect longevity?





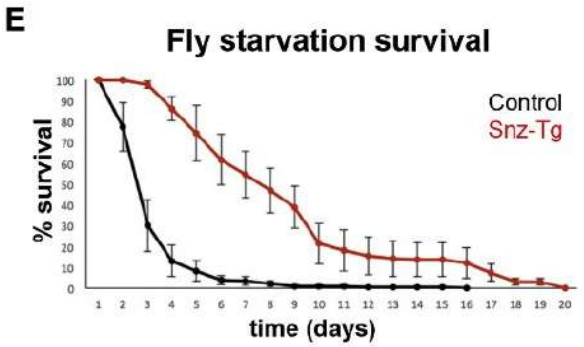


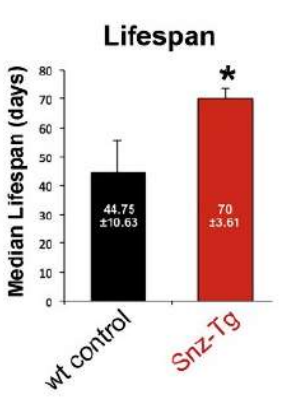


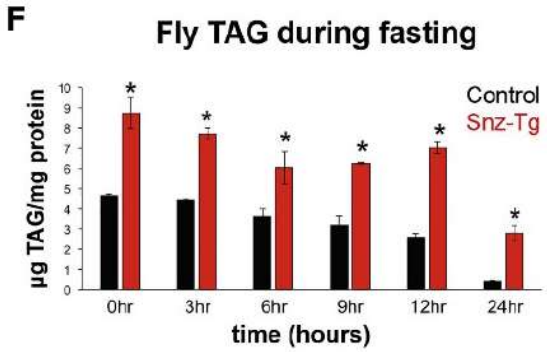


Transgenic fly **over-expressing Snz** in fat body (Snz-Tg)

Dcg-Gal4 > UAS-Snz-Tg







***Snz-Tg* flies are obese and have more LD stores, but are healthy, starvation resistant, and long-lived**

Rupali Ugrankar et al. *Developmental Cell* .2019

SUMMARY

Lipid and aging:

1. ***Drosophila*** **overexpressing Snz has higher triglycerides (TAG) in the storage of lipid droplets (LDs), which is more resistant to starvation stress and longer survival time.**

   过表达Snz的果蝇有更高的甘油三酯（TAG）在脂滴（LDs）的存储，因而更能抵抗饥饿应激，存活时间更长

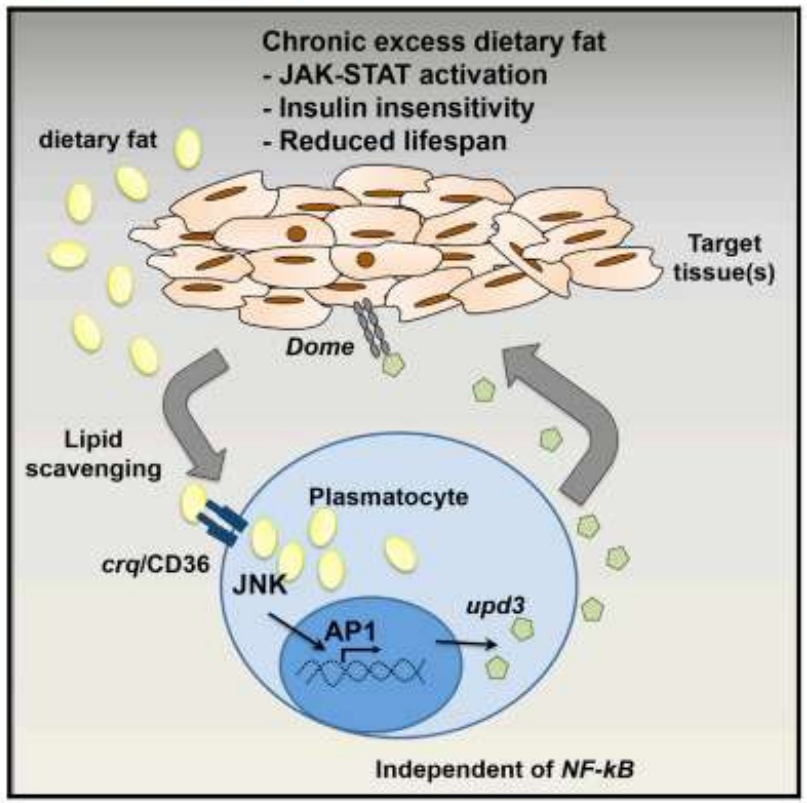
2. How does chronic lipid-rich diet affect lifespan?

Article

Immunity

Macrophage-Derived *upd3* Cytokine Causes Impaired Glucose Homeostasis and Reduced Lifespan in *Drosophila* Fed a Lipid-Rich Diet

Graphical Abstract



Authors

Katie J. Woodcock, Katrin Kierdorf, ..., Marc S. Dionne, Frédéric Geissmann

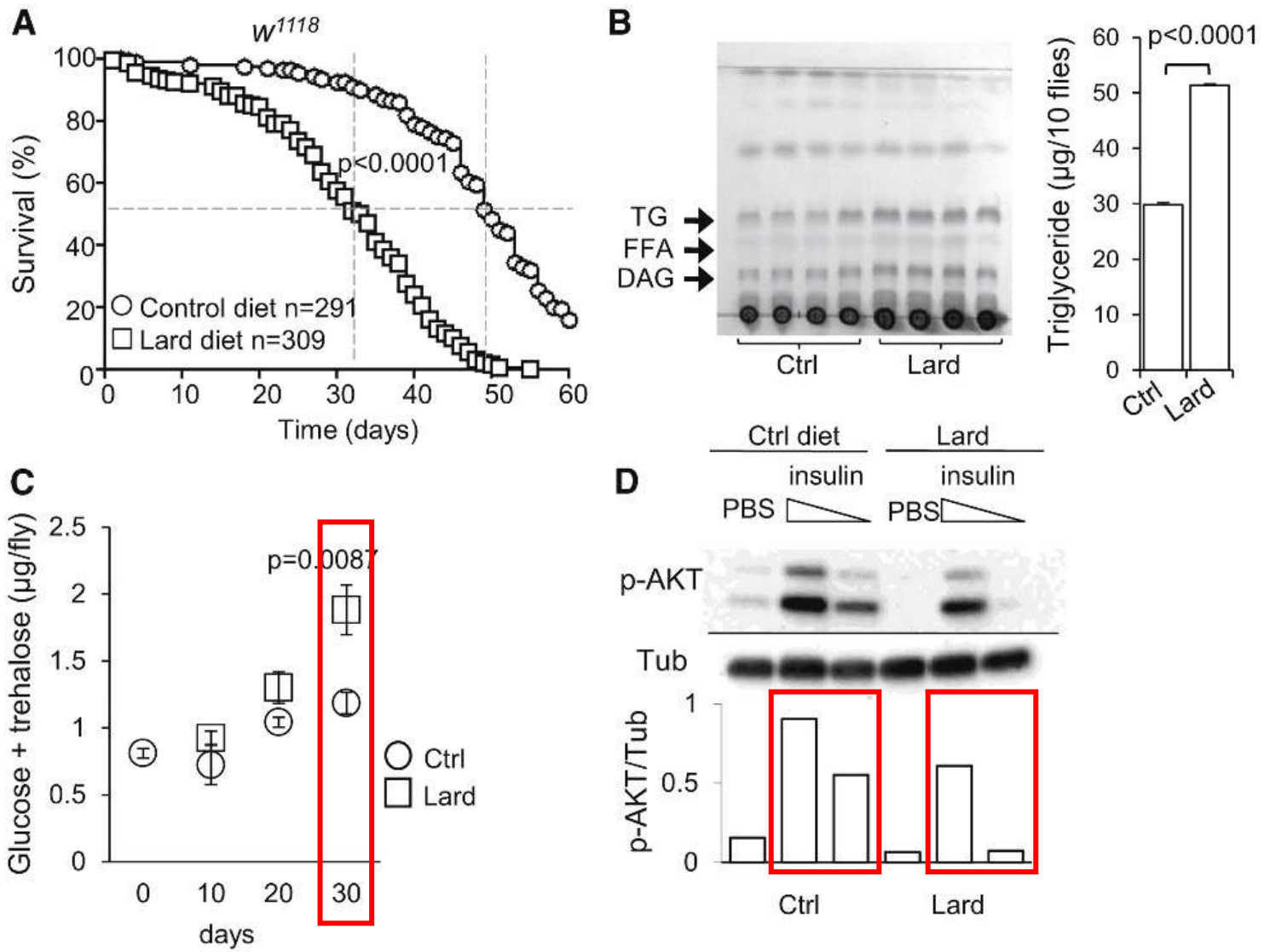
Correspondence

frederic.geissmann@kcl.ac.uk

In Brief

Consumption of fatty foods is associated across species with inflammation, metabolic imbalance, and reduced lifespan. Woodcock et al. use *Drosophila* fed a lipid-rich diet to demonstrate that an evolutionarily conserved "scavenger receptor-JNK-type 1 cytokine" cassette in macrophages controls glucose metabolism and reduces lifespan via activation of the JAK-STAT pathway.

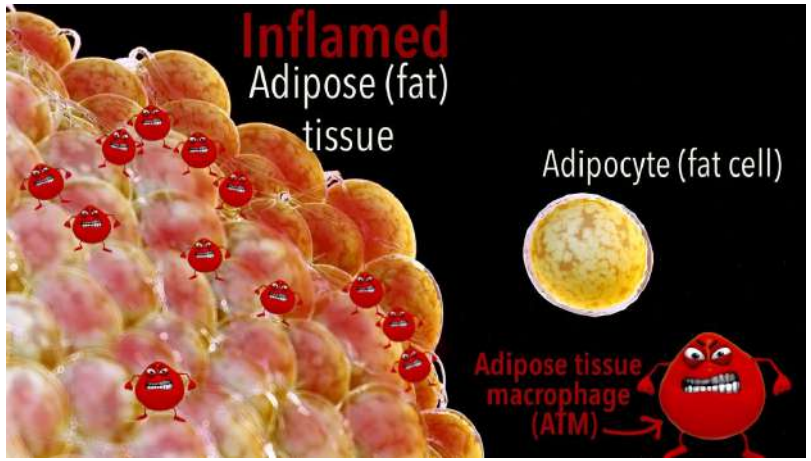
2. How does chronic lipid-rich diet affect lifespan?



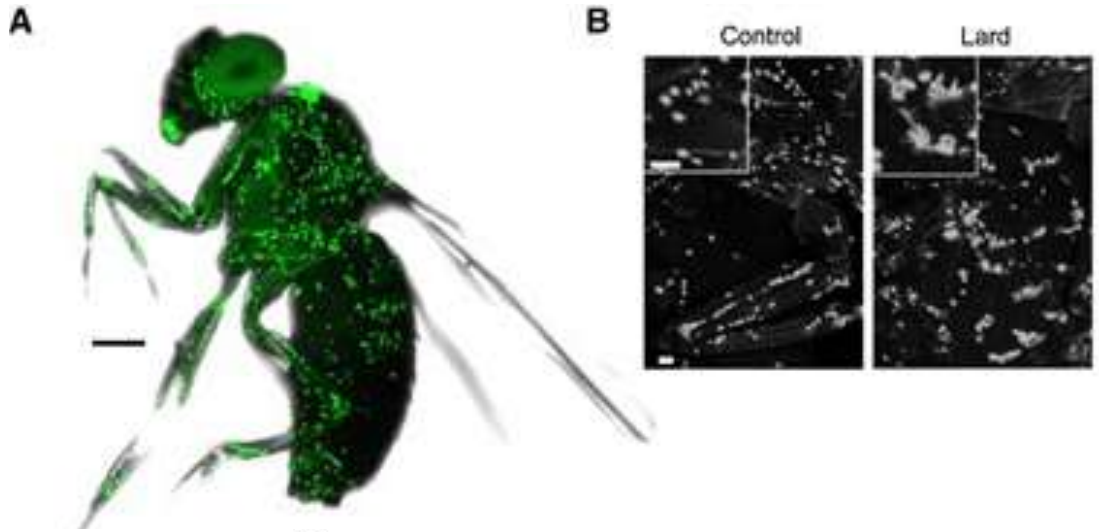
chronic lipid-rich diet results in shortened life expectancy, loss of glucose homeostasis, and insulin insensitivity

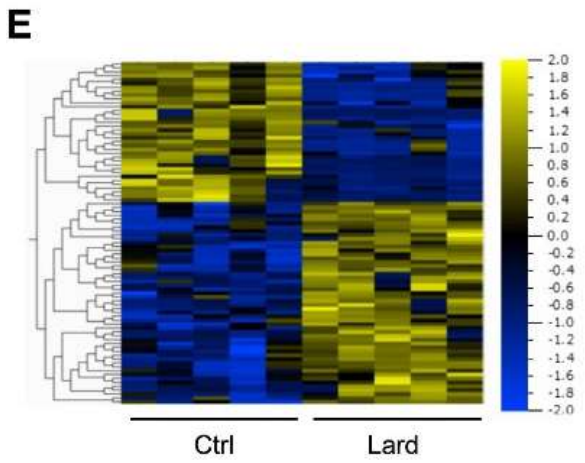
Katie J. Woodcock et al. *Immunity* .2015

2. How does chronic lipid-rich diet affect lifespan?



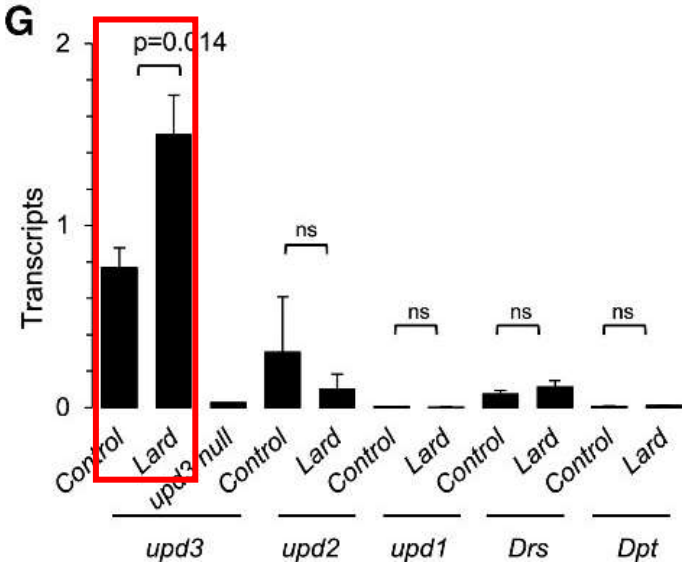
From: drconley.org





F

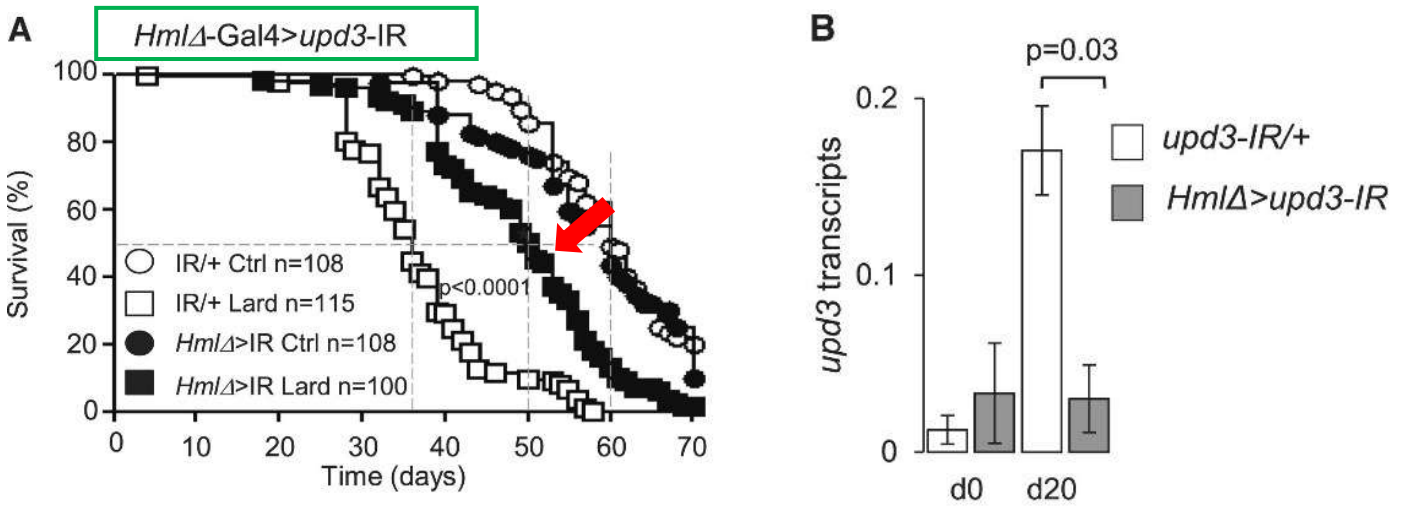
TF binding site	UP	DOWN
AP-1	0.003	n/s
NF-kB	n/s	n/s
Fox	0.005	n/s
ATF/CREB	0.005	n/s
myc/max	n/s	0.004



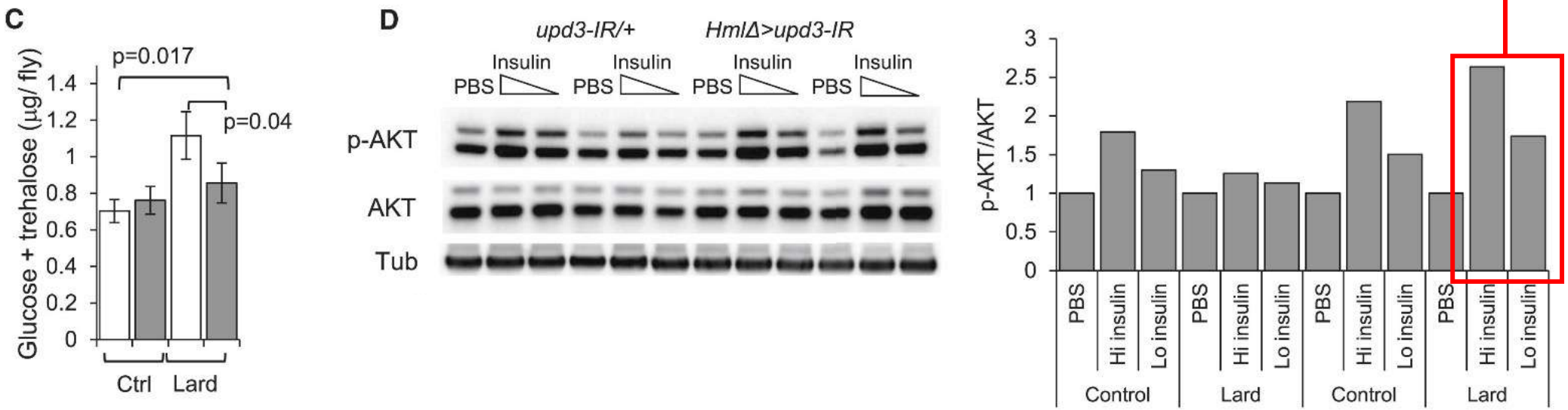
Lipid-Rich Diet Promotes Upd3 Production by Macrophages in *Drosophila*

Katie J. Woodcock et al. *Immunity* .2015

2. How does chronic lipid-rich diet affect lifespan?



胰岛素对AKT磷酸化的响应得到恢复



Macrophage-Derived Upd3 Controls Survival and Insulin Sensitivity in Lipid-Rich Diet

Katie J. Woodcock et al. *Immunity* .2015

SUMMARY

Lipid and aging:

1. ***Drosophila*** **overexpressing Snz has higher triglycerides (TAG) in the storage of lipid droplets (LDs), which is more resistant to starvation stress and longer survival time.**

2. **Under the condition of long-term high-fat diet, *Drosophila* macrophages mediate the destruction of glucose homeostasis and shorten life span by producing upd3.**

   长期高脂饮食条件下，果蝇巨噬细胞通过产生upd3介导葡萄糖稳态的破坏以及寿命缩短

3. How does moderate high fat in an isocaloric diet affect longevity?

高脂--高热量

HFD Feeding Regime

Bottles of flies were emptied and dated; then 5 days after emptying the vial, all flies were taken and placed in a new vial of NF and aged 5 more days. This population was then spilt into two populations, one on NF and one on the designated concentration of HFD, for either 2, 5, or 10 days. We used 30% HFD for 5 days for the majority of the experiments, since it gave strong and reproducible phenotypes.

在大部分实验组给果蝇喂食5d时间30%的高脂饮食，因为这种方式喂养得到的表型更加明显和稳定。

（适度）高脂—等热量

Cell Metabolism

CellPress

Article

An isocaloric moderately high-fat diet extends lifespan in male rats and *Drosophila*

Dan Shi,[1,3] TianShu Han,[1,3] Xia Chu,[1] Huimin Lu,[1] Xue Yang,[1] TianQi Zi,[1] YanHe Zhao,[1] XinYue Wang,[1] ZhiPeng Liu,[1] JingQi Ruan,[1] Xin Liu,[1] Hua Ning,[1] MaoQing Wang,[1] Zhen Tian,[1] Wei Wei,[1] Yue Sun,[1] YinLing Li,[1] Rui Guo,[1] Yu Wang,[1] Fan Ling,[1] Yue Guan,[1] Da Shen,[2] YuCun Niu,[1,*] Ying Li,[1,*] and ChangHao Sun[1,4,*]

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[2]Gene Regulatory Laboratory, School of Medicine, Tsinghua University, Beijing 100084, China

[3]These authors contributed equally

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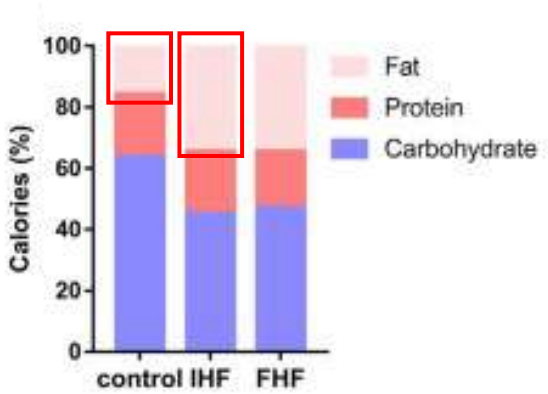
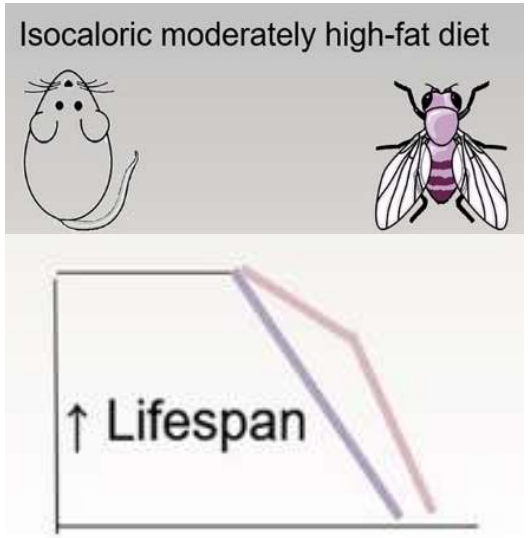
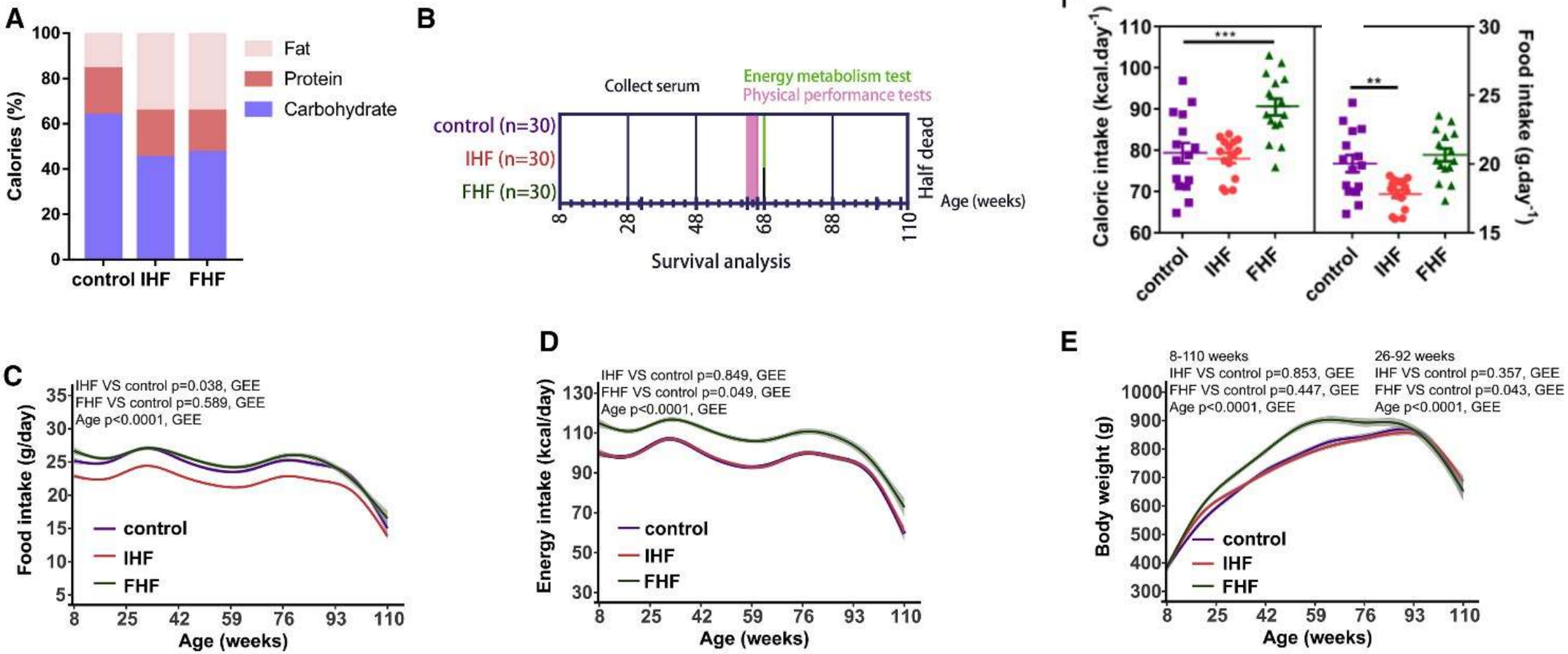




3. How does moderate high fat in an isocaloric diet affect longevity?

① IHF（isocaloric moderately high-fat ）等热量中等高脂肪饮食的实现

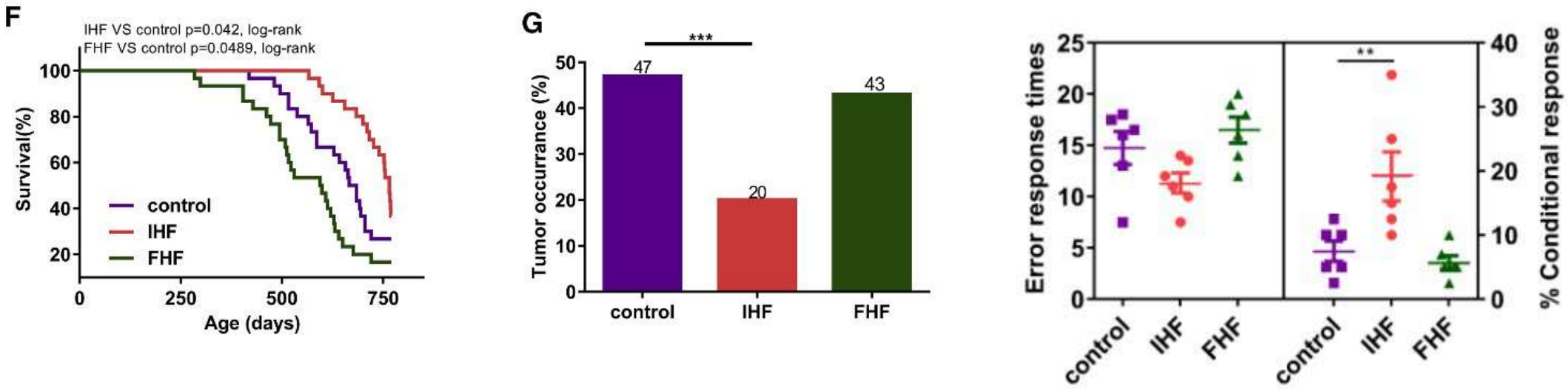


An isocaloric moderately high-fat diet

Dan Shi et al. *Cell Metabolism* .2021

3. How does moderate high fat in an isocaloric diet affect longevity?

② IHF显著延长了大鼠的寿命，改善了整体健康

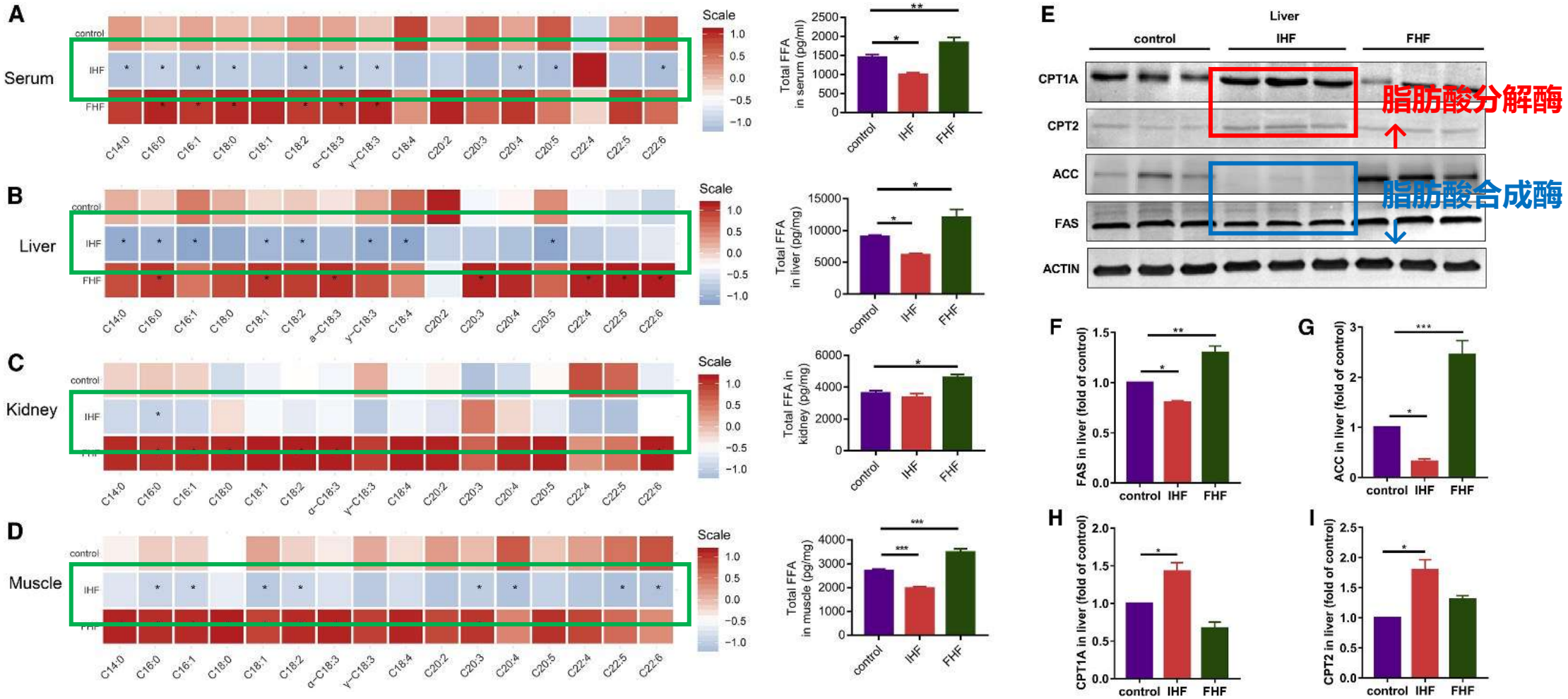


IHF prolongs the lifespan and healthspan of rats

Dan Shi et al. *Cell Metabolism* .2021

3. How does moderate high fat in an isocaloric diet affect longevity?

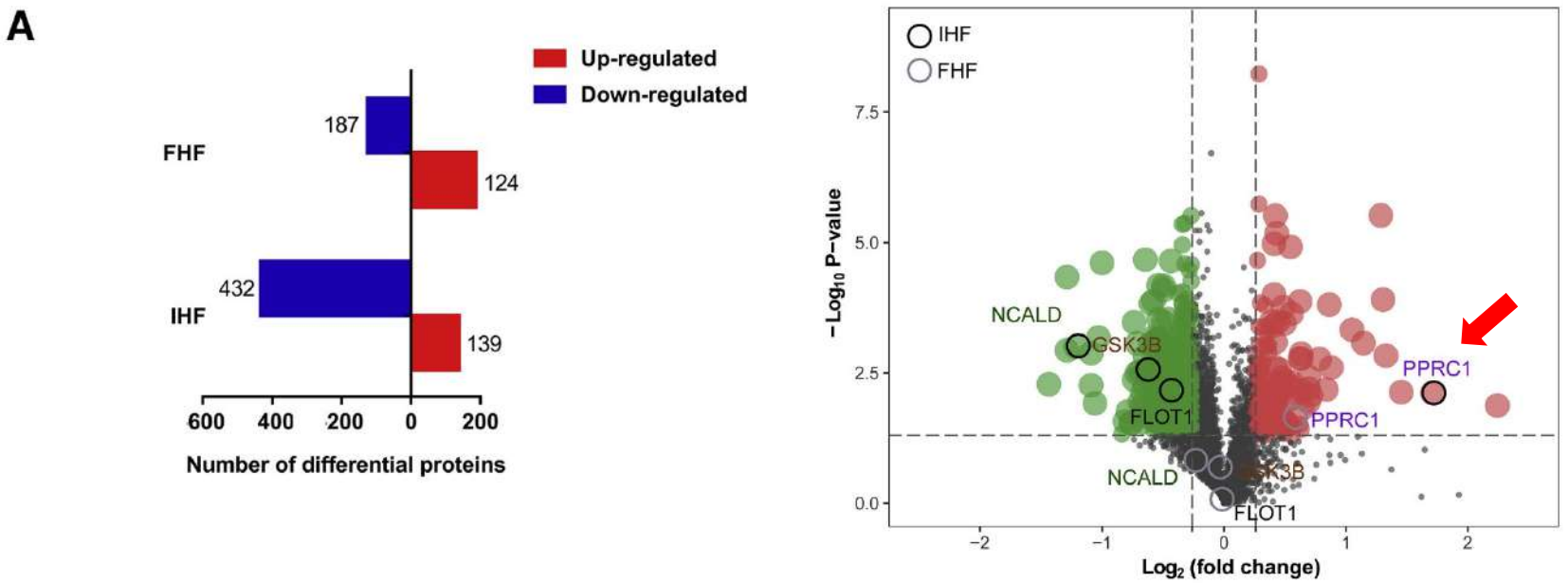
③ IHF通过下调脂肪酸合成，上调脂肪酸分解，从而降低游离脂肪酸，加速脂肪代谢



Dan Shi et al. *Cell Metabolism* .2021

3. How does moderate high fat in an isocaloric diet affect longevity?

④ 蛋白质组学确定 PPRC1 作为候选靶点



Dan Shi et al. *Cell Metabolism* .2021

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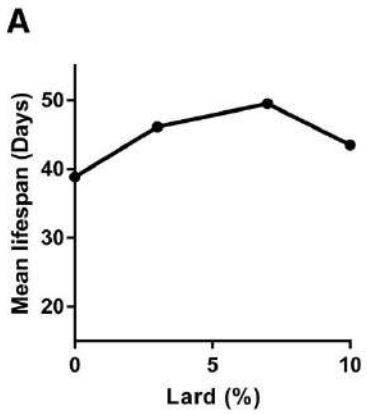
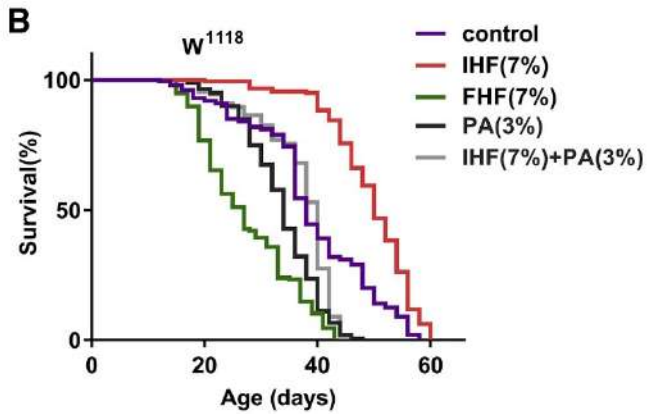
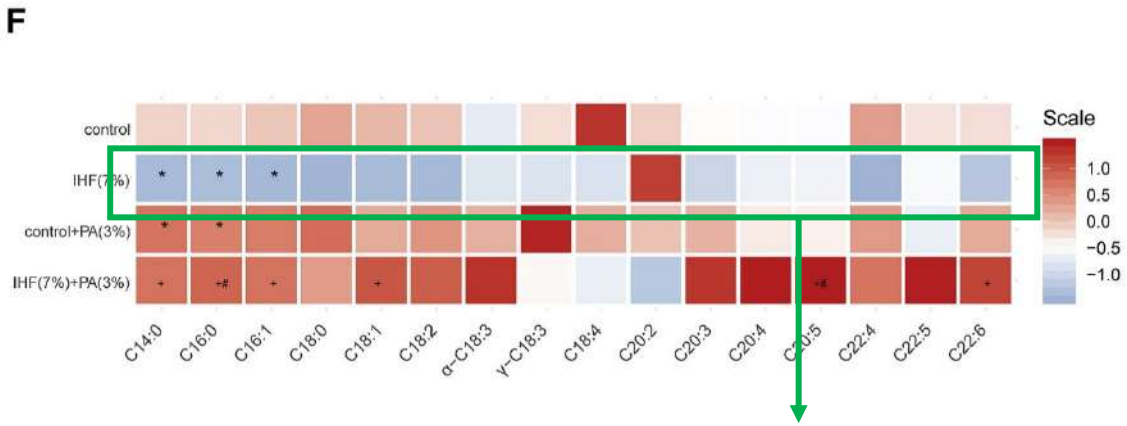
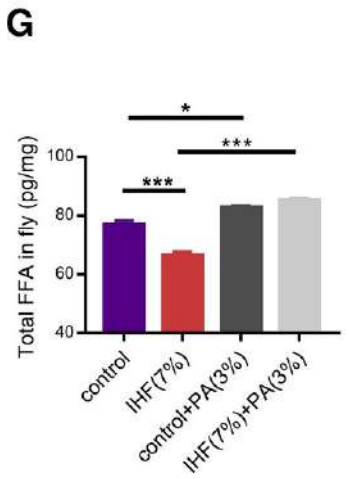
⑤ IHF 也可以延长果蝇的寿命

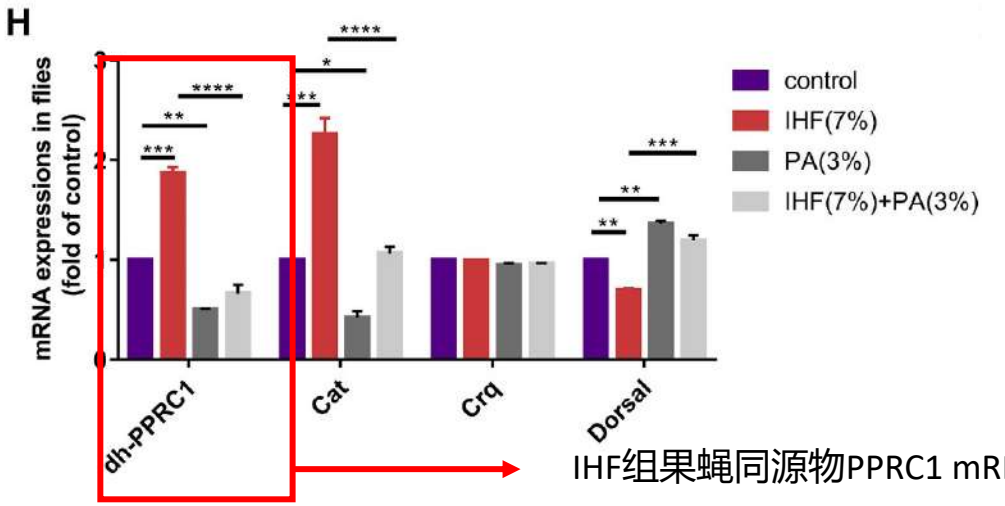






IHF组游离脂肪酸下降，脂肪代谢增加





IHF组果蝇同源物PPRC1 mRNA表达上调

Dan Shi et al. *Cell Metabolism* .2021

SUMMARY

Lipid and aging:

1. ***Drosophila*** **overexpressing Snz has higher triglycerides (TAG) in**
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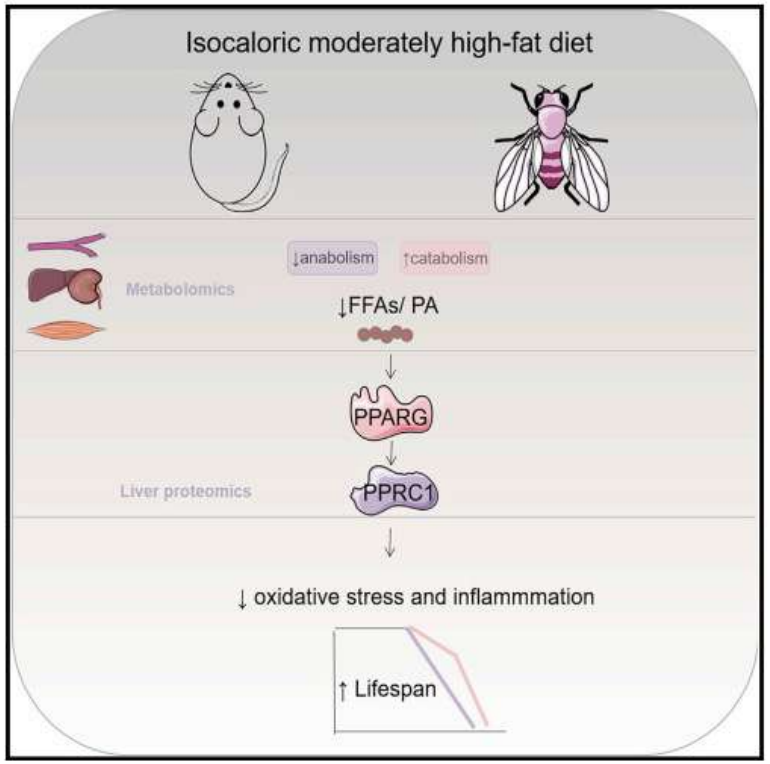
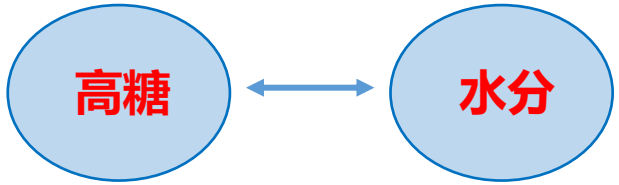


3. **Isocaloric moderately high-fat can significantly improve fatty acid metabolism and reduce the level of free fatty acids. The reduced free fatty acids can improve inflammation and stress response by up regulating PPRC1, and finally prolong lifespan.**

等能量高脂肪饮食可以显著提高脂肪酸代谢，降低游离脂肪酸水平，而降低的游离脂肪酸通过上调PPRC1，改善炎症和应激反应，最终延长寿命

➢How does sugar metabolism influence aging?



Cell Metabolism
Article

Sugar-Induced Obesity and Insulin Resistance Are Uncoupled from Shortened Survival in *Drosophila*

Esther van Dam,[1,2,7] Lucie A.G. van Leeuwen,[1,2,7] Eliano dos Santos,[1,2,7] Joel James,[1,2,7] Lena Best,[3,7] Claudia Lennicke,[1,2] Alec J. Vincent,[1,2] Georgios Marinos,[3] Andrea Foley,[1,2] Marcela Buricova,[1,2] Joao B. Mokochinski,[1,2] Holger B. Kramer,[1,2] Wolfgang Lieb,[4] Matthias Laudes,[5] Andre Franke,[6] Christoph Kaleta,[3] and Helena M. Cochemé[1,2,8,*]

[1]MRC London Institute of Medical Sciences, Du Cane Road, London W12 0NN, UK
[2]Institute of Clinical Sciences, Imperial College London, Hammersmith Hospital Campus, Du Cane Road, London W12 0NN, UK
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[5]Department of Internal Medicine I, University Hospital Schleswig-Holstein, 24105 Kiel, Germany
[6]Institute of Clinical Molecular Biology, Kiel University, 24105 Kiel, Germany
[7]These authors contributed equally
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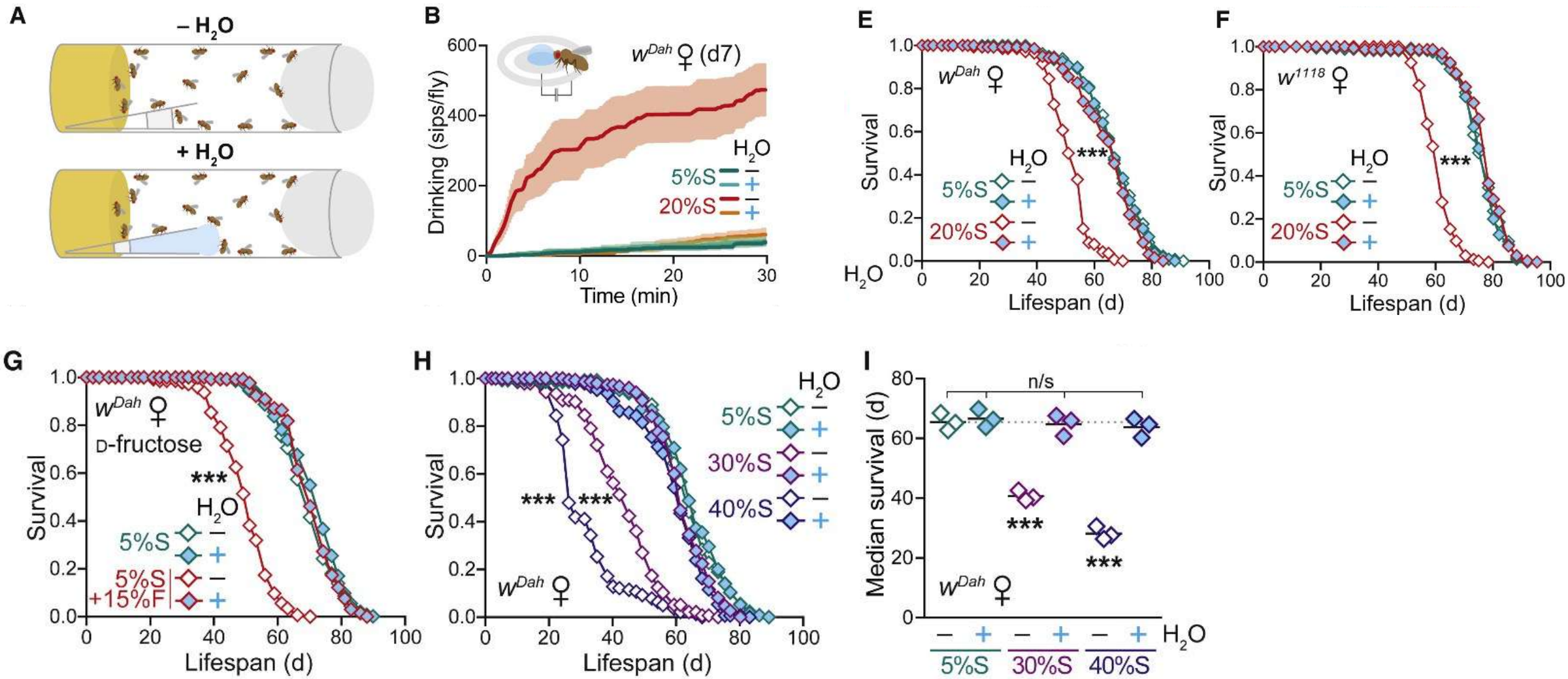
https://doi.org/10.1016/j.cmet.2020.02.016

1. How does sugar metabolism influence aging?

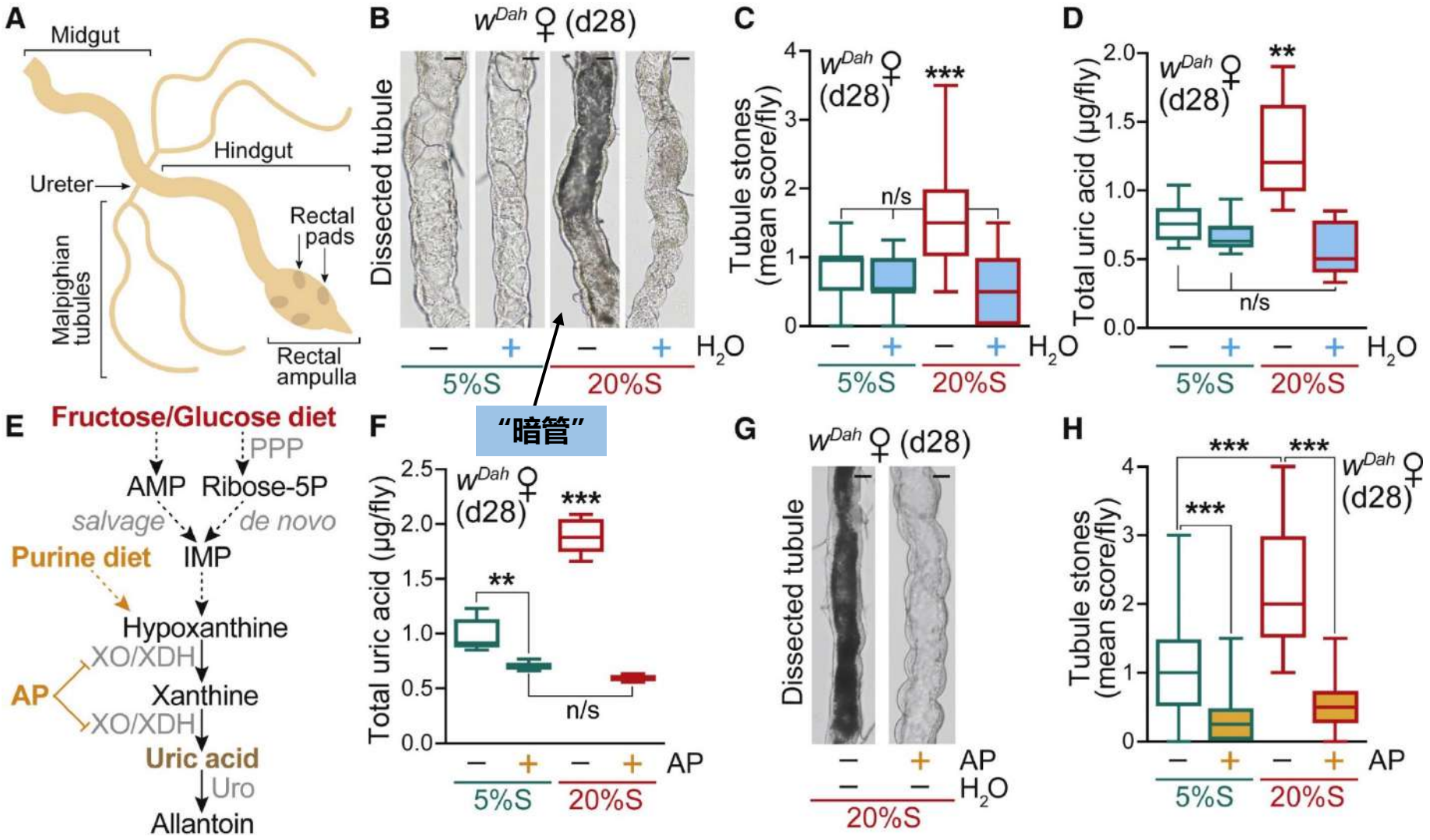
水分补充充分而有力地挽救了高糖饮食引起的寿命缩短



Esther van Dam et al. *Cell Metabolism* .2020

1. How does sugar metabolism influence aging?

高糖饮食与嘌呤分解代谢失调导致肾结石的小管功能障碍有关



Esther van Dam et al. *Cell Metabolism* .2020

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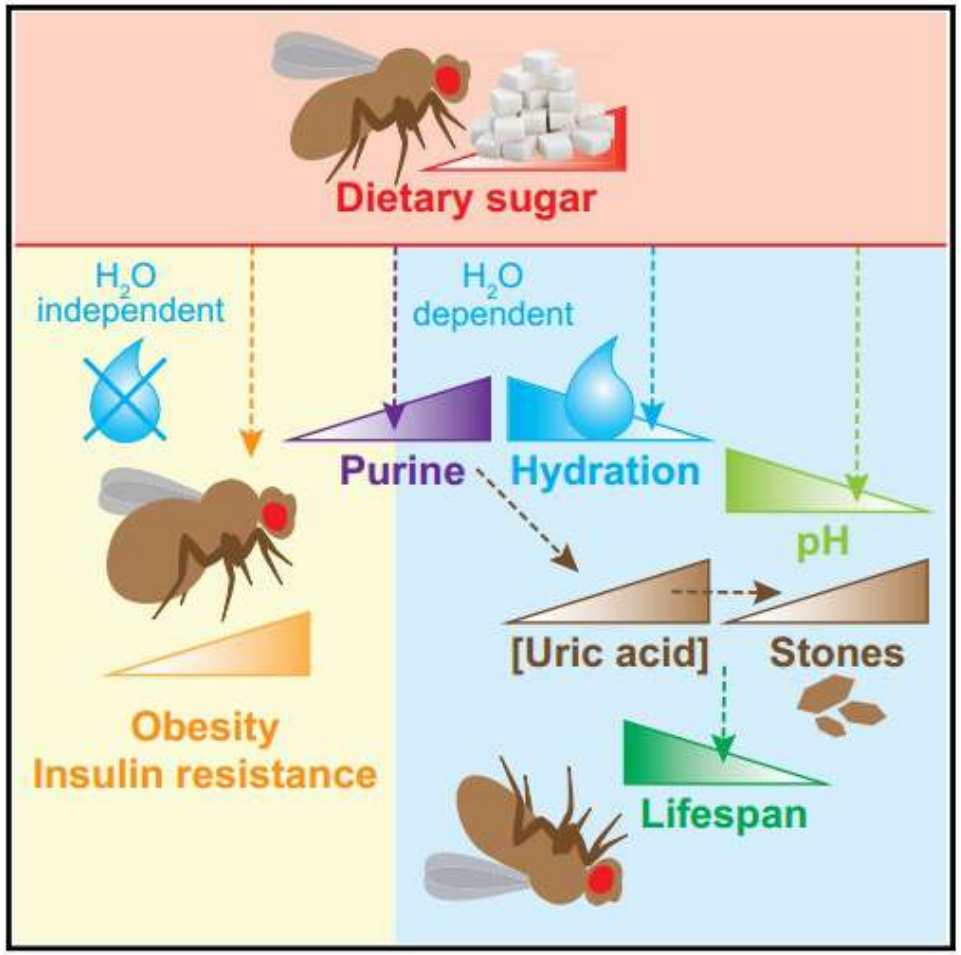

Sugar and aging:

1. High sugar diet induces uric acid deposition and tubule dysfunction, and then affects life expectancy.

高糖饮食以依赖于水的方式调节尿酸的产生，加剧肾小管结石的形成，进而影响寿命

SUMMARY

Lipid and aging:

1. *Drosophila* overexpressing Snz has higher triglycerides (TAG) in the storage of lipid droplets (LDs), which is more resistant to starvation stress and longer survival time.

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Sugar and aging:

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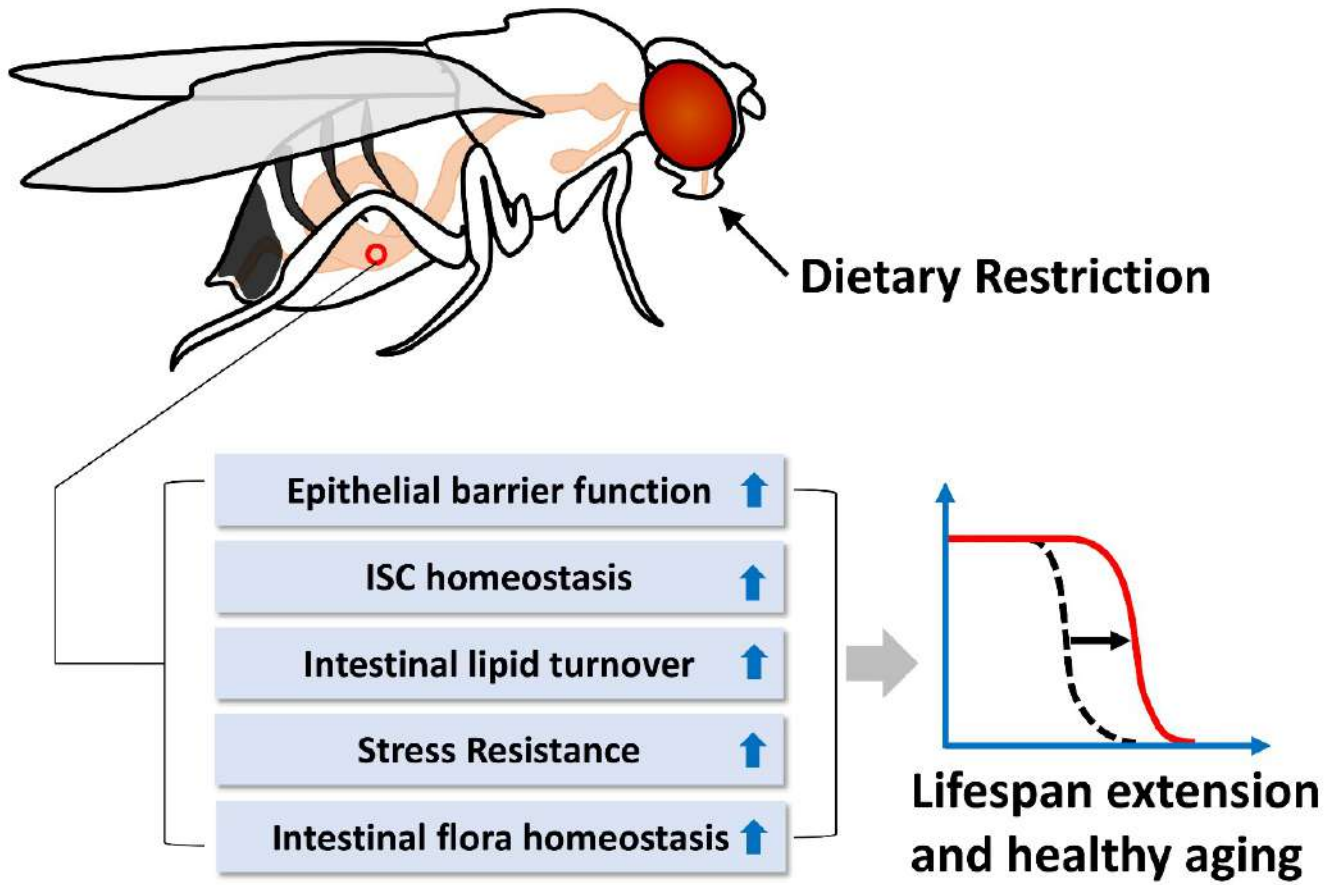
合理膳食，健康科研


Dietary Restriction
Epithelial barrier function
ISC homeostasis
Intestinal lipid turnover
Stress Resistance
Intestinal flora homeostasis
Lifespan extension
and healthy aging

THANKS!