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High-Sugar Adapted Drosophila Melanogaster Display Differences in Feeding Behavior

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High-sugar adapted *Drosophila melanogaster* display differences in feeding behavior

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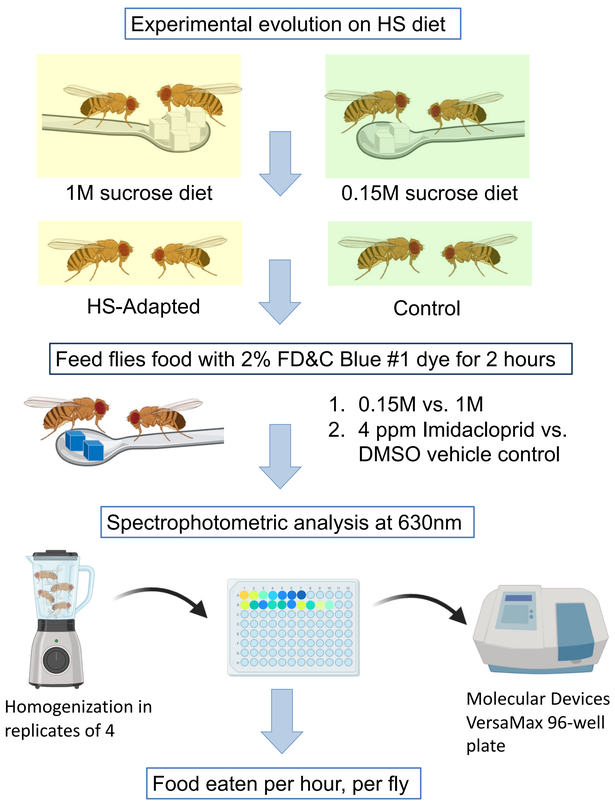
BACKGROUND

- Overnutrition due to chronic **high-sugar** (HS) feeding has been shown to elicit **type II diabetes**-like pathophysiology phenotypes, such as obesity and insulin resistance, in *Drosophila melanogaster* (1)
- We used an **experimental evolution** approach in Drosophila populations, using a HS diet as the selective pressure
- This has produced **rapid phenotypic adaptation**, and one mechanism by which flies might reduce the effects of a HS-diet would be to reduce **consumption**.
- Thus, we hypothesize that there will be **differences in feeding behavior** between the control (ctl) and HS-adapted (adp) populations.

- After comparing allele frequencies and gene expression between the control and adapted populations, we found that one overrepresented class of genes encoded proteins in the **acetylcholine signaling pathway**
- Based on previous studies demonstrating that **cholinergic signaling reduces feeding** (2,3), we hypothesize that **this pathway has a causal link to the feeding behavior differences**, and a competitive agonist, **imidacloprid**, of the acetylcholine receptor will **eliminate the consumption differences**.

METHODS

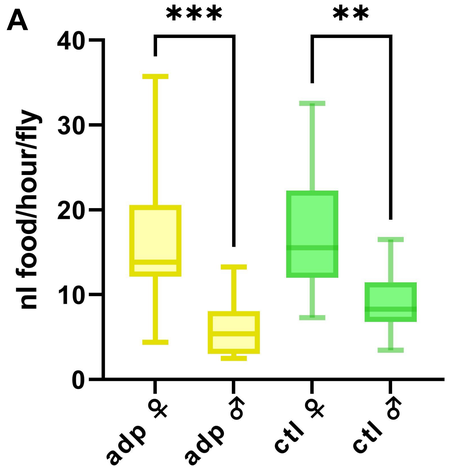
Figure 1. Measuring the consumption rates of adult flies.



High-sugar adapted *Drosophila* eat less, which may be mediated by acetylcholine signaling

RESULTS

Regardless of population, females ate more than males



Adapted populations ate significantly less than the control, regardless of the diet

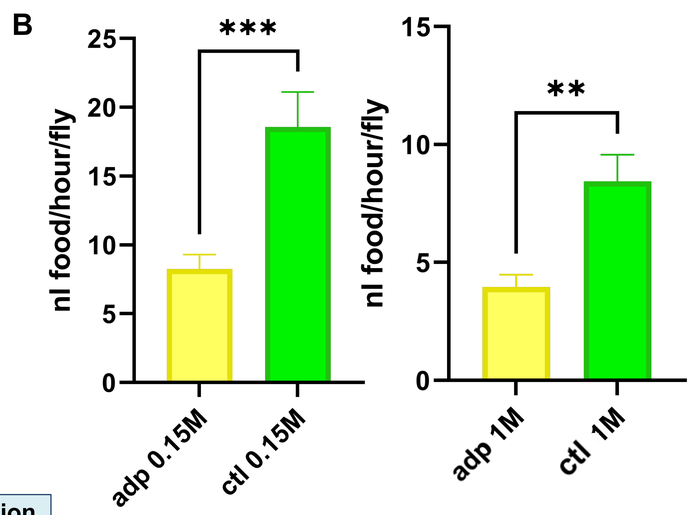


Figure 2 (above). Consumption differences between adapted and control populations. (A) Populations were separated by sex and fed on 0.15M (low sugar) food. (B) Females from the adapted and control populations were fed on either 0.15M or 1M. Data were transformed to nanoliters of food per hour, per fly, and significance was determined by a (A) one-way ANOVA and Tukey's multiple comparisons test and (B) two-tailed unpaired student's t-test. **p<0.01; ***p<0.001

Imidacloprid eliminated the consumption differences between the adapted and control populations

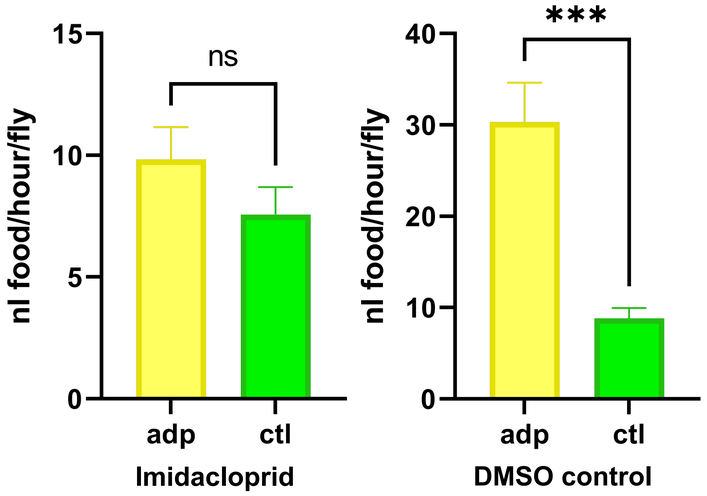


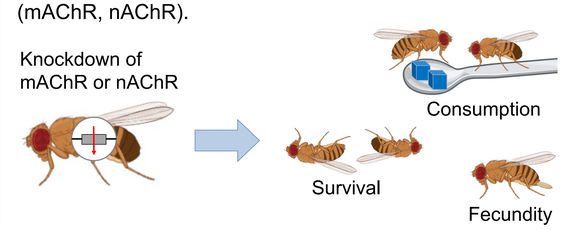
Figure 3 (left). Consumption differences between adapted and control populations on imidacloprid-supplemented food. Females were separated by population and fed on either 4ppm imidacloprid-supplemented or 1% DMSO-supplemented food. Data were transformed to nanoliters of food per hour, per fly, and significance was determined by two-tailed unpaired student's t-test. **p<0.01; ***p<0.001

CONCLUSIONS

- Consistent with previous studies, males ate less than females, regardless of sucrose quantity in the diet.
- Adapted populations consumed significantly less food than the control, regardless of the diet. There may be some underlying biochemical or neurological process driving this decrease in consumption.
- As suggested by the elimination of consumption difference by imidacloprid, acetylcholine signaling may be involved in the reduced feeding observed with HS-adapted flies.

FUTURE STEPS

Phenotype genotypes with loss-of-function in several different acetylcholine pathway-associated genes, such as the muscarinic and nicotinic acetylcholine receptors (mAChR, nAChR).



- If the acetylcholine signaling pathway is protective against overnutrition, knockdowns should have decreased fitness on HS diet compared with control.

- The discovery that the acetylcholine signaling pathway protects against overnutrition and increases the lifespan of Drosophila will allow us to investigate this pathway as a potential therapeutic target to increase resilience against metabolic disease.

ACKNOWLEDGEMENTS

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