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Effect of Larval Starvation on Lipid Content of Drosophila melanogaster Over 15 Days

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Introduction

- Starvation-resistant “S” *Drosophila melanogaster,* common fruit flies are genetically, behaviorally, and physiologically different to wildtype “F” flies
- S flies are more obese, twice as much lipids as F flies; results from S larva feeding for 5 days while F larva only feed for 4.
- S flies have energy-conserving behaviors not observed in F flies or any wild populations.
- Question: Are S flies genetically predisposed to be substantially more obese than S flies or if it is a result of this alternate behavior exhibited as larva where they feed for a longer amount of time?
- 3 populations of S *Drosophila* were raised from eggs where they were only allowed 4 days to feed, as opposed to 5 days, in order to observe what effects it would have on the lipid content of these individuals once they reached adulthood.
- Control populations of S and F flies also raised to make meaningful comparisons.

Figure 1. Selection for starvation resistance. Each generation of flies are transferred to population cages containing two dishes of 1% agar as a water source. When >80% have died, agar is replaced with food. Fed control populations receive food continuously. Each selection treatment includes three replicate populations A, B and C. The samples in this experiment are the 121st generation of selection.

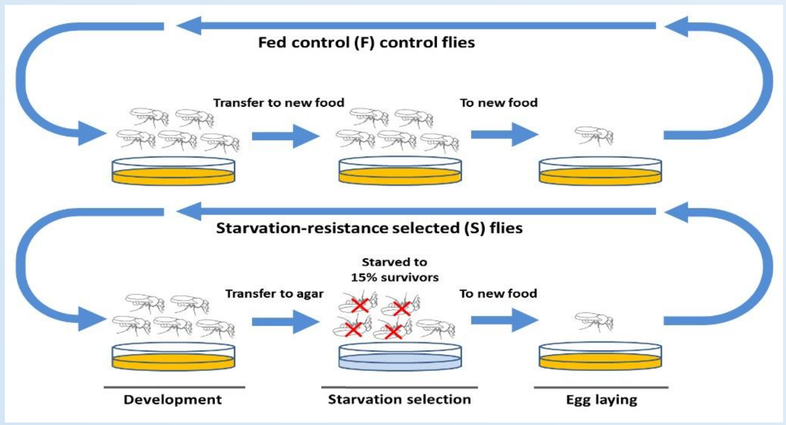
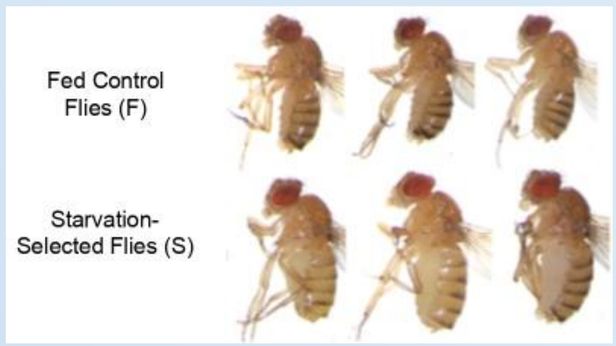


Figure 2. Starvation-selected (S) flies are visibly larger than controls. This mass discrepancy results from higher lipid content, protein content is approximately the same in F and S populations.



Methods

- 3 fly treatments were observed with 3 replicate populations for each S, F and LS
- F and S flies allowed food throughout entire lifespan; LS flies allowed to feed for 4 out of 5 days of larval stage, allowed food at all times in adulthood
- All populations in question placed under identical conditions for adult lifespans
- 10 Samples were collected from each population during their adult lives for days 0, 1, 2, 3, 6, 9, 12, and 15 and preserved in a freezer.
- 3 Masses were recorded from each fly sampled, Dry Mass, Extracted Mass, and Lipid Mass.

Results

Figure 3. Dry Mass Averages The masses of fly samples after ~24 hours in a 50°C oven. Measured in milligrams, S flies had the largest total mass of all populations at all points in time, with females having an overall greater mass than males. Throughout their lifetimes, Male flies exhibited a consistent mass while LS and F females increased at a near constant rate.

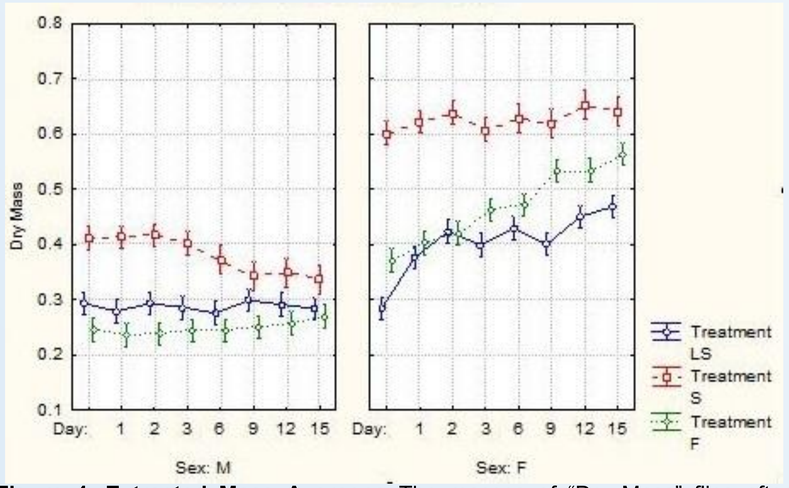


Figure 4. Extracted Mass Averages The masses of “Dry Mass” flies after extracting all lipids, Measured in milligrams. A measure of protein: the masses of the S and F flies is for the most part comparable throughout their lives while the LS mass is significantly lower, an evident result from larval starvation.

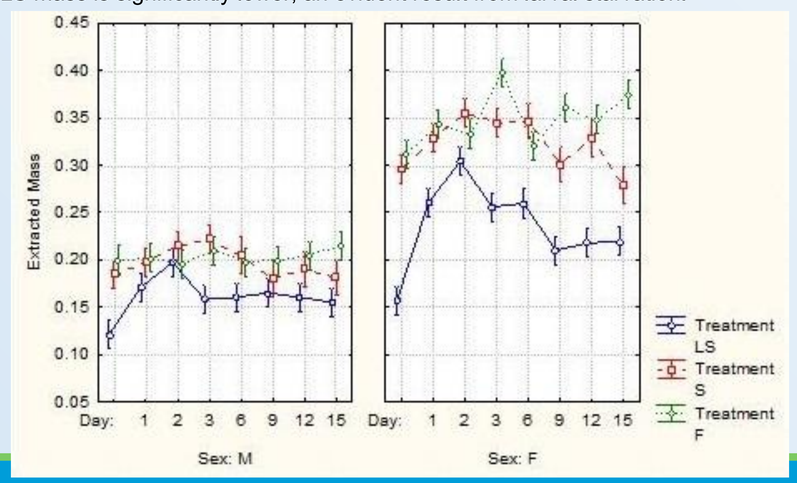
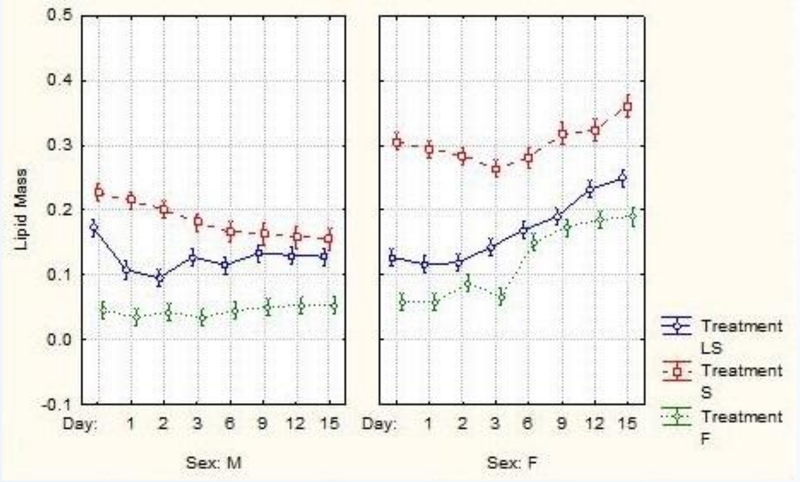


Figure 5. Lipid Mass Averages The difference of “Extracted Mass” subtracted from the “Dry Mass” and the primary piece of data of interest. It can be clearly observed that at no point do the LS masses reach S mases. This discrepancy is more evident with the female populations, however, it can be confidently stated that LS lipid mass will ever equate the mass of an S fly.



Conclusion

- Lipid content of the LS flies never definitively equaled lipid content of S flies,
- Flies starved as larva resulted in very skinny starvation-resistant individuals that had masses usually only observed after a prolonged period of adult starvation
- Larval starvation also caused a reduction in protein content compared to the F and S populations who had similar extracted masses throughout
- LS flies as adults had both lower lipid content and lower protein content throughout their entire life spans from which they never recovered from.
- The amount of nutrients that a larva eats is monumentally important in its development into adulthood
- Obesity is likely not a predetermined genetic property of a fly; availability of food during early development is far more impactful.

Future Implications

- Observing behavior and physiology of the LS flies could be valuable; It is not known whether the LS flies were under a healthy form of homeostasis or if they were physiologically limited by their reduced weight.
- Relatively little is known regarding animal starvation in general; further study using more samples and alternate variables could potentiallly be useful in the fields of physiology and ecology

Acknowledgements

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