Metabolic mechanisms of cold tolerance in *Drosophila melanogaster*

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**Abstract**

The objective of this project is to identify metabolic mechanisms of cold tolerance in *Drosophila melanogaster* (fruit flies) using metabolomics. For my project we conducted a preliminary experiment to test cold shock tolerance between -1 and -7°C in 20 isogenic lines from the Drosophila Genetic Reference Panel (DGRP). Among these lines there was considerable variation in cold tolerance; the best-performing lines showed little to no mortality until -6°C, while lines at the other extreme showed considerable mortality at temperatures as high as -1°C. Lines from each end of the cold tolerance distribution will be used for metabolomics experiments to identify metabolic features that correlate with cold tolerance.

**Introduction**

Insects are constantly subjected to changes in the environmental temperatures on both seasonal and daily time scales. Low temperature affects insects based on the severity of the cold and the duration of exposure. *Drosophila melanogaster* experience “cold shock”, i.e. injury due to cold damage to membranes, proteins, and other cellular components, when exposed to moderately cold temperatures. However the genetic and biochemical mechanisms of cold tolerance are poorly understood. Thus in study we will use metabolomics to explore biochemical adaptations off cold tolerance in a panel of lines with genetic variation in cold temperatures.

**Hypothesis**

Naturally segregating genetic variation in cold tolerance is partly explained by genetic variations in metabolism.

**Goals**

- Find lines from the DGRP that show variable tolerance to low temperatures
- Determine weather allelic variation in cold tolerance candidate genes explains phenotypic variance in cold tolerance
- With a subset of lines with high and low cold tolerance, use metabolomics to determine metabolic adaptations that permit survival at low temperature

**Materials & Methods**

- *Drosophila melanogaster* were reared for a period of two weeks at 25°C in half pint milk bottles containing Drosophila medium (cornmeal, molasses, yeast, agar).
- The flies were lightly anesthetized with CO2. After being removed from the bottle groups of 20 females were placed in separate vials
- All lines were exposed to low temperatures between -1 and -7°C for 1 h
- The righting response was used to score live and dead flies

In this study 20 *D. melanogaster* lines were exposed to a 1 h cold shock at different temperatures. The results clearly indicate there is considerable genetic variation in the ability to survive subzero temperatures. The best lines show that survival of flies was near 100% until -6°C, while the worst lines death had considerable mortality starting at -1°C. The below graphs are arranged in order from the best lines to the worst lines.

**Future Project Direction**

To explore the effects of cold shock on the metabolome of *D. melanogaster*

Identifying the specific metabolites that correlate with low temperature tolerance

Use the metabolite profiles of *D. melanogaster* to show the intermediate stage in between genotype and phenotype

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**References**