Exposure to mild hot stress or to chill coma stress correlate with changes in lipid profiles, physiological performance and longevity in the Medfly, *Ceratitis capitata*

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Introduction:

Ageing is a combination of internal and external factors acting upon the microheterogeneous genetic background of an individual within a population, thus contributing to senescence parameters of that population. Stress experiments are useful to analyze physiological changes in *C. capitata*, the Medfly. Indicators of functional senescence can be correlated with different kinds of stress, eventually induced at different ages of adult medflies.

1. Characterization of Lab populations

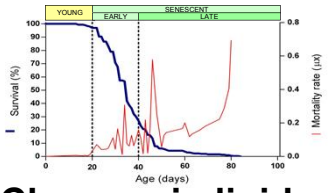

Figure 1. Reference curves of % survival and mortality rate (red) of Medfly laboratory populations at 23ºC, and classification in young <20d and senescent.

2.Changes in lipid profiles with age

Neutral and polar lipids profiles of *C. capitata* populations kept at 23°C, at different ages were analyzed. Lipid classes were separated by planar TLC, and quantitative values were used to find patterns of change using a multivariate Principal component analysis PCA approach. Functional senescence components (FSC) are indicators of functional state of flies.

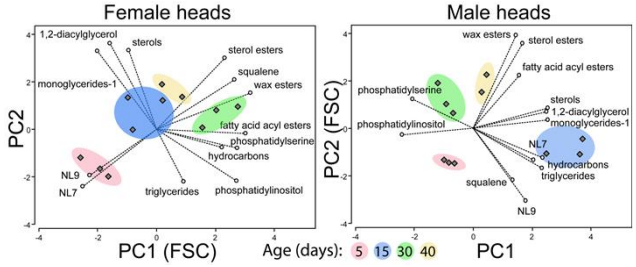

Figure 2. PCA biplot of PC1 vs. PC2 for male and female heads. Different populations with the same chronological age became grouped (color areas)

3. Survival, behavior and lipid profiles under mild hot stress

Adult populations were kept at 28°C and compared to those obtained at 23°C. FSC obtained at 23°C were used to estimate changes at 28°C.

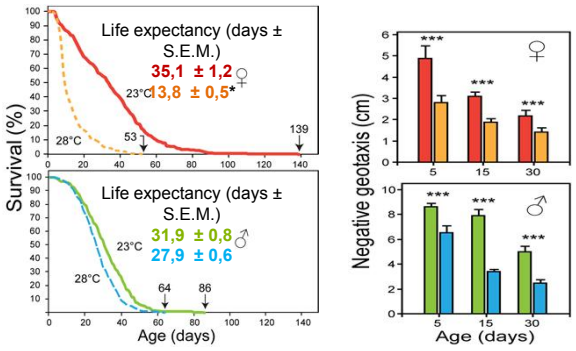

Figure 3 Survival (%) and negative geotaxis of male and female populations with age under normal (23°C) and mild hot stress (28°C) conditions.

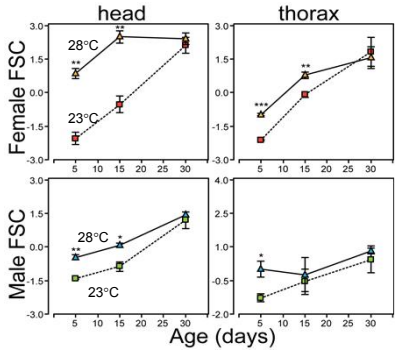

Figure 4. FSC of male and female head and thorax under normal (23°C) and mild hot stress (28°C) conditions. Lipid profiles in young female stressed populations where primarily affected in head, and to a lesser extend in thorax. In males, the changes produced under thermal stress caused statistically significant but smaller differences in lipid profiles.

Statistics.*p<0.05,**p<0.01,***p<0.001. Letters indicate differences (p<0.05).

4. Survival, behavior, lipids and gene expression after chill coma recovery

C. capitata experimental populations of 15 and 30 days old were subjected to a chill-coma recovery assay (chill-coma 4h at 0°C; recovery at 23°C), and separated according to their recovery time in three subgroups per age and sex. FSG, Fast-Subgroup (blue); ISG, Intermediate-Subgroup (red); SSG, Slow-Subgroup (green).

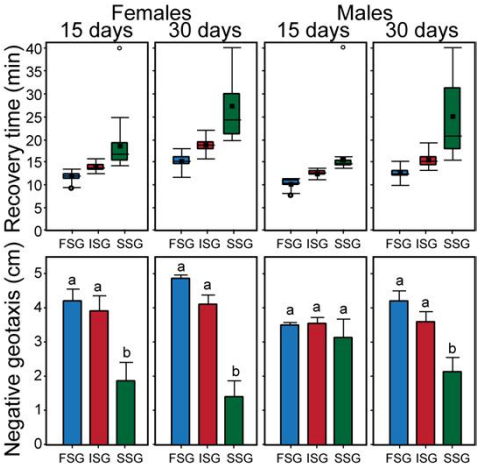

Figure 5. Recovery time of subgroups and their behavioral output. The boxplot graphs show that the variability in recovery time of flies was greater for SSG, except for 15-day-old males. Negative geotaxis results show that flies from SSG climbed a lower distance comparing with FSG and ISG except for 15-day-old males. Young males were somehow resilient to cold stress, as showed also for their survival (Figure 5).

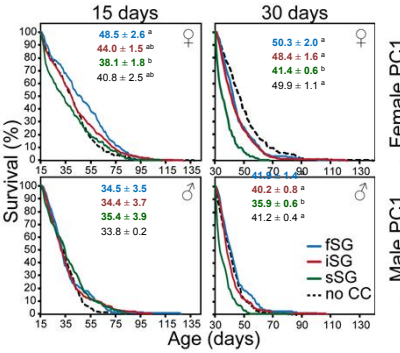

Figure 6. Survival (%) of male and female subgroups. No CC: not subjected to chill-coma. Inset tables: life expectancy (days ± S.E.M.).

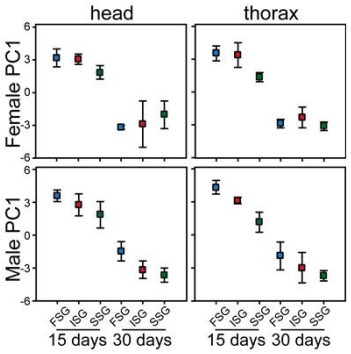

Figure 7. Lipid profiles change with age and subgroup as showed by PC1 for head and thorax.

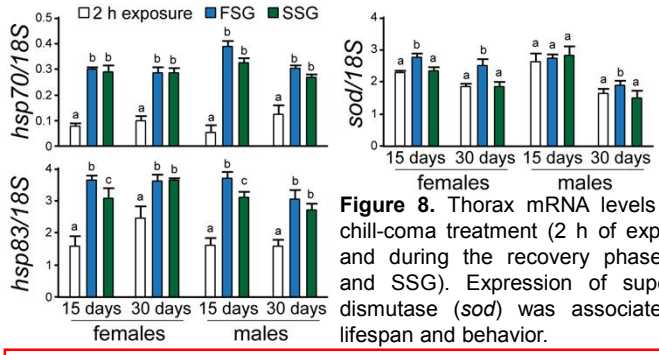

Figure 8. Thorax mRNA levels during chill-coma treatment (2 h of exposure), and during the recovery phase (FSG and SSG). Expression of superoxide dismutase (*sod*) was associated with lifespan and behavior.

Conclusion:

Both neutral (mostly reserve) an polar (mostly membrane) lipids seem excellent indicators of the functional state of flies within a population. Young stressed insects showed similar parameters than older non-stressed ones, establishing a proof of principle. Behavioral parameters and changes in gene expression under stress correlated well with lipid profiles .

Pujol-Lereis et al. **(2016)** Journal of Insect Physiology. 87:53-62.
Pujol-Lereis, et al. **(2014)** Journal of Insect Physiology. 71:156-163.