Lipid Peroxidation Recovery after an Acute Thermal Challenge in a Marine Intertidal Mussel (*Mytilus californianus*)

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Introduction

- The California mussel (*Mytilus californianus*) lives in the intertidal zone, a stressful environment ranging from fully terrestrial to fully aquatic conditions.
- Heat stress during low tide can induce the formation of reactive oxygen species (ROS), which can cause lipid peroxidation (LPO) damage in cellular membranes.
- Oxidative stress (accumulation of oxidative damage to cellular molecules) results from an imbalance between ROS production and cellular antioxidant defenses.
- It is known that an acute thermal challenge to 33 °C causes increased LPO in gill. However, there is no chronic accumulation of LPO after daily exposure to 30 °C for a month ("Heat" in Figure 1).

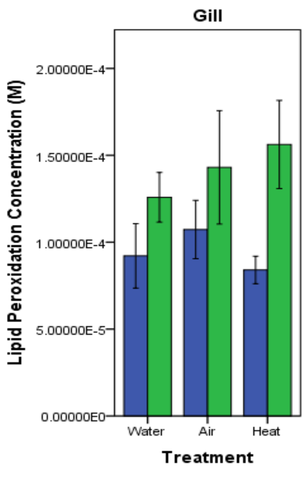

Figure 1: LPO significantly increases after acute thermal challenge (Jimenez et al. 2016).

Objective

- The present study had two objectives:
  1. Determine the time course of recovery for acute exposure to 33 °C.
  2. Determine whether 30 °C causes a similar, acute rise in LPO in gill.

Methods

- 37 mussels were common gardened for four months to erase residual effects of environmental factors due to variation in their natural environment.
- The mussels were then divided into thermal challenge groups (30 °C or 33 °C) and then time-point groups (n = 5-6) for each thermal challenge.

Methods (continued)

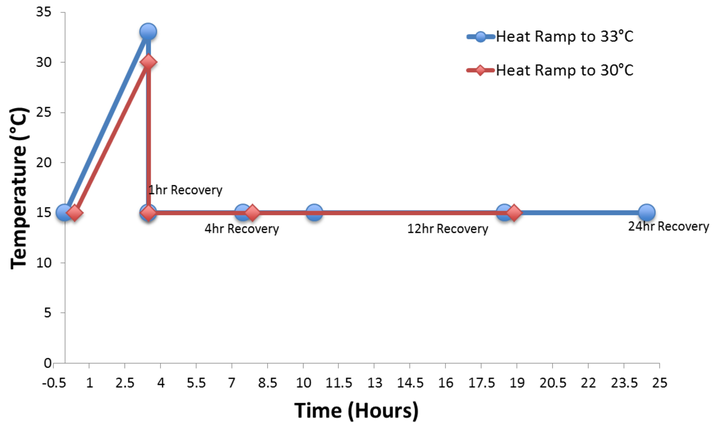

Figure 2: Animals exposed to a 33 °C heat ramp were sampled at the following time-points: baseline (before heat ramp), top of the ramp, and 1, 4, 12, and 24hr recovery. Animals exposed to 30 °C were sampled at the top, 1hr, and 12hr time-points

- To assess lipid peroxidation, we used a microplate-based version of the Ferrous Oxidation of Xylenol Orange (FOX) assay (Wolff 1994; Jimenez et al. 2016).

Figure 3: Thermal challenge in a neo-natal incubator.

Results

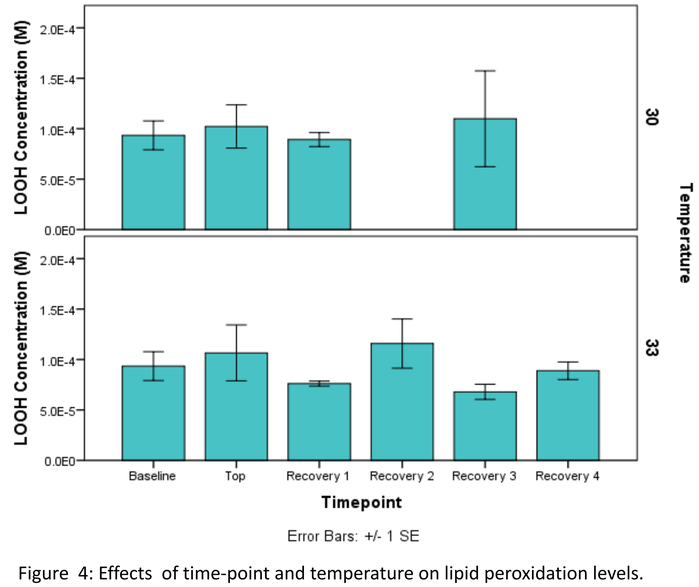

Figure 4: Effects of time-point and temperature on lipid peroxidation levels.

Results (continued)

- Box-Cox transformed data from each thermal challenge group were analyzed together using a 2-way ANCOVA and separately with a 1-way ANCOVA, with shell length as a covariate in all cases.
- In no case was LPO found to vary significantly, specifically:
  - LPO did not vary between thermal challenge groups ($p = 0.881$).
  - LPO did not vary significant at recovery time-points for either the 33 °C ($p = 0.573$) thermal challenge or the 30 °C ($p = 0.714$).
  - Length did not significantly affect amount of LPO ($p > 0.05$).

Conclusions and Future Work

- A thermal challenge to 30 °C did not cause an acute rise in LPO.
- Recovery time could not be measured in the 33 °C thermal challenge group because no acute rise in LPO was observed.
- Our results contradict previous research that showed a thermal challenge to 33 °C to cause an acute rise in LPO.
- Future work would include first repeating these experiments; there are some concerns about the health of our animals that might have affected the data, especially considering that our data disagree with previous results.

Acknowledgements

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Citations

Jimenez, A. G., Alves, S., Dallmer, J., Njoo, E., Roa, S., & Dowd, W. W. (2016). Acclimation to elevated emersion temperature has no effect on susceptibility to acute, heat-induced lipid peroxidation in an intertidal mussel (*Mytilus californianus*). *Marine Biology*, 163(3), 1-10.

Wolff, S. Ferrous Ion Oxidation in Presence of Ferric Ion Indicator Xylenol Orange for Measurement of Hydroperoxides. Methods in Enzymology, 233 (1994), 182-189.