Mitochondrial response to OAW in Atlantic cod embryos

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Introduction:

- Atlantic cod (*Gadus morhua*) is an economically important fish exploited by both fishery and aquaculture, especially in the North Atlantic and Arctic Oceans.
- Climate changes happen faster in the high latitude oceans with a higher increase of temperature and a steeper decrease in water pH threatening the existence of Atlantic cod in the areas of its maximum exploitation.
- Embryos might be more sensitive to temperature and PCO_2 stress because their compensatory systems are not fully developed

Method:

Atlantic cod broodstock from aquaculture were incubated in the facilities of the National Cod Breeding Centre of Tromsø (Norway) at:

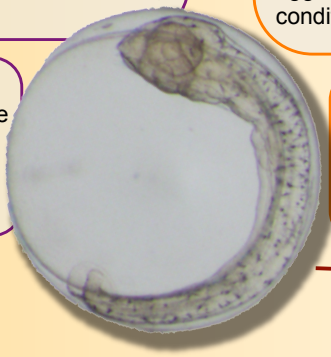
- 5°C / 390µatm CO_2 (habitat conditions)
- 10°C / 390µatm CO_2
- 10°C / 1000µatm CO_2 (year 2100 conditions)

After 2 months of incubation the animals were stripped, the eggs fertilized *in vitro* and reared under the same conditions of their parents until gastrulation.

Objectives:

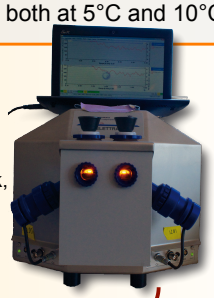
In this study we looked at the mitochondrial response at the OAW conditions forecasted for the year 2100:

- Effect of temperature on embryonic mitochondria.
- Effect of temperature and CO_2 combined.

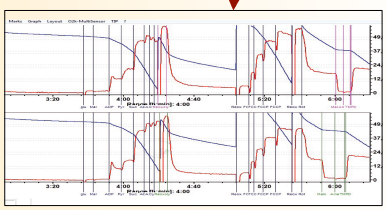


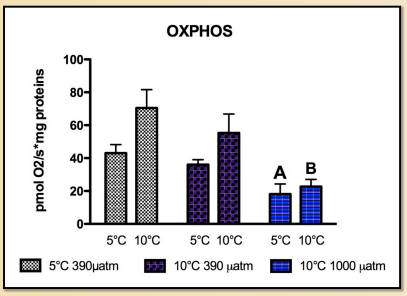
At the achievement of the "end of gastrulation" stage:

- Isolation of mitochondria from the whole embryo
- Mitochondrial respiration analysed by high-resolution respirometry
- Each group was analysed both at 5°C and 10°C

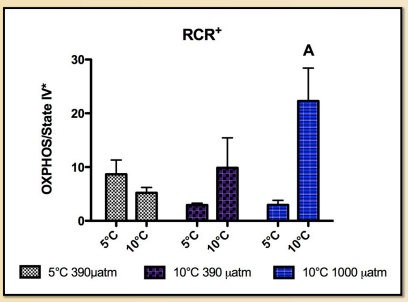


Oxygraph-O2k, OROBOROS Instruments

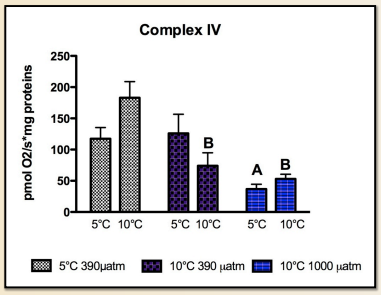




The Oxydative Phosphorilation capacity (OXPHOS) indicates the maximum activity of the ATP production pathway under physiological conditions. In our study the OXPHOS of the 10°C / 1000µatm group is reduced compared to all the other groups at both assay temperatures.



RCR+ is the ratio betwen OXPHOS and the respiration without ATP production induced by chemical inhibition (State IV+). The ratio depicts the coupling ratio of the mitochondria, higher is RCR+ and better coupled the mitochondria are.



Complex IV, or cytochrome c oxidase, is the final electron acceptor of the Electron Transport System, reducing O_2 to H_2O. In this study the capacity of Complex IV is lower in both groups incubated at 10°C compared to the control group.

Conclusions:

- The high RCR+ of the 10°C / 1000µatm group suggests that the mitochondria are very well coupled, probably as a mechanism to counteract the negative effects of high temperature and PCO_2. Therefore, the decrease in OXPHOS of this group could be caused by the action of regulatory-inhibitory systems triggered by the combination of temperature and PCO_2 rather than by the degradation of the mitochondrial structure.
- Because of the peculiar role of Complex IV in the Electron Transport System, the decreased capacity of this complex at 10°C might point at the complex as one of the targets of these regulatory-inhibitory systems.

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