

# Energy allocation in larvae of Atlantic cod, *Gadus morhua*



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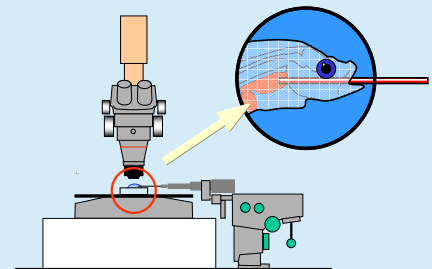
## Introduction

Marine fish larvae generally have low proteolytic capacity before the development of a stomach. Studies have indicated that early larvae have lower absorption rates and assimilation efficiency for protein than free amino acids (FAA), and that they have lower utilization efficiency of protein than more developed larvae. It is therefore very important to determine how this affects the parameters in energy budgets.

This experiment is the first step towards quantifying dietary effects on specific dynamic action (SDA) in developing Atlantic cod (7-50 days post hatch).

## Methods

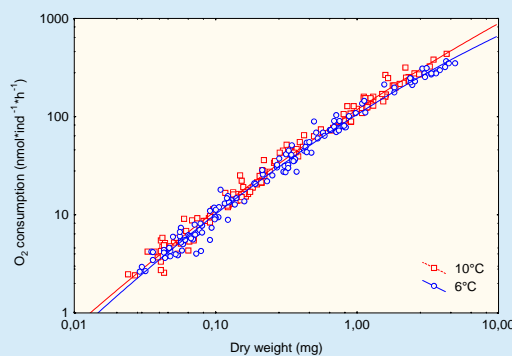
- The cod were reared in the laboratory at two different temperatures (6 and 10 °C). Samples were taken regularly during the experimental period.
- One of three highly concentrated test solutions (FAA, protein or NaCl) was tube-fed directly into the stomach/presumptive stomach of the larva with a tube-feeding method (Rønnestad et al., 2001) (figure 1).
- The oxygen-consumption for each larva was measured by closed respirometry and quantified as  $\text{nmolO}_2 \cdot \text{h}^{-1}$ .



**Figure 1:** The experimental setup of the tube-feeding method developed by Rust (1995) and modified by Rønnestad et al.(2000)

## Results

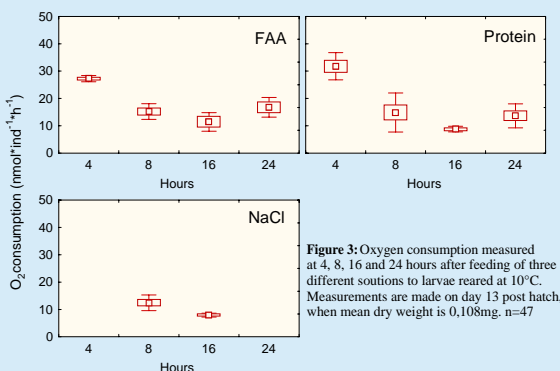
- The oxygen consumption for larvae reared at 10°C is significantly higher than for larvae with same weight reared at 6°C (ANCOVA,  $p < 0.05$ ). The difference is 10% (Figure 2).
- Both for the FAA and protein solutions tube-fed to 10°C larvae, the average oxygen consumption after four hours was significantly higher than average oxygen consumption after 8, 16 and 24 hours (ANOVA,  $p < 0.05$ ) (Figure 3).
- For larvae at 6°C tube-fed with FAA solution, the oxygen consumption after eight hours is significantly different from the oxygen consumption after 16 hours, (ANOVA,  $p < 0.05$ ) (Figure 4).
- There is no significant difference in oxygen consumption between different solutions.



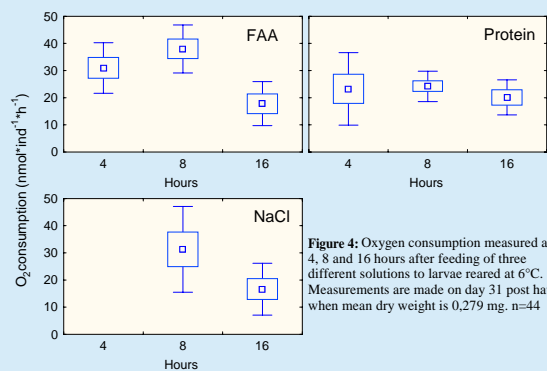
**Figure 2:** Oxygen consumption for cod larvae reared at 10°C (red) and at 6°C (blue) measured 18 hours after tube feeding.

## References

- Rust, M.B., Hardy, R.W., Stickney, R.R. (1993) A new method for force-feeding larval fish. *Aquaculture* 116, no 4, 341-352
- Rønnestad, I., Perèz Dominguez, R., Tanaka, M. (2000). Ontogeny of the digestive tract functionality in Japanese flounder, *Paralichthys olivaceus*, studied by in vivo microinjection: pH and assimilation of free amino acids. *Fish Physiology and Biochemistry* 22, 225-235.
- Rønnestad, I., C R. Rojas-García, S. Tonheim, and L.E.C. Conceição (2001). In vivo studies of digestion and nutrient assimilation in marine fish larvae. *Aquaculture* 201, 161-175



**Figure 3:** Oxygen consumption measured at 4, 8, 16 and 24 hours after feeding of three different solutions to larvae reared at 10°C. Measurements are made on day 13 post hatch, when mean dry weight is 0,108mg, n=47



**Figure 4:** Oxygen consumption measured at 4, 8 and 16 hours after feeding of three different solutions to larvae reared at 6°C. Measurements are made on day 31 post hatch, when mean dry weight is 0,279 mg, n=44

## Conclusions

- There is no difference in energy expenditure for larvae given different solutions by tube feeding.
- SDA seems to be completed within eight hours for larvae reared at 10°C and within 16 hours for larvae reared at 6°C.
- SDA contributes in this experiment to a minor proportion of the total metabolism compared to basal metabolism.