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Tailoring your feeds

MODELLING OXYGEN CONSUMPTION AND UTILIZATION OF PROTEIN AND LIPIDS AS ENERGY SOURCES IN LARVAE AND POST-LARVAE OF TWO FLATFISH

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INTRODUCTION

Models of growth and metabolism

Energy losses are a major driver of feed utilization

- indirectly estimated by oxygen consumption measurement
- simultaneous measurement of oxygen consumption and ammonia excretion allows to investigate relative utilization of protein and lipids as energy sources

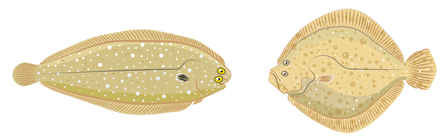
• **May be affected by crude protein and/or crude fat dietary levels**

Precision Feeding

Use of modelling techniques

Senegalese sole & turbot

• High interest for fish farming



Young stages have:
• High amino acid requirements
• Feeds with high cost:
(+50%) crude protein

Objectives: To assess the impact of diet protein and energy levels, feeding state, and feeding level, on the oxygen consumption and ammonia excretion of Senegalese sole (*Solea senegalensis*) and turbot larvae and post-larvae:
=> derive parameters of energy loss for modelling growth and nutrient utilization
=> investigate relative utilization of protein and lipids as energy sources using O:N ratios

CONCLUSIONS

- **Energy costs of maintenance and growth are non-additive in sole from 0.02 to 5 g, and in turbot from 0.02 to 8 g**
  => Oxygen consumption of fasted fish cannot be taken as good estimator of the energetic cost of maintenance in early life stages of Senegalese sole and turbot
- **Protein and energy dietary levels do not seem to affect oxygen consumption of early life stages of Senegalese sole and turbot**
- **Senegalese sole use essentially protein as energy substrate up to 5 g; the same holds for turbot up to 2 g; from 2 - 8 g turbot use more lipid than protein as energy substrate, and specially in the fed state**

MATERIALS AND METHODS

Fed 3 Diets with = DP/DE 100% and 80% of *Ad Libitium*

55:12 CP/CF

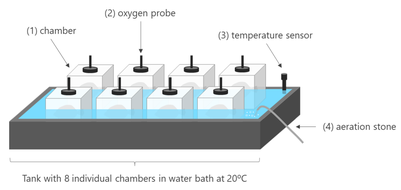
58:14 CP/CF

61:16 CP/CF

CP: **Crude Protein; CF: Crude Fat**

Senegalese sole *Solea Senegalensis*		Turbot *Scophthalmus maximus*
0.02 – 5 g	**Body Weight**	0.02 – 8 g
20.5 ± 0.6 ºC 35.9 ± 0.4 ppt	**Temperature** **Salinity**	20.5 ± 0.5 ºC 34.0 ± 0.9 ppt
	**Trial Facility**	
8 x / day for 115 days	**Feeding**	10 x / day for 60 days

Oxygen consumption and ammonia excretion



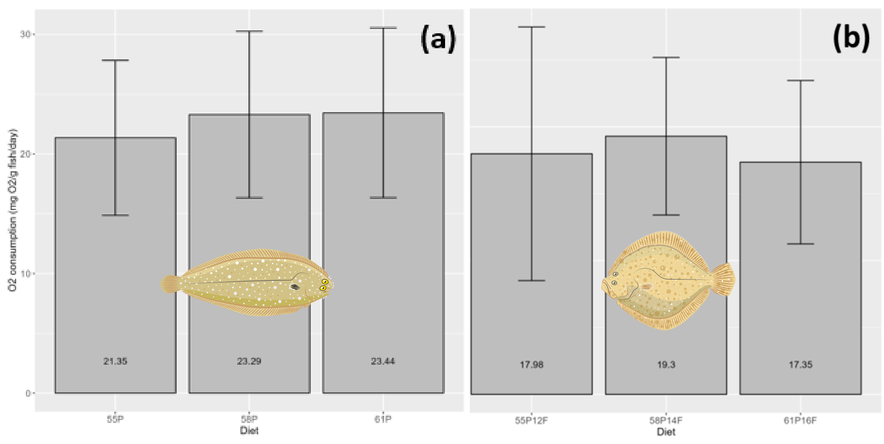
Oxygen probe: Oxy-4 ST, PRESENS, Regensburg, Germany

Closed respirometry until reaching an oxygen saturation threshold of 85-90%

Data analysis: Allometric model, after filtering, transforming and evaluating data robustness, using scripts written in R (version 4.2.3)

RESULTS

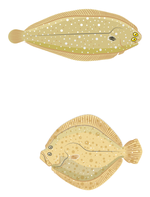
Oxygen consumption



Oxygen consumption (mgO_2/g fish/day) of:
(a) Senegalese sole at 40DAH; **(b)** turbot at 48DAH, fed 3 different diets

Fasted **sole** O_2Cons (mgO_2 $fish^{-1}day^{-1}$) = 9.02 . BW $^{0.81}$
Fed **sole** O_2Cons (mgO_2 $fish^{-1}day^{-1}$) = 10.15 . BW $^{0.78}$
Fasted **turbot** O_2Cons (mgO_2 $fish^{-1}day^{-1}$) = 16.92 . BW $^{0.84}$
Fed **turbot** O_2Cons (mgO_2 $fish^{-1}day^{-1}$) = 11.56 . BW $^{0.53}$

O:N ratio



Age	Fasted	Fed
DAH	Mean sd	Mean sd
48	4.8 ± 7.4	5.8 ± 12.7
90	6.9 ± 8.6	5.8 ± 15.9
141	3.8 ± 2.5	2.4 ± 1.0
40	1.0 ± 0.8	0.8 ± 0.6
53	4.6 ± 2.8	22.2 ± 94.9
67	144 ± 104	245 ± 803

O:N ratios (mgO_2/g fish/day / $mgNH_3$/g fish/day) of sole and turbot at different days after hatching (DAH)

- Both Senegalese sole and turbot have a very high variability in energy substrate utilization
- Senegalese sole use essentially protein as energy substrate up to 5 g; the same holds for turbot up to 2 g; from 2 - 8 g turbot use more lipid than protein as energy substrate, specially in the fed state
- Neither diet, nor feeding state (fasted or fed), affected the oxygen consumption during the early life of Senegalese sole and turbot

HATCHTOOLS

Acknowledgments:

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