

# OPTIMISATION OF DIETARY MACRONUTRIENT COMPOSITION FOR ATLANTIC HALIBUT (*HIPPOGLOSSUS HIPPOGLOSSUS*, L.) LARVAE AND JUVENILES



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# Experiments

- Optimisation of dietary macronutrient composition for Atlantic halibut juveniles
- Macronutrient composition of copepods and *Artemia* and responses in Atlantic halibut larvae fed the two diets

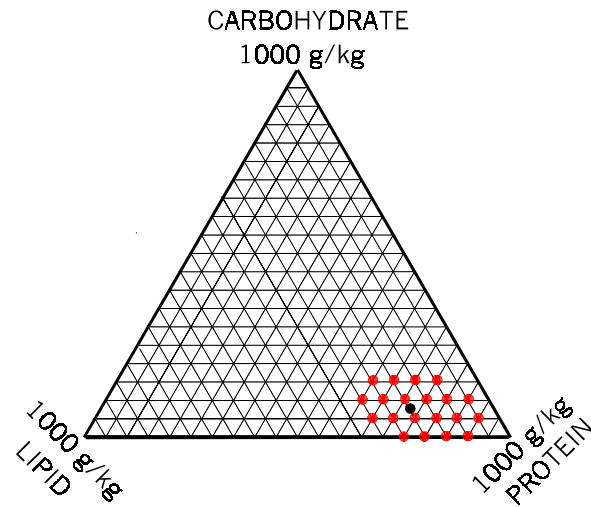
# **Optimisation of macronutrients:**

## **Dietary ingredients**

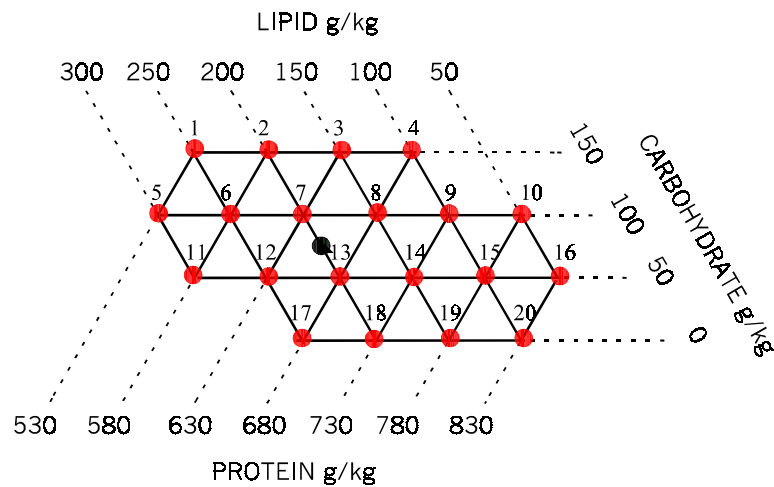
- **Protein source:** Cod muscle:squid mantle 9:1
- **Lipid source:** Sardine oil:lecithin 9:1
- **Carbohydrate source:** Extruded wheat
- **Vitamins**
- **Minerals**

# Design

a)



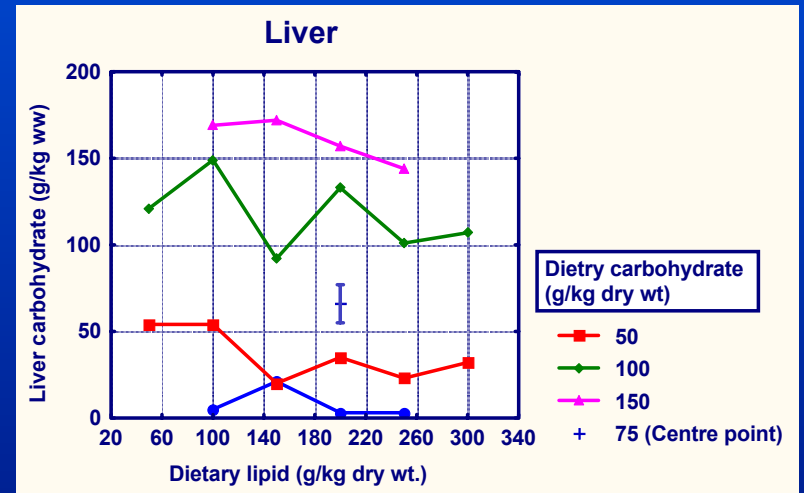
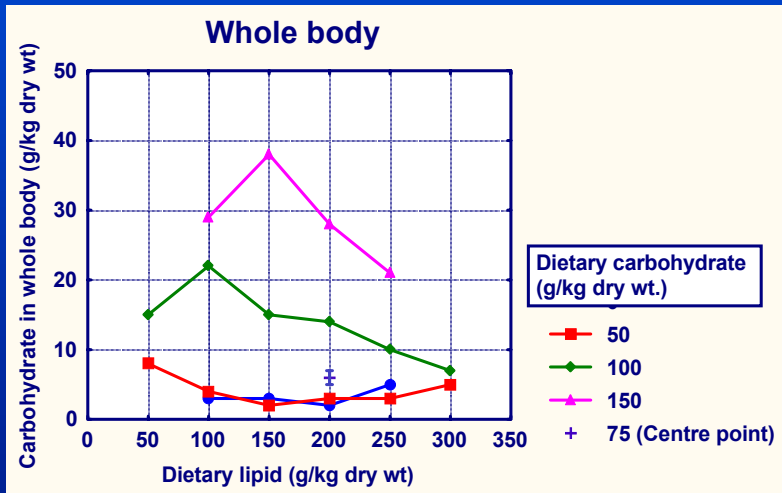
b)



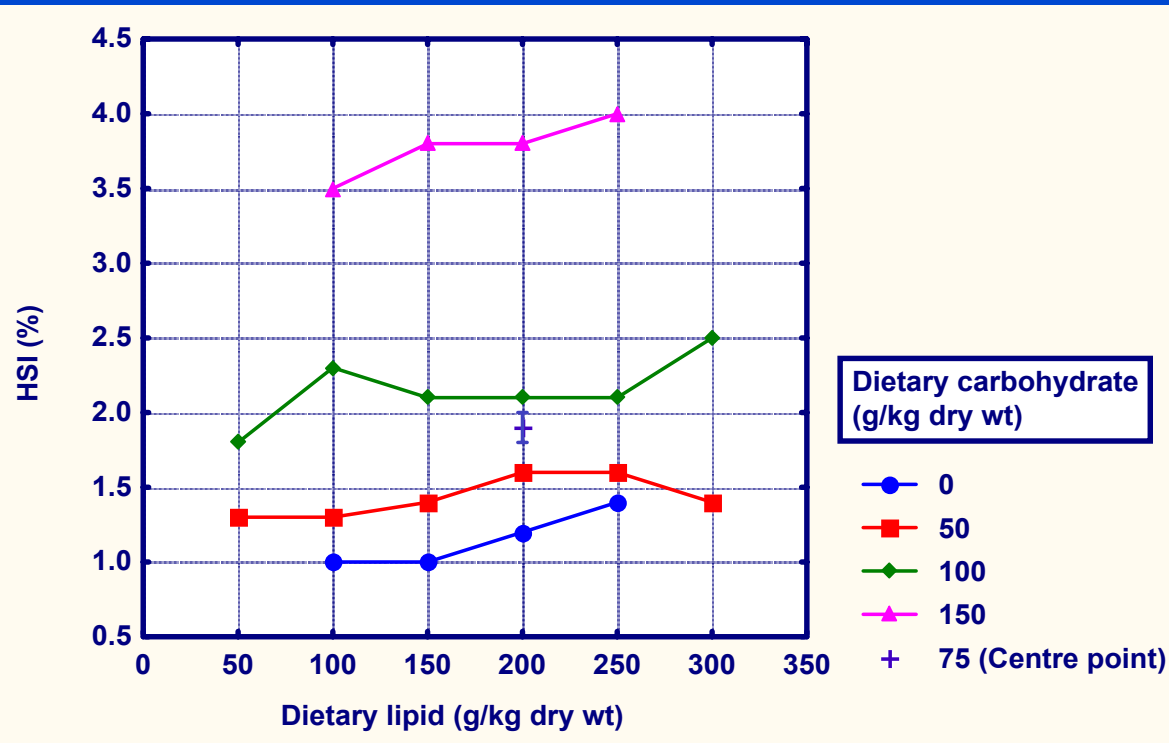
# Experimental

- Each diet was fed to fish in one tank, except the centre point diet which was fed to fish in 4 tanks to estimate inter tank variation
- Initial fish weight:  $0.5 \pm 0.2\text{g}$
- Experimental period: 70 days
- Overall mean final weight:  $6.2 \pm 1.1\text{g}$

# Carbohydrate in tissues



# Hepatosomatic index



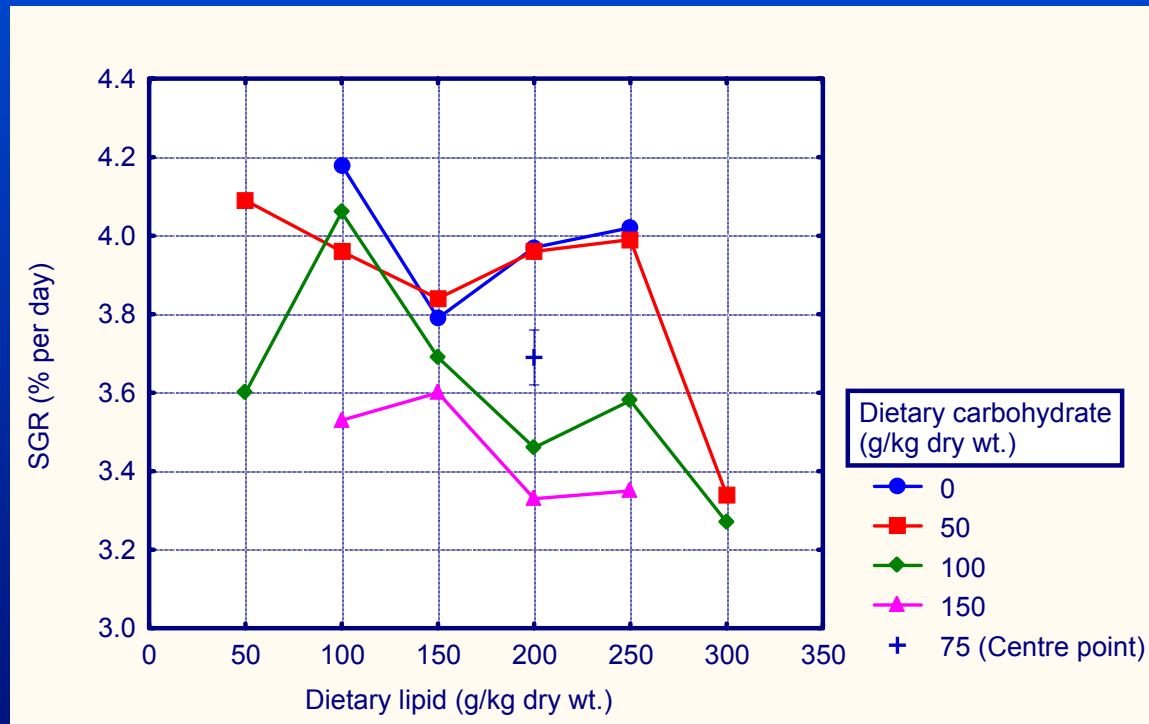
# Carbohydrate in tissues

(g kg<sup>-1</sup> wet wt.)

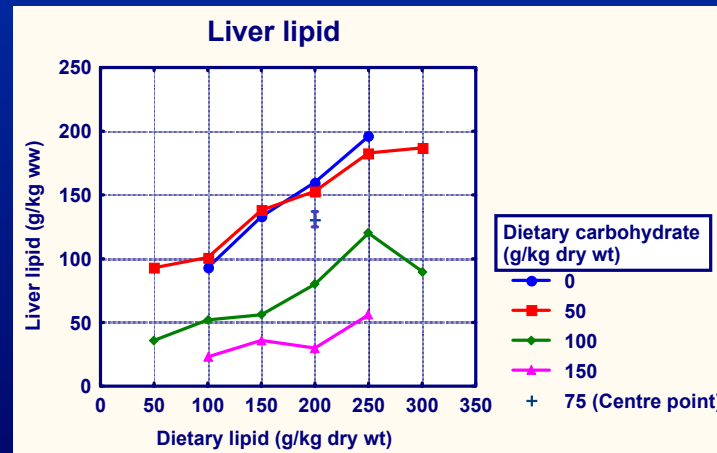
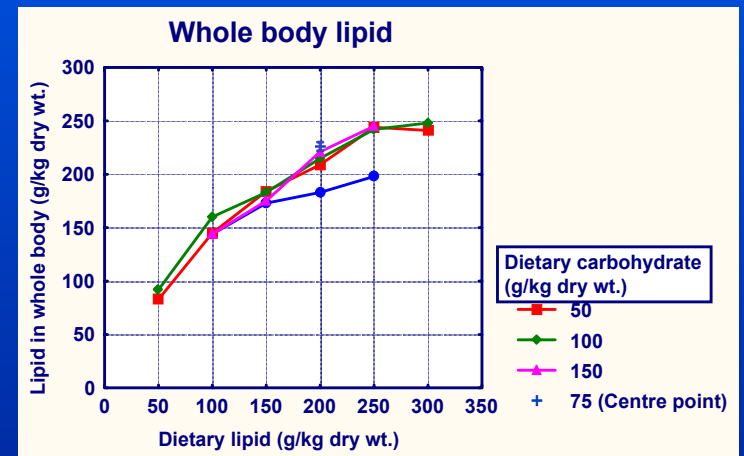
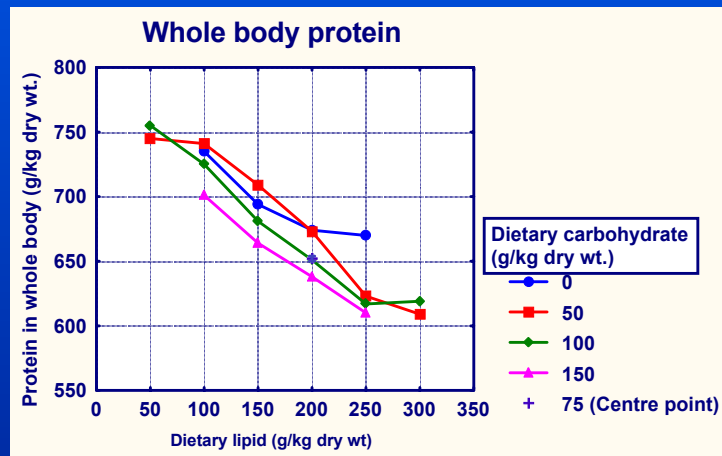
CH <sub>feed</sub>	HSI	CH <sub>liver</sub>	CH <sub>whole body</sub>	CH <sub>whole body</sub> -
(g kg <sup>-1</sup> dry wt)	(%)			CH <sub>liver</sub>
0	1.2±0.2 <sup>a</sup>	8±9 <sup>a</sup>	3.3±1.3 <sup>a</sup>	3.2±1.3 <sup>a</sup>
50	1.4±0.1 <sup>a</sup>	36±15 <sup>ab</sup>	4.2±2.1 <sup>a</sup>	3.7±2.0 <sup>a</sup>
75	1.9±0.1 <sup>b</sup>	66±11 <sup>b</sup>	2.8±1.0 <sup>a</sup>	1.5±0.8 <sup>a</sup>
100	2.2±0.2 <sup>b</sup>	117±21 <sup>c</sup>	14±5 <sup>b</sup>	11±5 <sup>b</sup>
150	3.8±0.2 <sup>c</sup>	161±13 <sup>d</sup>	29±7 <sup>c</sup>	23±7 <sup>c</sup>



# Specific growth rate



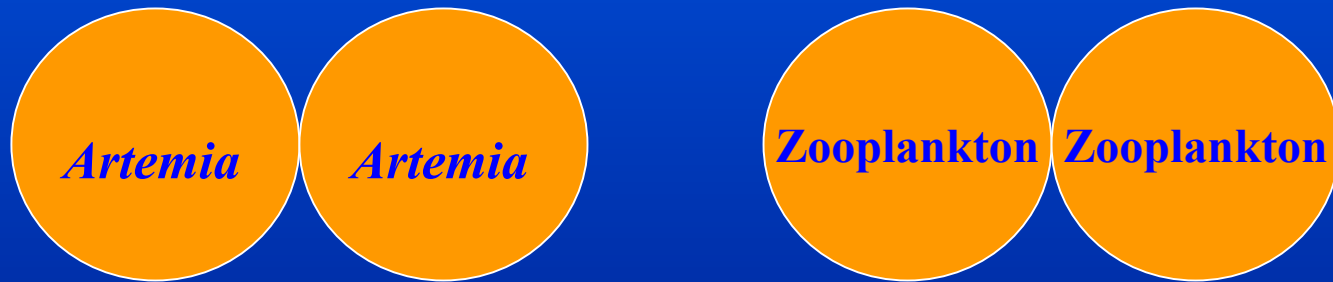
# Protein and lipid in tissues



# Conclusions

- Dietary carbohydrate above 7.5% of dry weight is detrimental to Atlantic halibut juveniles. 0-5% appears acceptable.
- At low carbohydrate, 5-25% dietary lipid seems to give similar growth rates. 30% lipid may be too high, but this must be confirmed in an experiment with triplicate treatments.
- Assuming 5% carbohydrate and 25% lipid as limits, dietary protein requirement can be estimated as 63% of dry weight.

# Macronutrients in *Artemia* and zooplankton



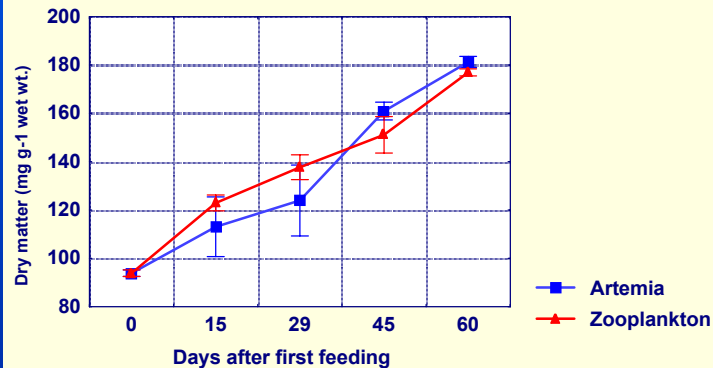
- *Artemia* enriched with DHA Selco
- Zooplankton collected from a fertilised sea water pond (Svartatjønn, Austevoll), mostly *Eurytemora affinis* and *Centrophages hamatus*.
- Experimental period: First-feeding until 60 DPF

# Macronutrients in live feed

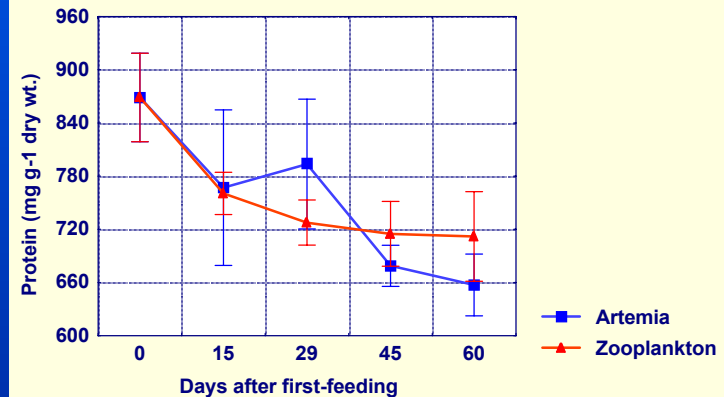
(% of dry wt)	<i>Artemia</i>	Zooplankton
Protein	62±4	72±8
Lipid	27±1 <sup>a</sup>	16±3 <sup>b</sup>
Glycogen	7.4±0.6 <sup>a</sup>	0.5±0.2 <sup>b</sup>

# Macronutrient composition of larvae

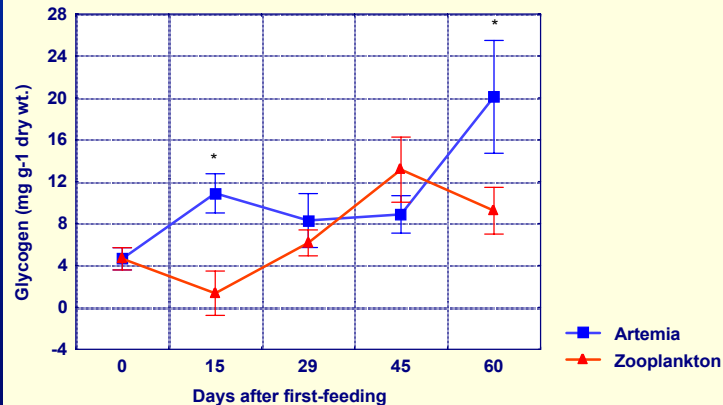
## Dry matter



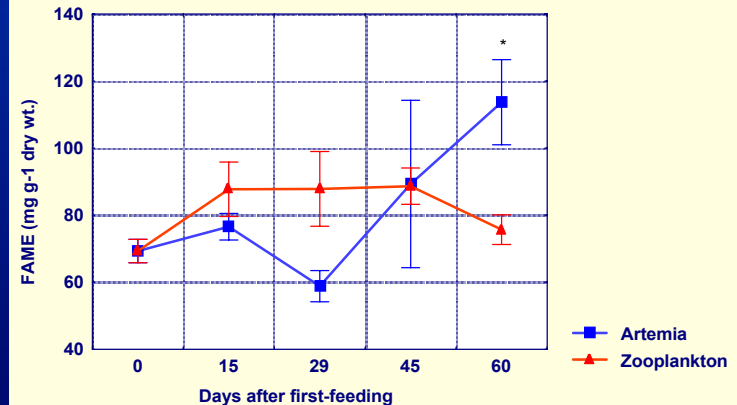
## Protein



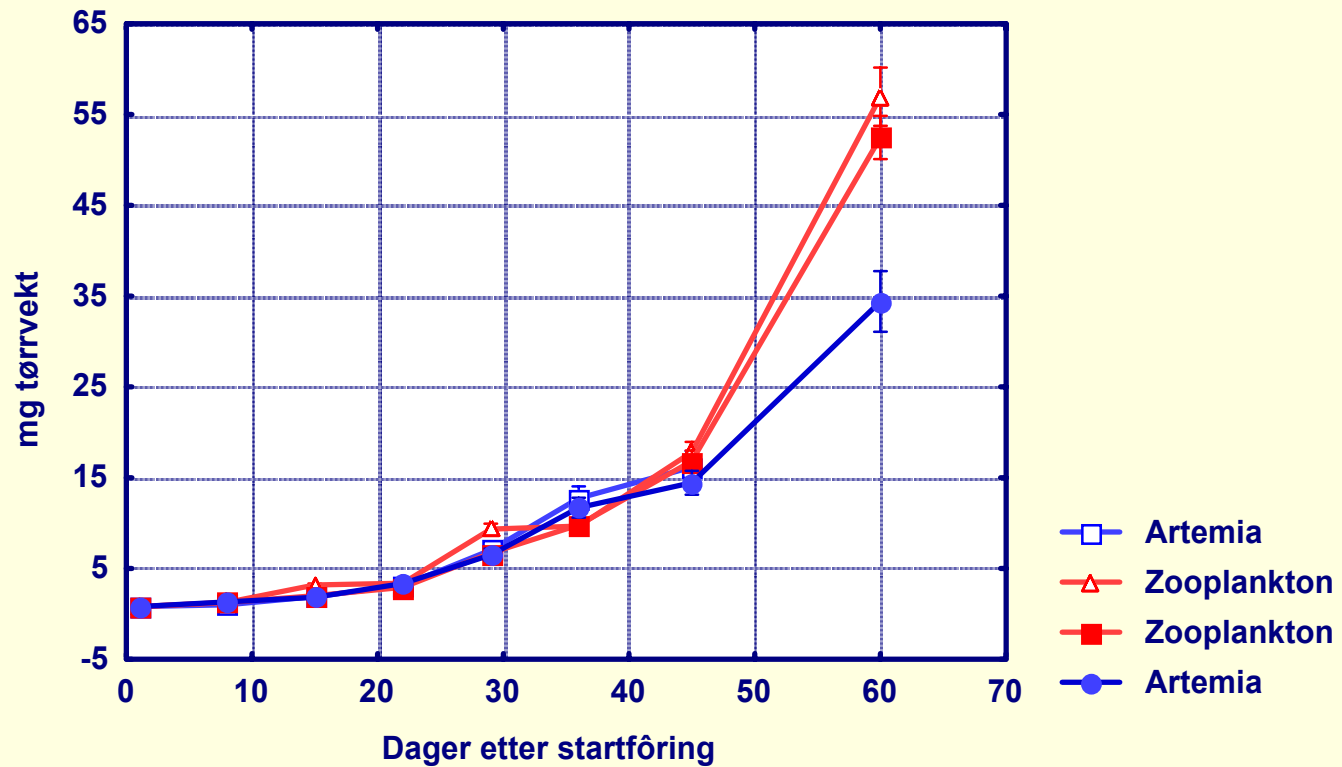
## Glycogen



## Lipid



# Growth



# Conclusions

- Lipid and carbohydrate were higher in *Artemia* than in zooplankton and relatively high compared to assumed requirements as found in juveniles
- There was no statistical difference in protein contents in *Artemia* and zooplankton, but the nominal value in *Artemia* was near to the estimated requirement in juveniles
- Growth depression found in larvae fed *Artemia* at the end of the experiment may be explained by high carbohydrate and lipid levels in the prey organism
- Enrichment procedures for *Artemia* should focus on lowering lipid levels



# Acknowledgement

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