

Modulation of Hormonal Regulation and Digestive Capability in Atlantic Cod Larvae (*Gadus morhua*) as influenced by prey

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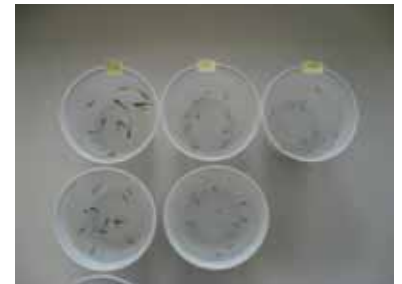
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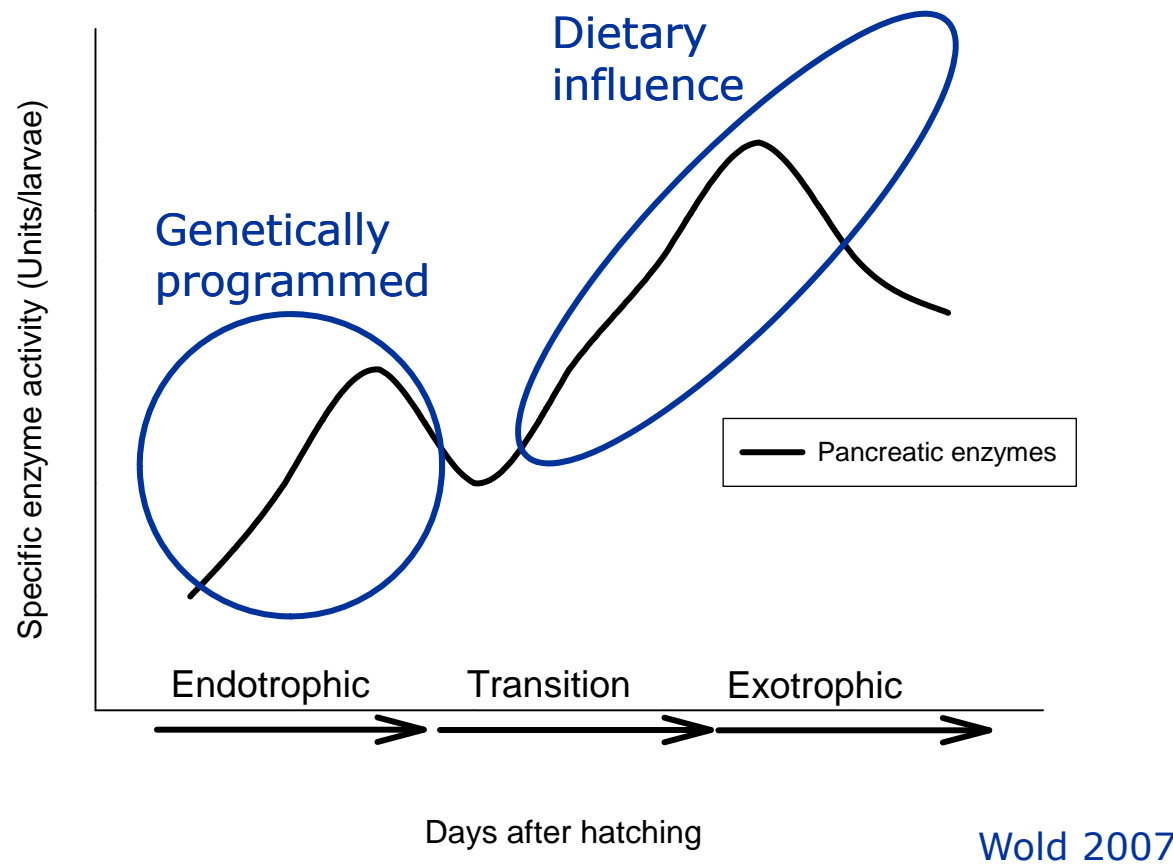


Challenges in aquaculture of Atlantic cod during early developmental stages:

- 1) Growth is critical in the start-feeding phase
 - Larvae showing an early onset of growth maintain their lead until metamorphosis
 - They also show better survival and viability in later stages
- 2) Optimal nutrition is a prerequisite for growth
- 3) The digestive capability may be affected by feed type, dietary composition and diet concentration
- 4) The molecular basis for these are not understood

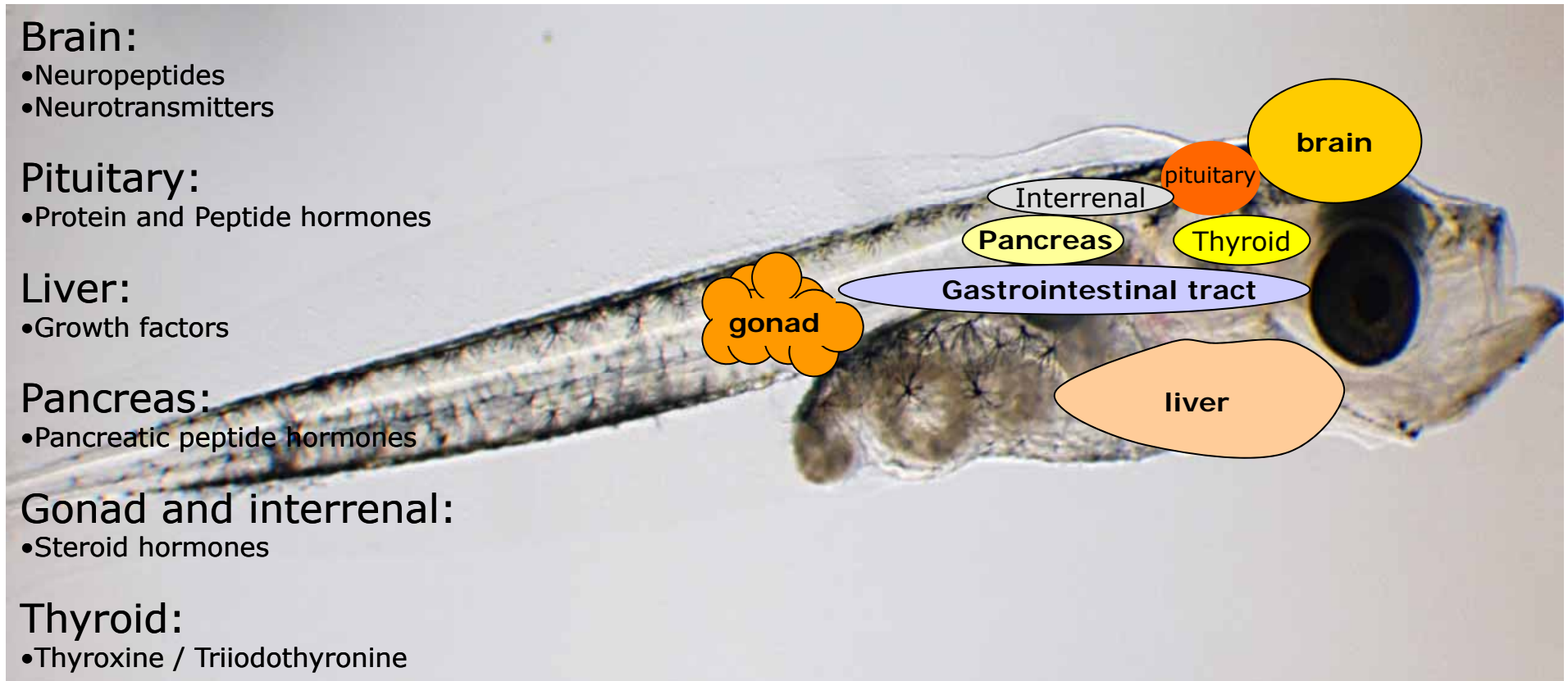


Pancreatic response to diet



Nutritional regulation of endocrine functions

- Food intake and endocrine function are probably closely coupled



The diagram shows a zebrafish embryo with various endocrine organs highlighted in colored ovals and labeled. The brain is yellow, the pituitary is orange, the interrenal is grey, the pancreas is yellow, the thyroid is yellow, the gastrointestinal tract is blue, the liver is orange, and the gonad is orange.

Brain:

- Neuropeptides
- Neurotransmitters

Pituitary:

- Protein and Peptide hormones

Liver:

- Growth factors

Pancreas:

- Pancreatic peptide hormones

Gonad and interrenal:

- Steroid hormones

Thyroid:

- Thyroxine / Triiodothyronine

A mechanistic approach

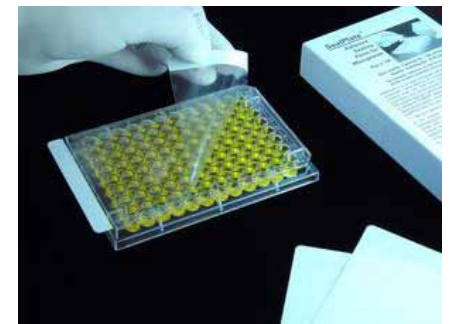
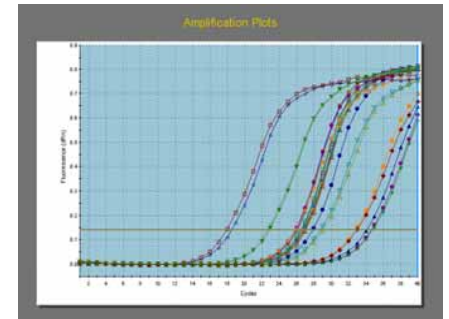
"later effects"

Increasing ecological value



- ✓ Ecosystem
- ✓ Population
- ✓ Individual
- ✓ Organs
- ✓ Physiological and metabolic functions
- ✓ Molecular profile
 - Transcriptome
 - Proteome
 - Metabolome

✓ *New technologies*
✓ *Lack of information*
✓ *Most studies conducted on mammalian systems*

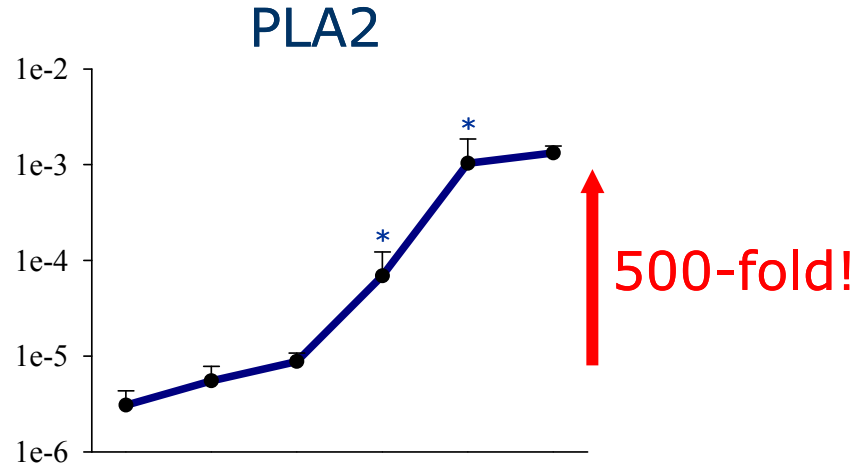
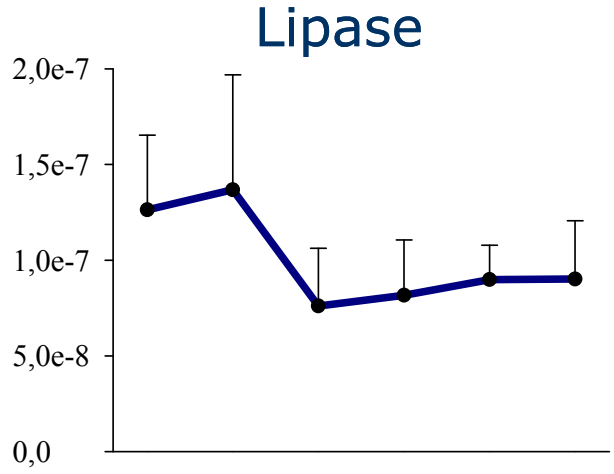
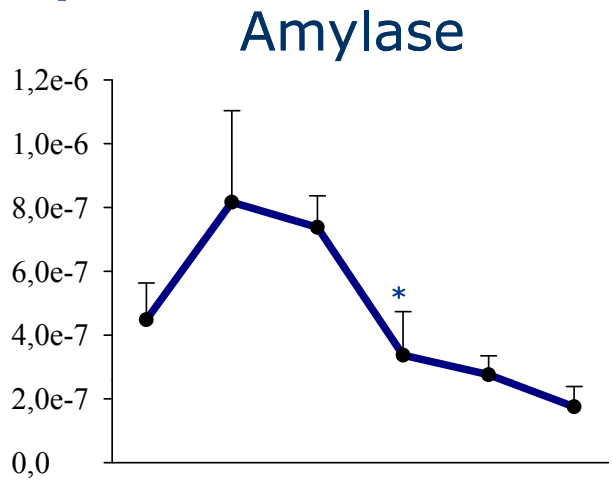
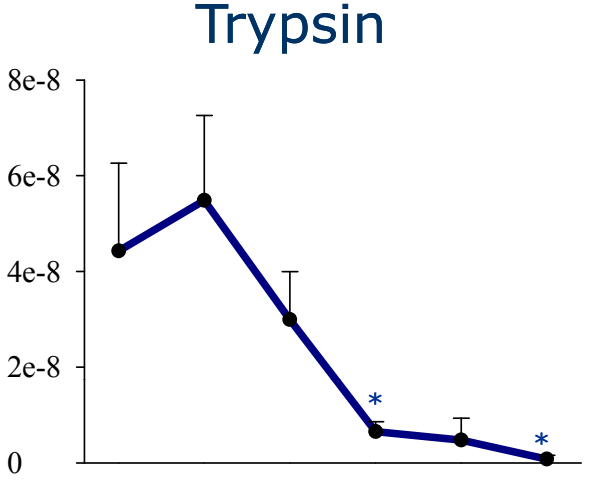


Main Objectives

1. Develop quantitative and qualitative molecular markers for the ontogeny of digestive capability, feed uptake and feed preferences in cod larvae
2. We hypothesized that manipulation of nutrition feeding protocols will produce differential hormonal and digestive gene expression patterns whose functional products will modulate early growth and development of cod larvae

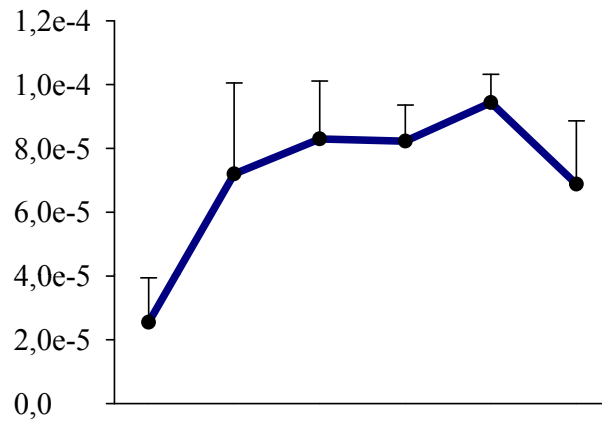


mRNA abundance during larval growth 5-50 dph

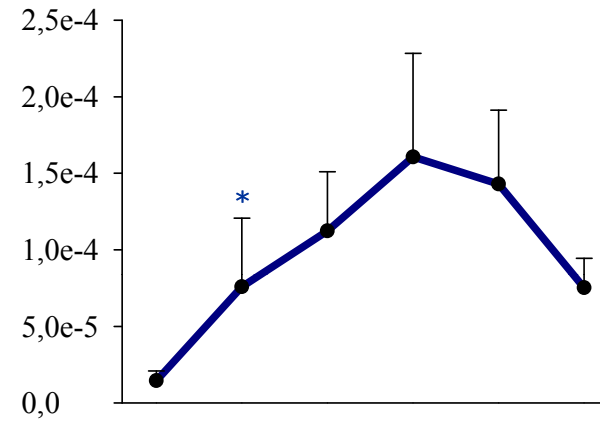


mRNA abundance during larval growth 5-50 dph

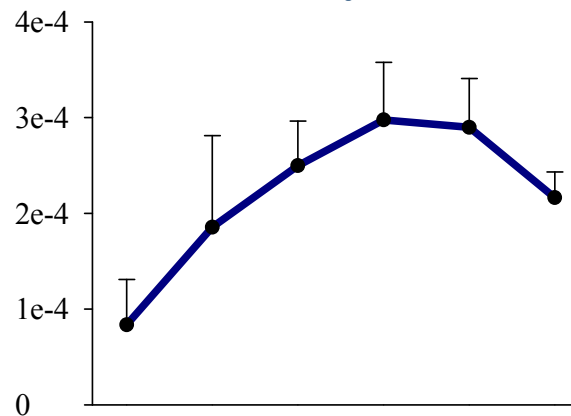
Neuropeptide Y



Growth hormone



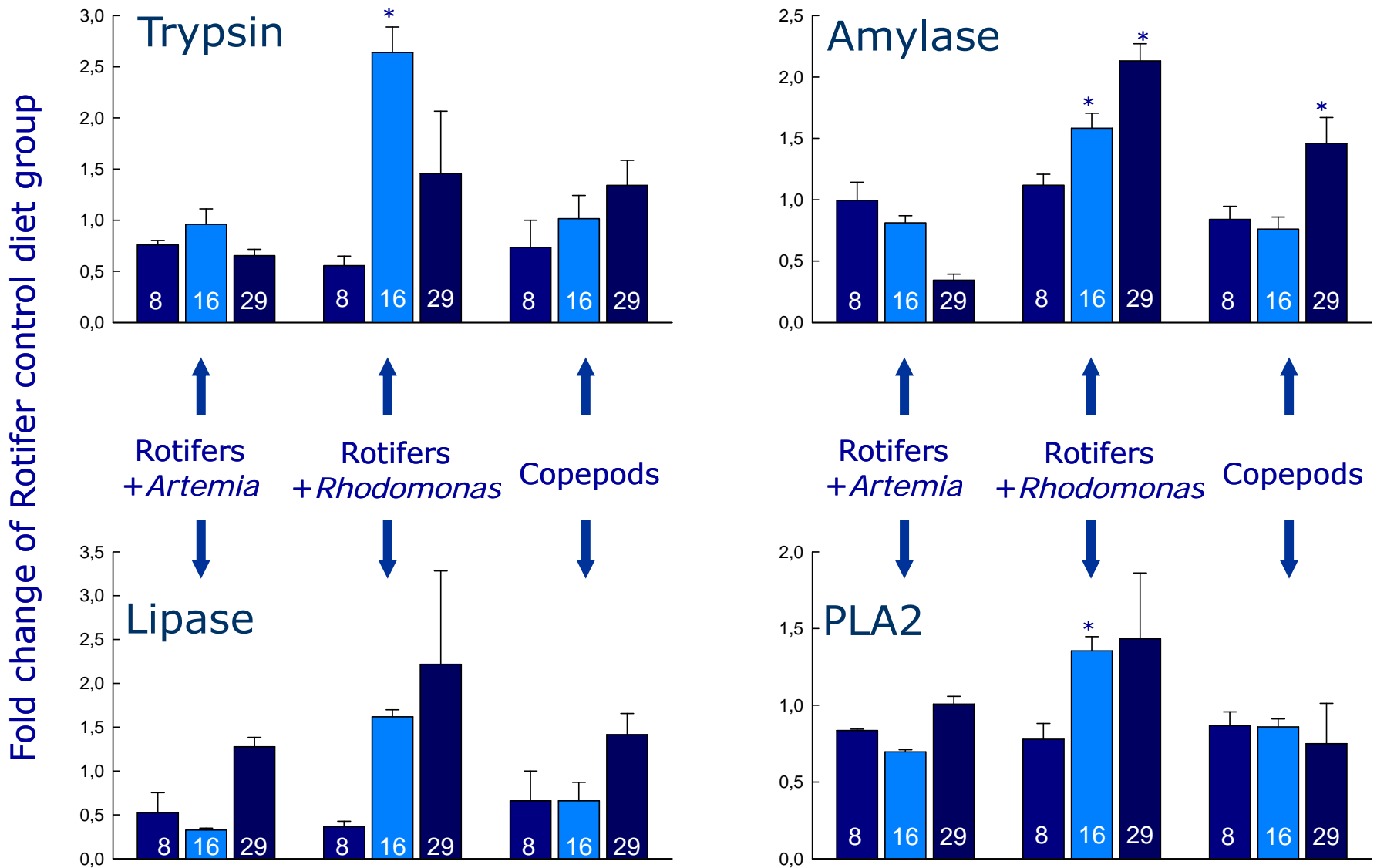
TRa



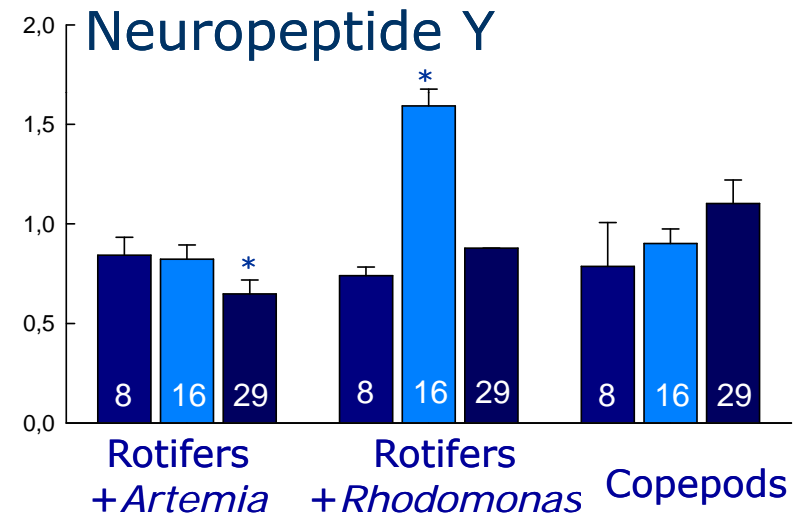
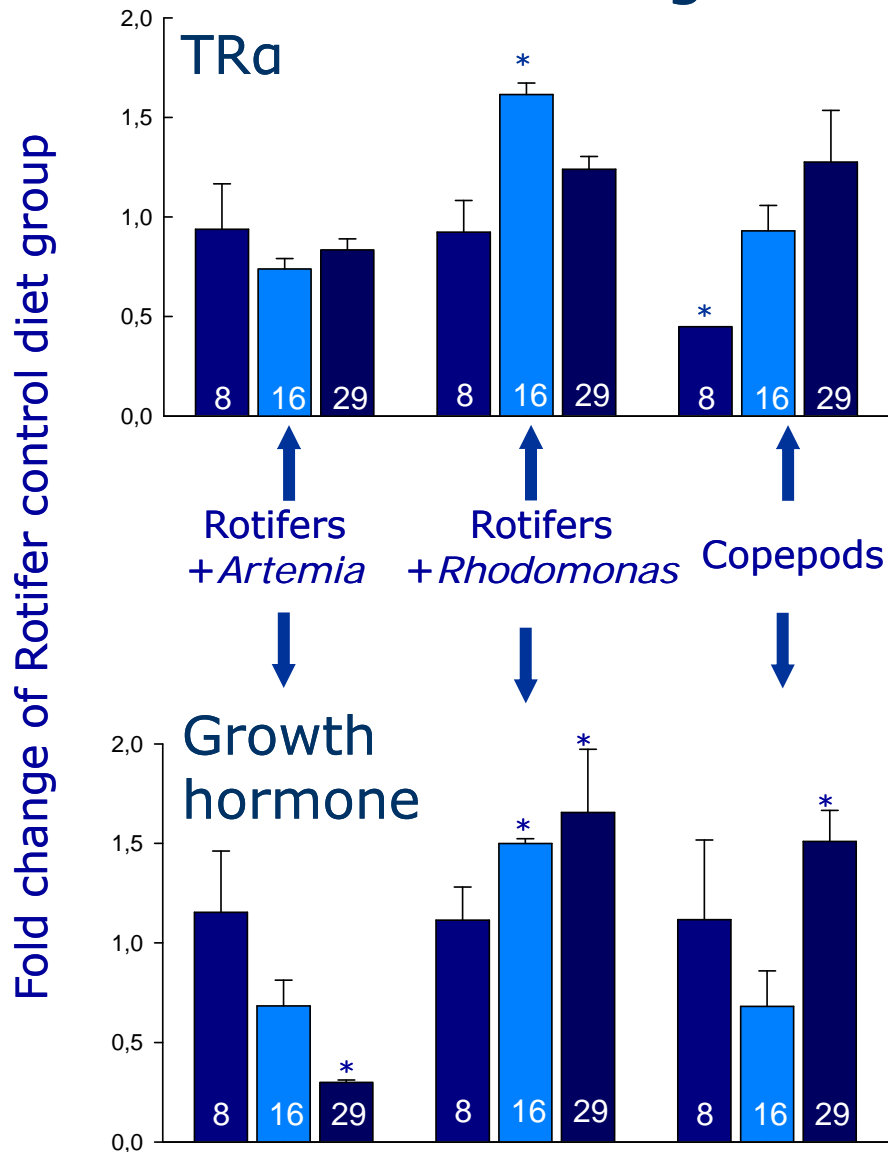
Overall mRNA abundance during larval growth:

- Significant transcript levels of all genes examined were observed at 5 dph
- mRNA levels of digestive enzymes (trypsin, amylase, lipase) decreased during larval growth
- Interestingly, PLA2 mRNA levels increased over 500-fold from 5 to 50 dph
- Generally, mRNA levels of neural and growth controlling factors increased from 5 to 29 dph

Influence of feed on digestive enzyme gene expression

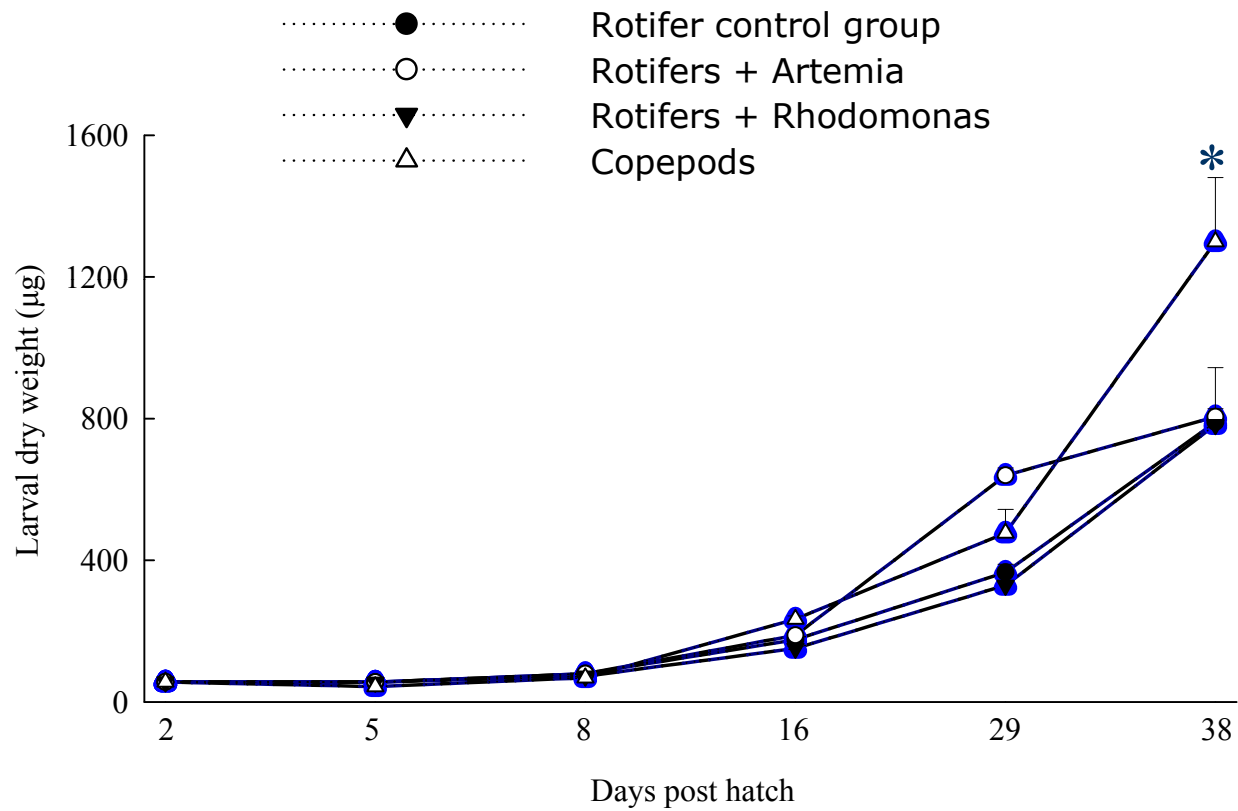


Influence of feed on neural and growth controlling gene expression



Correlation with digestive enzyme mRNA profiles

Larval growth



Summary of results

- 1) Genes involved in appetite regulation and digestion showed differential expression patterns based on different feeding protocols
- 2) Correlation between transcript profiles for digestive enzymes and neural controlling factors were demonstrated
- 3) These relationships were partially reflected in larval specific growth rates
- 4) The ontogeny of digestive capability and its hormonal components may directly be tied to the type and quality of early and initial dietary constituents

Thank you for your attention

- This study was supported by the functional genomics research program of Central Norway (FUGE Midt-Norge, Norwegian Research Council), Innovation Norway and Mabit.
- We thank Per-Arvid Wold and Tora Bardal for technical assistance during sampling

Questions?