Krill-enriched feed gives rapid recovery and higher end-weight following experimental challenge with salmon pancreas disease virus (SPDV)

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WORLD CLASS FISH FEED

Aim

- Test the effects of phospholipid rich diets
  - Investigate growth rate, pathology and transcriptomic response of different feed groups in a PD challenge trial

Krill meal:

- Rich in protein (60%) and astaxanthin
- Fat content in average 15%
- High phospholipid (PL) content
- Source for omega-3 fatty acids such as EPA and DHA (>23% of lipids)
  - DHA anti-inflammatory and correlated to milder immune reactions against HSMI and CMS
  - EPA and DHA potentially increase the cell membrane integrity
- Increase of appetite of fish and palatability of feed

Diets and hypothesis:

TLL: **T**riglyceride **L**ow in EPA+DHA

PLL: **P**hospho**L**ipide **L**ow in EPA+DHA

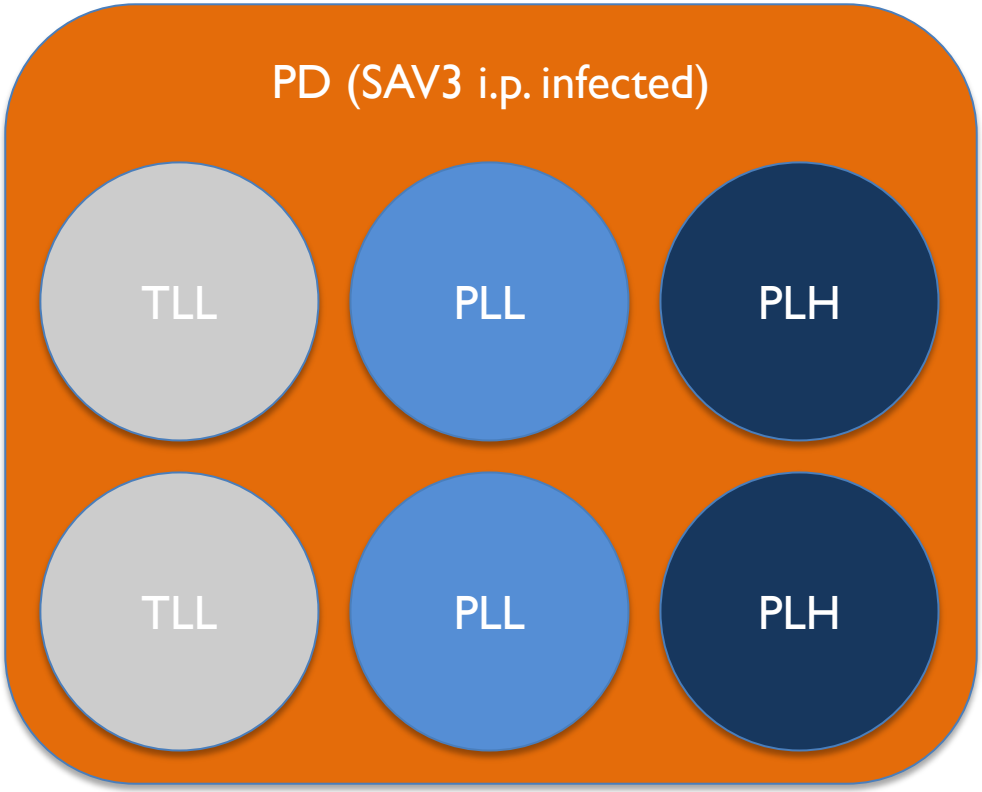
PLH: Phospho**L**ipide **H**igh in EPA+DHA

Hypothesis:

- **TLL vs PLL:** Do EPA+DHA from krill phospholipids give a different effect than EPA+DHA from fish oil?

- **PLH vs PLL**: Is there a difference between low and ad high levels of EPA+DHA from krill phospholipids ?

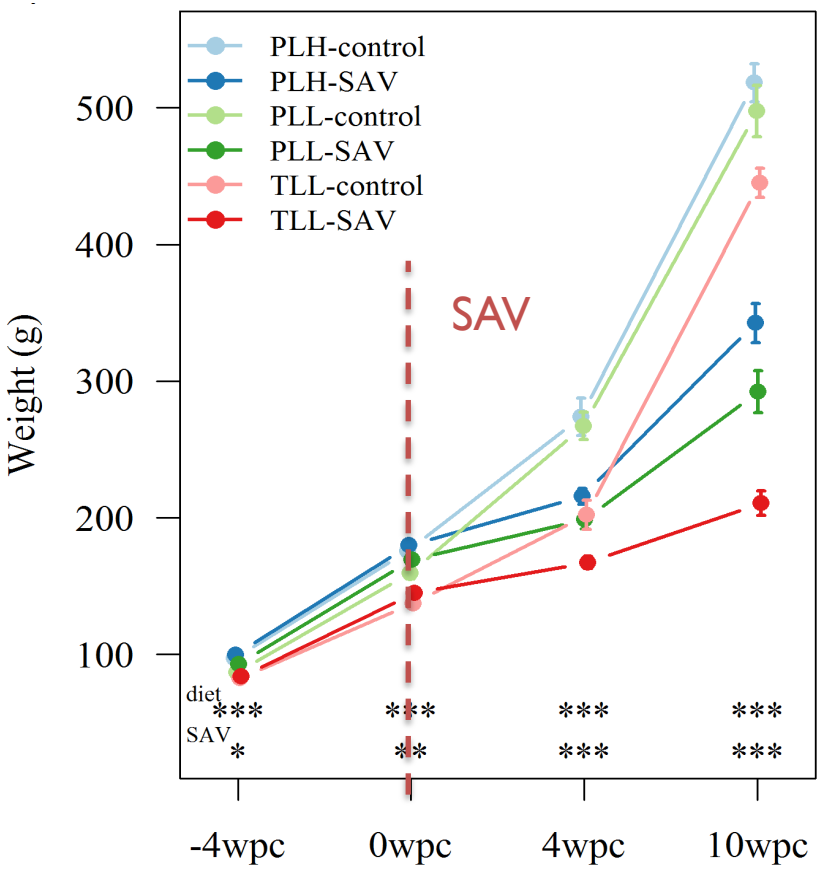
Experimental setup (VESO Vikan)



- Sampling time points: 0, 4 and 10 wpi
- n = 50 fish/tank (Pit tagged)

Weight (g)

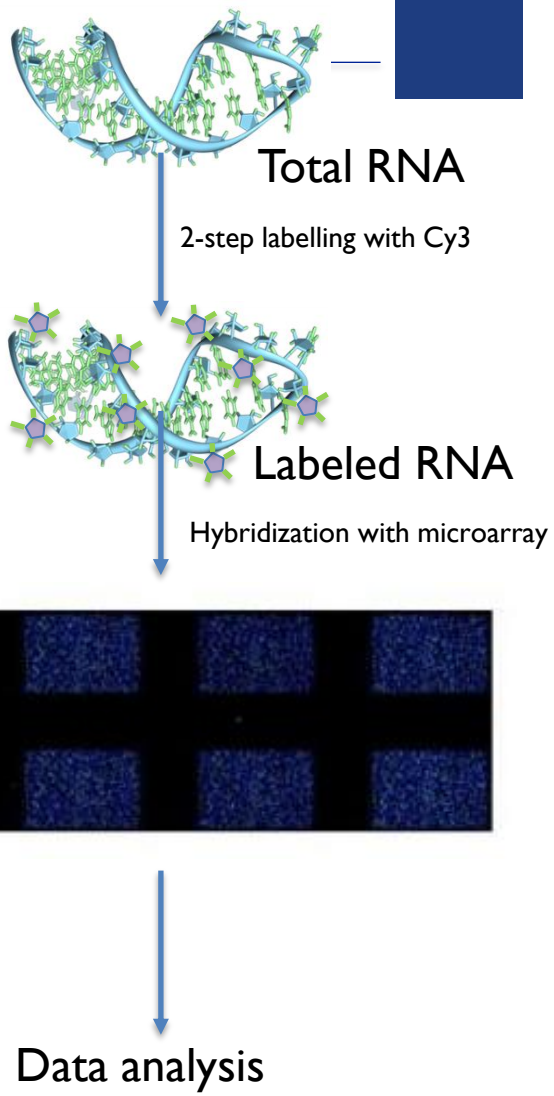
- Weight of PLH > PLL > TLL at beginning of the experiment
- Infected groups grew slower due to PD
- Higher growth for both PL-feeding groups compared to TLL
  - Difference is bigger in **infected** fish
  - **Uninfected** PLH and PLL reach similar weights



Mean of pit tagged fish
n = 50 fish/tank

Transcriptomics

- 72 AGILENT oligo microarrays
  - 3 TP (0, 4, 10wpc)
  - 3 groups (**TLL**, **PLL**, **PLH**)
  - 8 individuals each
- Platform:
  - 15k custom design
  - Good functional annotation



Statistical test	**n: p<0.05**
ANOVA:TP	8117
ANOVA:feed	2004
Post-hoc: PLL-PLH	1057
Post-hoc: TLL-PLH	1418
Post-hoc: TLL-PLL	289

Transcriptomics, SAV infected

Upregulated in krill meal groups

- Myofiber
- Cell stress
- Immune
- AA metabolism
- ECM, RBC

Down regulated

- Cell signaling
  - 1 apoptosis marker
- Immune genes
  - 2 immune globulins
- Metabolism
- Tissue differentiation

Overall

- Gene expression indicates increased recovery rate
- Milder immune response
- Effects on metabolism and tissue differentation
- Stronger effect of PLH (high krill) than PLL (low krill), but same effect

Conclusion

- Krill enriched feed with increased EPA/DHA dampens the growth arrest effect of SAV3 infection in salmon
- Two "coping styles", differing in TGC (threshold ~1.1 TGC)
- Krill feeds increase the number of fish with TGC > 1.1 (PLL 2x, PLH 3x)
- Cannot be explained by average virus replication levels
- Pathology score of heart is lower in the krill enriched groups

- Same virus amount – less pathology from the infection (tolerability)

Cell culture data in progress