

# SALMOSIM-DIGEST: AN IN-VITRO ASSAY DEVELOPED TO PREDICT THE DIGESTIBILITY OF COMPLETE DIETS FOR SALMONIDS.

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## Introduction

- Growth of the aquaculture industry and high cost of marine ingredients → shift within the feed sector
- Diets containing a novel diet → need testing.
- **In vivo testing:** best to assess digestibility and feed quality; however trials are

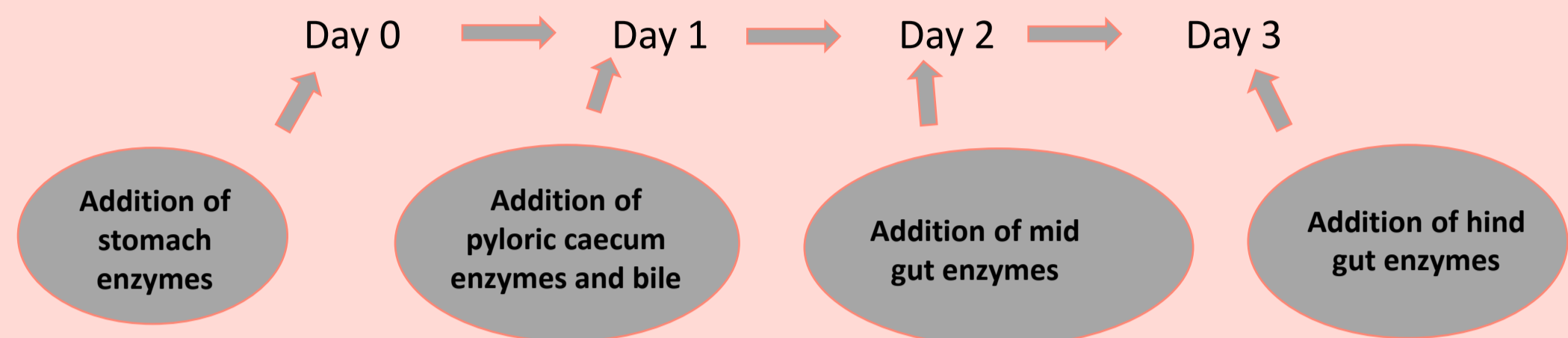
- 1) Time-consuming
- 2) Expensive

- **SalmoSim Digest is an *in vitro* gastrointestinal used to evaluate the digestibility of protein-rich ingredients.**
- Here we adapt **SalmoSim® Digest** to assay protein digestibility and absorption of complete diets
- **Aim: to test if SalmoSim®-Digest predictions match *in vivo* digestibility trial data for complete diet pellets.**

## Methodology

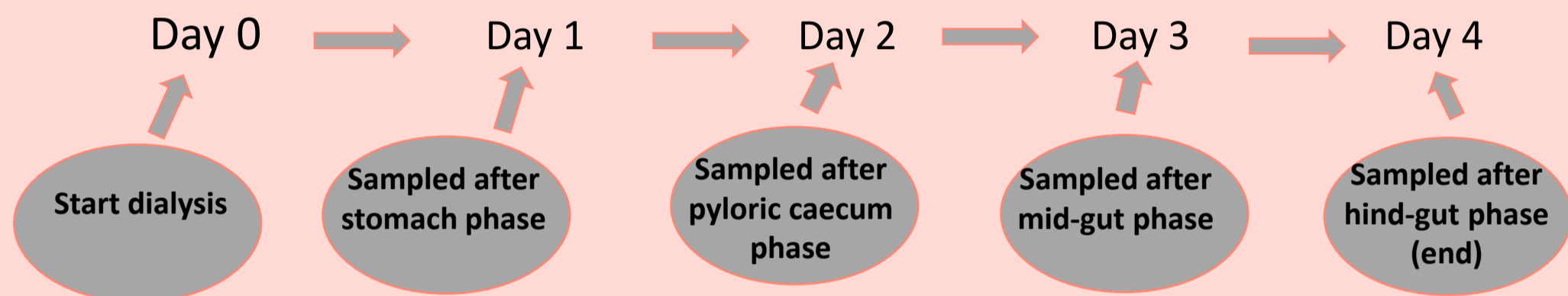
- SalmoSim®-Digest is a bioreactor-based system.
- pH and temperature parameters maintained to simulate four gut compartments of cultivated salmonoid fish
- Appropriate digestive enzyme cocktails were added to each compartment phase

### Digestion Phase



### Absorption

- Conducted over the same time-period
- Transfer of amino acids ( $\alpha$ ) into circulatory fluid



- $\alpha$  concentration by Phthalaldehyde amino acid assay
- Apparent digestibility coefficients (ADCs) calculated via crude protein concentrations (Kjeldahl) of undigested vs digested feed.

## Results

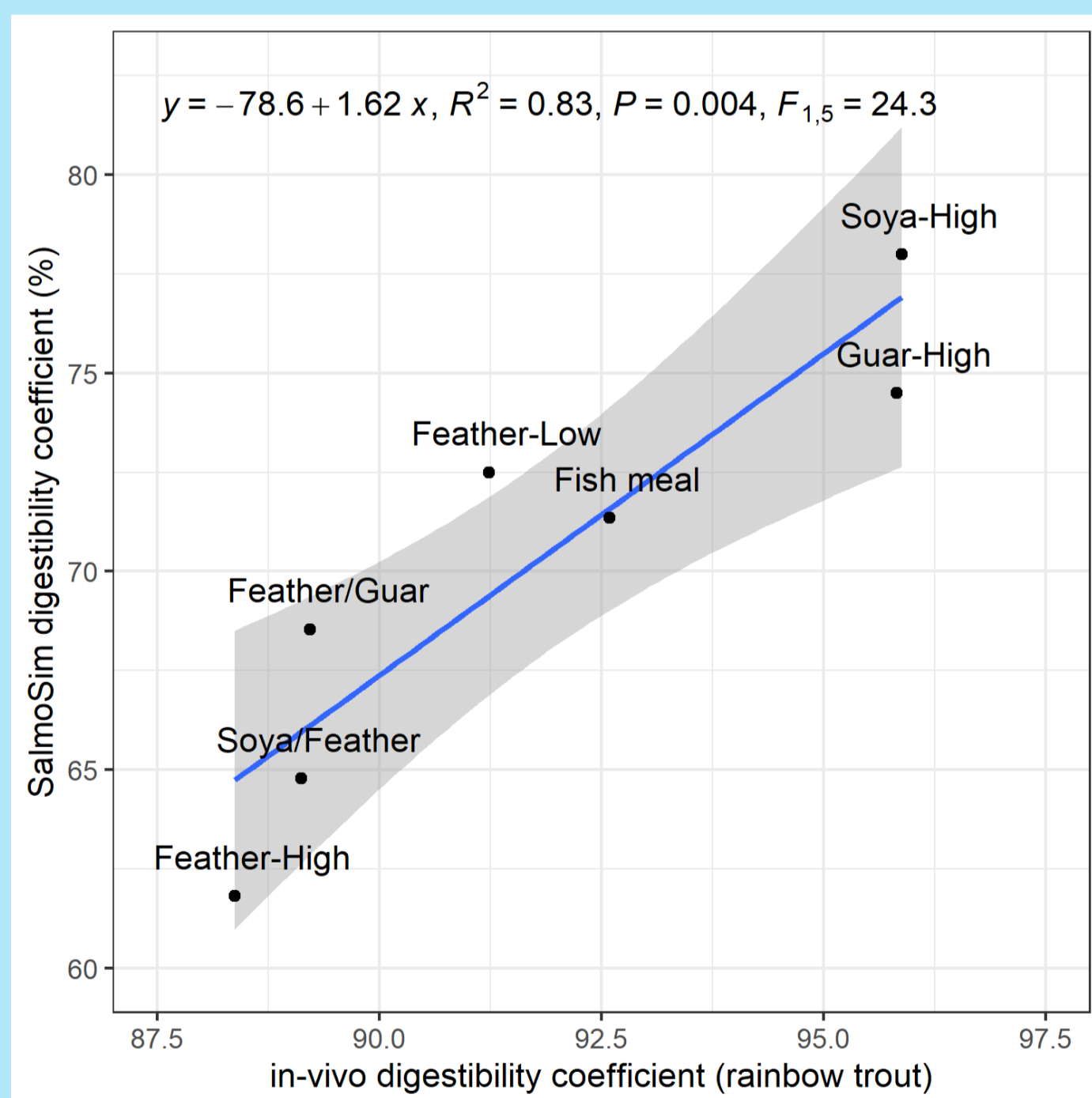
### Diet composition

Protein composition of complete pellets used in the feeding trial formulated and produced by Skretting Aquaculture Innovation, Stavanger, Norway

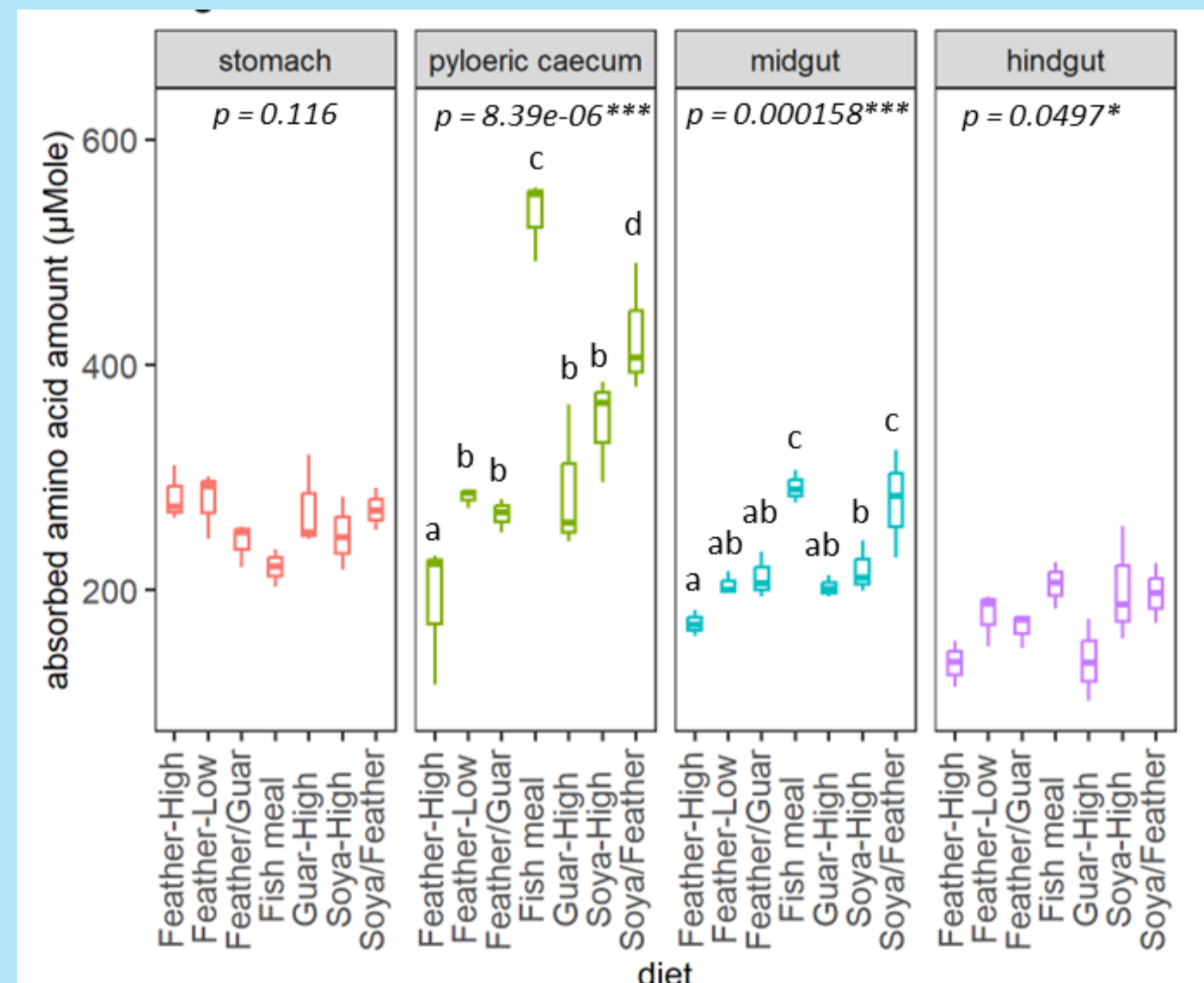
	Fish	Guar-High	Soya-High	Feather-Low	Feather-High	Guar/Feather	Soya/Feather
Fish meal	35.00	5.00	5.00	5.00	5.00	5.00	5.00
Soy bean meal			30.00				21.53
Guar meal 58%		20.00				15.27	
Feather meal				10.00	20.00	15.00	20.00
SPC	10.37	16.47	8.38	20.00	15.00	20.00	8.55
Wheat	21.73	13.53	6.07	18.02	18.19	16.15	11.08
Wheat gluten	9.00	18.00	23.50	18.68	13.22	5.81	10.00
Faba bean	5.00	5.00	4.97	5.00	5.00	0.00	0.00
DL-Methionine	0.00	0.22	0.19	0.28	0.35	0.30	0.33
Lysine	0.00	0.70	0.57	0.93	1.12	0.70	0.87

### SalmoSim®-Digest Results

- **Accurately predict *in vivo* digestibility trial data in salmonids ( $R^2 = 0.83$ )**
- **Concentration of  $\alpha$  absorbed could also be reproducibly quantified at desired time points during digestion, revealing statistically significant differences in distinct patterns of absorbance at each phase of digestion**



Apparent digestibility coefficients from *in vivo* trial data by NMBU for *Oncorhynchus mykiss* (Rainbow trout) correlated with either SalmoSim®-Digest,  $R^2 = 0.83$



Amino acid absorption ( $\mu$ Mole) from SalmoSim-Digest®, differences between diets were significant (\*) at hindgut phase and highly significant differences (\*\*\*) at pyloric caecum and midgut phases

## Discussion

- **SalmoSim®-Digest can accurately predict and rank *in vivo* digestibility for proteins in salmonids *in vitro*.**
- SalmoSim®-Digest provides a **powerful tool for repeated quantification of bioavailable amino acids** within the Salmon gut.
- SalmoSim®-Digest represents a **rapid, cost-effective** and **ethical** tool to assay diet digestibility, therefore avoiding *in vivo* trials.
- There is an opportunity to **combine SalmoSim®-Digest (digestibility) and SalmoSim® (gut microbial communities)** to explore the **link between gut microbes and ingredient digestibility** in the Atlantic Salmon gut.

## Summary

- **Seven complete diets** formulated with nutritional proteins originating from differing alternative sources
- ***In-vivo* digestibility trial by rainbow trout compared with SalmoSim-Digest** showed a highly significant correlation
- Diets showed distinct temporal patterns of **amino acids absorption during phases of *in-vitro* digestion**

## Take Home

**SalmoSim®-Digest accurately predicts *in vivo* digestibility trial data in salmonids for proteins ( $R^2 = 0.83$ )**



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