Growth promoting impacts of marine watersoluble N-compounds in feed for Atlantic salmon

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Nofima: Anders Aksnes, Eyolf Langmyhr, Katerina Kousoulaki
BioMar AS: Paddy Campbell, Hanne Jorun Olsen

SOURCES: Marine water solubles

- **FISHMEAL Stickwater fraction**
- **Fish by-products Hydrolysates**

Properties & attributes to farmed animals

Cytosolic peptidases, hydrolysing peptides to free amino acids

- Fishmeal and Fishoil replacement, ↑ (Gilthead seabream)
- ↑ nutrient absorption, ↑ enzyme activity, ↑ survival, ↑ growth rates & ↓ malformation rates in fish larvae fry or adults (Atlantic salmon, halibut, European sea bass)
- Non-specific immune system responses (Japanese sea bass, Coho salmon)

Special marine water soluble Compounds

- Taurine
- Anserine
- Creatinine
- Carnosine
- Nucleotides
- Free amino-acids
- Peptides
- Small proteins
- Minerals
- Water soluble vitamins

(Aksnes, 2005)

Experiment

- SCOPE: Documentation of the importance of MWS for fish performance

- METHOD: Extraction/removal of fishmeal WS fraction: Stickwater (SW) + Presscake (PC)

  &

  Reintroduction at graded levels

Raw Materials

Herring Fish meal:

- Heating (90 ^{o}C)
- Press/filter/centrifuge
  - Press cake (solids)
  - Sludge
  - **Stickwater** (water solubles) (+ Ultrafiltration)
  - Oil

Stickwater (SW)

- 20-50% (raw material weight)
- 30% fish meal solids

- High collagen content (33.3%, Zarkadas et al., 1986)
- Special physicochemical characteristics

Experimental design

- 10 week Atlantic **salmon** trial (137-410 g)
- High fish meal control diet (30% in the diet)
- **7 High plant protein** experimental diets (10% fish meal in the diet)/ graded levels of **whole** SW or **fractions** (<&>10,000 Da)
- Diets: 42% P, 25% L, 23 MJ kg^{-1} E

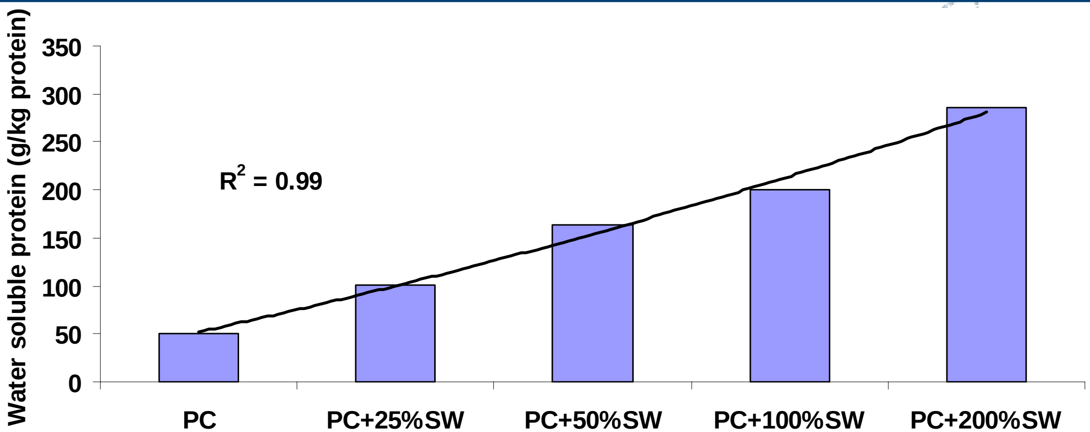
» **10% fishmeal**

diet	FM control	PC	PC+ 25%SW	PC+ 50%SW	PC+ 100%SW	PC+ 200%SW	PC+ 100%RSW	PC+ 100%PSW
Standard fish meal	30	5	5	5	5	5	5	5
Experimental fish meal		5	5	5	5	5	5	5

Washed PC

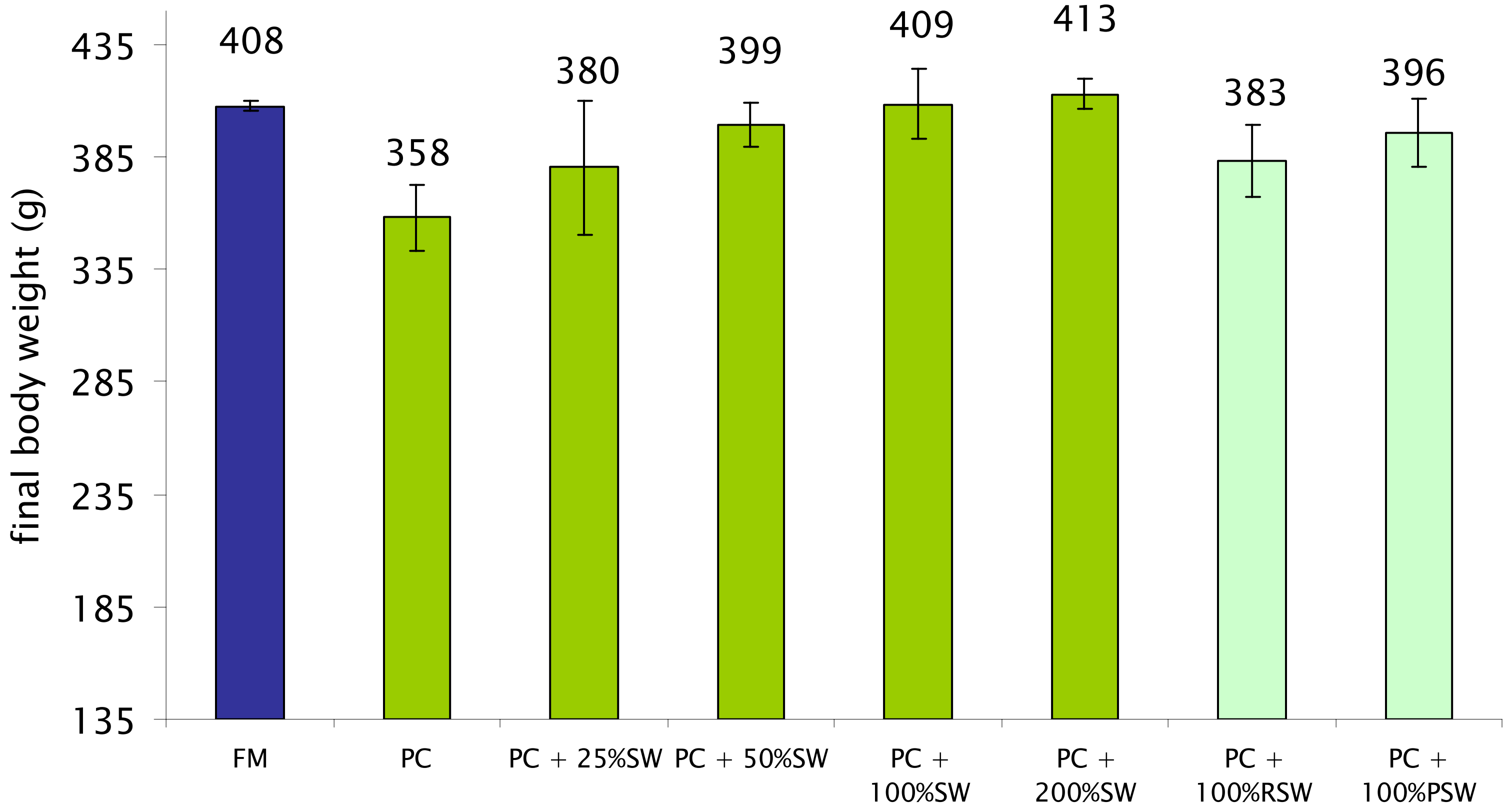
Experimental fish meals

	PC Diet 2	PC+ 25%SW Diet 3	PC+ 50%SW Diet 4	PC+ 100%SW Diet 5	PC+ 200%SW Diet 6	PC+ 100%RSW Diet 7	PC+ 100%PSW Diet 8
Protein, crude	817	768	761	750	754	795	813
Moisture	43	72	78	86	76	71	34
Ash	93	96	105	106	117	98	126
Lipid	63	78	77	77	77	66	57
Water soluble protein	50	101	164	200	286	201	137



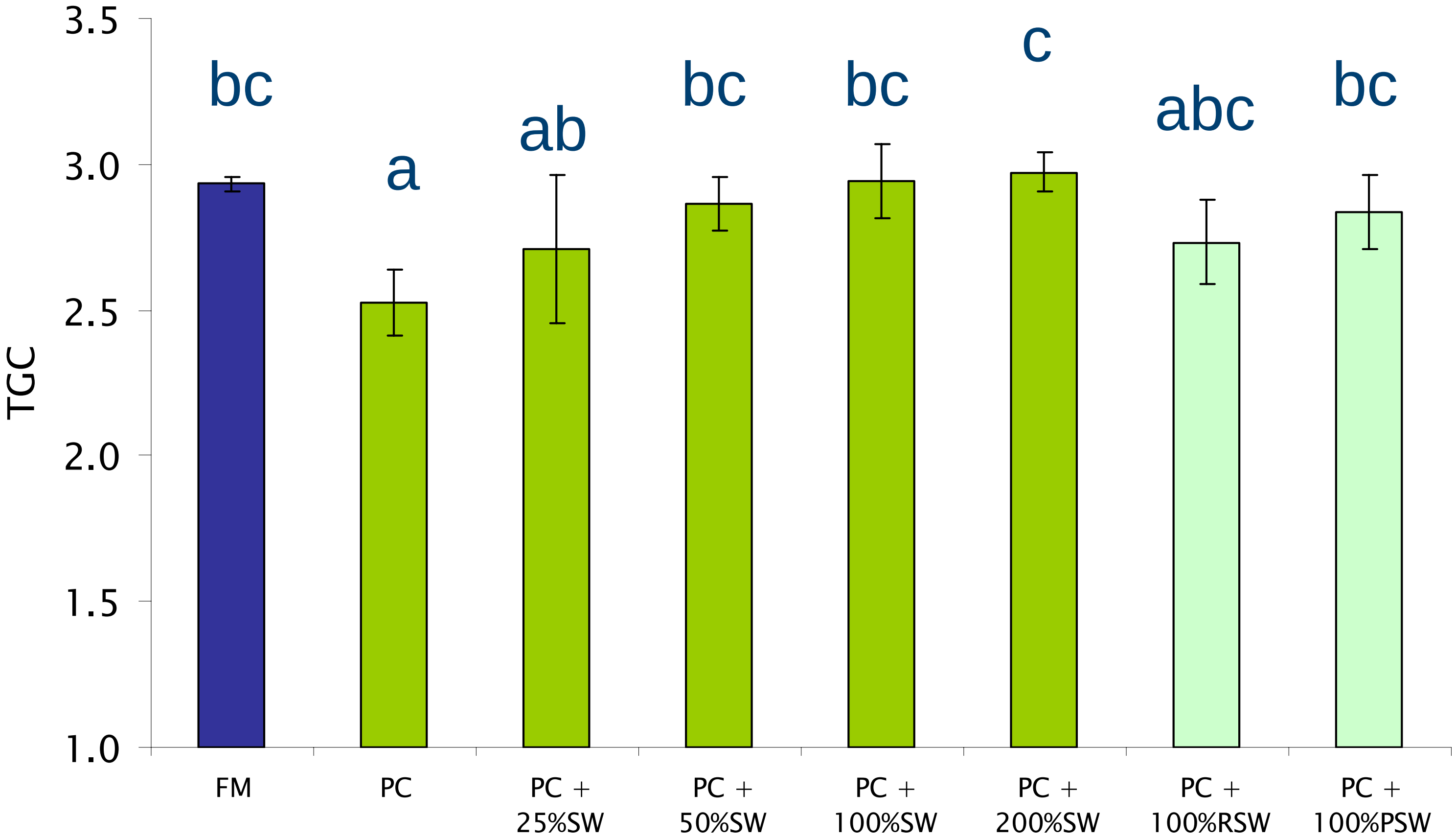
Results

GROWTH



final body weight (g)
435
385
335
285
235
185
135
408
358
380
399
409
413
383
396
FM
PC
PC + 25%SW
PC + 50%SW
PC + 100%SW
PC + 200%SW
PC + 100%RSW
PC + 100%PSW

GROWTH



TGC
3.5
3.0
2.5
2.0
1.5
1.0
bc
a
ab
bc
bc
c
abc
bc
FM
PC
PC + 25%SW
PC + 50%SW
PC + 100%SW
PC + 200%SW
PC + 100%RSW
PC + 100%PSW

P<0.05

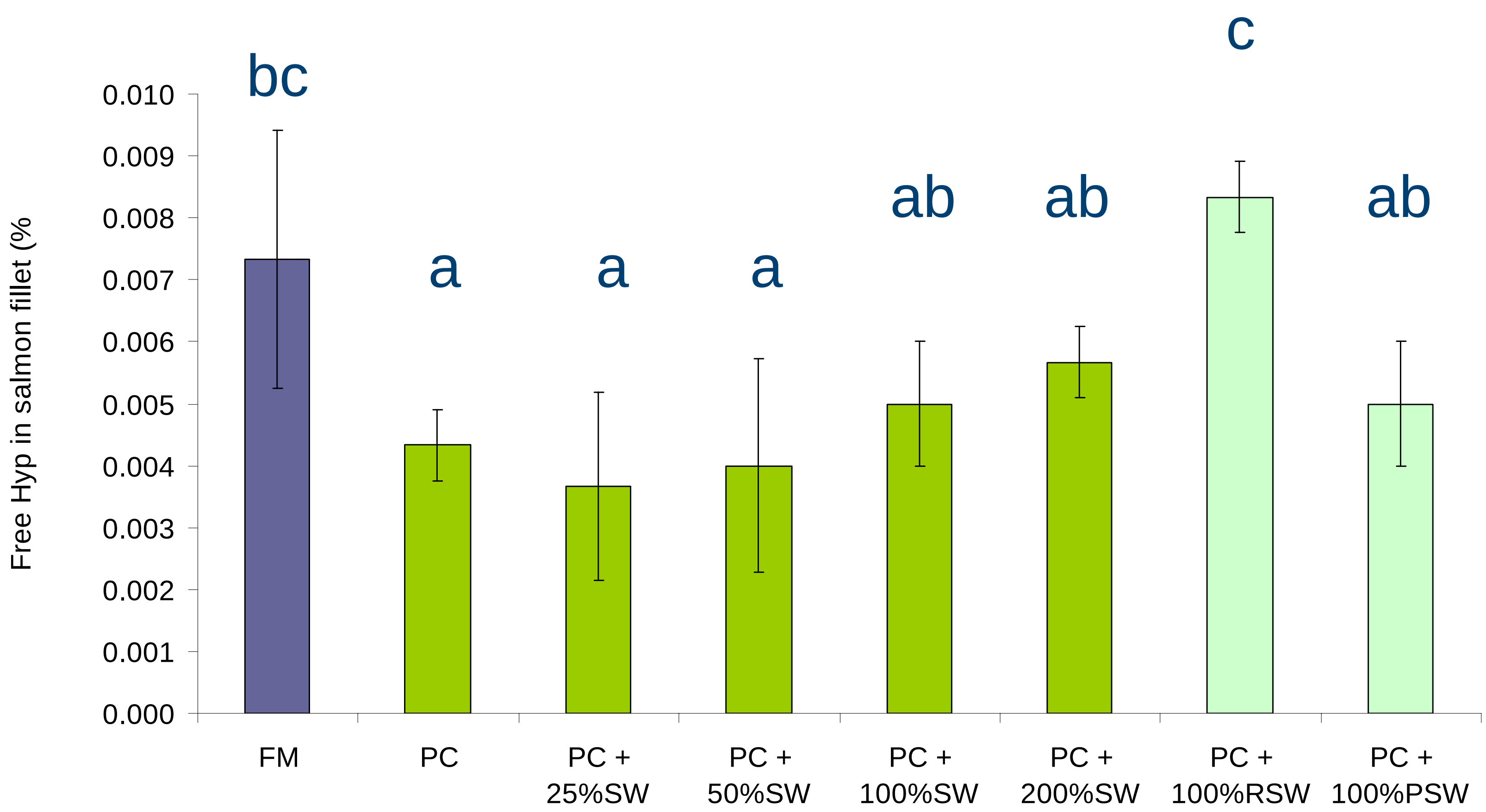
More Results

Morphometry	ns
Feed intake	ns
Feed efficiency	ns
Protein efficiency	ns
Whole body composition	no effects
ADC	no effects

SW inclusion level

Correlation	R^2	*n*	*P*	
BW x SW inclusion level	0.64	15	<0.01	
SGR x SW inclusion level	0.64	15	<0.01	
TGC x SW inclusion level	0.64	15	<0.01	
FI x SW inclusion level	0.37	14	ns	<0.1
FE x SW inclusion level	0.36	15	ns	<0.1
FI x BW	0.70	15	<0.01	

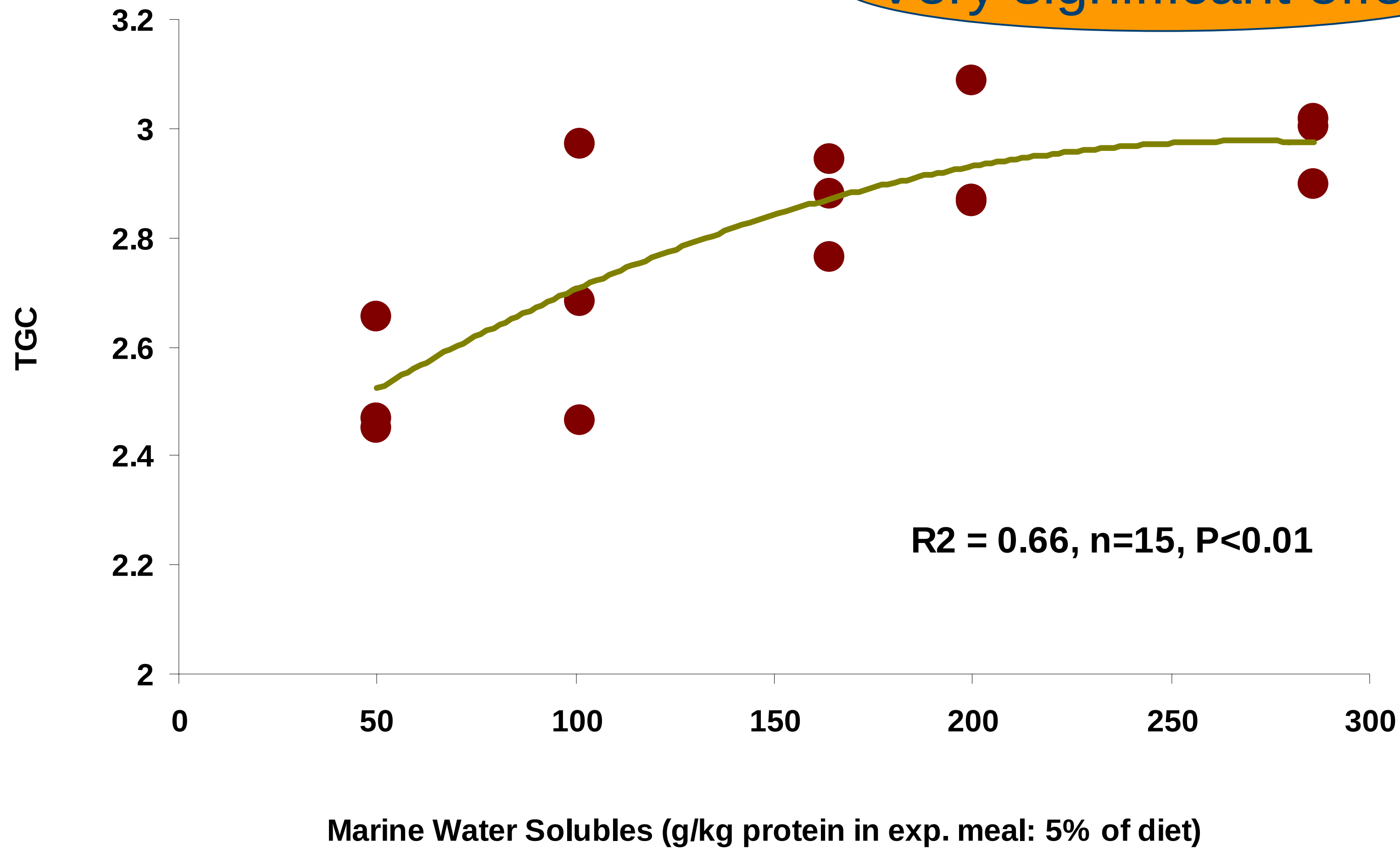
FILLET AA COMPOSITION: Hyp



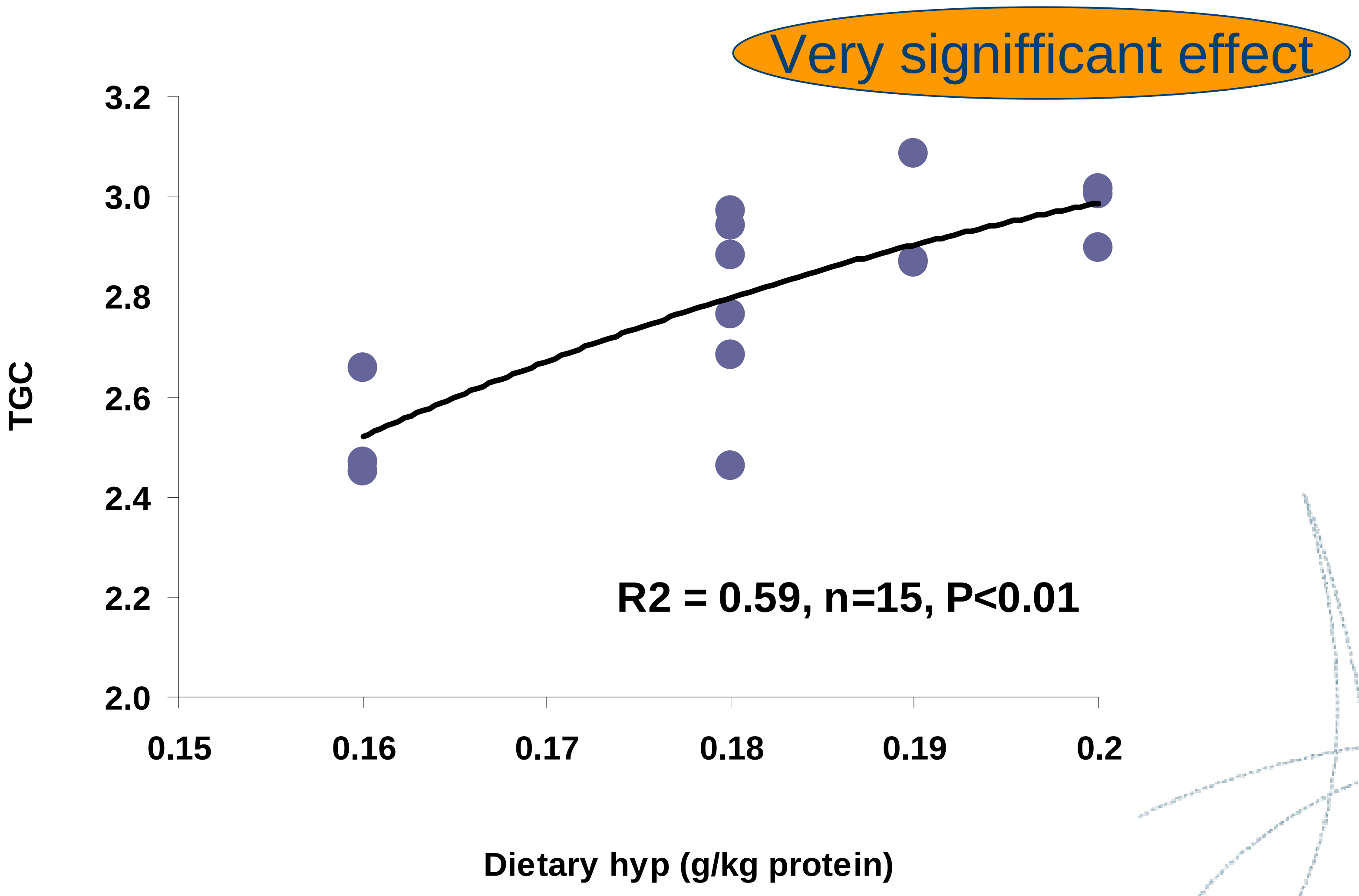
Potential factors in MWS affecting fish growth…

Dietary **Marine Water Solubles** level

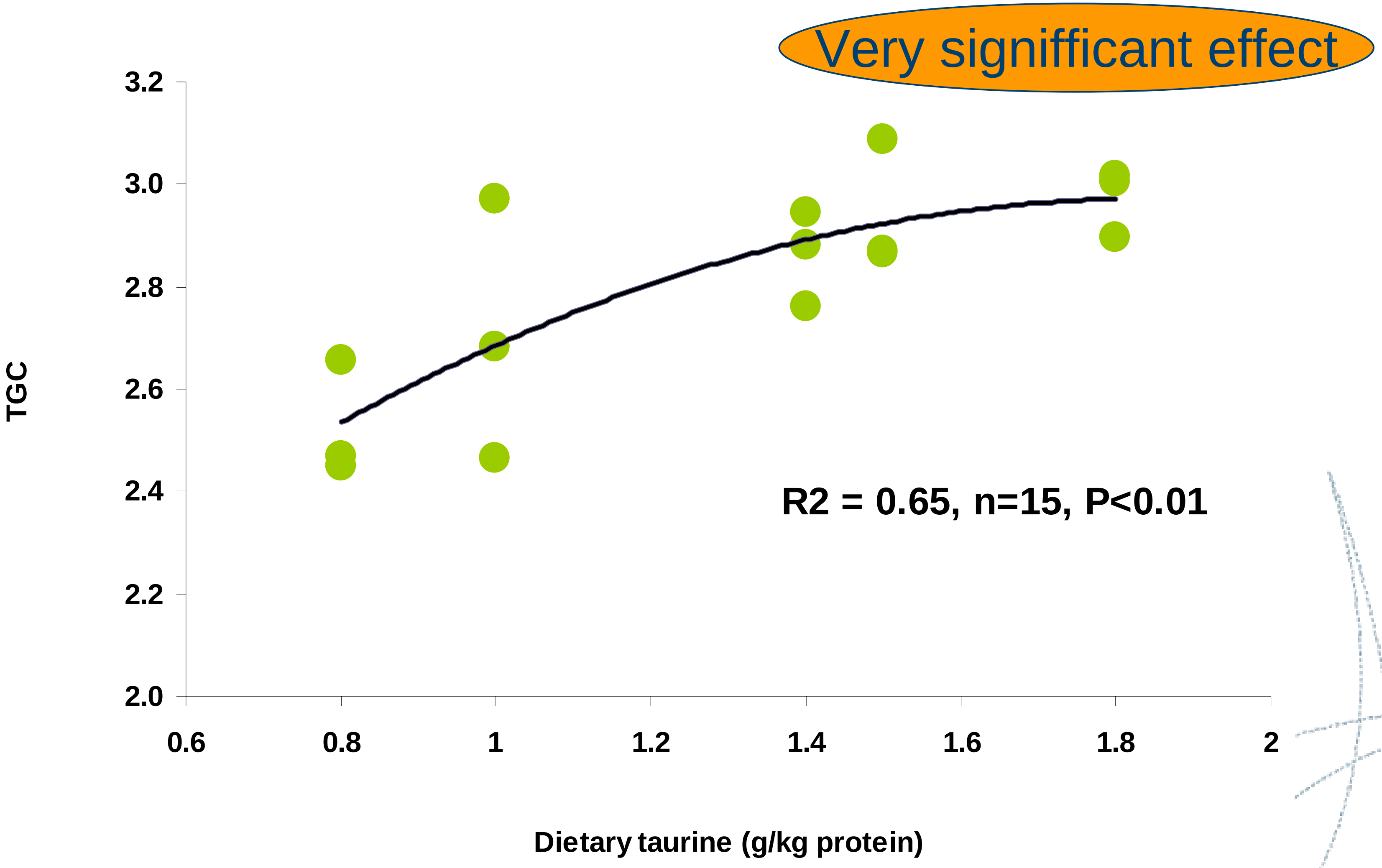
Very signifficant effect



Dietary **Hyp** level

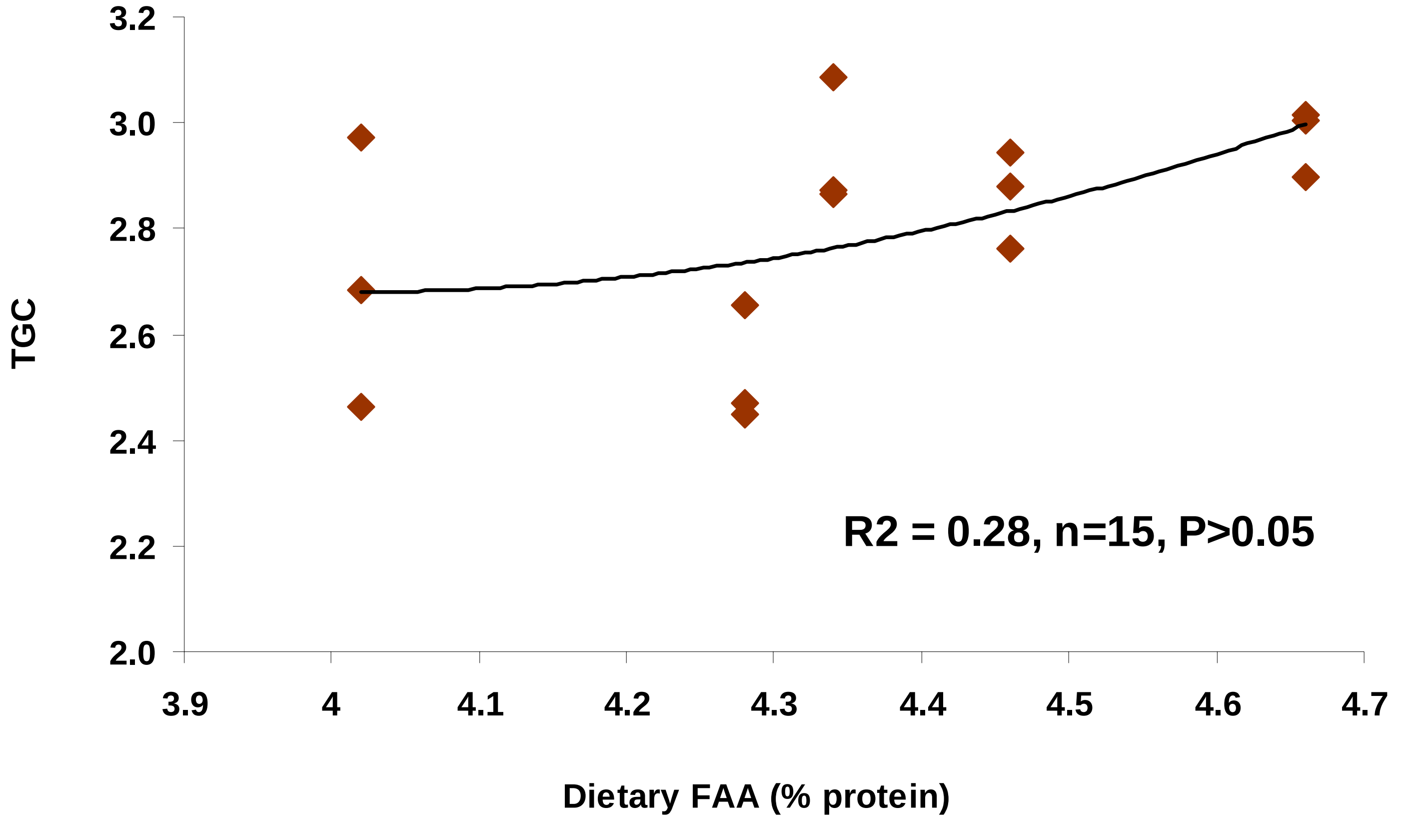


Dietary free **Taurine** level



Dietary **Total Free Amino Acid** level

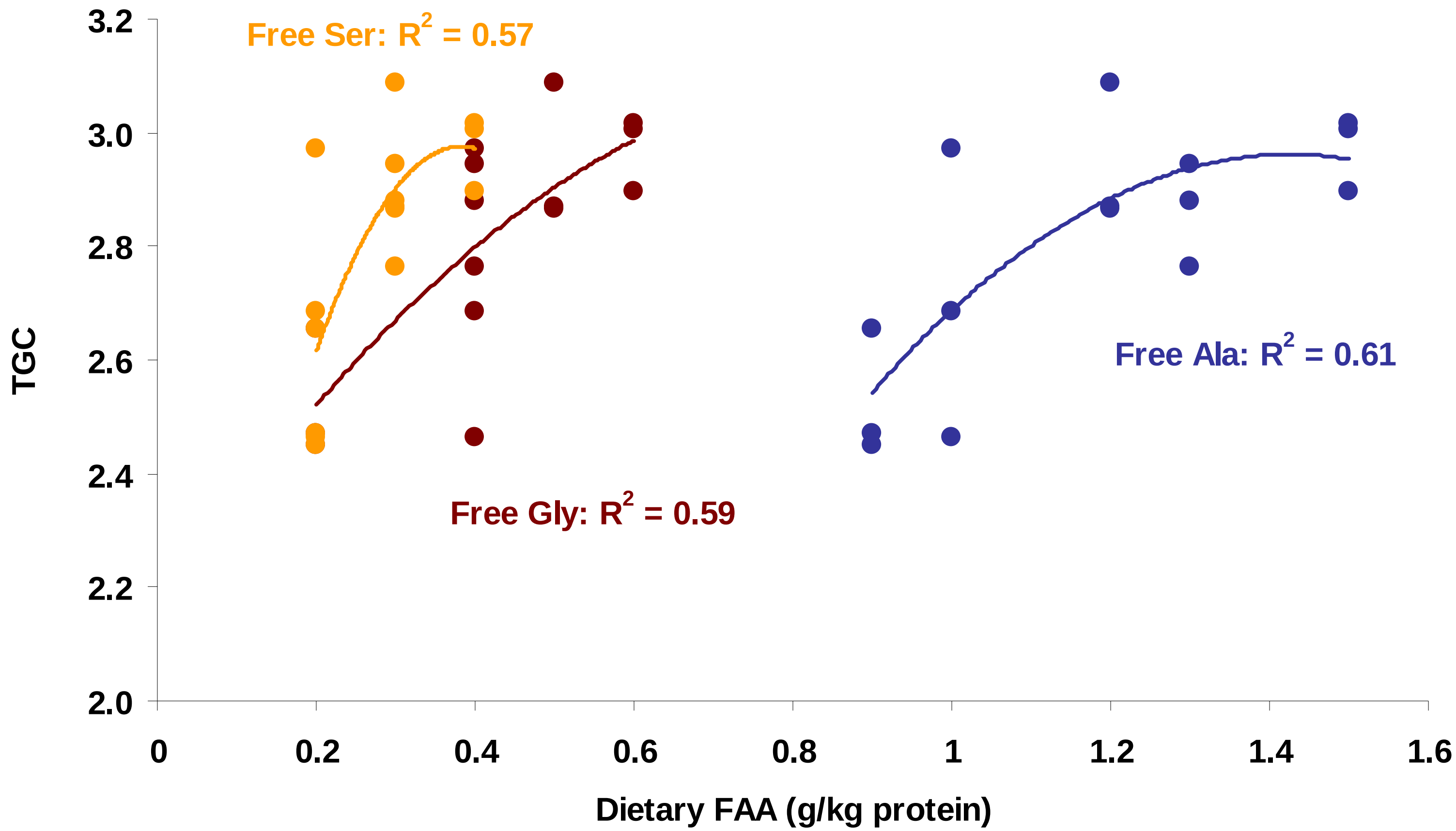
No signifficant effect



Nofima

Dietary specific **Free Amino acid** level

Very signifficant effect



Candidate factors in marine water solubles affecting fish growth:

Hyp, Tau, Gly, Ser, Ala…

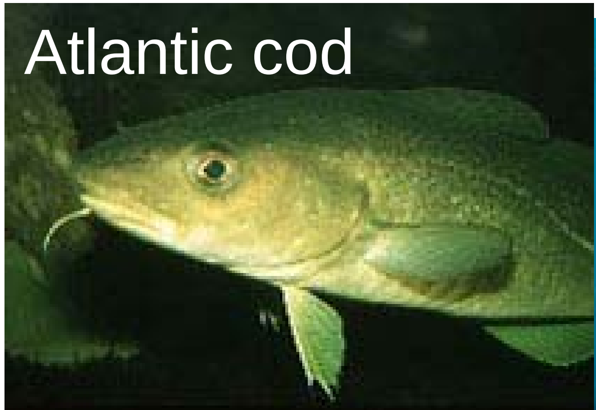
Peptides…
Small proteins…
Combination of different compounds…

More research needed for identification of special growth promoting compounds in in marine water solubles

METHODS

- Hydrolysis/ Extraction
- Fractionation
- Separation technology

SPECIES

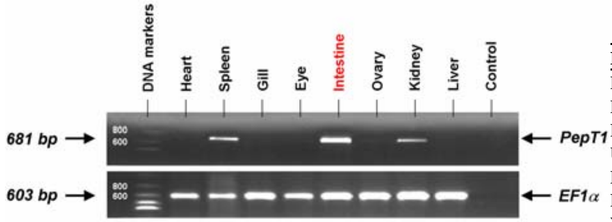


Terrestrial animals

Dietary protein hydrolysates affect spatial expression of peptide transporter PepT1 in the digestive tract of Atlantic cod, *Gadus morhua*.

Presented at *Transporters 2008*. Murten, Switzerland, August 27 – 30, 2008.

Snorre Bakke[1], Ann-Elise Olderbakk Jordal[1], Pedro Gómez-Requeni[1], Katerina Kousoulaki[2], Tiziano Verri[3] and Ivar Rønnestad[1]



Ingredient (%)	FM	FH	UFR	NFR	FAA
Fish meal 268/06	51.8	35.3	35.1	35.1	34.6
Raw wheat 209/06	48.0	56.0	58.0	54.0	36.5
Fish hydrolysate	0.0	14.4	0.0	0.0	0.0
Ultra filtration retentive	0.0	0.0	13.2	0.0	0.0
Nano filtration permeate	0.0	0.0	0.0	13.0	0.0
Fish oil	12.2	14.1	14.1	14.1	14.0
Vitamin mix	1.0	1.0	1.0	1.0	2.0
Mineral mix	0.4	0.4	0.4	0.4	0.4
Betafine	0.4	0.4	0.4	0.4	0.4
Inositol	0.03	0.03	0.03	0.03	0.0
					0.0
					0.0
					12.1
					95.5
					4.5
					41.5
					19.1
					30
					4.9
					22.6

The goal of this study was to investigate how inclusion of peptides and free amino acids (FAA)
preser
PepT1
uptake
PepT1-
found

Dietary protein hydrolysates affect PepT1 mRNA expression in cod

(PepT1: small peptide transporter protein along the intestine)

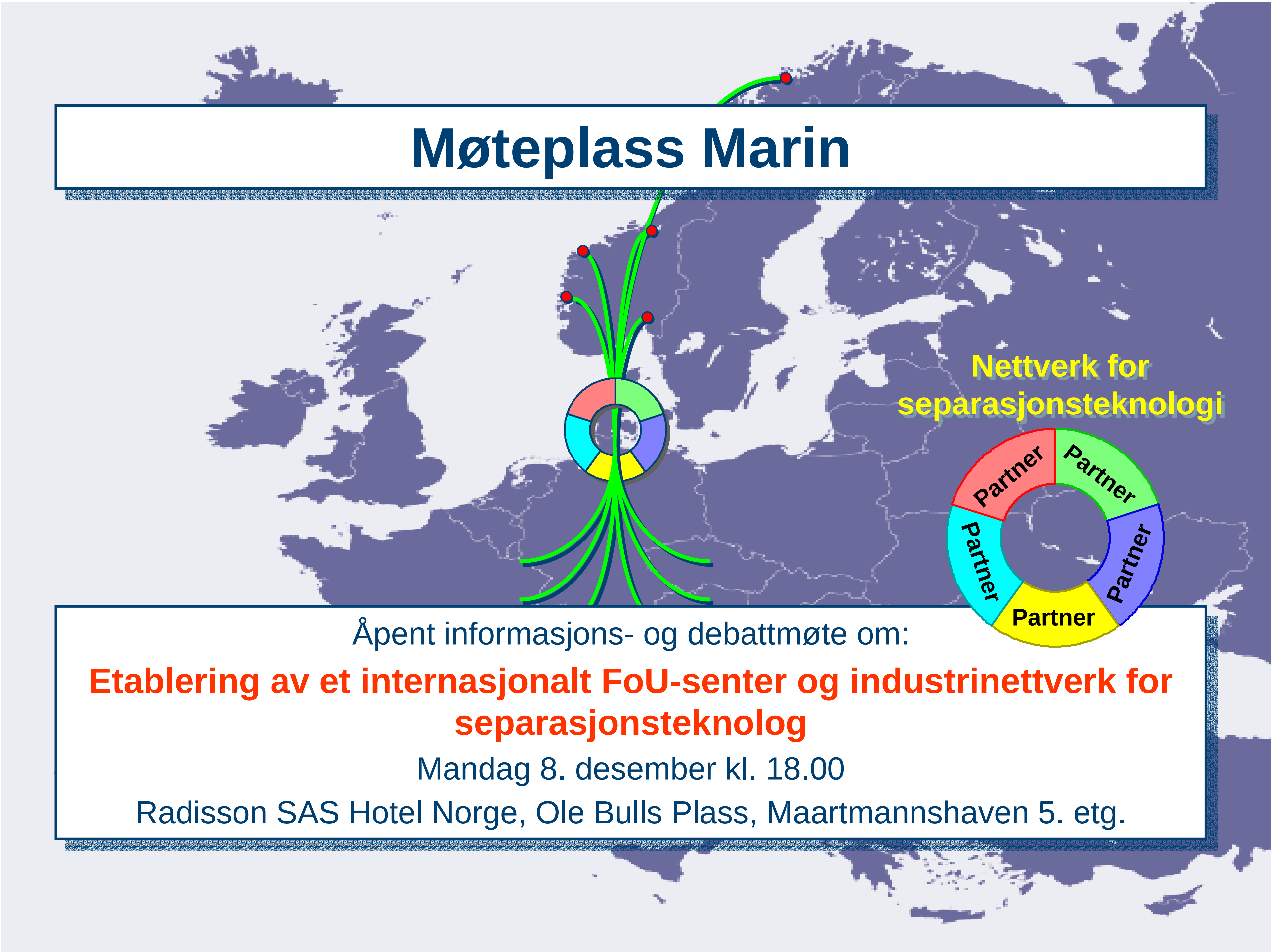
Hypot
of available substrates for the peptide transporter in the intestinal lumen. In order to absorb the increased levels of peptides we expect an increase in PepT1 activity. If the absorptive capacity for peptides in the proximal part of the intestine becomes saturated we hypothesize that there will be additional mobilization of PepT1 in distal regions of the intestine that are normally less active in protein/peptide absorption.

			NFR
Yield by fractionation (%)	100.0	57.0	29.0
Crude protein	913.0	972.0	959.0
Lipid	<1.0	<1.0	<1.0
Ash	78.0	15.0	64.0
Free amino acids (% of protein)	10.4	1.7	14.8
Peptides 10.000-20.000 Da	<1.0	<1.0	<1.0
Peptides 5.000-10.000 Da	35.9	35.0	19.7
Peptides 1.000-5.000 Da	9.7	25.8	12.4
Peptides 100-1.000 Da	36.1	28.0	58.8
Peptides <100 Da	16.0	6.7	9.0
Anserine (g/kg prot)	27.5	48.0	41.2
Taurine (g/kg prot)	11.0	17.0	17.0

Conclusion: The results suggest that PepT1 mRNA expression is variably affected by dietary peptides as well as FAA. Further, that dietary hydrolysates, peptides in various chain length as well as free amino acids affect segments relative expression of PepT1 along the whole intestinal tract. The regulation of PepT1 mRNA seems to be highest in the pyloric caeca and proximal segments, where maximal peptide load and maximal peptide variety is experienced by the fish after meal ingestion.

Thank you very much for your ATTENTION!!!

Møteplass Marin



Åpent informasjons- og debattmøte om:

Etablering av et internasjonalt FoU-senter og industrinettverk for separasjonsteknolog

Mandag 8. desember kl. 18.00

Radisson SAS Hotel Norge, Ole Bulls Plass, Maartmannshaven 5. etg.