



INSECT AND MUSSEL BASED FEED FOR CULTURED FISH-RESULTS OVERVIEW

Baltic Sea Mussel Farming and Nutrient Offset Conference-
Malmö, April 24th, 2019

Aleksandar Vidakovic (SLU)

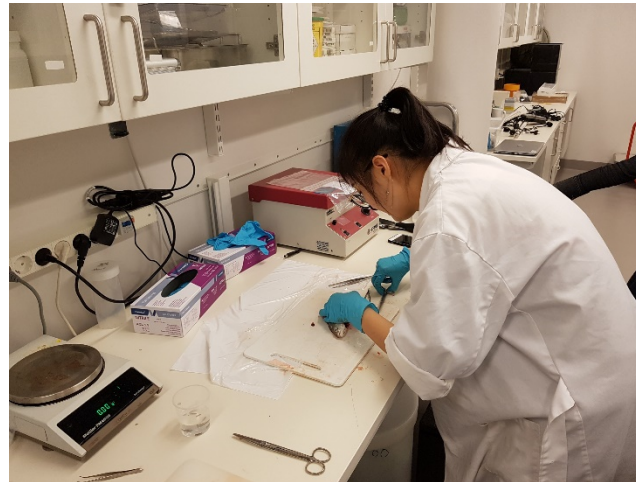
Process and objectives



Material and methods

Tank volume	200 liters
Number of tanks	16
Number of diets	4
Number of replicates	4
Size of fish	65.9±21.9g (mean ± SD)
Number of fish	192 (12 per tank)
Duration of trial (days)	63
Daily feed allowance (%bw)	1.5

- Daily collection of feed waste
- Daily collection of faeces
- Analysis of ADC
- Recording of growth performance and feed efficiency
- Recording of filet fatty acid profiles



Feed formulation

Ingredients	Control diet	MD	LD	Control 2
Fish meal	280.0	-	-	-
Fish oil	50.0	55.0	20.0	50.0
Pea protein concentrate	280.0	395.0	425.0	550.0
Wheat meal	160.0	140.0	135.0	155.0
Larvae meal	-	-	200.0	-
Mussel meal	-	165.0	-	-
Alpha cellulose	30.0	30.0	25.0	30.0
Titanium dioxide	5.0	5.0	5.0	5.0
Rapeseed oil	115.0	130.0	110.0	130.0
Mineral/ vitamin premix	20.0	20.0	20.0	20.0
Gelatin	60.0	60.0	60.0	60.0

All values are expressed in g/kg on 'as is' basis

MD= 10% of dietary protein from mussel meal

LD= 10% of dietary protein from larvae meal

Feed composition

	Control	MD	LD	Control 2
Dry matter (%)	93.9	94.2	94.2	95.1
Crude protein	519.0	508.0	505.0	523.0
Sum of amino acids	467.8	427.8	443.4	495.5
Crude lipid	215.0	223.0	225.0	240.0
Ash	55.0	38.0	58.0	30.0
Gross energy	24.5	24.6	24.8	25.5
Lysine	34.1	30.1	29.9	34.6
Methionine	9.2	6.9	6.3	7.3
Sum of IAA	208.8	189.8	196.7	223.3

All values are expressed in g/kg on 'as is' basis

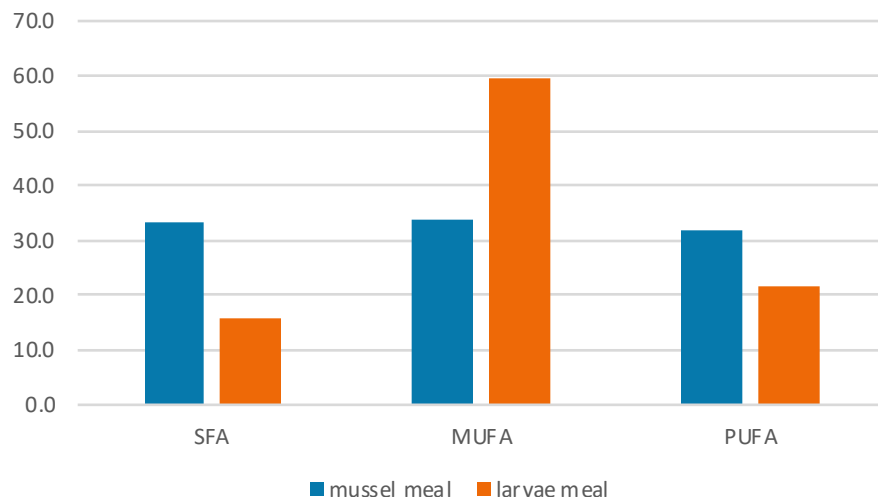
Composition of larvae meal and mussel meal

Proximate composition

	Mussel meal	Larvae meal
Crude protein	666	433
Sum of amino acids	526	336.1
Crude lipid	77	262
Ash	117	198
Gross energy	19.1	24.6
Lysine	41.4	22.9
Methionine	12.0	7.2

Fatty acids

FA % of total fat



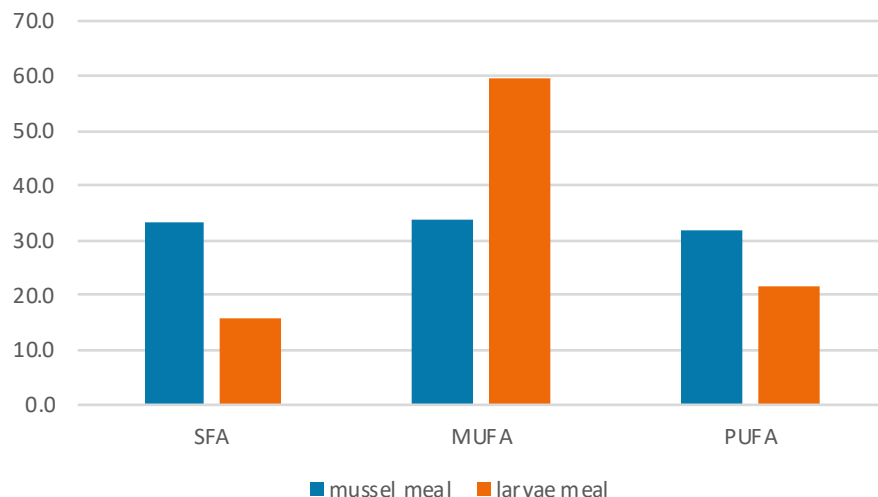
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Fatty acids

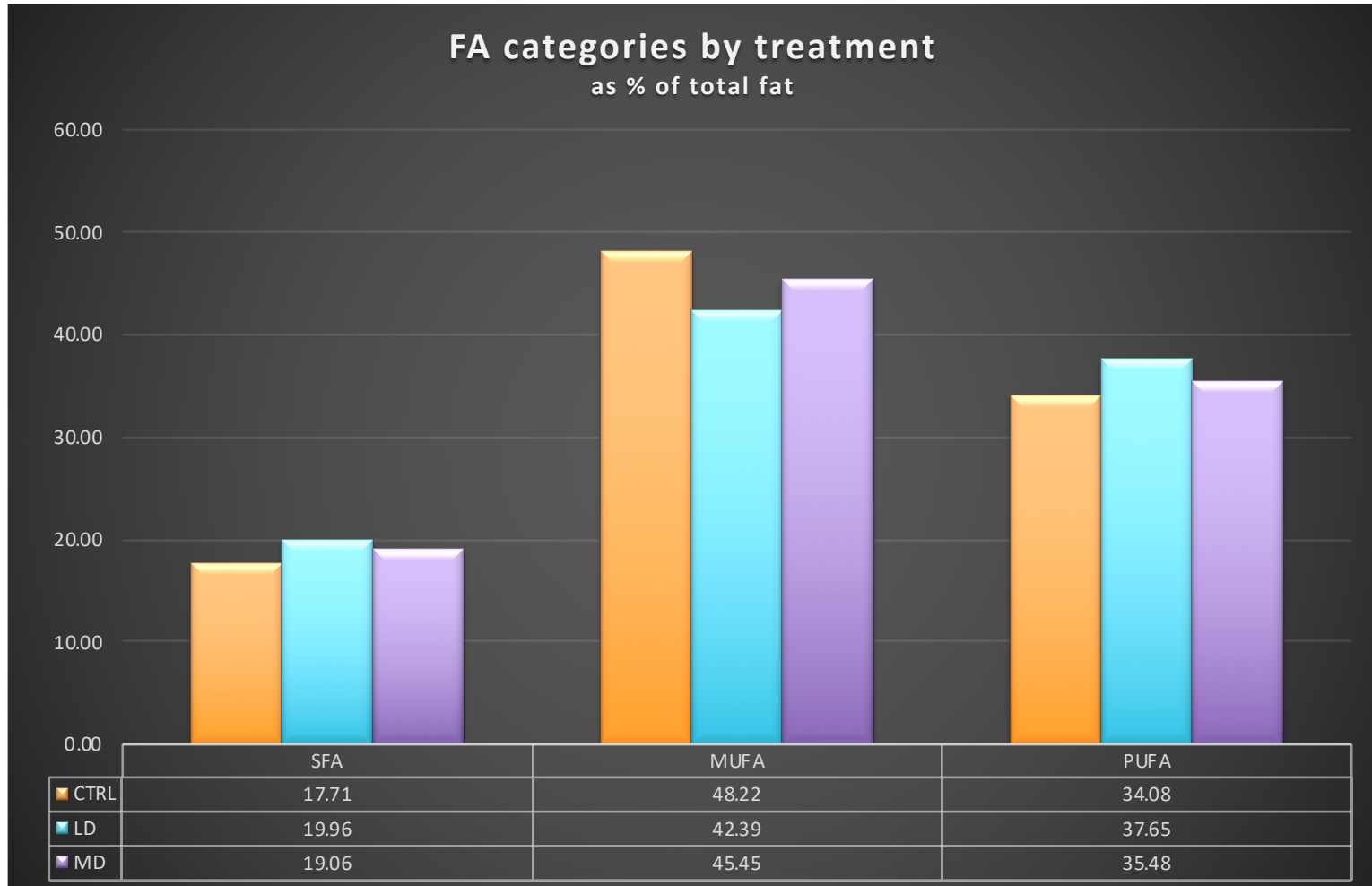
FA % of total fat



	EPA	DHA
Mussel meal	10.81	9.95
Larvae meal	6.04	1.64

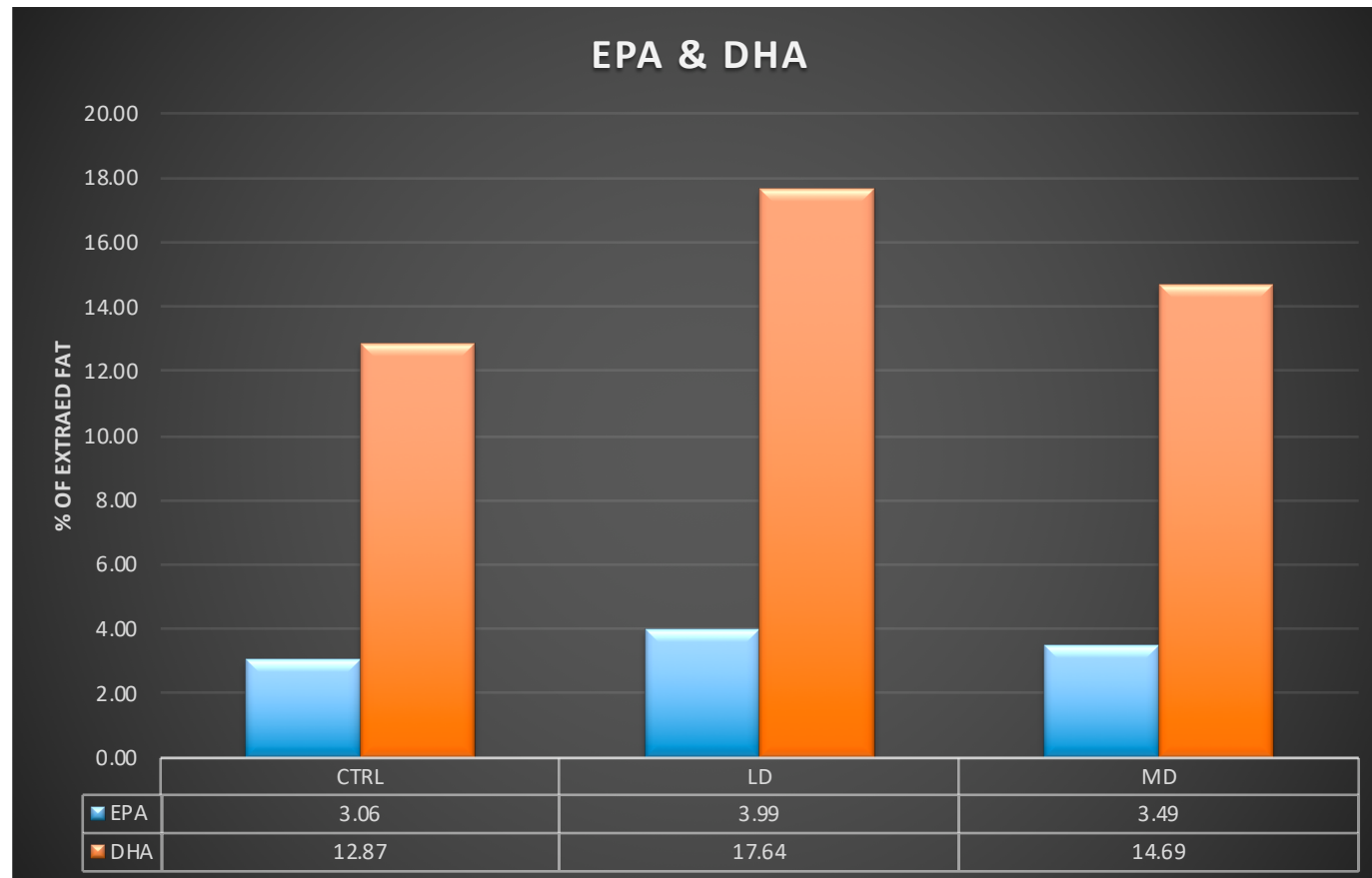
Results

Omega-3 fatty acids in fillet



Baltic Blue Growth

EPA and DHA in fillet



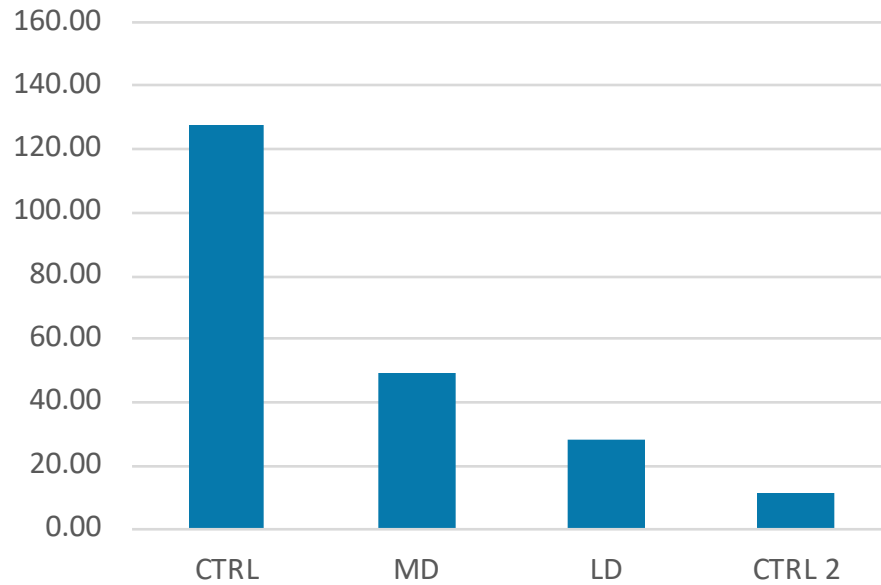
Apparent digestibility of diets

	Control diet	MD	LD	P-value
Dry matter	78.0 ^b	80.1 ^a	75.2 ^c	<0.0001
Crude protein	94.4 ^b	96.3 ^a	93.5 ^b	0.0001
Gross energy	81.68 ^a	82.9 ^a	77.85 ^b	0.0001
Crude fat	86.75 ^a	85.43 ^a	77.03 ^b	0.0009
Lysine	97.2 ^a	97.5 ^a	96.0 ^b	0.0019
Methionine	95.0 ^{ab}	96.1 ^a	94.0 ^b	0.0102
Sum of essential amino acids	96.0 ^a	96.7 ^a	94.8 ^b	0.0014

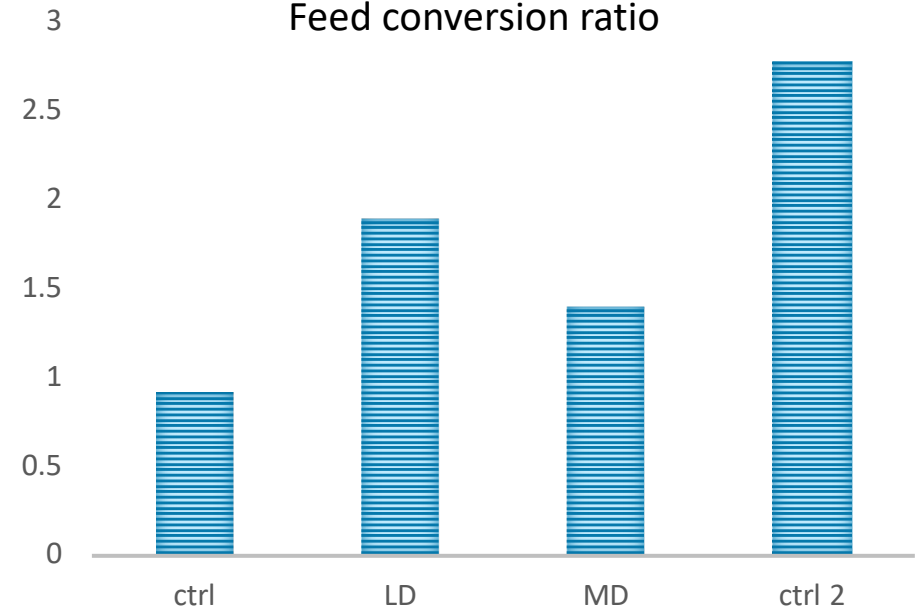
- High digestibility of all diets
- Only minor differences in ADC of major nutrients
- Lower fat digestibility of Larvae diet, possibly due to C12 (Lauric acid) fraction

Fish growth performance

Weight gain %



Feed conversion ratio



Fish growth performance

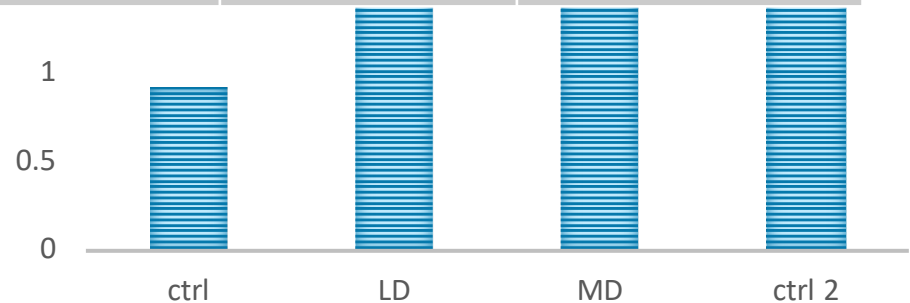
Weight gain %



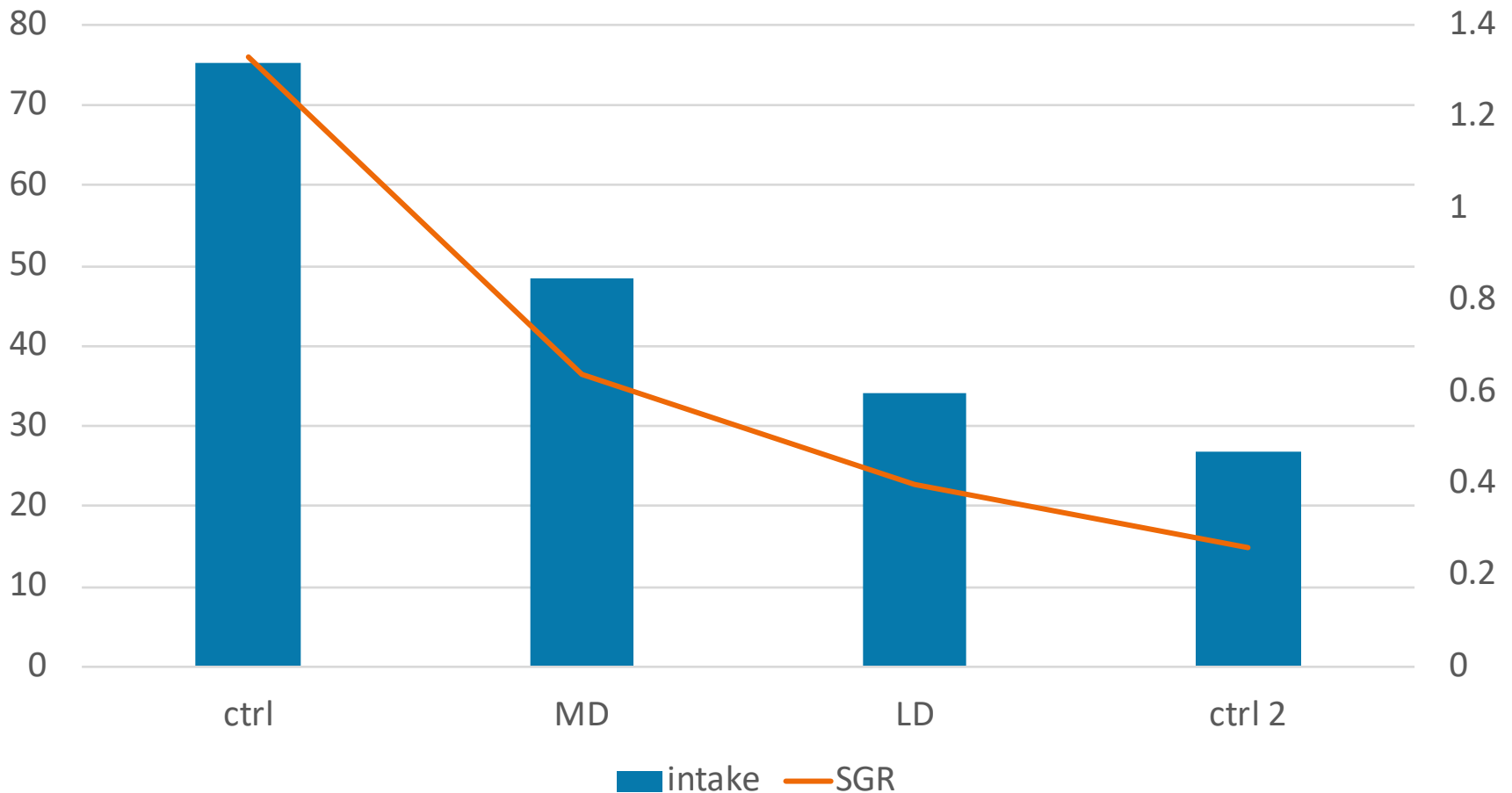
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Feed intake vs growth performance



Summary

- High digestibility of protein, energy and dry matter in both mussel meal and larvae meal
- Fat digestibility of larvae diet rather low, a limiting factor in use as whole meal?
- Feed efficiency low for LD and MD diets, likely due to bitter taste of pea protein (clear dose response)
- Mussels **improve** the fat quality in black soldier fly larvae.

Recomendations

- Up to 10% protein in diets for rainbow trout can be supplied by Baltic mussel meal.
- Larvae meal shows high potential and could be used to replace up to 10% protein.
- With both meals, inclusion of fish meal in low amounts for appetite stimulation.
- Both sources should be used in conjunction with possible metionine supplementation.
- Some important points for future development of larvae meal:
 - Optimization of fatty acid profiles in relation to PUFA and C12 could improve the final quality of fat in larvae.
 - Fat could be separated from the meal in order to produce a protein concentrate and increase the acceptance.

Unwanted substance removal potential

		mussels	larvae	unit
diuretic	DST	280	42-67	µg OA eq/kg
azaspiracid	AZA	<30	<30	µg AZA eq/kg
pectenotoxin	PTX	<30	<30	µg PTX eq/kg
yessotoxin	YTX	0.17	<0.10	mg YTX eq/kg

Thank you for your attention!



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