REQUIREMENTS FOR N-3 HUFA OF MEAGRE (*Argyrosomus regius*, Asso 1801) FINGERLINGS

Grupo de Investigación en Acuicultura

(GIA; www.giaqua.org)

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SEVENTH FRAMEWORK PROGRAMME

Grupo de Investigación en Acuicultura

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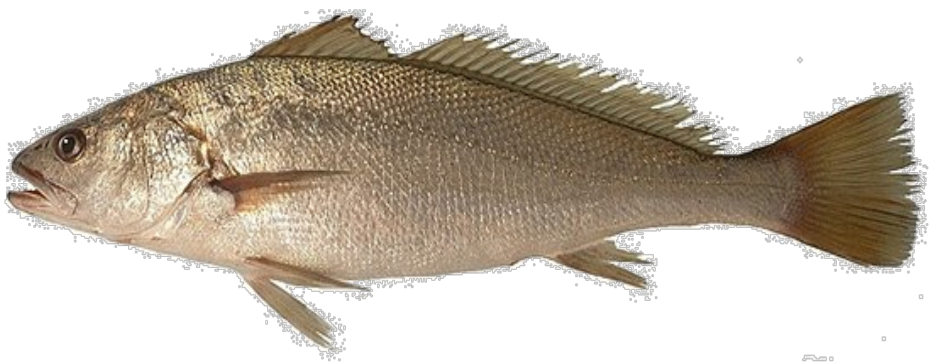
Task 8.2: Determination of nutritional requirements to promote feed utilization, consistent growth rates and fish welfare

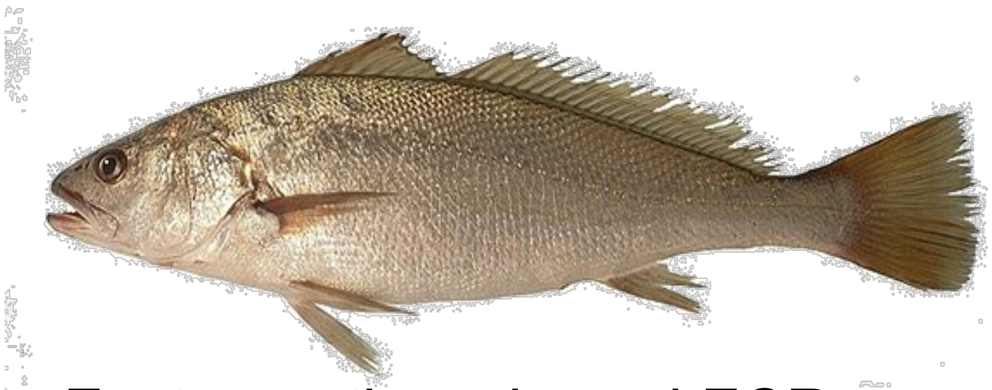
- Define the requirement for n-3 HUFA of meagre fingerlings



- *This study will contribute to deliverable D8.2*
- **Publication**: Carvalho et al. Dietary requirement for n-3 long-chain polyunsaturated fatty acids for fast growth of meagre (*Argyrosomus regius* Asso, 1801) fingerlings, *Aquaculture (2018)*, in press.

Introduction

- Meagre is a promising species for aquaculture diversification



- Fast growth and good FCR
- Costs of production similar to seabream
- High flesh nutritional quality (protein, omega-3)

Limitation to production → Gap in knowledge of nutritional requirements

Introduction

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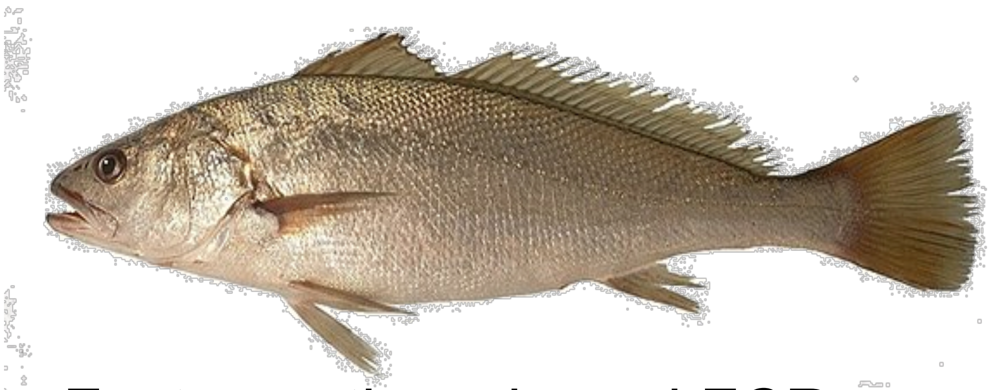

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Gap in knowledge of nutritional requirements → EFA requirements (n-3 and n-6 HUFA)

Objective

- Evaluate the effect of 5 increasing dietary n-3 HUFA levels on:
  - Growth performance
  - Feed utilization
  - Whole-body composition
  - Desaturase and elongase gene expression

- Estimate the n-3 HUFA requirements for meagre fingerlings

Methodological approach

Dietary treatments

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16.5% DM lipids
0.9 EPA/DHA
0.1-0.7% ARA (of total FA)
Feeding: 3x/day until apparent satiety during 30 days.

Composition (%) and proximate analysis of the experimental diets for meagre fingerlings.

	Dietary n-3 HUFA level (%DM)				
	0.8	1.4	2.0	2.6	3.6
Ingredients (%)					
Fish meal, N. Atlantic[a]	15.0	15.0	15.0	15.0	15.0
Corn gluten[b]	10.0	10.0	10.0	10.0	10.0
Faba beans[a]	10.0	10.0	10.0	10.0	10.0
Wheat[a]	8.0	8.0	8.0	8.0	8.0
Wheat gluten[a]	18.4	18.4	18.4	18.4	18.4
Soy protein concentrate[a]	25.0	25.0	25.0	25.0	25.0
Fish oil, S. American[a]	0.0	2.7	5.4	8.2	10.9
Linseed oil[c]	1.6	1.2	0.8	0.4	0.0
Palm oil[3]	3.3	2.5	1.7	0.8	0.0
Rapeseed oil[a]	6.0	4.5	3.0	1.5	0.0
Premix[d]	2.8	2.8	2.8	2.8	2.8
Proximate analysis (% DM)					
Protein	56.5	54.5	54.5	56.0	54.3
Lipids	16.2	17.0	16.5	16.9	16.2
Ash	4.9	5.0	5.1	5.2	5.0
Moisture	8.7	8.5	8.5	8.2	7.9

Methodological approach

- Rearing conditions
  - IBW: 2.8 g; IBL: 6.4 cm
  - 200 L - tanks (3 x treatment)
  - 45 fish/tank
  - Temperature: 23±0.2 ºC

- Final sampling
  - Biological parameters: body weight, lenght and feed intake
  - Biochemistry: whole-body composition and diets (protein, lipids, FA content, ash and moisture)
  - Gene expression in liver: Δ6 desaturase and Elovl5

Results- Growth performance

	Dietary n-3 HUFA level (%DM)				
	0.8	1.4	2.0	2.6	3.6
Survival (%)	93.3±0.7	97.8±1.3	99.3±0.7	94.8±1.5	97.8±2.2
Initial total length (cm)	6.4±0.0	6.3±0.1	6.3±0.0	6.4±0.0	6.2±0.0
Final total length (cm)	9.0±0.1^{c}	9.4±0.1^{b}	9.3±0.1^{ab}	9.6±0.1^{a}	9.3±0.1^{bc}
Initial body weight (g)	2.8±0.1	2.8±0.1	2.7±0.1	2.7±0.1	2.6±0.1
Final body weight (g)	9.5±0.3^{b}	10.4±0.3^{a}	10.2±0.4^{ab}	10.7±0.3^{a}	10.4±0.3^{a}
WG (g)	6.7±0.4	7.5±0.4	7.6±0.3	8.0±0.3	7.8±0.2
SGR (% day^{-1})	4.1±0.1	4.3±0.2	4.5±0.1	4.5±0.1	4.6±0.1
TGC	1.0±0.0	1.1±0.1	1.1±0.0	1.2±0.0	1.2±0.0
FI (g feed fish^{-1}day^{-1})	0.2±0.0	0.2±0.0	0.2±0.0	0.2±0.0	0.2±0.0
FCR	0.8±0.1	0.7±0.0	0.7±0.0	0.7±0.0	0.7±0.0
K (%)	1.3±0.0	1.3±0.0	1.3±0.1	1.2±0.1	1.3±0.0
PER	2.4±0.2	2.6±0.1	2.5±0.1	2.6±0.1	2.6±0.1

Different letters are significantly different ($P<0.05$)

- No external signs of EFA-deficiency nor mortality (~seabream, Ibeas et al., 1994; seabass, Skalli and Robin, 2004)
- **Higher growth rates (>Güroy et al., 2017) and good feed conversion ratios (~FAO, 2017; Monfort, 2010)**

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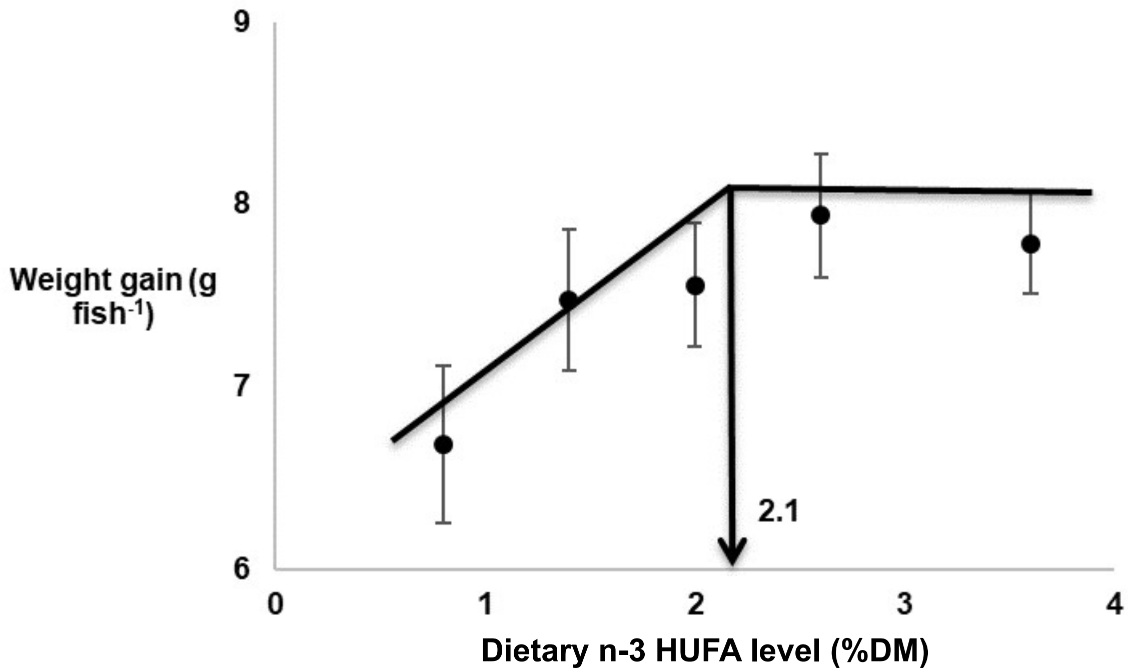
K (%)	1.3±0.0	1.3±0.0	1.3±0.1	1.2±0.1	1.3±0.0
PER	2.4±0.2	2.6±0.1	2.5±0.1	2.6±0.1	2.6±0.1

Different letters are significantly different ($P<0.05$)

Dietary n-3 HUFA increase was **significantly correlated** to final body weight ($P=0.09$, $r^2=0.82$), WG ($P=0.05$, $r^2=0.86$), SGR ($P=0.01$, $r^2=0.94$) and TGC ($P=0.01$, $r^2=0.94$).

Results- Growth performance



Requirement: **2.1%** n-3 HUFA

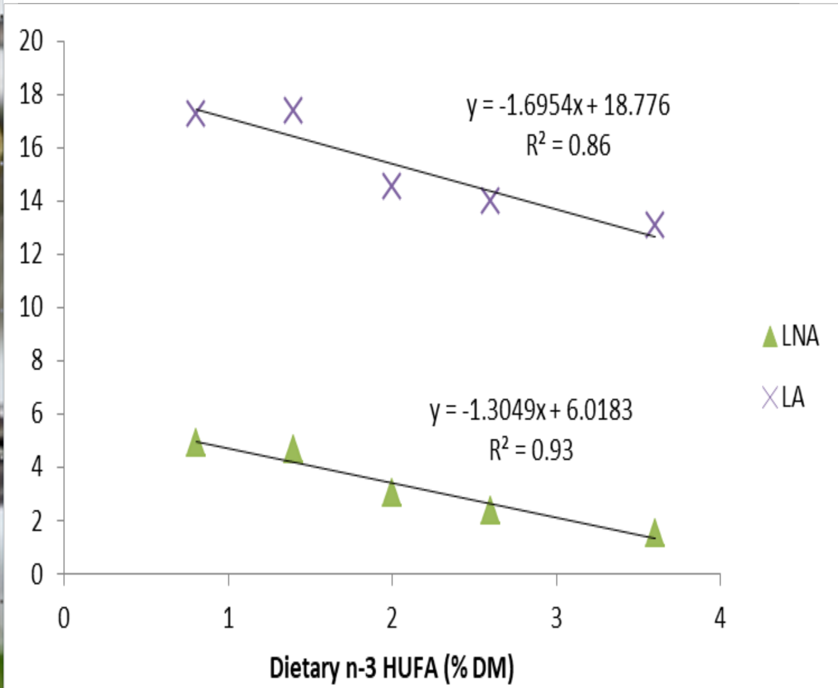
Similar to what found for red seabream (Takeuchi et al., 1992a) and yellowtail (Takeuchi et al., 1992b) , but higher than red drum (Lochman and Gatlin, 1993), seabream (Ibeas et al., 1996) and seabass (Skalli and Robin, 2004).

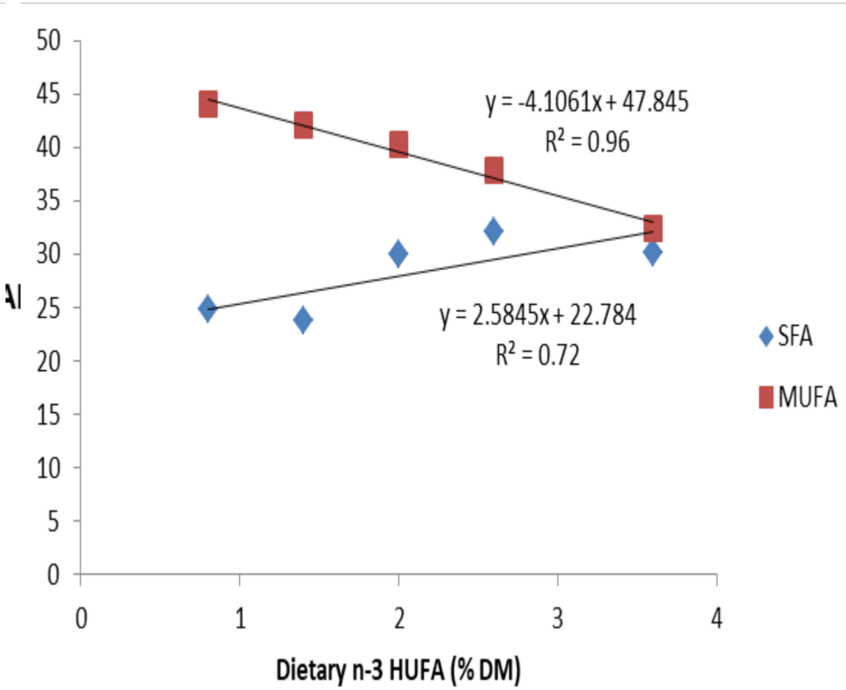
Results- Body composition (% wet weight)

	Dietary n-3 HUFA level (% DM)					
	Initial	0.8	1.4	2.0	2.6	3.6
Protein	15.6±0.49	15.8±0.17	16.1±0.12	15.6±0.28	16.3±0.50	16.0±0.61
Lipid	2.2±0.12	4.1±0.47	4.1±0.25	3.8±0.24	3.8±0.28	3.9±0.25
Ash	3.9±0.26	2.7±0.22	2.7±0.09	2.8±0.14	2.8±0.04	2.6±0.29
Moisture	78.6±0.28	78.1±0.82	77.7±0.03	78.0±0.60	78.5±0.13	78.7±0.20

No significant differences observed between fish fed different treatments.

Results- Whole-body FA content (% total FA)





Reflecting diet composition → According to the increase substitution of VO by FO

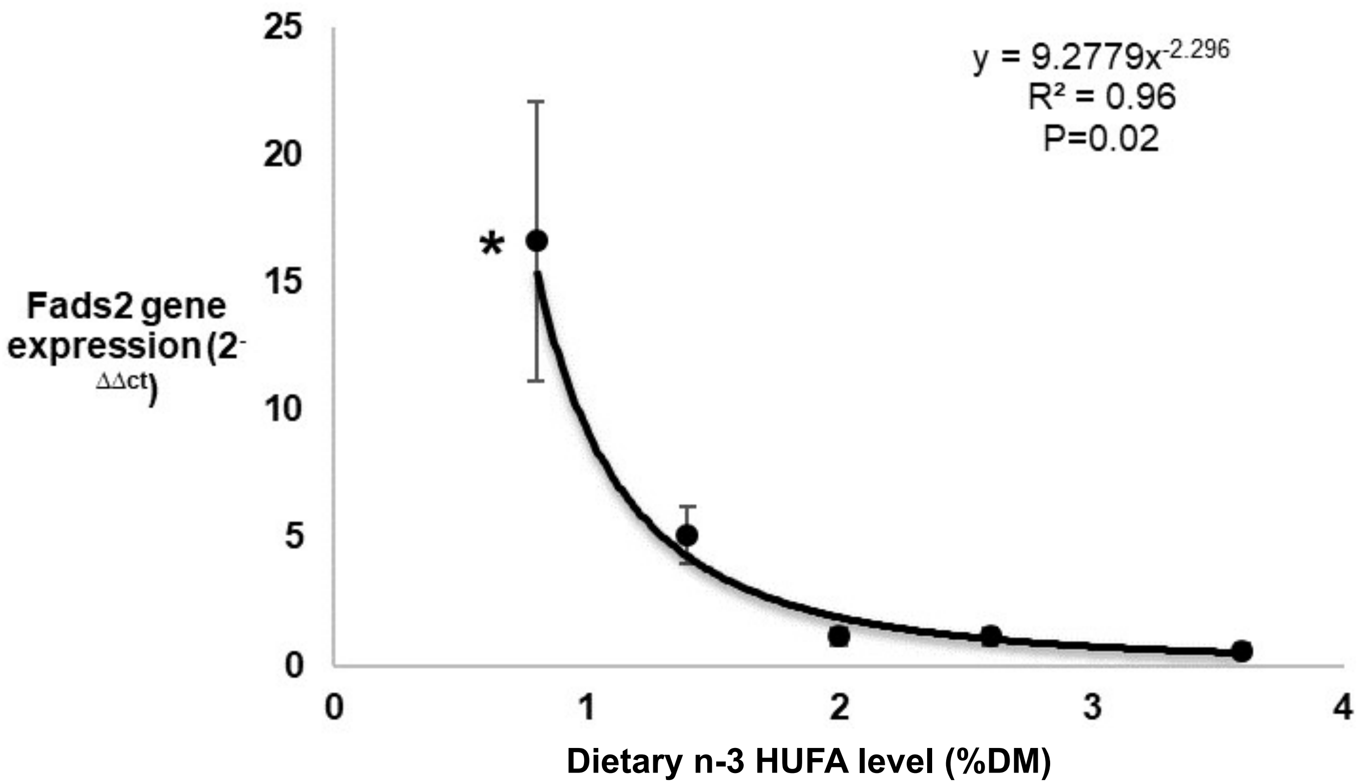
Results- FA rentention efficiency (% FA intake)

Fatty acid	Dietary n-3 HUFA level (% DM)				
	0.8	1.4	2.0	2.6	3.6
18:2n-9	251.9±43.0^{a}	125.7±16.5^{b}	55.1±16.2^{b}	47.2±1.2^{b}	37.7±1.4^{b}
18:3n-6	190.8±44.8	107.8±14.7	48.2±13.7	40.9±2.4	65.5±12.6
18:4n-3	23.3±3.6	26.9±4.7	14.6±4.3	18.9±3.3	30.0±3.2
18:3n-3	25.7±5.3^{b}	38.7±4.1^{ab}	24.5±4.3^{b}	31.7±2.9^{b}	56.8±5.2^{a}
20:3n-3	315.0±88.6^{a}	256.1±24.6^{ab}	136.6±12.9^{abc}	50.8±0.6^{b}	68.2±10.7^{b}
20:2n-6	227.8±57.4^{a}	165.4±11.4^{ab}	114.2±12.8^{ab}	82.2±110.7^{b}	86.5±10.3^{ab}
20:4n-6	55.0±18.2	57.2±2.8	28.7±8.9	32.9±3.0	53.1±6.7
20:5n-3	25.0±6.7	31.3±4.4	13.3±4.7	17.9±4.1	30.3±4.3
22:6n-3	56.1±5.8^{a}	41.4±3. ^{b}	41.5±4.7^{b}	37.5±0.7^{b}	39.9±3.7^{b}

Δ6 desaturase product

Elovl5 product

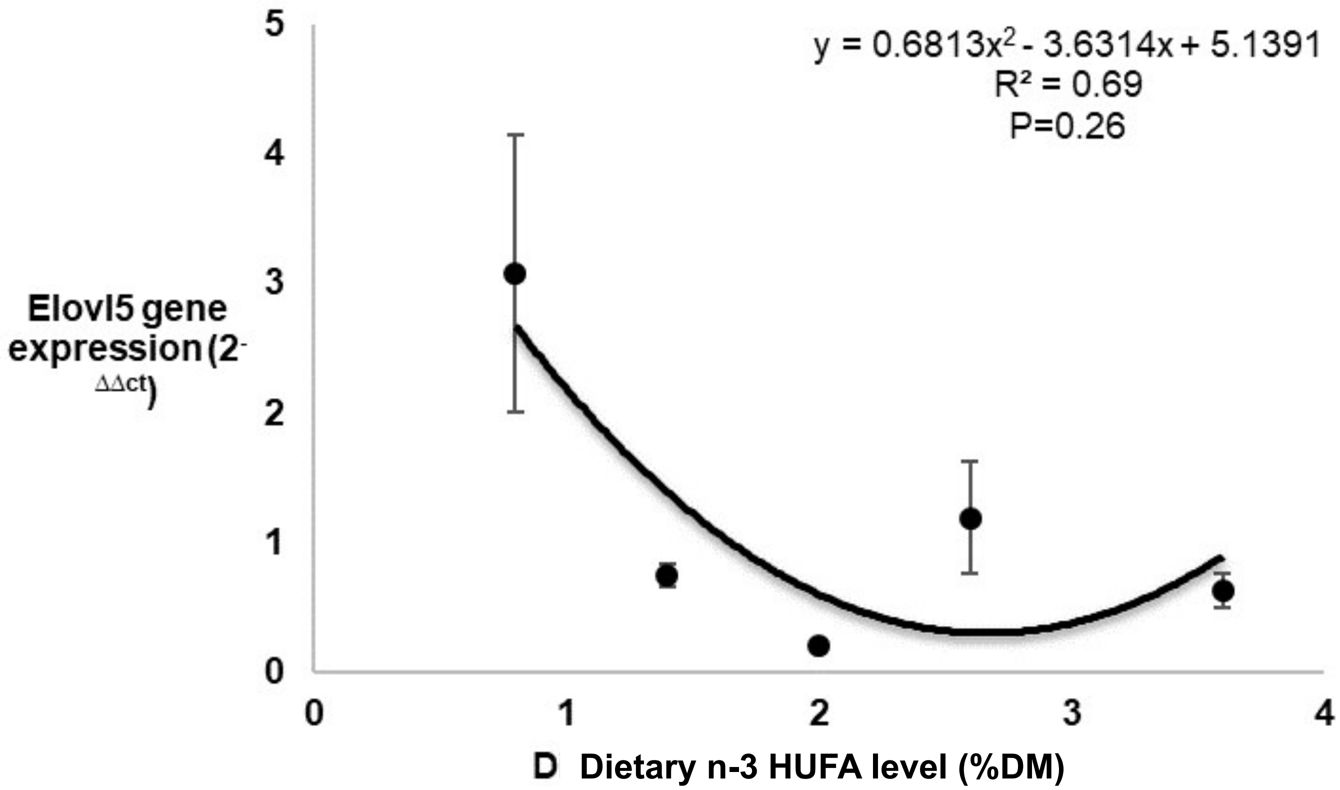
Results- Gene expression



* indicates significance difference (P=0.04) compared to diet 3.6% n-3 HUFA

Similar results found by Monroing et al., 2013

Results- Gene expression



Similar results found by Monroing et al., 2013

Conclusions

- Meagre showed the ability to selectively conserve key FA, particularly DHA and ARA over other FA, in response to EFA-deficiency.
- Meagre seems to have active Δ6 desaturase and Elovl5, but their activities being insufficient to produce enough DHA and EPA from PUFA precursors to sustain fast growth.
- Meagre fingerlings have n-3 HUFA requirement around 2.1% DM in diets containing 16.5% DM lipids, 0.9 EPA/DHA and 0.4% ARA of total FA contents.

THANK YOU FOR YOUR ATTENTION

Acknowledgements

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