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Co-funded by the Seventh Framework Programme of the European Union

Annual Coordination Meeting 2018

University of La Laguna (ULL) & Instituto Español de Oceanografía (IEO)

23-25 January 2018, Tenerife, Spain.

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EFFECT OF DIETARY FATTY ACIDS ON SPAWN QUALITY IN GREATER AMBERJACK (*Seriola dumerili*) BROODSTOCK

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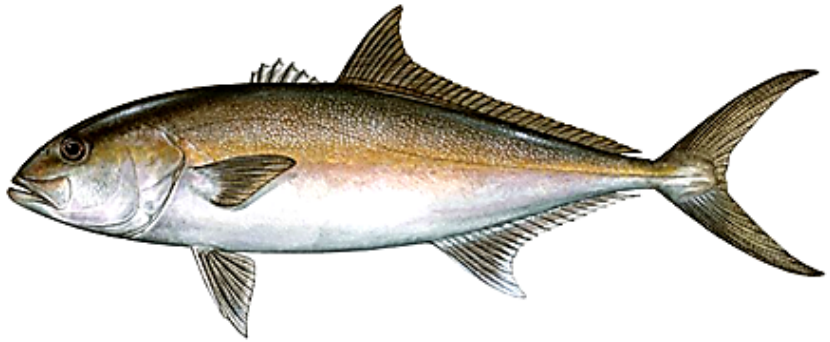
Introduction

Greater amberjack *Seriola dumerili* (RISSO, 1810)



Excellent candidate to aquaculture

Excellent flesh quality (Nakada, 2000)

Rapid growth (Thompson et al., 1999; Harris et al., 2007)

High market price (García y Díaz, 1995; Thompson et al., 1999)

Adaptation to captivity (Jerez et al., 2006; Fernández-Palacios et al., 2015; Sarih et al., 2018)

Bottlenecks

Reliable reproduction

Production of adequate numbers of juveniles

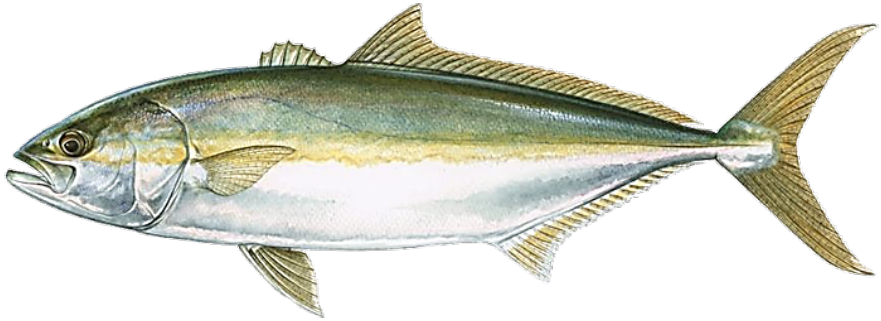
Bottlenecks

Egg quality is variable and generally low (Lazzari *et al.,* 2000; Mylonas *et al.,* 2004, Jerez et al., 2006; Fernández-Palacios et al., 2015).

Low larval survival (Papandroulakis et al., 2005)

Production of adequate numbers of juveniles

Introduction



Seriola lalandi
(Tachihara *et al.*, 1997)

Seriola quinqueradiata
(Matsunari *et al.*, 2006)

Nutritional deficiency in broodstock diet

Low egg quality and larval survival

WP 9. Nutrition – greater amberjack

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Objective

Task 9.3. Design adequate feeding regimes for broodstock to optimize reproduction.

Sub-Task 9.3.1 (FCTP). The optimum DHA and EPA levels as essential fatty acids for reproductive success of greater amberjack (*Seriola dumerili*) has been studied.

Material & Methods

Experimental fish

Material & Methods

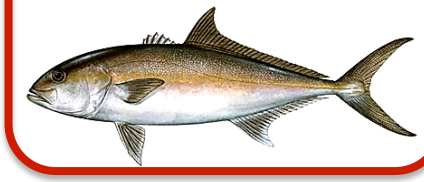
Experimental design

Mar. Apr. May June Jul. Aug. Sept. Oct.

Experimental diets
Egg quality

Common diet
Egg quality

Weigh & Size



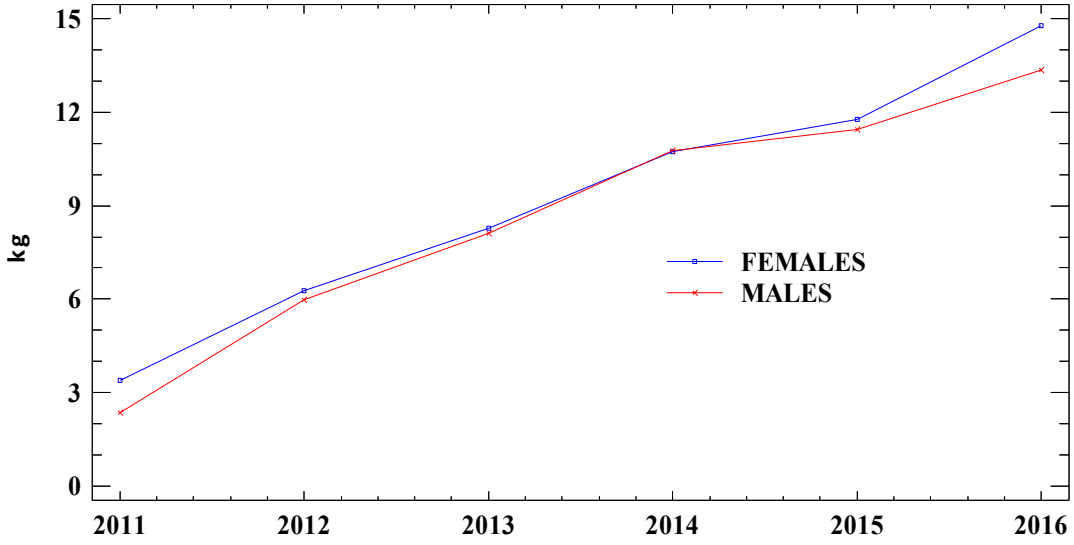
Intramuscular injection

Material & Methods

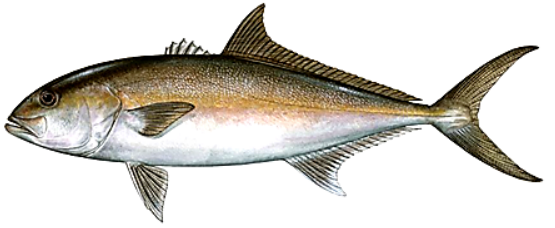
Experimental design

Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.

All fish were weighted and sized.
Weight evolution of broodstock lot from 2011 to 2016.



16 Broodstock selected
8 ♀: 14.62 ± 2.06 kg
8 ♂: 12.98 ± 3.45 kg



Experimental design

Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.

All females were not cannulated, neither the abdominal massage was performed on males.

The selected fish were distributed (sex ratio 1:1) in 4 circular tanks of 40 m^3 (2♀ and 2♂ in each one).

Material & Methods

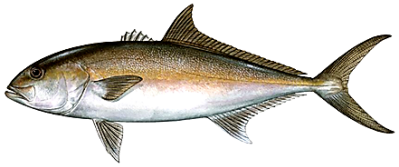
Experimental design

Mar. Apr. May June Jul. Aug. Sept. Oct.

Experimental diets
Egg quality

Common diet
Egg quality

Weigh & Size



Intramuscular injection

Material & Methods

Experimental design

Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.

Intramuscular injection

GnRHa: 20 µg kg^{-1} ♀ & ♂ (Fernández-Palacios *et al.*, 2015)

Twice a week alternating the broodstock

Material & Methods

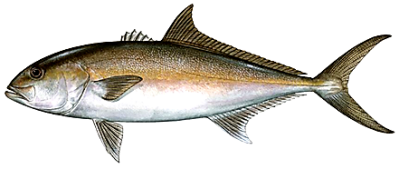
Experimental design

Mar. Apr. May June Jul. Aug. Sept. Oct.

Experimental diets
Egg quality

Common diet
Egg quality

Weigh & Size



Intramuscular injection

Material & Methods

Experimental design

Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.

1. Common diet

Twice a week: commercial diet at 1% (13 mm, Vitalis CAL, Skretting)

Once a week: Atlantic mackerel (*Scomber scombrus*) at 2%

+

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2. Egg quality

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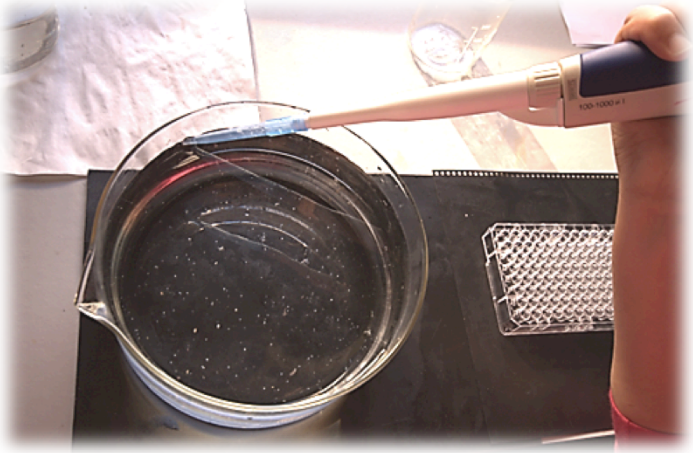


Results

Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.

Common diet

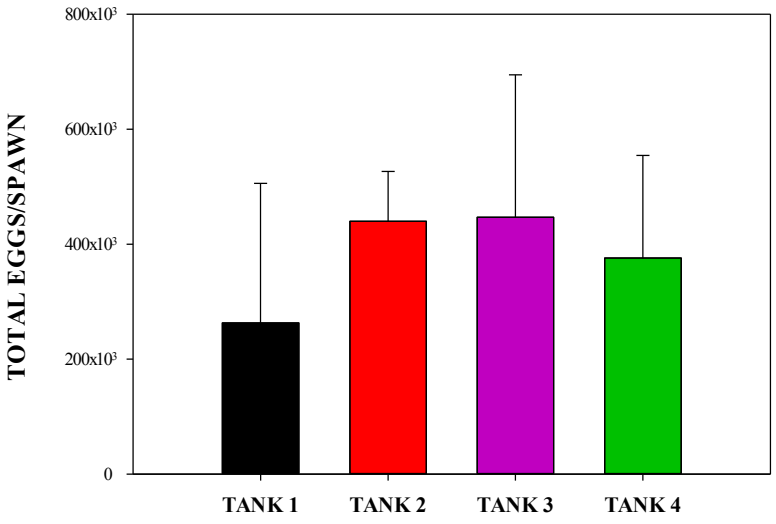
Tank	% Females with spawns	Number inductions	Number spawns	Number of eggs
1	100	12	9	2 366 100
2	100	12	7	3 080 000
3	100	12	7	2 682 000
4	100	12	8	3 008 800

Results

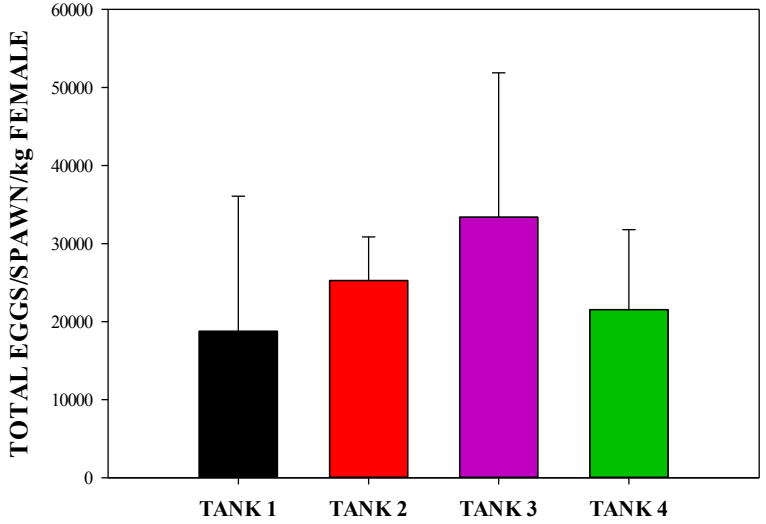
Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.

Common diet

Number of eggs per spawn



Number of eggs per spawn and kg female



Results

Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.

Common diet

Quality of egg and larvae obtained during the feeding period with the common diet

Tank	% Fertilization	% Viable 24h	% Hatching
1	55.66±26.22	83.43±7.50	81.04±8.03
2	61.65±15.94	88.71±0.76	86.90±0.96
3	41.93±29.61	89.58±4.55	86.67±6.01
4	64.92±14.86	86.67±7.21	82.29±8.05
Tank	**% 1 dph survival**	**% 3 dph survival**	**% 5 dph survival**
1	63.68±14.93	39.81±14.13	2.84±1.63
2	74.34±9.70	28.32±7.35	4.27±1.66
3	70.45±9.33	29.78±8.25	3.17±2.27
4	72.04±11.08	37.39±12.95	3.21±2.27

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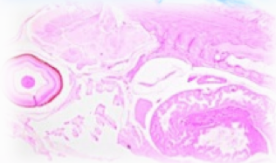
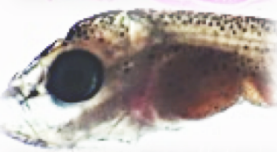





Results

Selected fatty acid composition (% total fatty acids) of eggs obtained during the feeding period with the common diet

Fatty acid	Tank 1	Tank 2	Tank 3	Tank 4
14:0	1.48 ± 0.21	1.59 ± 0.08	1.81 ± 0.34	1.74 ± 0.22
16:0	15.09 ± 0.65	15.87 ± 0.53	16.44 ± 0.56	16.33 ± 1.55
18:0	5.26 ± 0.57	5.31 ± 0.67	4.51 ± 0.26	5.98 ± 1.38
18:1n-9	23.00 ± 0.53	23.31 ± 1.57	24.27 ± 1.03	23.99 ± 0.68
18:1n-7	4.04 ± 0.06	3.94 ± 0.16	4.05 ± 0.08	4.10 ± 0.04
18:2n-6	10.15 ± 0.19	10.21 ± 0.45	9.77 ± 0.51	9.51 ± 0.32
18:3n-6	0.24 ± 0.01	0.36 ± 0.04	0.31 ± 0.07	0.25 ± 0.02
18:3n-3	1.31 ± 0.07	1.29 ± 0.11	1.21 ± 0.08	1.29 ± 0.13
20:4n-6 (ARA)	1.45 ± 0.07	1.34 ± 0.04	1.21 ± 0.10	1.56 ± 0.07
20:5n-3 (EPA)	5.99 ± 0.37	5.99 ± 0.28	5.65 ± 0.50	5.16 ± 0.45
22:6n-3 (DHA)	18.63 ± 0.53	17.84 ± 0.80	17.09 ± 0.44	16.62 ± 1.66
Total n-3	33.10 ± 0.58	33.21 ± 1.53	34.81 ± 0.47	34.47 ± 0.50
Total n-6	29.91 ± 0.53	28.73 ± 1.25	27.78 ± 0.53	26.66 ± 2.11
Total n-9	12.93 ± 0.22	12.88 ± 0.41	12.24 ± 0.72	12.44 ± 0.28
Total n-3 HUFA	23.52 ± 0.50	24.00 ± 1.67	24.93 ± 1.08	24.67 ± 0.65
DHA/EPA	3.12 ± 0.24	2.98 ± 0.04	3.04 ± 0.33	3.23 ± 0.35
DHA/ARA	12.82 ± 0.35	13.36 ± 0.34	14.20 ± 1.20	10.67 ± 1.10
EPA/ARA	4.12 ± 0.32	4.48 ± 0.08	4.70 ± 0.69	3.32 ± 0.43
EPA+DHA	24.62 ± 0.49	23.83 ± 1.07	22.74 ± 0.35	21.77 ± 1.85
n-3/n-6	2.31 ± 0.05	2.23 ± 0.07	2.27 ± 0.18	2.14 ± 0.18

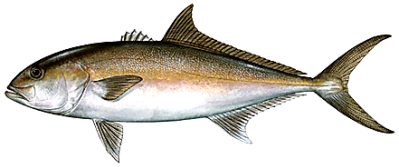
Experimental design

Mar. Apr. May June Jul. Aug. Sept. Oct.

Experimental diets
Egg quality

Common diet
Egg quality

Weigh & Size



Intramuscular injection

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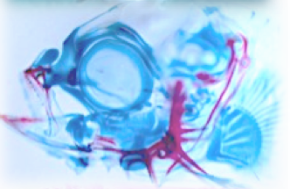
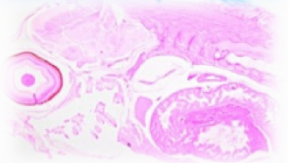






Proportion of ingredients and proximate of the experimental diets (Skretting Aquaculture Research Center, Stavanger, Norway).

Diet	1	2	3	4
Lineseed oil	0.00	1.52	3.01	4.50
Wheat	19.09	19.13	19.13	19.13
Wheat gluten	13.62	14.99	14.99	14.99
Fish meal	44.97	43.46	43.46	43.46
Squid meal	10.00	10.00	10.00	10.00
Fish oil	10.93	7.48	4.04	0.61
Palm oil	0.00	2.03	3.98	5.93
Premix vit. Min.	0.64	0.64	0.64	0.64
EPA+DHA (% total fatty acids)	**2.80**	**2.17**	**1.57**	**0.96**
Proximate composition (%)				
Crude protein	58.50	58.91	58.91	59.06
Crude fat	24.25	24.89	24.35	25.61
Moisture	7.27	5.41	7.22	8.30
Ash	7.46	7.19	7.25	7.30

Material & Methods

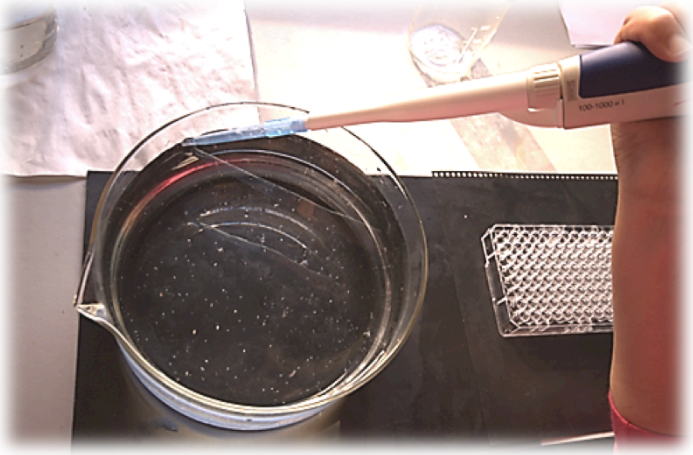
Experimental design

Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.

Experimental diets

Twice a day and 5 days a week (2% of biomass day^{-1})

Egg quality



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After three weeks of feeding with experimental diets

(Fernández-Palacios *et al*., 1995; Tandler *et al*., 1995).

Results

Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.

Experimental diets

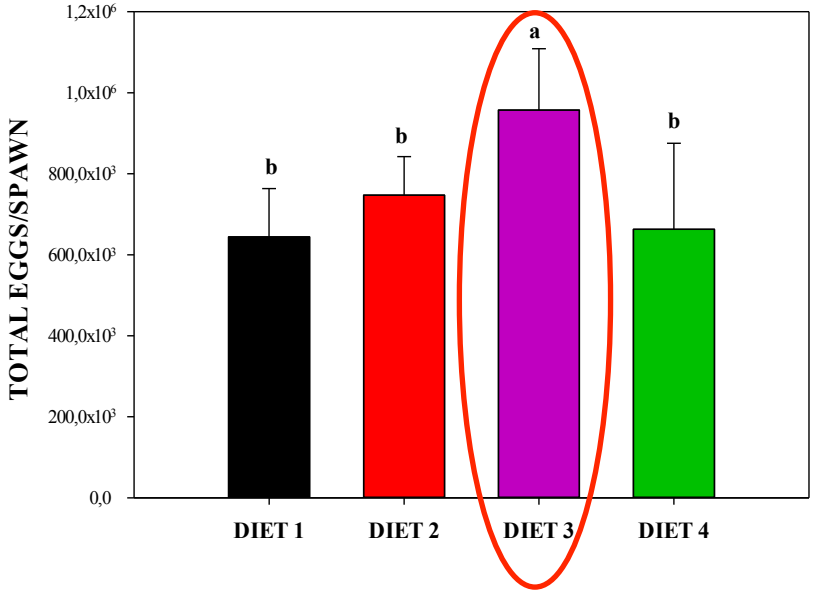
Diet	% Females with spawns	Number inductions	Number spawns	Number of eggs
1	100	20	14	9 021 880
2	100	20	14	10 465 000
3	100	20	15	14 360 250
4	100	20	15	9 946 500

Results

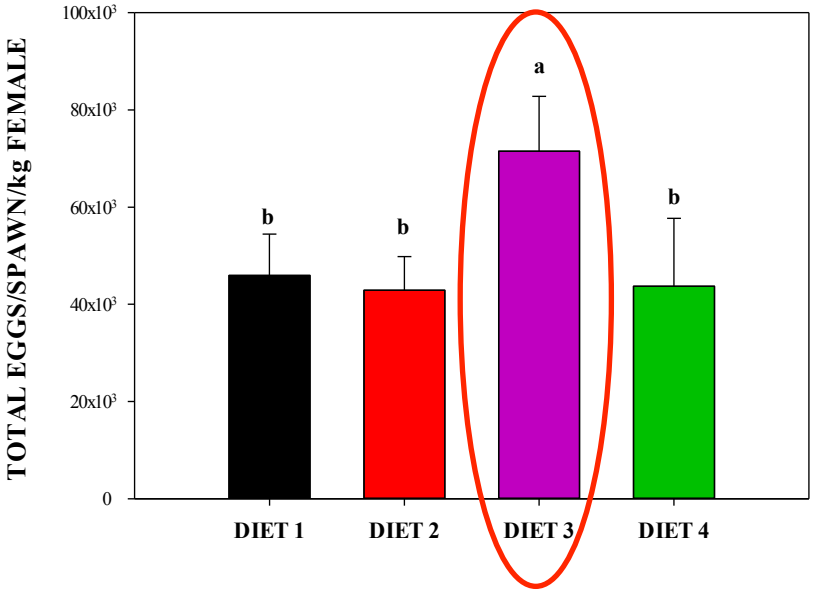
Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.

Experimental diets

Number of eggs per spawn



Number of eggs per spawn and kg female



*Bars, of the same shade, with the same letter were not significantly different ($P < 0.05$).

Results

Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.

Experimental diets

Quality of egg and larvae obtained after feeding period with the experimental diets

Diet	% Fertilization	% Viable 24h	% Hatching
1	52.42±10.64^{c}	90.28±3.28^{b}	76.99±8.94^{b}
2	69.02±7.38^{b}	85.07±1.73^{c}	79.68±3.74^{b}
3	91.76±3.12^{a}	95.99±2.81^{a}	94.22±3.62^{a}
4	86.32±1.67^{a}	93.88±2.48^{a}	92.51±2.27^{a}

Diet	% 1 dph survival	% 3 dph survival	% 5 dph survival
1	57.44±3.08^{b}	16.15±4.96^{b}	1.56±1.04^{b}
2	59.85±2.94^{b}	11.59±2.22^{c}	2.95±1.98^{a}
3	85.25±9.97^{a}	28.33±8.01^{a}	3.98±1.52^{a}
4	87.04±2.92^{a}	28.12±2.05^{a}	3.73±1.08^{a}

* Means ± SD. Different superscripts in the same column indicate significant differences ($P < 0.05$).

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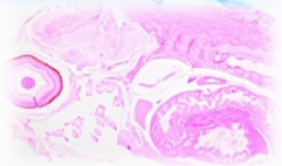
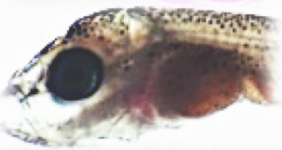



Results

Selected fatty acid composition (% total fatty acids) of eggs obtained after feeding period with the experimental diets

Fatty acid	Diet 1	Diet 2	Diet 3	Diet 4
14:0	2.61 ± 0.33	2.30 ± 0.12	2.05 ± 0.04	1.81 ± 0.37
16:0	18.73 ± 0.86	18.18 ± 0.62	18.52 ± 0.23	18.50 ± 0.45
18:0	5.78 ± 0.48	6.16 ± 0.22	4.90 ± 0.15	5.48 ± 0.66
18:1n-9	20.88 ± 2.43 ^{b}	20.85 ± 0.12 ^{b}	24.05 ± 0.57 ^{a}	24.43 ± 2.21 ^{a}
18:1n-7	4.09 ± 0.29	3.26 ± 0.17	3.04 ± 0.07	3.41 ± 0.48
18:2n-6	6.82 ± 0.45 ^{c}	9.02 ± 0.56 ^{ab}	10.39 ± 0.01 ^{a}	8.66 ± 0.21 ^{b}
18:3n-6	0.21 ± 0.01 ^{a}	0.17 ± 0.01 ^{b}	0.16 ± 0.01 ^{b}	0.19 ± 0.01 ^{ab}
18:3n-3	1.02 ± 0.06 ^{c}	4.67 ± 0.21 ^{b}	6.54 ± 0.40 ^{a}	4.07 ± 0.44 ^{b}
20:4n-6 (ARA)	1.33 ± 0.01 ^{a}	1.16 ± 0.08 ^{ab}	0.93 ± 0.01 ^{c}	1.07 ± 0.07 ^{bc}
20:5n-3 (EPA)	6.35 ± 1.10 ^{a}	6.22 ± 0.07 ^{a}	4.86 ± 0.11 ^{b}	4.98 ± 0.97 ^{b}
22:6n-3 (DHA)	16.88 ± 0.84 ^{a}	14.47 ± 0.35 ^{b}	12.43 ± 0.04 ^{c}	15.05 ± 0.28 ^{ab}
Total n-3	28.40 ± 2.36	28.80 ± 0.14	26.98 ± 0.54	27.46 ± 1.80
Total n-6	8.94 ± 0.40 ^{b}	10.84 ± 0.61 ^{a}	11.97 ± 0.01 ^{a}	10.48 ± 0.36 ^{ab}
Total n-9	21.50 ± 2.40	21.38 ± 0.13	24.56 ± 0.58	24.99 ± 2.16
Total n-3 HUFA	26.24 ± 2.01 ^{a}	22.97 ± 0.37 ^{ab}	19.63 ± 0.07 ^{b}	22.57 ± 1.06 ^{ab}
DHA/EPA	2.69 ± 0.34	2.33 ± 0.08	2.56 ± 0.06	3.08 ± 0.54
DHA/ARA	12.79 ± 0.71	12.57 ± 1.12	13.38 ± 0.13	14.08 ± 1.20
EPA/ARA	4.81 ± 0.86	5.39 ± 0.28	5.23 ± 0.08	4.68 ± 1.22
EPA+DHA	23.22 ± 1.94 ^{a}	20.69 ± 0.29 ^{b}	17.29 ± 0.09 ^{c}	20.02 ± 1.24 ^{b}
n-3/n-6	3.19 ± 0.41	2.66 ± 0.16	2.26 ± 0.05	2.63 ± 0.26

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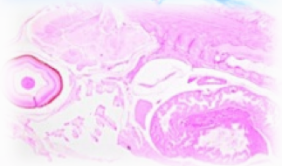
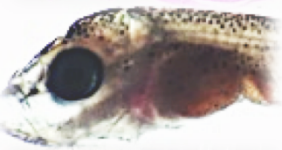



Results

Selected fatty acid composition (% total fatty acids) of eggs obtained after feeding period with the experimental diets

Fatty acid	Diet 1	Diet 2	Diet 3	Diet 4
14:0	2.61 ± 0.33	2.30 ± 0.12	2.05 ± 0.04	1.81 ± 0.37
16:0	18.73 ± 0.86	18.18 ± 0.62	18.52 ± 0.23	18.50 ± 0.45
18:0	5.78 ± 0.48	6.16 ± 0.22	4.90 ± 0.15	5.48 ± 0.66
18:1n-9	20.88 ± 2.43 ^{b}	20.85 ± 0.12 ^{b}	24.05 ± 0.57 ^{a}	24.43 ± 2.21 ^{a}
18:1n-7	4.09 ± 0.29	3.26 ± 0.17	3.04 ± 0.07	3.41 ± 0.48
18:2n-6	6.82 ± 0.45 ^{c}	9.02 ± 0.56 ^{ab}	10.39 ± 0.01 ^{a}	8.66 ± 0.21 ^{b}
18:3n-6	0.21 ± 0.01 ^{a}	0.17 ± 0.01 ^{b}	0.16 ± 0.01 ^{b}	0.19 ± 0.01 ^{ab}
18:3n-3	1.02 ± 0.06 ^{c}	4.67 ± 0.21 ^{b}	6.54 ± 0.40 ^{a}	4.07 ± 0.44 ^{b}
20:4n-6 (ARA)	1.33 ± 0.01 ^{a}	1.16 ± 0.08 ^{ab}	0.93 ± 0.01 ^{c}	1.07 ± 0.07 ^{bc}
20:5n-3 (EPA)	6.35 ± 1.10 ^{a}	6.22 ± 0.07 ^{a}	4.86 ± 0.11 ^{b}	4.98 ± 0.97 ^{b}
22:6n-3 (DHA)	16.88 ± 0.84 ^{a}	14.47 ± 0.35 ^{b}	12.43 ± 0.04 ^{c}	15.05 ± 0.28 ^{ab}
Total n-3	28.40 ± 2.36	28.80 ± 0.14	26.98 ± 0.54	27.46 ± 1.80
Total n-6	8.94 ± 0.40 ^{b}	10.84 ± 0.61 ^{a}	11.97 ± 0.01 ^{a}	10.48 ± 0.36 ^{ab}
Total n-9	21.50 ± 2.40	21.38 ± 0.13	24.56 ± 0.58	24.99 ± 2.16
Total n-3 HUFA	26.24 ± 2.01 ^{a}	22.97 ± 0.37 ^{ab}	19.63 ± 0.07 ^{b}	22.57 ± 1.06 ^{ab}
DHA/EPA	2.69 ± 0.34	2.33 ± 0.08	2.56 ± 0.06	3.08 ± 0.54
DHA/ARA	12.79 ± 0.71	12.57 ± 1.12	13.38 ± 0.13	14.08 ± 1.20
EPA/ARA	4.81 ± 0.86	5.39 ± 0.28	5.23 ± 0.08	4.68 ± 1.22
EPA+DHA	23.22 ± 1.94 ^{a}	20.69 ± 0.29 ^{b}	17.29 ± 0.09 ^{c}	20.02 ± 1.24 ^{b}
n-3/n-6	3.19 ± 0.41	2.66 ± 0.16	2.26 ± 0.05	2.63 ± 0.26

Conclusion

1. Best spawn quality and production parameters were obtained from broodstock fed diet 3 (1.57% EPA+DHA) and diet 4 (0.96% EPA+DHA).

2. Lowest fertilization and egg viability were obtained from broodstock fed diet 1 (2.8% EPA+DHA) and diet 2 (2.17% EPA+DHA) .

3. Egg fatty acid compositions are affected by broodstock diets in greater amberjack.

DIVERSIFY

Co-funded by the Seventh Framework Programme of the European Union

Thank you for your attention

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EFFECT OF DIETARY FATTY ACIDS ON SPAWN QUALITY IN GREATER AMBERJACK (*Seriola dumerili*) BROODSTOCK

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