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EFFECTS OF DIFFERENT PROTEIN AND LIPID RATIOS ON:

Growth
Fish quality
Heavy metals bioaccumulation

during a complete grow-out cycle of red drum in a recirculated aquaculture system.

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CONTEXT AND OBJECTIVES

OBJECTIVES

Testing the performance of **3 industrial feeds** with different **protein/lipid ratios** and **energy ratios** on:

1- Growth performance
2- Nutritional composition
3- Heavy metal bioaccumulation
4- Flesh sensory characteristics

during a **complete grow-out cycle** (30g-2200g) under controlled environmental conditions.

Nutritional attributes of experimental diets

	Concentration (%)		
Components	Diet A	Diet B	Diet C
Water	8	7,5	7,3
Gross protein	**48**	**48**	**44**
Gross lipids	**12**	**15,5**	**15,5**
Energy content	Diet A	Diet B	Diet C
Digestible energy (Kcal/kg feed)	**3777**	**4037**	**3830**
Digestible protein / digestible energy (mg/Kcal)	116,92	109,38	105,69

Adult red drum (*Sciaenops ocellatus*): 2.3 kg

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EXPERIMENTAL CONDITIONS

FILLET-SIZE PHASE (500-2200G)

Recirculated aquaculture system :
2 tanks / diet.
36 fish / diet (108 total).

Individual monitoring:
fish identified using PIT tags.

Photoperiod:
16L/ 8D.

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EXPERIMENTAL CONDITIONS

FILLET-SIZE PHASE (500-2200G)

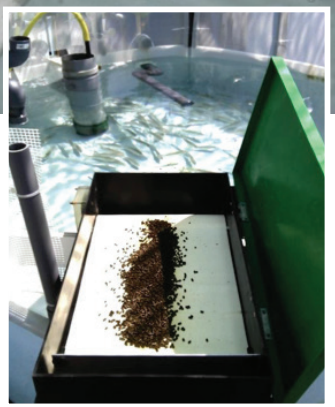
Feeding management:
automatic feeders + manual

Feeding ratios:
high feeding regimes adjusted to the hungriest tank

Feed size:
6mm ; 9mm (pressed)

Growth monitoring:
individual weight every 2 weeks (anaesthetized)

Anaesthetized fish during growth monitoring



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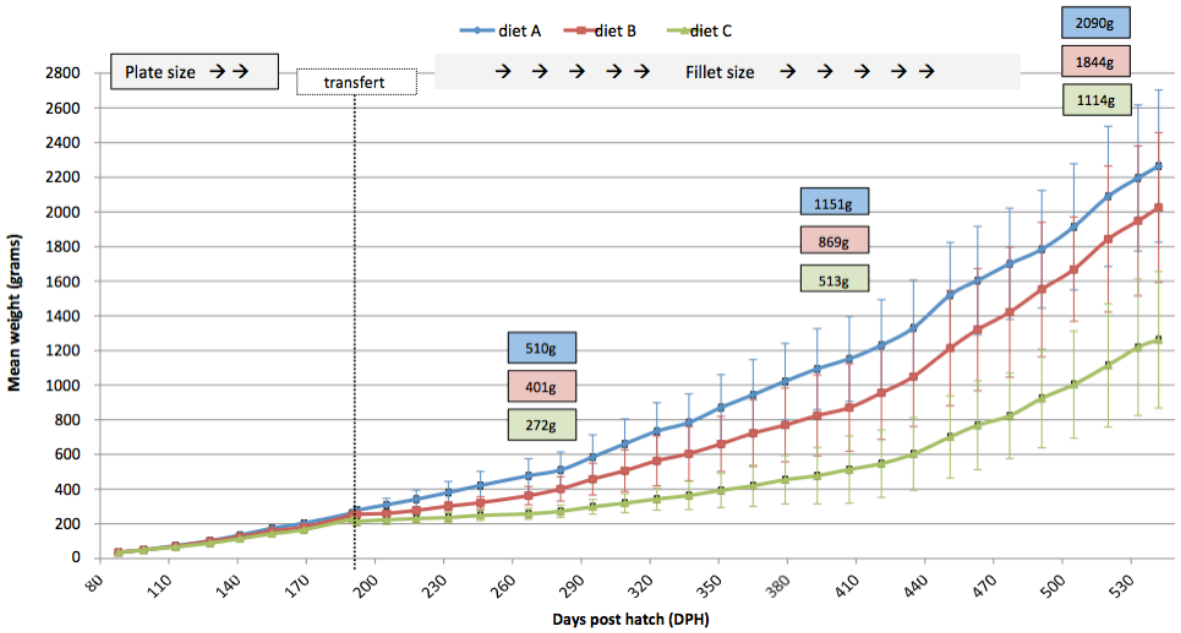
GROWTH PERFORMANCE:
MEAN WEIGHT GAIN

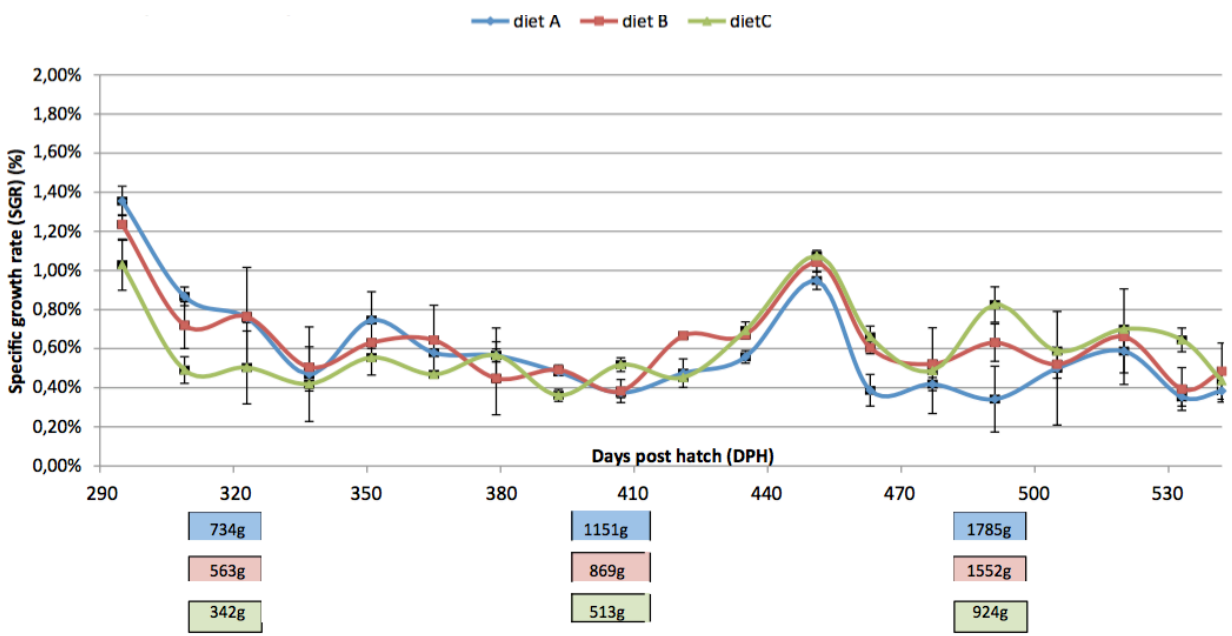


FILLET SIZE GROWOUT PHASE

No significant difference between diets A and B although diet A produced larger fish.

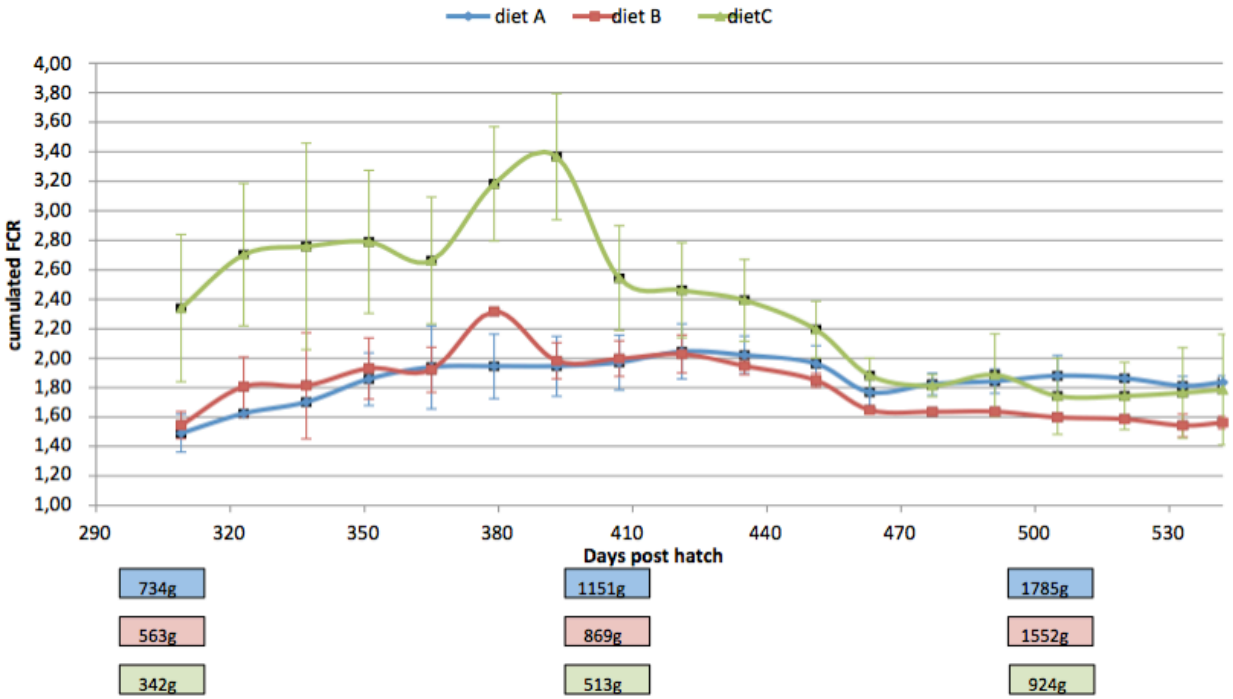
Both diets A and B outperformed diet C.

GROWTH PERFORMANCE:
SPECIFIC GROWTH RATES (SGRS)



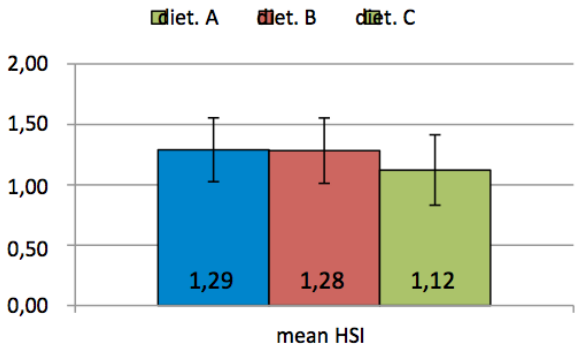
- Similar patterns for diets A and B.
- **Slight diminution of feeding ratios at 407 dph led to increased SGRs for all diets.**
- Diet B taking advantage over diet A from 407dph to 505 dph.
- Although fish from diet C were smaller, their SGRs improved with growth.

GROWTH PERFORMANCE:
CUMULATED FEED CONVERSION RATIOS (FCRS)



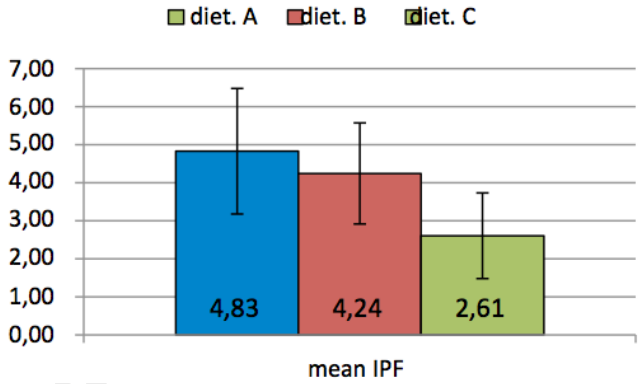
- **Similar patterns for diets A and B.**
- Diet B performs better than diet A as from 421 dph.
- FCR of diet C is higher but lowering over time.

HEPATOSOMATIC INDEX (HIS), INTRAPERITONEAL FAT RATIO (IPF), CONDITION FACTOR (CF)



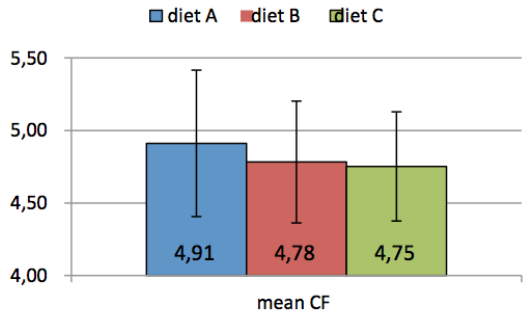
HIS

LARGER BUT HEALTHIER LIVERS FOR DIETS A AND B.



IPF

HIGHER FAT DEPOSITION FOR DIETS A AND B THAN FOR DIET C.



CF

NO REMARKABLE DIFFERENCE BETWEEN DIETS.

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NUTRITIONAL ANALYSES

LIVER TISSUE

No significant compositional difference between the 3 diets.

FLESH TISSUE

Similar amino acid composition between muscle from the 3 diets.

Higher lipid concentration in fish muscle from diet A than diets B and C.
Similarity in total nitrogen, proteins, ashes, total humidity for all diets.

Rise in concentrations of ω3 fatty acids across diets A, B and C.
Fluctuation in concentrations of ω6 fatty acids between the 3 diets.

- ω3/ ω6 ratios: diet A < diet C < diet B.
- EFA concentrations in flesh is impacted by diet composition.

Muscle component	Concentration (g/100g)		
	Diet A	Diet B	Diet C
Total Nitrogen	3,66	3,69	3,63
Proteins	**22,85**	**23,00**	**22,70**
Lipids	**3,75**	**1,90**	**1,15**
Ashes	1,20	1,30	1,35
Total Humidity (%)	72,50	74,35	75,75

Muscle concentration (mg/kg)			
	Diet A	Diet B	Diet C
ω3 fatty acids	16,81	18,30	20,02
ω6 fatty acids	16,03	15,57	17,24
ω3/ ω6 ratio	**1,05**	**1,15**	**1,16**
ω6 / ω3 ratio	0,95	0,85	0,86

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TOXICOLOGICAL ANALYSES

LEAD, CADMIUM, ARSENIC, MERCURY, FLUORIDE IONS

FLESH TISSUE

All flesh samples were safe for human consumption. Slight higher arsenic concentration in flesh from diet A. Cadmium, lead and fluoride ions not detected.

Toxicology in FLESH			
Heavy metal	Concentration (mg/kg)		
	Diet A	Diet B	Diet C
Arsenic	1,07	0,90	0,84
Mercury	0,08	0,07	0,06

LIVER TISSUE

Specific stocking site for cadmium. Arsenic concentration is higher in high lipid diets.

Toxicology in LIVER			
Heavy metal	Concentration (mg/kg)		
	Diet A	Diet B	Diet C
Cadmium	0,39	0,28	0,27
Arsenic	1,59	2,12	2,04
Mercury	0,04	0,03	0,02

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SENSORY ANALYSIS

SENSORY CHARACTERIZATION

Specialized panel (17 experts) characterizing:

- Smell
- Aspect
- Texture
- Flavor/Aroma

→ Texture of the flesh from **diets A and B was firmer** than from diet C.

→ Smell of the flesh from diets A and B was more pronounced and **stronger**, with a more marked **marine scent** than the flesh from diet C.

HEDONIC ANALYSIS

80 random consumers (mixed gender).

Overall satisfaction for all fillets with slight preference for the flesh from fish fed with diet A.

Consumers preferred the texture and taste of the fillets from diet A.

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CONCLUSIONS AND RECOMMENDATIONS

GROWTH EFFICIENCY

- High protein content is recommended to sustain growth.
- Increasing dietary energy content promotes feed conversion for larger fish when enough proteins are supplemented.
- Lowering feeding ratios after a year increases both FCRs and SGRs: room for faster growth.
- Low lipid diet resulted in fish flesh with higher lipid concentration than diets with high lipid concentrations.

BIOSECURITY GUARANTEED

- All diets lead to fish flesh complying with European thresholds for 5 heavy metals.

CONSUMER ACCEPTANCE VERIFIED

- High protein diets (A and B) produced fish with more desirable sensory traits (superior texture and taste).

	Concentration [%]		
Components	Diet A	Diet B	Diet C
Gross protein	**48**	**48**	**44**
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Region Reunion

Hydrô Réunion

Cape Town International Convention Centre

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

NRF SAIAB

World Aquaculture

WORLD AQUACULTURE Society

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