A first insight into genotype-diet interactions in European seabass (*Dicentrarchus labrax*) in the context of plant based diet use

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To face future decrease of marine resources, replacement of fishmeal and fish oil by plant products is nowadays worldwide priority for the aquaculture of carnivorous fish. Since high substitution rates can alter fish growth and quality, the existence of genotype-diet interactions is a key knowledge to further optimize fish selective breeding programs. For the first time, this study evaluated such interactions for late growth and fat content in European seabass (*Dicentrarchus labrax*).

Table 1. Formulation of the marine (M) and the plant-based (V) diets (%)

	M	V
Fishmeal	**38.0**	**0.0**
Maize gluten	18.0	20.0
Soybean meal	0.0	18.2
Wheat gluten	7.2	20.0
Extruded wheat	25.3	7.2
White lupin	0.00	14.0
Fishoil	**8.5**	**0.0**
Linseed oil	0.0	9.4
Soja lecitin	0.0	1.0
L-Lysine	0.0	2.7
$CaHPO_4.2H_20$ (18%P)	0.0	3.0
Binder	1.0	1.0
Attract Mix	0.0	1.5
Min. premix	1.0	1.0
Vit. Premix	1.0	1.0
Total	100.0	100.0
Crude Protein	47.02	47.33
Lipid	13.0	13.0
DE(MJ/Kg)	17.98	17.15

Experimental diets were formulated by INRA.

Material and methods

- Factorial mating design (41 males, 8 females)
  - Single batch in Ifremer aquaculture station until 190 g (Palavas-les-Flots, France), commercial diet
  - Two experimental diets (Table 1)
    - _ M Fishmeal, fishoil
    - _ V Mix of plant products
- Measures
  - On 785 fish
  - Of weight, length, FAT muscle content (using Torry Fish Fat Meter)
  - 7 times (period numbers 1 to 7).
- Microsatellite DNA markers were used to determine pedigrees a posteriori.

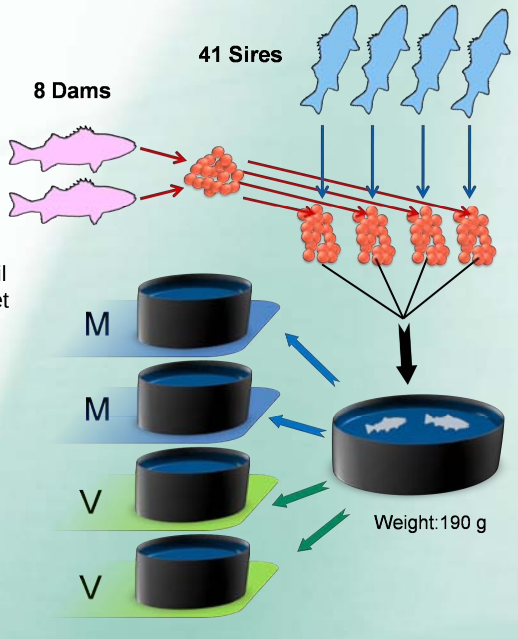


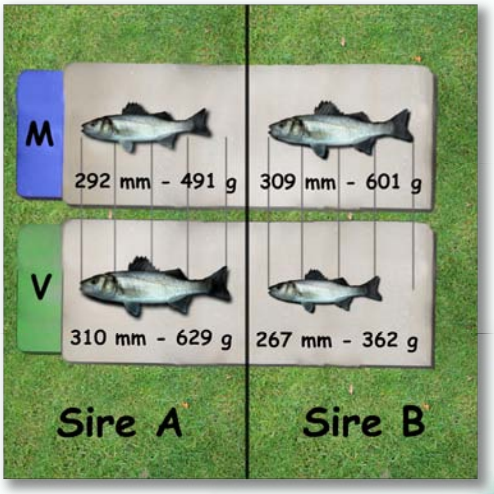
Figure 1. Experimental design

- To evaluate the significance of diet effects and genotype*diet interactions, we used the following model in SAS (SAS Institute Inc., Cary, NC):

$$Y_{ijklm} = \mu + Diet_i + Sex_j + tank(diet)_{i(k)} + sire_j + dam_k + sire * diet_{ij} + dam * diet_{ik} + e_{ij(k)lm}$$

Genetic correlations were estimated considering the trait in each diet as two different traits with VCE.

Figure 2. Illustration of genotype-diet interactions for extreme sire-families for length.

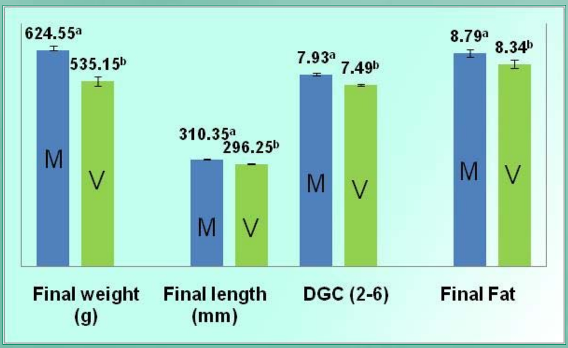


Mean weight (g) and mean length (mm) are indicated for 13 progenies of father A and 7 progenies of father B.

Results

The switch to plant-based diet at 255 days have led to a lower growth. Final weight (W) and length (L) of fish fed with plant based diet were significantly lower (**P<0.05, Figure 1**)) than fish fed on marine diet. Differences between half-sib families for these traits were noticed and **sire x diet interaction effect is significant for weight (P=0.0427), $DGC_{(2-6)}$ (P=0.0234) and FAT corrected the weight (P=0.0157) (Table 2)**.The heritability of weight was estimated to be **0.34 ± 0.15** on the plant diet and **0.32 ± 0.12** on the marine diet with a genetic correlation of **0.62 ± 0.24** for growth between the two diets.

Figure 1. Weight, length, DGC and FAT after 9 months.



Results are means. Significant differences between tanks were determined by one-way ANOVA. Values over the bars pairs having different superscript letters are significantly different (P<0.05). DGC is the daily growth rate between period 1 and 7 = $(W_7^{1/3} - W_7^{1/3})t_{1\to7}$.

Table 2. Evaluation of parents x diet effect, P-value

Traits	Dam x Diet	Sire x Diet
Final weight	0.1437	**0.0427**
Final length	0.1738	0.1229
DGC 2-6	0.1303	**0.0234**
FAT7/log(P7)	0.8819	**0.0157**

Conclusion

This preliminary study shows that some seabass families are able to grow better than others on plant-based diet with interesting traits heritability. If confirmed with a study involving more offspring per sire and using such contrasted diets right from early stages, it could indicate that genotype-diet interactions should be further taken into consideration for growth and, to a larger extend, for meat quality.

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