Effects of genotype and novel feeds on growth, fatty acid profile and e-sensing analysis of European seabass fillet

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1 Background

The search for new and more sustainable ingredients to reduce or replace fishmeal (FM) and fish oil (FO) in aquafeeds has gained significant attention. In this context, single-cell proteins (SCPs) have emerged as a promising alternative to fishmeal. This study explored the effects of partially substituting fishmeal with bacterial protein derived from *Methylococcus capsulatus*, as well as completely replacing FO with a blend of poultry oil (PO) and DHA-rich microalgae oil, in European seabass (*Dicentrarchus labrax*) of both non-selected (WT) and selected bred (HG) genotypes.

2 Materials & methods

The fish feeding experiment was conducted in the flow-through seawater system of the University of Las Palmas de Gran Canaria (ULPGC). The experimental feeds were produced at the feed pilot plant of Skretting Aquaculture Innovation (Norway). Hatched larvae of genotypes HG and WT were sent from the Ifremer Palavas research station (France) to the ULPGC and reared until they reached the initial experimental size of approximately 30 g. Then, 420 fish were randomly allocated to 12 tanks (6 tanks per genotype) and fed for 300 days with two diets: a commercial control diet (C) based on 20% FM and 5.09 to 7.14% FO, and an alternative diet (SCP) containing 15% FM, 0% FO, 10% SCP and 2-4% PO and 2-3% DHA oil from algae. At the end of the trial, 12 fish per tank were sampled for fatty acid profile analysis. In addition, 20 seabass fillets from each test group were collected for instrumental sensory analysis with e-nose (FOX 4000, Alpha MOS) and e-tongue (Astree, Alpha MOS).

3 Results

At the end of the feeding trial, the SCP had no adverse effects on the growth. The selected HG group showed better growth and feed conversion, but lower levels of major fatty acids (EPA, DHA, n-3 FAs, and n-3 LC-PUFAs) in their fillets. A combined influence of diet and genotype on the organoleptic characteristics of the fillets was observed. As indicated in **Table 1**, pairwise comparisons among the experimental groups revealed significant differences in e-tongue scores, while e-nose scores showed no significant variations. Specifically, the diet had a more pronounced impact on the taste of the WT fillets (**Fig. 1**).

A genotype effect was found for fillet chewiness, whereas hardness and adhesiveness were only influenced by diet. An interaction between genotype and diet was found for elasticity and cohesivity of the fillet (**Table 2**).

Table 1. Organoleptic distances and Pattern Discrimination Index (PDI%) between groups for smell (e-nose) and taste (e-tongue).

Compared groups	Organoleptic Distances	*p-value*	PDI (%)
e-nose			
HG-C *vs* WT-C	0.01	n.s	23.46
HG-C *vs* HG-SCP	0.01	n.s	30.26
HG-C *vs* WT-SCP	0.01	n.s	35.76
WT-C *vs* HG-SCP	0.0001	n.s	5.6
WT-C *vs* WT-SCP	0.0001	0.01	9.58
HG-SCP *vs* WT-SCP	0.0001	n.s	3.55
e-tongue			
HG-C *vs* WT-C	251.26	<0.001	22.25
HG-C *vs* HG-SCP	178.67	n.s	17.01
HG-C *vs* WT-SCP	214.57	<0.001	27.33
WT-C *vs* HG-SCP	298.10	<0.001	30.98
WT-C *vs* WT-SCP	285.53	<0.001	32.89
HG-SCP *vs* WT-SCP	349.40	<0.001	52.78

Table 2. Textural characteristics of fillets from WT and HG European seabass fed the experimental diets.

	WT-C	WT-SCP	HG-C	HG-SCP
Hardness	82.04 ± 18.55	55.14 ± 19.90	78.36 ± 19.25	42.94 ± 21.67
Elasticity	0.47 ± 0.08^{a}	0.43 ± 0.05^{ab}	0.39 ± 0.04^{b}	0.46 ± 0.04^{a}
Cohesivity	0.37 ± 0.03^{a}	0.32 ± 0.04^{b}	0.35 ± 0.04^{ab}	0.34 ± 0.03^{ab}
Gumminess	29.71 ± 6.93	18.30 ± 9.62	27.57 ± 7.74	14.71 ± 7.43
Chewiness	13.83 ± 4.50	8.24 ± 4.99	10.67 ± 3.03	6.57 ± 2.83
Adhesiveness	-0.27 ± 0.25	-0.15 ± 0.06	-0.18 ± 0.14	-0.12 ± 0.12
Resilience	0.11 ± 0.02	0.11 ± 0.03	0.11 ± 0.02	0.11 ± 0.01

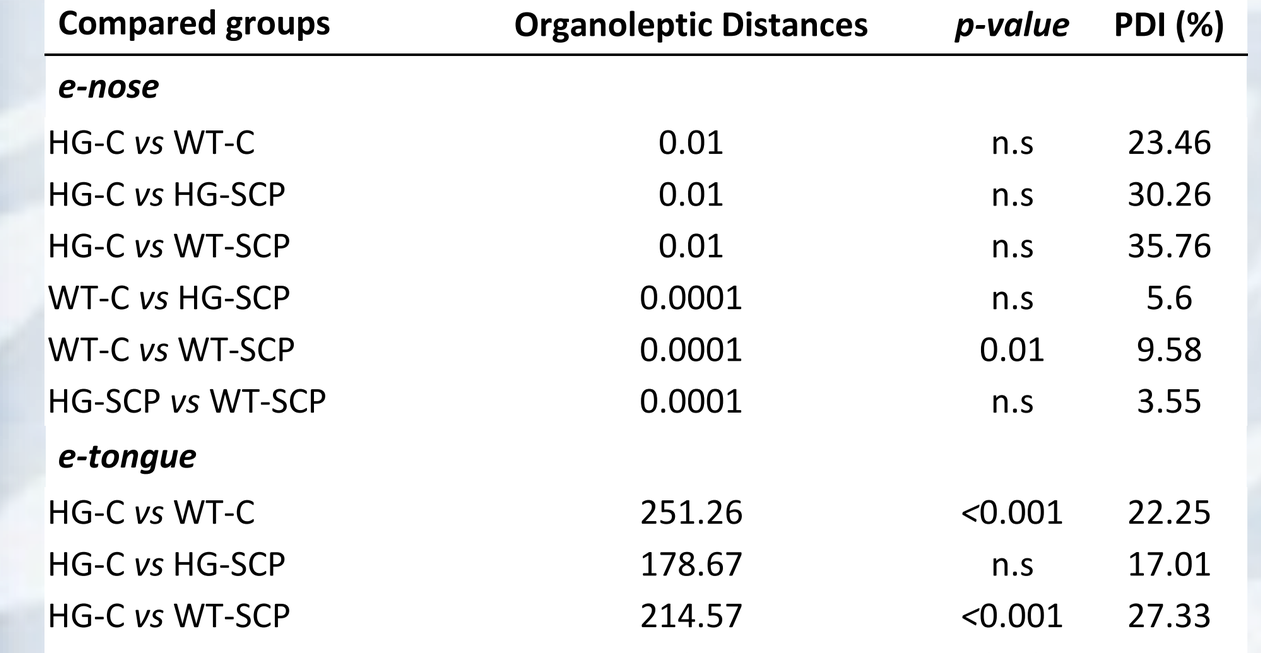

Figure 1. PCA diagrams of e-tongue (taste map) comparing groups **A)** HG-SCP and WT-SCP; **B)** HG-C and WT-C; **C)** WT-C and WT-SCP; **D)** HG-C and HG-SCP.

4 Conclusions

The SCPs from *M. capsulatus* are an effective alternative to FM for seabass. The effect of the feed in combination with genetic selection ensured that the fish achieved optimal growth performance. Despite the differences in lipid composition, the results of the e-sensing analysis underlined the ability of the selected fish to better utilize the alternative ingredients. Given these results, the e-nose and e-tongue have proven to be very powerful tools to study the sensory imprinting of fish fed with innovative and more sustainable feeds.

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