EFFECT OF BIOLOGICAL AND PHYSICAL PRE-TREATMENTS OF *Ulva rigida* IN THE QUALITY OF ON-GROWING EUROPEAN SEABASS *Dicentrarchus labrax*

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Content

A growth trial with European seabass was performed to assess the effect of the dietary inclusion of *Ulva rigida* as is or with technological pre-treatment with ultrasounds (US) or solid-state fermentation (SSF) with *Aspergillus ibericus*. Promising results of the pre-treatment of *U. rigida* prior to dietary inclusion on growth performance and feed utilization efficiency of seabass were obtained, however, the effect of these treatments on fillet nutritional and sensory quality was not yet evaluated.

Introduction

Macroalgae show high productivity and do not compete for arable land to be cultivated as terrestrial alternatives (Bikker *et al*., 2016)a biorefinery approach aimed at cascading valorisation of both protein and non-protein seaweed constituents is required to realise an economically feasible value chain. In this study, such a biorefinery approach is presented for the green seaweed Ulva lactuca containing 225 g protein (N\\thinspace{\\texttimes}\\thinspace4.6. *U. rigida* is a green macroalgae with promising applications in food and feed industries (Biancarosa *et* al., 2018). However, its high fiber content may impair its inclusion in aquafeeds as fish lack the digestive enzymes able to hydrolyze it. Therefore, pre-treatment can be

Table I: Plasma metabolites (mg dl^{-1}) levels and muscle fatty acid profile (% total identified fatty acids) of European seabass at the end of the experiment.

	FM-based diet	Untreated *U. rigida*	Ultra-sound *U. rigida*	Solid state fermented *U. rigida*
Glucose	117.2 ± 39.3	126.7 ± 14.5	111.2 ± 31.7	118.3 ± 14.4
Cholesterol	118.1 ± 32.5^{ab}	159.3 ± 34.3^{c}	151.6 ± 50.4^{bc}	108.6 ± 40.1^{a}
Triacylglycerides	185.9 ± 73.4	179.7 ± 76.0	144.1 ± 73.2	157.2 ± 43.8
Total proteins (g dl^{-1})	4.27 ± 0.41^{a}	4.77 ± 0.50^{b}	4.40 ± 0.13^{ab}	4.73 ± 0.58^{ab}
Total SFA	25.9 ±0.43	25.3 ±0.93	24.6 ±0.99	26.2 ±0.27
Total MUFA	38.2 ±1.01	37.8 ±0.57	38.9 ±0.47	37.5 ±1.60
Total ω3	20.3 ±1.23	20.7 ±0.84	19.8 ±0.99	21.1 ±1.37
Total ω6	13.4 ±0.49	13.9 ±0.73	14.4 ±0.64	13.2 ±0.83
ω3/ω6 ratio	1.52 ±0.10	1.50 ±0.13	1.38 ±0.08	1.60 ±0.08

Means (± standard deviation) in the same row with different superscript letters are significantly different (Duncan test; $p<0.05$).

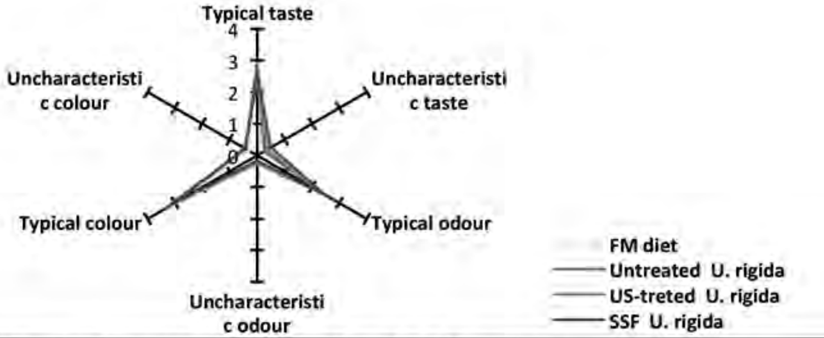

Fig. I: Sensory quality of European seabass fillets at the end of the experiment.

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a helpful strategy to disrupt the complex macroalgae cell-wall and promote the release of fermentable sugars and other valuable compounds and facilitating the access of digestive enzymes to the cell content (Fernandes *et al*., 2019a)and new applications for macroalgae should be considered. In this work, sequential biological treatments as solid-state fermentation (SSF. In a previous growth trial, it was observed that dietary replacement of fish meal by 5% untreated *U. rigida* reduced growth performance and feed efficiency of on-growing European seabass, while the dietary inclusion of *U. rigida* pre-treated with ultrasounds or solid-state fermentation with *Aspergillus ibericus* did not affect growth performance nor feed efficiency (Fernandes *et al.*, 2019b). However, the influenc of these biological and physical pre-treatments of *U. rigida* on the nutritional and sensory quality of commercial-size European seabass was not yet evaluated.

Materials & Methods

For the biological pre-treatment, dry micronized *U. rigida* was fermented with *A. ibericus* (MUM 03.49) for 7 days at 25°C, in tray-type bioreactors; for the physical pre-treatment, *U. rigida* was submitted to ultra-sounds (US) during 1 hour in protective containers, using a high-intensity ultrasonic processor at 50-60 Hz. A control diet containing 25% fishmeal (FM) (D1); untreated and pre-treated *U. rigida* were incorporated in test diets replacing 5% (w/w) FM, as follows: D2: untreated *U. rigida*; D3: US-treated *U. rigida*; and D4: SSF-treated *U. rigida*. All diets were isoproteic (45%) and isolipidic (18%). Triplicate groups of European seabass with 108 g IBW were fed to apparent visual satiation for 64 days. At the end of the experimental period (FBW averaging 240 g), plasma metabolites and fillet fatty acids profile and sensory properties were assessed.

Results & Discussion

Plasma glucose levels were lower in fish fed ultra-sound treated *U. rigida* diet relatively to fish fed the untreated *U. rigida* diet. Dietary inclusion of *U. rigida* increased plasma cholesterol levels, which were restored to the control levels in fish fed the SSF *U. rigida* diet (Table I).

Even though fillet polyunsaturated fatty acids (PUFA) content was similar among groups, fish fed *U. rigida* diets presented 8 to 13% more α-linolenic than fish fed the FM-based diet. The ω3/ω6 ratio was 8% lower in fish fed ultra-sound *U. rigida* diet but 7% higher in fish fed solid state fermented *U. rigida* diet than with the untreated *U. rigida* diet.

Concerning the organoleptic properties of European seabass, no significant differences in typical odor, color, and taste between groups were found (Fig.1).

Conclusions

U. rigida pre-treatment by solid-state fermentation or ultra-sounds did not compromise fillet FA profile and the sensory quality of European seabass. Such results support the potential for inclusion of pre-treated *U. rigida* in sustainable diets for European sea bass.

Acknowledgments: supported by PhD grant by FCT ref.SFRH/BD/131219/2017, IJFCT-POCI-01-0145-FEDER-030377 and MAR-02.01.01-FEAMP-0111

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