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EFFECTS OF DIETARY INCLUSION OF FISH OIL ETHYL ESTERS ON FATTY ACID PROFILE, PLASMA METABOLITES, AND LIVER OXIDATIVE STRESS IN EUROPEAN SEABASS (*Dicentrarchus labrax*)

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Introduction

The nutritional quality of dietary lipids plays a critical role in regulating physiological functions by modulating tissue fatty acid composition, metabolism, inflammatory and immunological responses, and cellular oxidative balance. The selection of dietary lipid sources influences growth performance and key health-related responses. In marine fish, fish oil (FO) remains the standard lipid source for providing essential n-3 LC-PUFA, such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). However, alternative lipid sources have emerged as potential substitutes. Ethyl esters (EE) oil is a sub-product of omega-3 production for human consumption and may be valorized as an alternative lipid source in the context of a circular economy. EE oil differs from FO in molecular structure, which may alter its biological efficacy. Marine fish species rely on dietary sources of n-3 LC-PUFA to meet fatty acid requirements, as they cannot synthesize it from C18 precursors. Thus, understanding how EE oil impacts lipid metabolism and redox status is essential for optimizing feed formulations. This study explores the effects of partial or total FO replacement with EE oil on the fatty acid profile, plasma metabolites, and hepatic oxidative stress of European seabass (*Dicentrarchus labrax*), an important species for Mediterranean aquaculture.

Materials and Methods

Four isonitrogenous (48% crude protein) and isolipidic (16% crude lipids) diets were formulated by varying the proportions of FO, rapeseed oil (RO), and EE oil in the total lipid blend, as follows (% total lipid inclusion): D1 (72% FO, 28% RO, 0% EE; EPA+DHA=12.8% FA), D2 (28% FO, 72% RO, 0% EE; EPA+DHA=4.2% FA), D3 (28% FO, 44% RO, 28% EE; EPA+DHA=4.9% FA), and D4 (0% FO, 28% RO, 72% EE; EPA+DHA=3.6% FA). Juvenile European seabass (*Dicentrarchus* labrax) with ~ 62 g initial body weight were randomly distributed into three replicate tanks under controlled temperature (23°C) in a RAS system for 88 days. Fish were fed to apparent satiation twice daily. At the end of the trial, blood, muscle, and liver samples were collected from three fish per tank for biochemical, fatty acid profile, and oxidative stress analysis. Statistical differences among treatments were evaluated by one-way ANOVA and Tukey's test when $p < 0.05$, using SPSS 29.0 (IBM® SPSS® Statistics, New York, USA).

Results

The zootechnical performance of the animals was not the aim of this study, and the results are presented in another work at this conference. Briefly, diet composition did not affect growth performance and whole body composition. The fatty acid profile of muscle and liver tissues reflected dietary lipid sources and exhibited statistically significant differences. In the muscle, α-linolenic acid (ALA, C18:3n-3) levels were significantly higher in fish fed the D2 and D3 diets compared to D4 and D1 diets. However, EPA (C20:5n-3) levels were significantly higher in fish fed the D4 diet than in D2 diet, whose values were comparable to D1 diet. DHA (C22:6n-3) was highest in fish fed the D1. In the liver, saturated fatty acids (SFA), such as C14:0 and C16:0, were significantly increased in fish fed the D4, leading to the highest total SFA, while D2 showed the lowest level. Monounsaturated fatty acids (MUFA), particularly C18:1n-9, were significantly increased in fish fed the D2. Plasma glucose concentration was significantly higher in fish fed the D2 than in D3 diets. In contrast, total protein, triglycerides, total lipids, and cholesterol remained unaffected by dietary treatments. Liver oxidative stress biomarkers showed that glutathione reductase activity and lipid peroxidation levels were significantly lower in fish fed the D4 than in the D1 diets. No significant differences were observed for glutathione peroxidase (GPX), catalase (CAT), and superoxide dismutase (SOD) among the dietary treatments.

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Conclusion

EE oil inclusion in European seabass juvenile diets altered tissue fatty acid profiles, reducing DHA and total n-3 PUFA compared to a FO-based diet. However, EPA levels were maintained, and hepatic lipid peroxidation was reduced. Overall, these results suggest the potential for dietary inclusion of EE oil in marine fish diets.

Acknowledgments

This work was supported by the Zero-Waste Omega-3: A Green Label Solution for Sustainable Aquaculture Feeds project, funded by the Portuguese Foundation for Science and Technology (Ref: 2023.13017.PEX; DOI:https://doi.org/10.54499/2023.13017.PEX). Yue Xu was supported by a CSC scholarship, funded by national resources from the Chinese government (Ref: 202108310020). Rui Magalhães received funding through a CEEC Individual contract (Ref: 2023.09082.CEECIND/CP2848/CT0017; DOI:https://doi.org/10.54499/2023.09082.CEECIND/CP2848/CT0017). EE oil was supplied by Epax® Norway AS, Ålesund, Norway.