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Effective complete replacement of fish oil by combining poultry and microalgae oils in practical diets for gilthead sea bream (*Sparus aurata*) fingerlings

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Abstract

Few ingredients allow the complete replacement of fish meals (FM) and fish oils (FO) in aquaculture feeds without affecting fish performance or fillet nutritive value. This is due to the adequate content of essential nutrients, including the n-3 long-chain polyunsaturated fatty acids (n-3 LC PUFA), and the unique high palatability of FM and fish oil. Some microalgae present abundant amounts of these fatty acids, for instance docosahexaenoic acid (DHA). Therefore, the aim of the present study was to evaluate the effect of two different microalgae products, one providing DHA and eicosapentaenoic acid (EPA, 20:5n-3; ED diet), and the other one DHA and n-6 docosapentaenoic acid (DPA, 22:5n-6; DD diet), in combination with poultry oil and rapeseed oil, as total replacers of fish oil, at two different dietary fish meal contents (15 and 7.5%). The effects of these dietary oil combinations on performance, composition and nutritive quality indexes of gilthead sea bream (*Sparus aurata*) juveniles were studied and compared against a positive control diet (FO) and two negative control diets (PO diets), one for each dietary fish meal content tested, giving in total 7 experimental diets. Both microalgae products in combination with poultry and rapseed oils were able to completely replace fish oil in practical diets with 15% FM without affecting growth performance, utilization of dietary fatty acids or the nutritional quality of fish fillet for the consumer. On the contrary, PO alone was not able to completely replace fish oil and negatively affected fish performance, in relation to an insufficient dietary n-3 LC-PUFA content. A similar decrease in growth performance was also observed with the reduction of the dietary FM content to 7.5%. In conclusion, both oils from microalgae, providing either DHA and EPA or DHA and n-6 DPA, were effective n-3 LC-PUFA sources for sea bream juveniles and allowed complete replacement of fish oil in combination with more cost-effective lipid sources, such as poultry and rapeseed oils.

Keywords:

Essential fatty acids, Fish oil replacement, Microalgae, Poultry oil

Introduction

The stagnation of fish wild stocks and fisheries, along with high global fish consumption, has increased the demand for aquaculture products over the last decades (FAO, 2016). Fishmeal (FM) and fish oil have been major dietary nutrient sources in feeds for farmed fish. However, their limited availability, high cost and potential bioaccumulation of toxic pollutants, have promoted the search for more sustainable alternative ingredients to reduce the inclusion of FM and fish oil in aquafeeds (FSAI, 2002; Lundebye et al., 2004). The main bulk of research has focused on the replacement of FM and fish oil by terrestrial vegetable meals (VM) and oils (VO), respectively (Montero et al., 2010; Turchini et al., 2009; Nasopoulou and Zabetakis, 2012; Torrecillas et al., 2017a; Benedito-Palos et al., 2007). These terrestrial ingredients have been considered good alternatives in fish diets, for their competitive price and availability and good catabolic potential to obtain dietary energy (El-Kerdawy and Salama, 1997). Although many studies have successfully incorporated VO as lipid sources in fish feeds, some have reported reduced performance at high dietary inclusions, and most of them stated a decreased n-3 LC-PUFA content in fish tissues, including fillets (reviewed in Nasopoulou and Zabetakis, 2012). Therefore, high fish oil replacement levels by VO may constrain production efficiency while also decreasing the benefits of eating fish for the consumers (Simopoulos, 2012). Indeed, intake of n-3 LC PUFA, particularly docosahexaenoic acid

Conclusions

In conclusion, the results of the present study showed that a blend of poultry oil and algae oils containing either DHA or both EPA and DHA, are effective in the total replacement of fish oil in practical (15% FM) diets for gilthead sea bream. These blends supported good growth while ensuring high nutritional quality of the fish fillet for the consumer. Both dietary algal lipid sources were effective in increasing fillet DHA content. On the contrary, PO was not able to completely replace fish oil and negatively affected fish performance, in relation to an insufficient dietary n-3 LC-PUFA content.

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