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EFFECTS OF FISHMEAL REPLACEMENT BY DEFATTED *Zophobas morio* LARVAE MEAL ON GROWTH AND FEED EFFICIENCY OF GILTHEAD SEABREAM (*Sparus aurata*)

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Introduction

Aquaculture is still searching for suitable and sustainable alternative protein sources to replace fishmeal in aquafeeds. The use of insect meals for fishmeal replacement has recently attracted massive scientific interest, especially after their recent approval in the European aquafeed chain. So far, most research has focused on insect species which have already been approved for fish nutrition, such as *Tenebrio molitor* and *Hermetia illucens*, with very promising outputs (Henry et al. 2015). However, other insect species that have not yet been studied extensively could also be proved suitable as fishmeal replacers. For instance, the giant mealworm, *Zophobas morio*, is a large tenebrionid beetle species, with high nutritive value (Finke et al. 2002). The aim of the present study was to evaluate the use of different % inclusion of defatted mealworm in diets for sea bream juveniles; an important species of the Mediterranean Aquaculture.

Materials and Methods

Late-instar larvae of *Z. morio* coming from a colony raised in our laboratory were dried, milled and defatted under petroleum ether extraction in order to produce a *Z. morio* larvae meal containing 4% crude lipid and 69% crude protein. A total number of 360 *S. aurata* juveniles of 3.4g initial mean weight were obtained from a commercial fish hatchery, transferred to our Departmental facilities and then distributed after an acclimatization period of 10 days in triplicate to 12 closed seawater circulation system tanks (125L). Each of the four dietary group was fed isoenergetic (20 MJ/Kg) and isonitrogenous (52% CP) diets, in which fishmeal protein of the control diet (FM) was replaced by low-fat *Z. morio* at 10% (ZLF10), 20% (ZLF20) and 30% (ZLF30). Fish were fed to satiation twice a day, 6 days per week for 100 days in total.

Results and Discussion

Survival rates higher than 95% were recorded in all dietary groups without statistical difference among them (Table 1). Feed intake was similar among the groups suggesting that *Z. morio* is a highly palatable feed ingredient for *S. aurata*. In addition, all dietary groups had similar ($P > 0.05$) final weight, specific growth rate, FCR, PER, protein and lipid retention. Up to date, studies with *Z. morio* in fish nutrition are scarce. In a previous study, we used a full fat, instead of a defatted, *Z. morio* meal as FM replacer in seabream's diet and found that a 10% replacement is possible without affecting growth performance and feed efficiency (Asimaki et al. 2020).

Table 1. Growth performance and feed utilization of *S.aurata* fed the experimental diets

Parameters / dietary groups	FM	ZLF10	ZLF20	ZLF30
Survival (%)	96.6 ± 3.3	97.7 ± 3.8	96.6 ± 3.3	95.5 ± 1.92
Feed intake (%/day)	2.5 ± 0.1	2.5 ± 0.2	2.4 ± 0.1	2.6 ± 0.1
IBW (g/fish)	3.4 ± 0.0	3.4 ± 0.0	3.4 ± 0.0	3.4 ± 0.0
FBW (g/fish)	38.4 ± 2.1	42.2 ± 2.4	38.8 ± 1.8	39.2 ± 2.3
WG (g/fish)	35.0 ± 2.1	38.8 ± 2.4	35.4 ± 1.8	35.8 ± 2.3
SGR (%/day)	2.4 ± 0.1	2.5 ± 0.1	2.4 ± 0.0	2.4 ± 0.1
FCR	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.0	1.3 ± 0.1
PER	1.5 ± 0.1	1.6 ± 0.1	1.6 ± 0.0	1.5 ± 0.1
Protein retention (%)	27.3 ± 1.8	28.2 ± 1.6	28.3 ± 1.1	26.9 ± 0.7
Lipid retention (%)	63.1 ± 7.8	74.8 ± 0.6	69.8 ± 3.2	74.9 ± 4.5

Note: Values represent means ± standard deviation of triplicates. No significant differences ($P > 0.05$) were noted among dietary groups for any of the parameters tested.

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Alves et al. (2021) testing *Z. morio* in Nile tilapia diet reported that even 30% fishmeal replacement had no adverse effects on growth performance and feed utilization, but changed the body proximal composition and modulated the innate immune response. Jabir et al. (2012) reported that even 100% FM replacement did not reduce significantly the growth of Nile tilapia. Interestingly, when *Z. morio* was used in combination with house cricket (*Acheta domesticus*) to replace FM at 25% in the diet of perch (*Perca fluviatilis*) the growth of fish and feed efficiency decreased (Tilami et al. 2020). Studies with other insect species in seabream's diet showed that up to 25-30% FM replacement is possible by *T. molitor* (Piccolo et al. 2017) and *H. illucens* (Karapanagiotidis et al. 2015). Overall, the findings of the present study suggest that the defatted *Z. morio* is an attractive feedstuff that could successfully replace fishmeal protein in seabream's diet up to 30%

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