

EFFECTS OF REARING DENSITY ON GROWTH, WELFARE INDICATORS AND DIGESTIVE CONDITIONS OF GILTHEAD SEA BREAM (*SPARUS AURATA*) FED DIFFERENT FISH MEAL AND FISH OIL DIETARY LEVELS

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Introduction

To maximize productivity, sustainability and fish welfare of Mediterranean aquaculture, research needs to focus on interaction between feeding and rearing condition, paving the way to a wise fish farming management. To this aim, the present study explored the effect of high and low rearing density on growth, plasma biochemistry, gut microbiome structure, humoral immunity of skin mucus and digestive enzymes activity in gilthead sea bream (*Sparus aurata*) fed low and high fishmeal (FM) and fish oil (FO) dietary level.

Materials and methods

Two isoenergetic diets with high and low FM and FO percentages, (FMFO30/15 and FMFO10/3, respectively) were tested in triplicated fish groups until reaching a final high density (HD 30kg/m³) and low density (LD 10kg/m³). Fish (initial body weight: 96.2g) were fed to satiation twice a day (10% overfeeding) over 97 days. At the end of the trial, growth performances, feed utilization and carcass composition were estimated. The activity of pancreatic and intestinal brush border digestive enzyme extracts (3 fish per tank) was determined as in Gisbert et al. (2018); while microbiome structure (5 fish per tank) was analysed by Next Generation Sequencing as described in Parma et al. (2016). Skin mucus (8 fish per tank) and plasma biochemistry (5 fish per tank) were analysed according to Guardiola et al. (2014) and Bonvini et al. (2018) respectively. All gained data were analysed by Two-way ANOVA followed by a Tukey's multiple comparison test. Differences among treatments were considered significant when P value was lower than 0.05.

Results

No significant effect on growth (final body weight FBW, weight gain and specific growth rate SGR) were detected between high and low rearing density for both dietary treatment while fish fed FMFO30/15 displayed higher FBW, weight gain and SGR compared to FMFO10/3. Feed intake (FI) was lower in HD compared to LD (density effect P = 0.002) with more marked differences in FMFO30/15 than FMFO10/3. No

significant diet effect on FI was detected. No significant effect of density on FCR was detected. Survival rate was lower at LD. No significant effect of density on skin mucus peroxidase and protease levels were found in FMFO10/3 individuals. Concerning pancreatic enzymes activity, trypsin was higher in fish fed FMFO30/15, while lipase had the opposite reaction. Activity of pepsin was significantly influenced by density which interacted with diet as well, while chymotrypsin was influenced only by density. Alkaline phosphatase and aminopeptidase in the anterior intestine brush border were reduced in FMFO10/3 compared to FMFO30/15, while maltase was lower only in FMFO10/3 reared at HD. The posterior intestine brush border alkaline phosphatase and maltase were negatively affected by FMFO10/3 while leucine alanine peptidase (LAP) was reduced at HD. Density had no significant effect on parameters analysed in plasma, while diet influenced total protein, urea and creatinine levels.

Discussion and conclusion

Rearing density did not show negative impact on growth and feed utilization at both high and low FM and FO dietary level. Similarly, density did not affect digestion condition except for trypsin, pepsin, chymotrypsin, maltase and LAP. At the end of the trial high density did not compromise fish welfare in terms of mucus enzymatic activity and plasma biochemistry. Though high vegetal dietary levels reduced growth efficiency, stocking density up to 30kg/m³ did not show negative effects on performances, digestive capacity and animal welfare at both feed regimes. Moreover, the absence of feed intake differences between high and low density at high vegetal dietary concentration could indicate a reduced competitiveness among fish under these feeding regimes. At the light of this study, at both considered FM and FO dietary levels, fish can be reared at both 10 and 30kg/m³ without compromising performance and health status.

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