

学位論文要旨 Dissertation Abstract

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学位論文題目 : Improvement of Nutritional Quality of Soy Protein Concentrate
Title of Dissertation (SPC) for Red Sea Bream (*Pagrus major*)
(マダイに対する濃縮大豆タンパク質の栄養価改善)

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Dissertation Abstract

Fish meal (FM) as main protein in fish feeds becomes unsustainable supply. Soy protein concentrate (SPC) is purified soy product, it is good candidate of FM replacer. High inclusion of SPC in diets results in reduction of feed intake and growth performance. This research aimed to find a reason of low growth in SPC fed fish and improve the nutritional quality of a FM-free SPC-based diet (SPC diet) for red sea bream (RSB; *Pagrus major*).

Chapter 1, plasma free amino acids (FAAs) and protein digestibility were examined in RSB fed either SPC or FM diets. FAAs levels of SPC group were higher than that of FM group. Protein digestibility of SPC fed fish were comparable to that of FM. RSB could digest and utilize SPC as a sole protein in SPC diet, suggesting that low growth in SPC fed fish is not associated with protein digestibility and absorbability.

Chapter 2, the same diets as Chapter 1 were fed to 3 groups of RSB: FM-sat and SPC groups were fed FM and SPC diets, respectively, until satiation; FM-pair group was fed the same amount of FM diet as that of SPC group for 6 weeks. Daily feeding rates (DFR) of SPC and FM-pair groups were significantly lower than FM-sat group ($p < 0.05$). Growth, feed utilization and lipid accumulation of FM-sat and FM-pair were

significantly higher than those of SPC group ($p < 0.05$). Low growth was not simply due to low feed intake only but also low lipid accumulation.

Chapter 3, effect of feeding stimulants either synthetic (SFS diet) or natural (NFS diet) which was fish meat hydrolysate (FMH) on digestive enzyme secretion was examined in 2 trials. Trial 1: A significantly higher lipase activity in pyloric and intestinal digesta of SFS group indicates that SFS has a potential to stimulate digestive enzyme secretion of SPC fed fish. Trial 2: The higher activities of trypsin in intestinal digesta; and lipase in pyloric and intestinal digesta were significantly found in NFS group ($p < 0.05$). NFS is more effective than SFS.

Chapter 4, four kinds of diets including SPC diet (Basal), Basal diet with FMH (FHM), FMH with glutamic acid (glu; FMHG) and FM diet were fed to RSB for 8 weeks. DFR, growth rate, and feed utilization of FM and FMHG groups were similar which was better than those of Basal and FMH groups ($p < 0.05$). No significant difference in digestive enzyme activities between SPC- and FM-fed fish. A comparable growth rate of FMHG group to that of FM group was mainly due to increasing feed intake by a combination of FMH and glu. Feeding stimulants did not trigger digestive enzyme secretion.

Chapter 5, as feed utilization of FM fed fish was slightly better than FMHG group in previous chapter, a paired-feeding experiment was conducted by feeding the amount of diets (Basal, FMHG and FM diets) to all treatments with triplicates for 8 weeks to find out whether improved growth in SPC fed fish by FMH and glu supplementation was due to enhancing feeding intake only or/and feed utilization. Growth rate, feed utilization, whole body lipid content, VFI and lipid retention of SPC fed fish (Basal and FMHG groups) were significantly lower than those of FM fed fish ($p < 0.05$). FMH and glu supplementation did not improve feed utilization; and low growth in SPC fed fish was related to poor lipid retention that may be associated with low lipid digestion resulting from insufficient bile salts.

Chapter 6, effect of emulsification reagents namely soybean lecithin (SBL) and a commercial product (F160) on growth and feed utilization was examined. RSB fed Basal, SBL, F160 and FM diets for 6 weeks. Feed intake, growth rate and feed utilization of SBL and FM groups were significantly higher than those of Basal and F160 groups ($p < 0.05$). Growth improvement in SBL group was due to increased feed utilization, possibly lipid utilization.

In conclusion, low growth in SPC fed fish is not simply due to low feed intake but also feed utilization. Low feed utilization may be resulting from insufficient bile salts. The nutritional quality of SPC is improved by supplementation of a combination of SFS, NFS and SBL to enhance palatability and lipid digestion of SPC diet for RSB.