

学位論文要旨 Dissertation Abstract

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Name

学位論文題目 : Use of insects meal as alternative protein sources for fish meal
Title of Dissertation (魚粉代替タンパク源としての昆虫ミールの利用)

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Dissertation Abstract

Stable supply of feed ingredients and environmentally friendly rearing conditions are the two key factors in sustainable aquaculture development. Insect protein is attracting attention as a raw material for aquafeed, while their application to carp and eels is small. In this research, two insects protein namely mealworm and black soldier fly larvae were tested in carp, and applicability of dry feed and development of digestibility was investigated in eel. Since Japanese commercial eel feeds contain a large amount of fish meal (more than 60%), the reduction of the fish meal in the diet would result in a large impact. However, there is not enough information available on the development of the eel diet, these two basic research were conducted. Moreover, these experiments were conducted with conger eel, due to the difficult availability of Japanese eel as an experimental animal.

Chapter 2, effects of soybean lecithin (SBL) supplementation on a mealworm-containing diet on the growth performance and lipid utilization was examined in common carp (*Cyprinus carpio* L.). Fish fed the mealworm diet showed significantly lower weight gain, specific growth rate, and feed conversion rate, protein retention, and lipid retention than those fed the fish meal control diet ($p < 0.05$). In contrast, these growth parameters of fish fed SBL supplemented diet did not differ significantly from fish fed the control diet. Furthermore, the plasma triglyceride level of fish fed SBL supplemented group was significantly higher than the non-supplement group ($p < 0.05$) and not significantly different from that of the control diet-fed fish.

Chapter 3, effects of soybean lecithin (SBL) supplementation on defatted

black soldier fly larvae (DBSFL) meal containing diet on the growth performance and lipid utilization was examined in common carp (*Cyprinus carpio* L.). Both fish fed DBSFL diet and fish fed SBL supplemented DBSFL diet showed significantly lower specific growth and feed efficiency than control diet-fed fish ($p < 0.05$). Moreover, the lipid retention rate (%) of the former dietary groups was lower than the control group. The DBSF containing diet-fed carp reduced the growth performance probably through low lipid utilization and it could not be restored by SBL supplementation as it could in the mealworm

Chapter 4, effects of dietary moisture contents on the growth performance and feed intake was examined in conger eel (*Conger myriaster*). In trial 1, the growth performance of conger eel fed either dry or moist diet was examined for 6 weeks and found that no significant difference between two dietary groups ($p > 0.05$). This result indicates that conger eel can utilize dietary nutrients equally irrespective of the moisture content of the diet. In trial 2, the effect of switching diet on feed intake amount and feed ingestion time was examined. Feeding Rate and ingestion time of fish were reduced and longer in fish switched diet from moist to dry diet than dry to moist diet. However, no significant difference was noted in both directions (dry to moist and moist to dry) after the 9th day of switching. Results from two trials demonstrating that moist or dry diets are equally acceptable to conger eels.

Chapter 5, effect of carboxymethylcellulose (CMC) and wheat gluten (WG) on digestibility of Japanese conger eel (*Conger myriaster*) using direct and indirect (chromic oxide as an indicator) methods were examined. The physical property of feces from fish fed WG 5% remained firm shape in the water and easily collected by siphon but that from WG 3% fed fish disintegrated easily. The average apparent digestibility of dry matter and protein tended to be higher in WG than CMC suggested that WG 3% and 5% is a better binder to diet for Anago compared to CMC 3% and 5%. Concerning a comparison of digestibility measurement by the direct and indirect method, the values from the direct method were always higher than the indirect method. The result from indicator (chromic oxide) determination in the feces revealed that the gap between the values from the two methods was due to the leaching of chromic oxide in the indirect method from feces rather than incomplete fecal retrieval in the direct method. Thus, the direct method can be applicable for digestibility study in Anguilliform.