（学位第３号様式）

学 位 論 文 要 旨

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題　目	**Studies on the nucleotide nutrition and development of functional feeds for cultured marine species** (海産養殖種におけるヌクレオチドの効果と機能性飼料開発に関する研究)

Although nucleotides (NT) have long been implicated as feed attractants in both vertebrate and invertebrate species, research into potential growth and health benefits of dietary NT in aquaculture species has just been implemented in early 2000s. To date, research pertaining to NT nutrition in fishes has shown rather consistent and encouraging, beneficial results in fish health management. Research to date on dietary NT has focused mainly on a mixture of NT, rather than specific types of NT. Therefore, additional research to explore specific effects of various individual NT along with mixed NT is necessary to gain a better understanding of NT nutrition in fish. Red sea bream, *Pagrus major*, and amberjack, *Seriolla dumerili*, are the two most important aquaculture species in East Asia. Intensive aquaculture of these species often caused stressful conditions which negatively affected their growth and health performances. Under these circumstances, research on dietary modulation for potential growth and health management is necessary for sustainable culture of these species. In this regards, development of functional feed through supplementing functional nutrients such as NT could be an effective alternative strategy. In the present study, both individual and mixed NT have been evaluated as functional nutrients and individual NT/nucleoside has been supplemented to develop functional feeds for these two species.

The efficacy of NT related products was evaluated initially in a feeding trial through supplementing a basal diet with NT related products such as nucleoside by- products (NBP) and inosine at 1, 3 and 0.03, 0.1%, respectively to formulate five experimental diets, including a control diet. After feeding the experimental diets to juvenile red sea breams for 60 days, results suggested that inosine and low concentration of NBP (1%) could be effectively used as dietary supplements for better growth and health performance.

In the second stage of research, six separate studies were conducted to optimize the supplementation of important purine and pyrimidine NT, *viz.* inosine 5′ monophosphate (IMP), adenosine 5′ monophosphate (AMP), guanosine 5′ monophosphate (GMP), uridine 5′ monophosphate (UMP) and cytidine 5′ monophosphate (CMP) for juvenile red sea bream and inosine nucleoside for juvenile amberjack. Simultaneously, functional effects of these supplements have been evaluated. In red sea bream, their optimal levels of IMP, inosine, UMP were about 0.4%. The optimal supplementation levels of GMP and CMP ranged from 0.45 to 0.48% and from 0.44 to 0.50%, respectively. In contrast, relatively low and a wide range of optimum AMP supplementation level were observed based on the regression analysis (0.16% for growth and 0.41 % for immunity). While, in the case of amberjack supplementation of inosine at 0.6% showed the optimum performances of growth and health parameters. Overall, the growth, feed utilization, stress resistance, intestinal health and immune responses of both species were enhanced by dietary supplementations.

To observe the functional effects of mixed purified NT, a feeding trial on juvenile red sea bream was also conducted for 56 days. Five dietary levels of purified NT mixture containing equal portion of IMP, AMP, GMP, UMP and CMP were supplemented to the basal diet (control) at 0.5, 1.0, 1.5, 2.0 and 2.5 g kg^{-1} to formulate a total of six experimental diets. After the feeding trial, results showed that dietary administration of 1.0-1.5 g kg^{-1} mixed NT was able to promote growth, immune responses and stress resistance.

In the final step of this study, inosine nucleoside and IMP were supplemented in alternative protein (dehhulled soy bean meal and soy protein concentrate, SPC) based diet as an initial step of low/non fishmeal (FM) based functional feed development for amberjack and red sea bream. Results indicated that amberjack can effectively utilize at least half of the replaced FM protein with soy bean meal protein without any compromising growth performances. Moreover, inosine supplementation in 50 to 75% FM replacement groups could be helpful to improve the digestibility, immune responses, stress resistance and intestinal health condition of amberjack. In the case of red sea bream trial, results showed that supplementation of IMP increased the efficiency of utilizing SPC (≤75%) as a sole protein source in the diet. Fish growth, feed utilization performances and blood chemical parameters were not significantly different up to 75% FM replacement groups in comparison with complete FM based control diet. In terms of non specific immune response, all replacement diet groups showed improved immune responses when compared with control diet group. Based on these studies, NT can be used as a potential functional supplement for the development of functional feeds for amberjack and red sea bream.