

EFFECT OF DIETARY LIPID CONTENTS ON GROWTH OF ESTUARY GROUPER, *Epinephelus coioides* JUVENILES

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ABSTRACT

Lipid is dietary component for energy and essential fatty acid sourced. Requirement of lipid for fish varies depending on species and size. The present study was conducted to evaluate the levels of dietary lipid on growth of estuary grouper *Epinephelus coioides* juveniles. Twelve fish of 5.0 ± 0.3 grams in body weight were reared in 30 liter tanks for 77 days with water flow through system. Temperature and salinity of the rearing water ranged between 28-30°C and 31-33 ppt., respectively. The levels of lipid in the test diets were 0.0%, 3.0%, 6.0%, 9.0%, 12.0%, and 15.0%. The results of experiment showed that dietary lipid affected growth and feed efficiency of estuary grouper juveniles. Juveniles of estuary grouper fed with 3.0%-12% dietary lipid had higher growth rate than fish fed diet without lipid, but increasing dietary lipid from 12% to 15% reduced the growth of fish ($P < 0.05$). The optimum level of dietary lipid for estuary grouper juveniles was 12%. The specific growth rate and feed efficiency of juveniles fed with 0.0%, 3.0%, 6.0%, 9.0%, 12.0%, and 15% of dietary lipid were 1.908, 2.017, 2.001, 2.038, 2.069, 1.996, and 0.82, 0.97, 1.10, 1.10, 1.08, 1.07, respectively.

KEYWORDS: estuary grouper, lipid, and growth

INTRODUCTION

At present, estuary grouper (*Epinephelus coioides*) breeding has been succeeded and need to continue in development to support mariculture. One the important factor is feed research for estuary grouper to anticipate its culture. Important feed component for carnivorous fish is lipid, that serves energy and essential fatty acids sources to support the growth of red sea bream (Vergara *et al.*, 1996). Dietary lipid content affected growth of red drum fish (Williams & Robinson, 1988) and humpback grouper (Giri *et al.*, 1999). Utilization of lipid by fish reduces the use of dietary protein in metabolism. Other important factor for lipid is fatty acid composition of lipid sources used in feed.

Most of marine fish has limited ability to synthesize n-3 HUFA from n-3 short chain fatty acids (Owen *et al.*, 1975; Kanazawa *et al.*, 1979; Ostrowski & Divakaran, 1990). N-3 HUFA such as 20:5n-3 (EPA) and 22:6n-3 (DHA) are essential fatty acids for most marine fish (Yano & Fujii, 1975; Fujita *et al.*, 1980; Watanabe *et al.*, 1983; Izquierdo *et al.*, 1989; Webster & Lovell, 1990). Lack of dietary n-3 HUFA causes high mortality, slow growth and unperfected development of swim bladder for fish larvae (Sorgeloos *et al.*, 1988; Webster & Lovell, 1990; Koven *et al.*, 1990). Salhi *et al.*, (1994) reported that the content of dietary n-3 HUFA 2.05-2.16% in microdiet had better survival rate than content of dietary n-3 HUFA 0.74-0.82% for gilthead sea bream larvae.

Ability of fish to use dietary lipid depends on species. Due to that reason, this experiment was conducted to know dietary lipid requirement for estuary grouper.

MATERIAL AND METHODS

Dietary protein sources of this experiment such as fish, tinny shrimp, and squid liver meal were extracted by method Bligh & Dryer (1959) to reduce lipid content. Experimental diets were formulated with different lipid contents. Equal energy content in each diet was adjusted by dextrin. Energy content of dextrin is half of fish oil energy (Williams & Robinson, 1988). Composition of experimental diets is shown in Table 1.

Dietary lipid contents in this experiment were 0.0%, 3.0%, 6.0%, 9.0%, 12.0%, and 15.0%, respectively. This experiment was done in CRD with six treatments and three replicates.

Hatchery produced juvenile of estuary grouper, 5.0 ± 0.3 gram in average body weight were stocked in 30 liters polycarbonate tanks with density of 12 fish per tank. Each tank was equipped with flow through system and aeration to maintain water quality in rearing tank. Water flow rate was 200 ml per minute. Water temperature and salinity during the experiment were 28-29°C and 31-33 ppt., respectively. Fish were fed twice daily to satiation.

Body weight and survival were recorded every week for 11 weeks. At the end of the experiment, a representative sample of fish from each tank was dried and chemical composition of fish was determined. Crude protein, lipid and ash content of diets and fish were analyzed following the standard methods of AOAC (1990). The growth, feed efficiency, protein efficiency as well as protein and lipid retention data were analyzed using one way ANOVA and differences between treatments were considered significant at $P < 0.05$ (Steel & Torrie, 1980).

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Table 1. Composition of raw material and nutrient the experimental diets (%)

Ingredients	Dietary lipid (%)					
	0.0	3.0	6.0	9.0	12.0	15.0
Casein	20.0	20.0	20.0	20.0	20.0	20.0
Fish meal	36.0	36.0	36.0	36.0	36.0	36.0
Squid meal	4.0	4.0	4.0	4.0	4.0	4.0
Krill meal	2.9	2.9	2.9	2.9	2.9	2.9
Mineral mix ¹	1.7	1.7	1.7	1.7	1.7	1.7
Vitamin mix ²	1.3	1.3	1.3	1.3	1.3	1.3
Carophylpink	0.1	0.1	0.1	0.1	0.1	0.1
CMC	2.0	2.0	2.0	2.0	2.0	2.0
Wheat flour	2.0	2.0	2.0	2.0	2.0	2.0
Dextrin	30.0	24.0	18.0	12.0	6.0	0.0
Fish oil	0.0	3.0	6.0	9.0	12.0	15.0
Cellulose	0.0	3.0	6.0	9.0	12.0	15.0
Analysis						
Crude protein	47.71	48.12	47.51	48.21	47.63	48.17
Crude lipid	1.10	4.12	7.50	10.21	13.70	16.21
Fiber	2.13	4.21	5.91	8.30	11.29	14.47
Ash	7.64	7.72	7.65	7.66	7.58	7.58
N-free extract	32.73	27.4	20.7	14.5	7.5	1.8
Energy(Kcal/g diet) ³	4.99	4.97	5.00	4.98	5.00	4.99

¹ Vitamin Mix (mg/100 gram diet): thiamin-HCl, 5.0; riboflavin, 5.0; Ca-pantothenate, 10.0; niacin, 2.0; pyridoxin-HCl, 4.0; biotin, 0.6; folic acid, 1.5; cyanocobalamin, 0.01; inositol, 200; p-aminobenzoic acid, 5.0; menadion, 4.0; b-carotin, 15.0; calciferol, 1.9; a-tocopherol, 25.0; vitamin C (phosphitan), 120; choline chloride, 900.

² Mineral mix (mg/100 gram diet): KH₂PO₄, 412; CaCO₃, 282; Ca(H₂PO₄), 618; FeCl₂, 166; ZnSO₄, 9.99; MnSO₄, 6.3; CuSO₄, 2; CoSO₄, 0.05; KJ, 0.15.

³Total energy based on energy content of protein = 5.65 Kcal/g; lipid= 9.45 Kcal/g; carbohydrate, 4.10 kcal/g).

RESULTS AND DISCUSSION

Growth of estuary grouper juvenile every 7 days for each treatment is shown in Figure 1. Estuary grouper juveniles fed dietary lipid 0% showed delay body weight development compared to other treatments in 49 days rearing period (Figure 1). Fish fed dietary lipid 0% and 3% was observed with delayed growth compared to fish fed dietary lipid 6%, 9%, and 12% in 56 days experiment. Figure 1 showed that dietary lipid has role to support growth of estuary grouper juveniles.

Specific growth rate, feed efficiency, and feed consumption at the end of the experiment were shown in Table 2. Fish fed dietary lipid 0% has lower specific growth rate than fish fed dietary lipid from 3% to 12% ($P < 0.05$). Increased dietary lipid from 3% to 12% has trend of increasing growth of estuary grouper juveniles, but dietary lipid increased from 12% to 15% has trend of reduced specific growth rate (Table 2). This experiment showed that dietary 12% is an optimum for growth of estuary grouper juveniles.

Dietary lipid affected feed efficiency on estuary grouper juveniles (Table 2). Estuary grouper juveniles fed diet with 0% lipid had lower feed efficiency than fish fed diets with 3% and 6% lipid ($P < 0.05$). The others fed diets from 6% to 15% lipid had same feed

efficiency ($P > 0.05$). This experiment showed that dietary lipid has to be considered in feed formulation of estuary grouper to increase feed efficiency. On other hand, dietary lipid has rule as sparing partner of protein.

Dietary lipid requirement varies with species. Some results of experiments showed that *Labio rohita* of 7.5 gram in size had the best growth fed 6% dietary lipid (Gangadhara *et al.*, 1997). Lipid requirement of sea bass (*Lates calcaifer*) and *Morone chrysops* of 4.5 gram in size were 12-18% (Cacutan & Coloso, 1997), and 13% (Gallagher, 1997), respectively. Ernullah & Jufri (1998a) reported that *Calta calta* dan *Labio rohita* had a maximum growth fed 36% dietary carbohydrate and 4% dietary lipid. Requirement of dietary carbohydrate and lipid for *Cirrhinus mrigala* fish were 27% and 8%, respectively.

The best dietary lipid for catfish (*Clarias batrachus*) was 8% (Ernullah & Jufri, 1998b). The other concern is the lipid source in feed formulation. Lipid source affects fish growth and feed efficiency. Tucker *et al.*, (1997) reported that red drum only utilized 1.5% dietary soybean oil and 12.7% dietary menhaden oil. Other report on humpback grouper shown that this fish had better growth rate when they were fed dietary squid oil compared to soybean oil (Suwirya *et al.*, 1999).

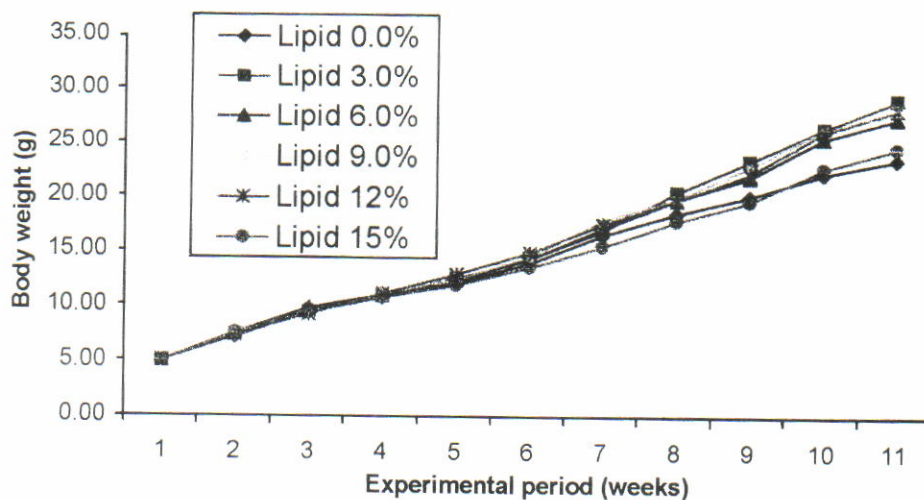


Figure 1. Growth of estuary grouper juveniles during the experiment.

Table 2. Specific growth rate, feed efficiency ratio, and feed intake of estuary grouper juvenile fed different dietary lipid levels

Dietary lipid (%)	Specific growth rate (G) ¹	Feed efficiency	Feed intake (gram/ind)
0.0	1.908 ± 0.0023 ^a	0.82 ± 0.0210 ^a	22.04 ± 0.86 ^a
3.0	2.017 ± 0.068 ^{bc}	0.97 ± 0.0493 ^b	23.80 ± 2.97 ^a
6.0	2.001 ± 0.072 ^{bc}	1.00 ± 0.0813 ^{bc}	20.38 ± 3.85 ^a
9.0	2.038 ± 0.002 ^{bc}	1.10 ± 0.0587 ^c	20.90 ± 0.84 ^a
12.0	2.069 ± 0.014 ^c	1.08 ± 0.0299 ^c	21.45 ± 2.20 ^a
15.0	1.996 ± 0.031 ^{ab}	1.01 ± 0.0412 ^{bc}	19.25 ± 2.31 ^a

Mean in column with the same superscript are not significantly different (P>0.05).

¹G = ((ln Wt - ln Wo)/t), where G = Specific growth rate, Wo = Initial body weight, Wt = End of body weight, t = period of experiment (days).

Grouper, *E. areolatus* fed 10% dietary lipid and 60% protein had the best growth (Chu *et al.*, 1996). The result of this experiment showed that estuary grouper (*E. coioides*) juveniles fed 12% dietary lipid and 48% dietary lipid had optimum growth.

Dietary lipid affected efficiency and retention protein on estuary grouper juveniles (Table 3). Juveniles fed dietary lipid from 6-15% had better efficiency protein compared to those fed 0-3% dietary lipid (P<0.05). Dietary lipid from 6-15% had the same efficiency protein on estuary grouper juveniles (P>0.05).

Estuary grouper fed 6% dietary lipid had better protein retention than those fed from 0-3% dietary protein (P<0.05). This experiment showed that estuary grouper juveniles fed 0-3% dietary lipid used higher protein for metabolism energy than those fed 6% dietary lipid.

Dietary lipid from 0-15% did not affect protein, ash, and fiber of body composition but dietary lipid tended to increase body lipid (Table 4). The same result was shown with stripped bass fed 8% and 12% dietary lipid for 9 weeks caused increasing body lipid significantly (Fair *et al.*, 1993).

Table 3. Protein efficiency and protein retention of estuary grouper juvenile fed diets with different dietary lipid levels

Dietary lipid (%)	Protein efficiency (%) [*]	Protein retention (%) ^{**}
0.0	1.9017 ± 0.2567 ^a	36.41 ± 0.43 ^a
3.0	1.9017 ± 0.2567 ^a	38.57 ± 0.90 ^{ab}
6.0	2.3175 ± 0.1709 ^b	39.55 ± 3.14 ^{bc}
9.0	2.3426 ± 0.1247 ^b	42.40 ± 2.20 ^c
12.0	2.2407 ± 0.0621 ^b	39.71 ± 2.10 ^{bc}
15.0	2.2336 ± 0.0861 ^b	39.83 ± 1.48 ^{bc}

Mean in column with same superscripts are not significantly different (P>0.05).

^{*}Protein efficiency = (the body weight at the end-initial of body weight)/protein intake).

^{**}Retention protein = storing body protein/protein consumption).

Table 4. Body composition of estuary grouper juveniles (%) at the end of the experiment

Dietary lipid (%)	Dry matters (%)	Protein (%)	Lipid (%)	Ash (%)	Fiber (%)
0.0	35.2	64.46	10.32	16.48	3.13
3.0	33.2	59.79	13.2	15.04	3.25
6.0	34.5	57.25	16.21	15.25	2.95
9.0	32.3	55.45	21.57	13.84	3.24
12.0	31.7	55.73	21.28	13.88	2.98
15.0	32.1	54.06	22.06	14.37	3.42

CONCLUSION

Content of dietary lipid affected growth of estuary grouper juveniles. Optimal content of dietary lipid for the best growth of estuary grouper juveniles was 12%.

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