International Journal of Fisheries and Aquatic Studies 2017; 5(4): 30-34

E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2017; 5(4): 30-34

www.fisheriesjournal.com
Received: 16-05-2017
Accepted: 17-06-2017

S Syed Raffic Ali
Assistant Professor,
Postgraduate and Research Department of Zoology, The New College, Chennai, India.

Correspondence
S Syed Raffic Ali
Postgraduate and Research Department of Zoology, The New College, Chennai, India.

Effect of varying levels of lipid on growth performance, survival and body composition of Milkfish (*Chanos chanos*)

S Syed Raffic Ali

Abstract
A 45 days feeding trial was conducted to study the effect of varying levels of lipid on growth performance, survival and body composition of milkfish (*Chanos chanos*) with average weight of (1.96 ± 0.02 g). Four is nitrogenous experimental diets formulated with increasing levels (4, 8, 12 and 16 %) of lipid. The trial was carried out in 300-L fiber reinforced polymer (FRP) tanks with three replicates (each containing 15 fish) for each treatment and fish were hand fed in twice daily at 10.00 and 16.00 hours The results of the feeding trial showed that there was a significant ($P < 0.05$) difference in the final body weight (7.42 ± 0.03), weight gain (5.47 ± 0.03) and feed conservation ratio (1.62 ± 0.03) of fish fed with the diet containing 8% lipid. However there was no significant ($P > 0.05$) difference in survival and daily growth coefficient among the fish fed with different experimental diets. Survival was greater than 95% in all treatments. Whole body composition of post fed animals showed significant differences ($P < 0.05$) in the moisture (69.82 ± 0.09), crude protein (62.50 ± 0.29), crude lipid (30.68 ± 0.06), crude fiber (0.17 ± 0.01) and total ash (11.27 ± 0.02) among the various treatment groups. There was no significant ($P > 0.05$) difference in condition factor, hepatosomatic index and viscerosomatic index (VSI) among the different treatment groups. The results of this experiment reveals that 8% lipid in diet of milkfish juveniles is optimal for the better growth and survival.

Keywords: Body indices, Feed formulation, Growth, Lipid, Milkfish, Proximate composition

1. Introduction
Milkfish (*Chanos chanos*) is widely distributed throughout the tropical and subtropical Indo-Pacific oceans and can tolerate very wide ranges of environmental conditions [1]. This fish is a potential candidate species with good production potential for culture in fresh, brackish and marine water [2]. It is considered as one of the cheapest source of animal protein. [3,4]. Dietary lipids are an important source of energy that also provides essential fatty acids, phospholipids, sterols and fat-soluble vitamins necessary for proper functioning of physiological processes and maintenance of biological structure and function of cell membranes [5]. Lipid used for energy can also spare dietary proteins and reduce nitrogenous waste production [6]. Increasing dietary lipid levels improves feed efficiency and growth by sparing protein, particularly in coldwater carnivorous fish, as they generally have a lesser ability to utilize carbohydrates for energy than do warm water species [7]. Fish oil is the main source of lipid used in the formulation of commercial aqua feeds, with essential n-3 highly unsaturated fatty acid (HUFA) predominantly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) which comprise 10% to 30% of total fatty acids in most fish oil [5]. Moreover, fish oil is excellent sources of energy owing to their high content of methyl palmitate and methyl stearate as the predominant saturated fatty acid (SFA) and substantial amounts of the mono unsaturated fatty acids (MUFA). Due to their high nutritional value, fish oil has traditionally been the major oil sources in aqua feeds especially for fin fishes [5]. Dietary lipids have been shown to enhance growth rates and survival of fish species Japanese seabass *Lateolabrax japonicas*, white seabass, *Atractoscion nobilis* and meagre *Argyrosomus regius* [10-13]. Therefore, an attempt has been made to evaluate the effect of varying levels of lipid on growth performance, survival, body composition and biological indices of milkfish under controlled laboratory conditions.

2. Materials and Methods

2.1 Preparation of experimental diets

The effect of varying levels of lipid was carried out by including it in the milkfish diet at four different (W/W) levels viz., 4, 8, 12 and 16%. The ingredients and proximate composition of the experimental diets is given in the (Table 1& 2). Dry solid feed ingredients were powdered in an electrical grinder and passed through a 0.5-mm sieve. They were mixed together along with additives and homogenized thoroughly in an electrical blender. The diet mix was made into soft dough by adding required quantity water at about 40%. The dough was steam cooked (at atmospheric pressure) for 5 minutes, cooled and pelletized in a hand pelletizer. The diet was dried in a hot air oven at 70º C to moisture content of less than 9% and stored in a dessicator until use.

2.2 Fish rearing and experimental design

Hatchery-bred and reared milk fish juveniles were procured from the fish hatchery at Muttukadu experimental station, Central Institute of Brackishwater Aquaculture (CIBA), Chennai, India. They were transported to the nutrition wet-laboratory and were acclimatized to the laboratory conditions for two weeks during which they were fed CIBA- Bhetkiahar (a pelleted feed developed at CIBA).The fingerlings (average body weight: 1.96 ± 0.02 g) were randomly distributed into fifteen oval 300 L fibre re-inforced plastic (FRP) tanks with three replicates in each treatment, a replicate containing 15 animals, the experiment being carried out in a completely randomized design. The tanks were supplied with sand-filtered seawater and continuous aeration through air diffuser stones. Throughout the trial, water in the tanks (about 80 %) was exchanged twice a day, in the morning and evening. Fishes were hand fed in excess twice daily (10.00 and16.00 hours) and after 30 minutes, unconsumed feed was siphoned out and dried to determine the actual feed consumption. Animals were weighed individually at the start and end of the experiment while bulk weighing was carried out at fortnightly intervals to ascertain the increase in weight. Fish died during the experimental period have been collected and weighed and taken for calculation of growth metrics. Fish were maintained under a natural photoperiodicity (12h L: 12h D).

2.3 Chemical analysis

The proximate composition of the ingredients, experimental diets and body composition of experimental animals was analyzed following standard procedures [14]. At the termination of the experiment, 5 fish from each tank were collected and killed by over dose of anesthesia for determination of whole body composition. The fish samples were homogenized and dried at 105°C for 24 h. The dried samples within a tank were pooled and analyzed.

Moisture content was estimated by gravimetric analysis after oven drying at 105 °C for 12 h. Crude protein (CP) was determined by Kjeldahl method (N x 6.25) after acid hydrolysis (Kjeltec 2100, FOSS, Tecator, Sweden). Crude lipid (CL) was calculated gravimetrically after extraction with petroleum ether in a soxhlet system (SOCS, Pelican, India). Total ash was determined gravimetrically by ignition at 600ºC for 6 h in muffle furnace. Crude fiber was estimated gravimetrically after acid and alkali digestion and loss in mass by combustion at 600 ºC for 3 h. Nitrogen free extract (NFE) was calculated by difference.

2.4 Sampling and data collection

On termination of the experiment, fish were anaesthetized using 2-phenoxyethanol at a dose of 0.3 mL L^{-1} and the total length and weight of each fish recorded. Three fish from each tank were randomly selected to measure the biometric indices. Liver and viscera of fish were dissected out and weighed for computation of hepatosomatic index (HSI) and viscerosomatic index (VSI).

2.5 Growth parameters

IBW (g): initial body weight

FBW (g): final body weight

WG (g $fish^{-1}$): weight gain = FBW (g) – IBW (g)

Survival (%) = (final count of fish / initial count of fish) x 100

DGC (% day^{-1}): daily growth coefficient, (= [($FBW^{1/3}$-$IBW^{1/3}$)/ 45 days] x 100

FCR: feed conversion ratio= feed consumed (g, dry weight) / weight gain (g)

CF (g $(cm^3)^{-1}$): Condition factor = [(live weight, g) / (length, cm)^3] x 100

HSI (%): Hepatosomatic index = (liver weight, g / body weight, g) x 100

VSI (%): Viscerosomatic index = (visceral weight, g / body weight, g) x 100

2.6 Statistical analysis

Data were analyzed using one-way ANOVA to compare significant differences between treatments, whereas Duncan's multiple range tests was used to compare the means of the treatments. All the data were analyzed using SPSS version 16.0 software (SPSS, Chicago, IL, USA).

3. Results and Discussion

3.1 Water quality parameters

Water quality parameters viz. temperature, salinity, pH, dissolved oxygen, and total ammonia nitrogen were analyzed on a weekly basis the values ranging from 26-29ºC, 28-31ppt, 7.4-8.2, 6.0-7.3 mgL^{-1} and 0.08-0.11 mg L^{-1}were analyzed during the experimental period.

3.2 Growth parameters

The growth performance and survival of milkfish fed with varying levels of lipid is presented in (Table 3). The results showed that there was a significant ($P < 0.05$) increase in the final body weight (7.42 ±0.03), weight gain (5.47 ±0.03) and feed conversion ratio (1.62 ± 0.03) of fish fed with 8% lipid diet compared to the rest of the treatments. However there was no significant ($P > 0.05$) difference in survival and daily growth coefficient (DGC) of fish fed with different experimental diets. Survival was greater than 95% in all treatments and no signs of stress or other health problems were observed. Growth was least in fish fed with diet more than 8%. Growth performance of milkfish fed with lipid containing diets indicated that lipid can be included up to a significant level in the diet. Similar to our results significant difference on growth performance was observed in Crucian carp *Carassius auratus gibelio*, Pikeperch *Sander lucioperca* and Bay snook *Petenia splendida* [8, 15, 16]. On the contrary negative effects of high lipid levels on growth performance reported in Tiger puffer *Takifugu rubripes*, Japanese seabass *Lateolabrax japonicas* and Cobia *Rachycentron canadum* [9, 17, 18]. When fish are fed diets with insufficient lipids, reduced growth performance might be because of insufficient digestible energy or deficiencies in essential fatty acids. [19].

The effect of dietary lipid levels on fish growth performance vary considerably with species, size, age, diet formulation and composition, range of lipid levels tested, and rearing conditions [15].

3.3 Whole body composition
Whole body composition of milkfish fed with varying levels of lipid is presented in (Table 4). Analysis of whole body composition of post fed experimental animals revealed that there was a significant (P < 0.05) difference in the moisture (69.82 ± 0.09), crude protein (62.50 ± 0.29), crude lipid (30.68 ± 0.06), crude fiber (0.17 ± 0.01) and total ash (11.27 ± 0.02) content among the experimental diets. The increase in dietary lipid levels is correlated with increases in whole body lipid content and excessive dietary lipids results in excessive fat deposition in visceral cavity, liver, and muscle tissues of fishes [20]. Excessive fat deposition in fish tissues may affect processing yield, product quality and storage stability of the final product and consequently its commercial value [21]. In the present study, whole body lipid content was observed to increase with increase in dietary lipid levels (4-16%) Additionally, increase in dietary lipid levels resulted in decreasing trend of whole body protein proportion with no apparent effect on growth performance. The differences in whole-body protein are lower in fish fed high lipid diets as a result of dilution with lipid.

3.4 Biological indices
The biological indices of milkfish fed with varying levels of lipid are presented in (Table 5). The condition factor, HSI and VSI showed non-significant differences among the experimental diets. However the fish fed with 12% lipid diet showed the highest values in the condition factor (0.84 ± 0.16) and HSI (1.17±0.03). A trend of increasing VSI with an increase in dietary lipid more than 8% was obvious although not statistically significant (7.03 ±1.72, 8.1 ± 1.06). Condition factor is used to compare the 'condition', 'fatness' or 'well being' of fish and are based on the hypothesis that heavier fish of a given length are in better condition. Based on results of the present study, liver lipid content was not affected by dietary lipid levels and no statistical differences were noted in HSI and liver lipid contents among the four treatments. This indicates that liver does not contribute significantly to lipid deposition. These results were observed in various other fishes Atlantic halibut *Hippoglossus hippoglossus* [22] (sea bream *Diplodus sargus* [23] meagre *Argyrosomus regius* [11]. Increase in dietary lipid level caused an increase in visceral lipid deposition [27]. As the dietary lipid increased, a significant proportion of the lipid was deposited in the viscera.

Table 1: Ingredient composition of experimental diets, containing varying levels of lipid

Diets / Ingredients (%)	4% Lipid	8% Lipid	12% Lipid	16% Lipid
Fish meal [a]	33	33	33	33
Acetes	12	12	12	12
Dry fish	10	10	10	10
Squid	5	5	5	5
Soybean meal	5	5	5	5
Wheat	22	17	15	10
Rice	9	9	5	4
Fish oil [a]	0	3	6	9
Lecithin	0	2	4	6
Vitamin &Minerals [b]	3	3	3	3
Binder [c]	1	1	1	1
Wheat gluten	0	0	1	2

[a] Sardine fishmeal and fish oil. Bismifisheries, Mayiladuthurai, Tamil Nadu, India.
[b] Commercially sourced premix and each kg contains Vitamin A - 2000000IU, Vitamin D - 400000 IU, Vitamin E – 300 U, Vitamin K - 450 mg, Riboflavin - 800 mg, Panthothenic acid - 1 g, Nicotinamide - 4 g, Vitamin B12 - 2.4 mg, Choline chloride - 60 g, Ca - 300 g, Mg – 11 g, I - 400 mg, Fe - 3 g, Zn - 6 g, Cu - 800 mg, Co - 180 mg. Sarabhai Zydus Animal Health Ltd, Vadodara, Gujarat, India.
[c] Pegabind, BentoliAgri nutrition Asia pvt Ltd, Singapore.

Table 2: Proximate composition (% dry matter basis) of experimental diets with varying levels of lipid

Proximate composition	4% Lipid	8% Lipid	12% Lipid	16% Lipid
Moisture	6.8	6.9	6.4	6.3
Crude protein	36.4	36.2	36.7	36.8
Crude lipid	3.58	7.72	11.8	15.4
Crude fiber	1.78	1.85	1.05	1.02
Total ash	16.4	16.9	16.8	16.3
NFE	35.04	30.43	27.25	24.18

Table 3: Growth performance and survival of milkfish fed experimental diets with varying levels of lipid for 45 days

Parameters	4% Lipid	8 % Lipid	12% Lipid	16 % Lipid
IBW(g)	1.96 ± 0.02	1.95±0.02	1.96±0.03	1.97±0.02
FBW (g)	6.60^{b} ±0.03	7.42^{a}±0.03	6.59±^{b} 0.03	6.58^{b}±0.05
WG (g)	4.64^{b} ± 0.02	5.47^{a}±0.03	4.63^{b}±0.02	4.61±^{b} 0.02
Survival (%)	96.33 ± 2.51	95.66±1.52	97.33±1.52	96.66±2.08
DGC	1.49±0.16	1.40±0.12	1.54±0.35	1.46±0.27
FCR	1.71^{a}±0.02	1.62^{b}±0.03	1.72^{a}±0.03	1.74^{a}±0.02

All values are mean ± SE of three observation.
Mean bearing different superscript in a row differ significantly (P< 0.05).

Table 4: Whole body composition (% dry matter basis) of milkfish fed experimental diets with varying levels lipid for 45 days

Parameters	4% lipid	8% lipid	12% lipid	16% lipid
Moisture	$71.45^{a} \pm 0.29$	$69.82^{b} \pm 0.09$	$71.3^{a} \pm 0.46$	$71.22^{a} \pm 0.06$
Crude protein	$62.50^{a} \pm 0.29$	$60.5^{b} \pm 0.04$	$59.5^{c} \pm 0.06$	$56.7^{d} \pm 0.05$
Crude lipid	$22.68^{d} \pm 0.21$	$26.45^{c} \pm 0.01$	$28.41^{b} \pm 0.17$	$30.68^{a} \pm 0.06$
Crude fiber	$0.17^{b} \pm 0.01$	$0.18^{ab} \pm 0.01$	$0.22^{a} \pm 0.02$	$0.15^{b} \pm 0.02$
Total ash	$11.04^{a} \pm 0.0$	$10.19^{ab} \pm 0.01$	$11.27^{a} \pm 0.02$	$10.00^{b} \pm 0.16$

All values are mean ± SE of three observation.
Mean bearing different superscript in a row differ significantly ($P < 0.05$).

Table 5: Biological indices of milkfish fed experimental diets with varying levels of lipid for 45 days.

Parameters	4% lipid	8% lipid	12% lipid	16% lipid
CF (k)	0.73±0.06	0.72±0.01	0.84±0.16	0.77±0.03
HIS (%)	1.15±0.22	1.04±0.30	1.17±0.03	1.00±0.07
VSI (%)	6.32±3.91	5.84±0.35	7.03±1.72	8.1±1.06

All values are mean ± SE of three observation.
No significant differences for all parameters ($P > 0.05$)

4. Conclusion

In conclusion, milkfish have less dietary lipid requirements than typically cultured carnivorous fishes. Dietary lipid level of 8% will result in optimal growth and better survival of milkfish juveniles. A dietary lipid level that is too high (16%) can have negative effects on growth. A low lipid diet formulated specially for milkfish would help make the aquaculture and marketing of a successful industry.

5. Acknowledgement

The authors are grateful to the Indian Council of Agricultural Research, New Delhi for the project on Outreach activity on Fish feeds. Authors express their sincere thanks to Dr. K. Ambasankar, Principal Scientist, Central Institute of Brackishwater Aquaculture for providing necessary facilities for carrying out this work.

6. References

1. Franklin Martinez S, Mei-Chen T, Sin-Ping Y. Milkfish *Chanos chanos* Culture situations and trends. Journal of Fish Society Taiwan. 2006; 33:229-244.
2. Syed Raffic Ali S, Ambasankar K, Stanlin S, Balachandran S, Ramachandran K. Effect of temperature and moisture on the extrudate properties of Milkfish (*Chanos chanos*) feed (10th IFAF) 2014; (Abs.PPPA-52):312.
3. Barman UK, Garg SK, Bhavnagar A. Effect of different salinity and ration levels on growth performance and nutritive physiology of Milkfish *Chanos chanos*. Fish Aquaculture Journal. 2012; 53:1-11.
4. Sivakumar R, Jayaprakash M, Munnusamy N. Impact of heavy metals on antioxidant activity in different tissue of milkfish *Chanos chanos*. International Journal of Applied Biology and Pharmaceutical Technology. 2013; 4:272-279.
5. Sargent JR, Tocher DR, Bell JG. The lipids. In: Halver, J.E., Hardy, R.W. (Eds.). Fish Nutrition 3rd. Academic Press, San Diego, 2002, 181-257.
6. Vergara JM, Lopez-Calero G, Robaina L, Caballero MJ, Montero D, Izquierdo MS *et al.* Aksnes A Growth, feed utilization and body lipid content of gilthead seabream *Sparus aurata* fed increasing lipid levels and fish meals of different quality. Aquaculture.1999; 179:35-44.
7. Hardy RW. Problems and opportunities in fish feed formulation. Aquaculture Magazine. 1999; 25:56-60.
8. Wang A, Han G, Lv FU, Yang W, Huang J, Yin X. Effects of dietary lipid levels on growth performance, apparent digestibility coefficients of nutrients, and blood characteristics of Juvenile Crucian carp *Carassius auratus gibelio*. Turkish Journal of Fisheries and Aquatic Science. 2014; 14:1-10.
9. Xu JH, Qin J, Yan BL, Zhu M, Luo G. Effects of dietary lipid levels on growth performance, feed utilization and fatty acid composition of juvenile Japanese seabass *Lateolabrax japonicus*. Aquacult International. 2011; 19:79-89.
10. Zheng KK, Zhu XM, Han D, Yang YX, Lei W, Xie SQ *et al*. Effects of dietary lipid levels on growth, survival and lipid metabolism during early ontogeny of *Pelteobagrus vachelli larvae*. Aquaculture. 2010; 299:121-127.
11. Chatzifotis S, Panagiotidou M, Papaioannou N, Pavlidis M, Nengas I, Mylonas CC *et al*. Effect of dietary lipid levels on growth, feed utilization, body composition and serum metabolites of meagre *Argyrosomus regius* juveniles. Aquaculture. 2010; 307:65-70.
12. Lopez LM, Durazo E, Viana MT, Drawbridge M, Bureau DP. Effect of dietary lipid levels on performance, body composition and fatty acid profile of juvenile white seabass, (*Atractoscion nobilis*). Aquaculture. 2009; 289:101-105.
13. Morais S, Caballero MJ, Conceicao LEC, Izquierdo MS, Dinis MT. Dietary neutral lipid level and source in Senegalese sole (*Solea senegalensis*) larvae: Effect on growth, lipid metabolism and digestive capacity. Comparative Biochemistry and Physiology. B: Biochemistry Molecular Biology. 2006; 144:57-69.
14. AOAC. Official methods of analysis, 19th edn. Association of Official Analytical Chemists, Arlington, 2012.
15. Arredondo-Figueroa JL, Matsumoto-Soule JJ, Ponce-Palafox JT, Shirai-Matsumoto K, Gomez-Marquez JL. Effects of protein and lipids on growth performance, feed efficiency and survival rate in fingerlings of Bay snook *Petenia splendida*. International Journal of Animal and Veterinary Advances. 2012; 4:204-213.
16. Molnar T, Szabo A, Szabo G, Szabo C, Hancz C. Effect of different dietary fat content and fat type on the growth and body composition of intensively reared pikeperch *Sander lucioperca L*. Aquaculture Nutrition. 2006; 12:173-182.
17. Kotaro K, Takeshi F, Nakahiro I, Kazue O, Tamo N. Effect of dietary lipid levels on the growth, feed

utilization, body composition and blood characteristics of tiger puffer *Takifugu rubripes*. Aquaculture. 2009; 298:111-117.

18. Wang JT, Liu YJ, Tian LX, Mai KS, Du ZY, Wang Y *et al*. Effect of dietary lipid level on growth performance, lipid deposition, hepatic lipogenesis in juvenile cobia *Rachycentron canadum*. Aquaculture. 2005; 249:439-447.
19. Ghanawi J, Roy L, Allen Davis D, Patrick Saoud I. Effects of dietary lipid levels on growth performance of marbled spine foot rabbit fish *Siganus rivulatus*. Aquaculture. 2011; 310:395-400.
20. Song LP, An L, Zhu YA, Li X, Wang Y. Effects of dietary lipids on growth and feed utilization of jade perch, *Scortum barcoo*. Journal of World Aquaculture Society. 2009; 40:266-273.
21. Cowey CB. Some effects of nutrition on flesh quality of cultured fish. Fish nutrition in practice, Proceedings of the IV international symposium fish nutrition and feeding. : In: Kaushik SJ, Luquet, P. (Eds.), Les Colloques, 61. INRA Editions, Paris, France, 1993, 227-236.
22. Martins DA, Valente LMP, Lall SP. Effects of dietary lipid level on growth and lipid utilization by juvenile Atlantic halibut *Hippoglossus hippoglossus* L. Aquaculture. 2007; 263:150-158.
23. Sa R, Pousao-Ferreira P, Oliva-Teles A. Effect of dietary protein and lipid levels on growth and feed utilization of White sea bream (*Diplodus sargus*) juveniles. Aquaculture Nutrition. 2006; 12:310-321.