



Nilem Carp Fish (*Osteochilus hasselti*) Performance in Various Feed Energy-Protein Ratios

Yuli Andriani^{1*}, Fikri Khairun Akbar¹, Zahidah¹, Rita Rostika¹, Kiki Haetami¹ and Junianto¹

¹*Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, Jln. Raya Bandung Sumedang KM 21, Jatinangor, West Java, 40600, Indonesia.*

Authors' contributions

This work was carried out in collaboration between all authors. Author YA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors FKA and Zahidah managed the analyses of the study. Authors RR, KH and Junianto managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study aimed to understand the effects of various energy-protein ratios of feed on Nilem carp fish (*Osteochilus hasselti*) growth. This study was conducted from September to October 2017 at the Laboratory of Building 4, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran. The average size of the test fish was ± 7 cm with an average weight of 3 grams. This was a Completely Randomized Design (CRD) experimental study consisting of 5 treatments and 3 repetition. The treatments given were 5 feed formulas based on different feed protein energy ratios, i.e. treatment A (31% protein, ratio 10), treatment B (31% protein, ratio 8), treatment C (28% protein, ratio 10), D (28% protein, ratio 8), and E (30% protein commercial feed/control). Feed, 5% of the test fish total weight, was provided 3 times a day. Parameters observed were daily growth rate, feed conversion, and survival. Data gained were analyzed using F-test, followed by Duncan Test if differences were found between treatments. Results showed that growth rate and feed

*Corresponding author: Email: yuli.andriani@unpad.ac.id;

conversion of all treatments were not different compared to control. The highest result was found in treatment A (31% protein, ratio 10) with a daily growth rate of 3.99% and feed conversion of 1.95%.

Keywords: Nilem carp fish; protein-energy ratio; feed conversion; daily growth rate.

1. INTRODUCTION

Nilem (*Osteochilus hasselti*) plays an important role to provide animal protein, with a very good potentials to be cultivated because it is easy to maintain, affordable, and has a good nutrition value. Nilem carp fish cultivation is done in many areas in East Priangan and this fish is considered as one of unique fish of West Java. Nilem carp fish production tends to decline, making improvement in its cultivation is necessary, including through, among others, feed provision approach for nilem carp fish.

Energy ratio is one of the aspects of fish feed quality assessment. Optimum energy-protein ratio in feed is needed to get maximum fish growth. This is due to the fact that the energy needed for maintenance should be met first and that surplus of energy is needed for growth [1]. If the feed energy content is low, the feed protein will be used as the energy source; however, if the energy is too high, fish's appetite will be reduced and growth will decline. Therefore, feed needs to have a certain energy-protein ratio to be able to provide adequate non-protein energy to ensure that most of the protein will be used for growth [2].

The determination of energy-protein ratio also aims to make protein utilization in the feed more efficient. Protein saving in feed will significantly reduce the cost of feed because protein is the most expensive ingredient in fish feed composition, and play the important rule in fish growth as well. Dietary protein and energy levels are known to influence the growth and body composition of fish [3].

In addition to meeting amino acid need, protein is also used as the main energy source in feed, rather than carbohydrate and fat. When the protein content in feed is inadequate, it will only meet the need for body defense mechanism and will not be able to support growth. Considering to water quality, the use of protein that is too high will have an impact on reducing the quality of aquaculture because it will increase the content of ammonia in the waters [4]. Hence, it is important to pay attention to the optimum protein

content in fish feed to be able to support growth with more efficient utilization to achieve more affordable feed manufacture cost.

2. MATERIALS AND METHODS

Instruments used in this study were: 40 x 30 x 20 cm³ aquariums, Turbo-B 8200 pumps, aeration tubes, air stones, AND EK-120G digital scale, Luthron pH meter, Hanna HI-3810 DO meter, mercury thermometer, 75 watt AMARA heater, and pelletizer. The materials used were: 3-5 cm nilem carp fish from Tarogong Nilem carp fish Cultivation in Garut District, test feed that had been formulated with 28% and 31% protein contents and 8 and 10 protein energy ratio each, and HI-Pro-Vite commercial feed from PT. Central Pangan Pertiwi with 31 - 33% protein content.

2.1 Methods

The method applied in this study was the experimental method using Complete Randomized Design (CRD) consisting of 5 treatments and 3 repetitions. Treatments consisted of five feed formulations with different energy-protein ratios:

Treatment A: 31% protein level and energy-protein ratio of 10

Treatment B: 31% protein level and energy-protein ratio of 8

Treatment C: 28% protein level and energy-protein ratio of 10

Treatment D: 28% protein level and energy-protein ratio of 8

Treatment E: commercial feed with 31 % protein level (Control).

Feed for treatment was formulated by first testing the ingredients to be used using proximate analysis. After the contents of the ingredients were identified, the ingredients were used to formulate the feed based on the treatments in this study (Table 1A). The

proximate test is carried out on the test feed, which includes crude protein and energy content. Feed control using commercial feed containing 31% crude protein. Feed control using commercial feed containing 31% crude protein.

2.2 Procedure

Nilem carp fry were acclimated for three days before the study. Test fish was weighed to determine its initial weight and to define the amount of feed to be given. The test fish was put in an aquarium with 10 fish per aquarium. Feed was given according to the treatment, three times a day, at 08.00, 12.00, 16.00 Indonesian Western Time WIB, 5% of the fish biomass weight [5] assuming that all food is eaten by fishes. Siphoning was performed each morning, 30% each, to maintain the quality of water. Fish biomass weight weighing and water quality measurement were conducted every 10 days for 40 days of the study. Water quality was assessed based on temperature, pH, and dissolved oxygen (DO). Water quality assessment was done in the beginning, middle, and end of the study.

2.3 Observation Parameters

Data observed in this study includes specific growth rate (SGR), feed conversion ratio, and survival using the following formula:

$$\text{Specific Growth Rate (SGR)} = \frac{(\ln W_2 - \ln W_1)}{T}$$

Note:

- SGR = Specific growth rate (%/day)
- W₁ = Initial weight of fish (g)
- W₂ = Final weight of fish (g)
- T = The number of days during cultivation (days)

Feed Conversion Ratio (FCR)

$$FCR = \frac{F}{(B_t - D) - B_0}$$

Notes:

- FCR = Feed Conversion Ratio
- F = Amount of feed (g)
- B_t = Fish biomass at the end of the cultivation period (g)
- D = Fish biomass that died during the cultivation period (g)
- B₀ = Fish biomass at the beginning of the cultivation period (g)

Survival Rate

$$SR = \frac{N_t}{N_0} \times 100\%$$

Note :

- SR = survival rate (%)
- N_t = Fish number at the end of the research (individu)
- N₀ = Fish number at the beginning of the research (individu)

Table 1A. Feed formulation and nutrition content

Feed Ingredients	Treatment			
	A	B	C	D
Soybean Meal	26	30	23	24
Fish meal	18	13	17	12
Bran	12	9	8	8
Pollard	6	19	18	15
Coconut Meal	12	14	19	20
Corn	17	9	14	15
Fish Oil	2	1	2	2
CMC	2	2	2	2
Bone meal	1	1	1	2
Premix	2	2	2	2
Total	100	100	100	100
Crude Protein (%)	31.34	31.13	28	27.77
Energy (kkal)	3185.3	2522	2845.7	2237
D/E Ratio	31/10	31/8	28/10	28/8

Notes: Based on feed formulation using Microsoft Excel software using trial and error method.

Table 1B. Average nilem fry growth rate

Treatment	Protein	Daily weight gain (%)
A	31% Ratio 10	3,99 ^a ± 0,01
B	31% Ratio 8	3.96 ^a ± 0,008
C	28% Ratio 10	3,97 ^a ± 0,004
D	28% Ratio 8	3,91 ^a ± 0,016
E	31% Control	4 ^a ± 0,004

Note: Value that is followed by a similar letter is not significantly different based on Duncan Multiple range test at 95% significance level

2.4 Data Analysis

Data collected were analyzed using F Test, followed by Duncan Test if there were differences among treatments.

that had different protein levels and EPR gave results that were not significantly different in terms of growth rate when compared to control (commercial feed) (Table 1B). ERP 8 and 10 treatments, both with 31% and 28, can be responded well with no significant differences in growth rate.

3. RESULTS AND DISCUSSION

3.1 Daily Growth Rate

Results of this study showed that nilem carp fish weight in each treatment increased along with the time of cultivation (Fig. 3). Control feed produced the highest weight of 64.50 grams followed by treatment with Energy-Protein Ratio (EPR) of 11, i.e. with 31% and 28% protein levels (60.63 grams). In EPR 8 with 31% protein level, the fish weight was 60.89 grams while feed with 28% protein level produced the lowest weight of 58.4 grams.

Referring to the results of the study in Table 1, the highest average growth rate was produced by treatment A of 3.99 grams. The high fish daily growth rate in Treatment A is due to the fact that the feed composition in this treatment has a higher fish meal content when compared to other treatments. Another treatment, i.e. 18% (180 grams in 1 kg of feed, also used it as one of the protein sources. The high protein content in feed produces a high growth rate because protein is the primary energy source of fish. This is in line with a statement made by [6] stating that protein in feed plays a role as an energy and amino acid source as well as meeting the demands for functional protein (enzymes and hormones) and structural protein (flesh and organs).

Based on variance analysis, it was shown that the nilem carp fish that was provided with feed

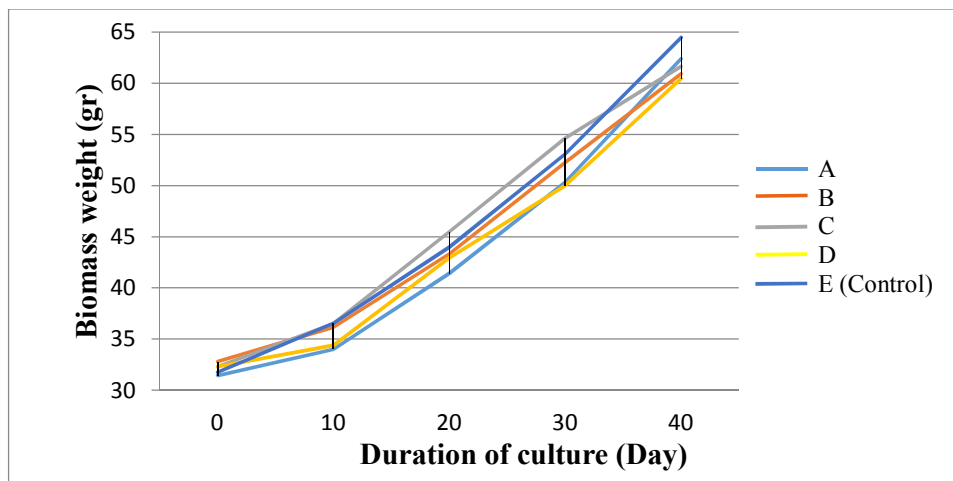


Fig. 1. Nilem carp fish growth

The different level of protein content in the test feed does not give significant effect on nilem carp fish growth rate. This shows that nilem carp fish is less sensitive to the increase in protein content of feed, where the increase in protein is not followed by protein assimilation into body protein. The need for protein in fish is influenced by feed provision level and the energy content. Meanwhile, the amount of feed provided is influenced not only by the energy content but also by the capacity of the fish digestive capacity. [7] states that the protein requirement in nilem fish feed is 27% -42%.

Feed with appropriate energy-protein ratio with appropriate method of provision will result in the best growth and feed conversion ratio. The utilization of protein and fish growth can be optimized by providing appropriate energy-protein ratio [8]. The fish need for protein is mostly met by non-protein nutrients such as fat and carbohydrate so protein (amino acid) is expected to be concentrated for body tissue synthesis materials. In this experiment, the nilem carp fish used was in seed stadium, In early stage of life, fish needs more protein than non-protein materials such as carbohydrate and fat. However, the adequacy of energy from non-protein materials in synthetic feed composition can also support the fish growth. Furthermore, in this study, both for 31% protein level and 28%

protein level, with different EPR (10 and 8 kcal/gram protein), produce similar growth responses in test fishes. This is because, among others, of the right amount of fish oil and fish meal that improves the palatability of the feed. In addition, the amount of feed provided in each treatment is the same, which is 5% of body weight per day, that there is no difference in daily growth rate in each treatment.

3.2 Feed Conversion

Feed conversion presents the amount of feed needed to produce one kilogram of fish weight. The increase in fish weight relates to the ability of the fish to utilize the feed provided. The difference between the total amount of feed given and weight gained is referred to as feed conversion ratio

Fig. 2 presents the feed conversion ratios in treatments with different energy-protein ratio formulation, which are quite good. In this study, good feed conversion ratios are achieved, i.e. Treatment E/control with 1.93 followed by Treatment A (1.95), C (2.14), B (2.19), and D (2.32). The feed conversion ratio ranges between 1.93-2.32, which means that when 1.93-2.32 grams of feed is provided, 1 gram of weight is gained by the fish.

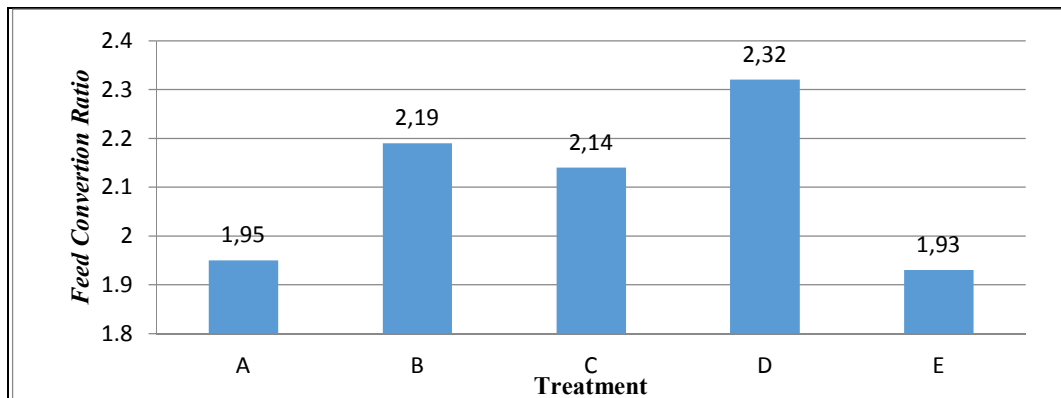


Fig. 2. Feed conversion ratio

Table 2. Average feed conversion ratios

Treatment	Protein	Feed conversion ratio
A	31% Ratio 10	1,95 ^a ±0,12
B	31% Ratio 8	2,19 ^b ±0,16
C	28% Ratio 10	2,14 ^b ±0,09
D	28% Ratio 8	2,32 ^c ±0,14
E	31% Control	1,93 ^a ±0,08

Note: Value that is followed by a similar letter is not significantly different based on Duncan Multiple range test at 95% significance level

The results of Duncan's Multiple Range Test (Table 2) shows that feed with 31% protein level produces a feed conversion ratio of 1.93 (commercial feed) and 1.95 (at EPR 10) is better than feed with the same protein level (31%) with EPR 8, that is 2.19. Although the feed consumption rate in Nile carp fish was not observed, it is assumed that the protein that enters the body of the fish with energy-protein ratio of 10 is utilized for body tissues. [9] suggested that factors that influence growth include, among others, physiology activities, metabolism process, and digestibility that are different between individual fish. In this study it is shown that the provision of 31% feed formulation with EPR 10 is not different from the provision of the control feed, meaning that both feeds have the same quality. Meanwhile, the provision of feed formulation with the same protein level (31%) with EPR 8, the feed quality is lower, especially when referring to the higher feed conversion ratio (2.19). The low feed conversion in treatment B (2.19) and D (2.32) is thought to be related to the amount of fish meal that is less in the feed formulation compared to treatment A, C and controls. Fish meal is a protein source that has the highest digestibility in fish feed. In other hand, marine fish meal is often utilized in aquafeeds because it offers a balanced source of indispensable amino acids, essential fatty acids, vitamins, minerals, and generally enhances palatability. This is different from the result of a study on *jambal siam* fish (*Pangasius hypophthalmus*) with the DE/P (energy-protein ratio) value for fish optimum growth ranges between 8-9 kcal/g [10]. If the DE/P is higher than the optimum limit, fish will feel full earlier that consumption reduces. However, in Nile carp fish, an energy-protein ratio of 10 still leads

to a good response in terms of growth. Nematipour et al. [11] stated that the high energy in fish feed will lead to high fat accumulation in fish body. However, this study shows that feed conversion ratio of feed with EPR 10 is better than the ratio for feed with EPR 8. This means that Nile carp fish needs higher energy portion than the non-protein ingredients when compared to the *jambal siam* fish (*Pangasius hypophthalmus*). Nile carp fish is an omnivorous fish that tends to be herbivorous. Nevertheless, in fry stages, this fish needs more protein compared to the adult stages.

The highest feed conversion ratio (2.32) is found in feed with 28% protein and EPR 8 formula which reflects lower quality of feed when compared to other feed formulations (Table 2). When compared to the feed with the same protein level (28%) but with EPR 10, the feed conversion ratio of the later is better (2.14). This supports the suggestion from [10], stating that if the energy-protein level in the feed is lower than the optimum DE/P value, the energy source in the feed—especially fat and carbohydrate—cannot meet the demand of the body. Hence, fish will get energy from amino acid through the gluconeogenesis process, making the allocation for body protein synthesis reduced.

In feed with 28% protein and EPR 8, the feed conversion ratio is higher than that of feed with 28% with EPR 10. The lower the FCR is, the more efficient the feed and feed consumed used by the fish for its growth [12]. This is in line with what is stated by Haryati et al. [13] that the protein content in the feed will partially be absorbed and used to form or repair damaged cells while the remaining protein will be converted into energy.

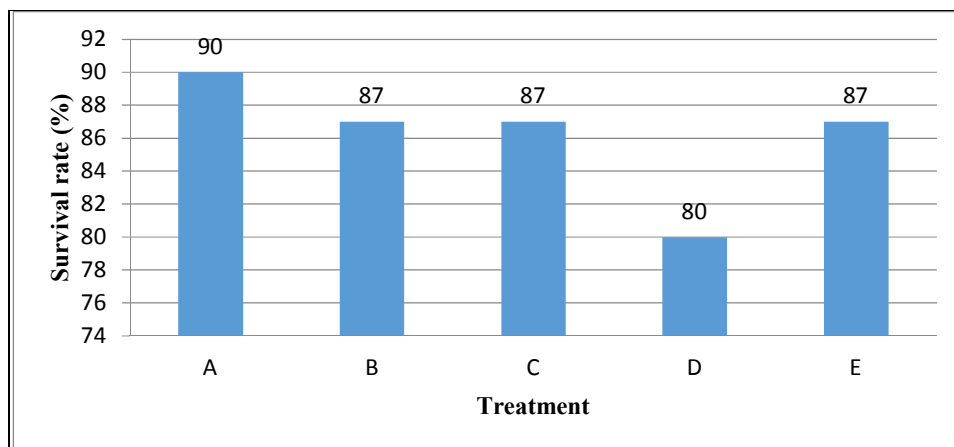


Fig. 3. Survival rate

3.3 Survival Rate

The 40-day study shows that nilem carp fish fry that is given feed with different energy-protein ratio produces a quite high survival rate (Fig. 3).

The highest survival rate of nilem carp fish is found in Treatment A (31% protein, EPR 10) with 90% rate while the average survival rate in Treatment B (31% protein, EPR 8), Treatment C (28% protein, EPR 10), and commercial feed is 87% while the lowest is found in Treatment D (28% protein, EPR 8) with a survival rate of 80%. Fish survival rate in Treatment A is better than the rate in other treatments (90%). The lowest survival is found in treatment D (80%), this is thought to be related to the lowest protein and energy content in feed test compared to other treatments. Energy and nutrient requirements are affected by several factors and they may vary in different stages of the life cycle of the animal, include fish [14]. It is suggested that this is due to the fact that nilem carp fish can adapt easily to the culture environment and feed, as well as having good appetite. Survival rate can be used as the indicator to identify the toleration and ability of fish to survive. The survival rate is a comparison between the number of organisms that survive at the end of the period with the number of organisms in at the start of the period [15].

4. CONCLUSION

Based on the stud, it can be concluded that the effect of energy-protein ratio 31% protein level and energy-protein ratio of 10 produces the best growth for nilem carp fish seed with a growth rate of 3.99 ± 0.01 and a feed conversion ratio of 1.95.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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