

## Growth Response of Patin Fish (*Pangasius* Sp.) To Nutrinex Enerc Supplementation in Feed at Various Dose Levels

Muhammad Gilang Ramadhan<sup>1</sup>, Ren Fitriadi<sup>1\*</sup>, Agnes Heratri<sup>2</sup>, Maghfira Selia Irawati<sup>2</sup>, Sreshi Asa Mahendra<sup>2</sup>

<sup>1</sup>Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Jenderal Soedirman University, Purwokerto 53122, Central Java, Indonesia.

<sup>2</sup>CV. Pradipta Paramita, Jl. Waru Raya, Waru, Pulosari, Kec. Kebakkramat. Karanganyar 57762 Central Java, Indonesia.

### Article Information

#### Article history :

Received: March 17, 2026

Accepted: April 20, 2026

Available online: May 23, 2026

**Keywords:** : Feed efficiency, multivitamins, Nutrinex Enerc, *Pangasius* sp., growth performance

#### Correspondence:

[renfitriadi@unsoed.ac.id](mailto:renfitriadi@unsoed.ac.id)

### Abstract

Optimizing feed utilization is an important strategy in increasing the productivity of Patin Fish (*Pangasius* sp.) rearing. The addition of multivitamin supplements to feed can increase metabolic efficiency and nutrient utilization, thereby improving fish growth performance. This study aims to evaluate the effects of Nutrinex EnerC supplementation at different doses on the growth performance and feed utilization efficiency of Patin Fish. The study used a Completely Randomized Design (CRD) with three treatments and three replications, namely P1 (0 g/kg feed), P2 (3 g/kg feed), and P3 (6 g/kg feed). Fish were reared in a biofloc system and fed at a feeding rate of 3% of body weight during the maintenance period. The parameters observed included weight growth, length growth, Average Daily Growth (ADG), Specific Growth Rate (SGR), Feed Conversion Ratio (FCR), feed efficiency, and Survival Rate (SR). Data were analyzed using analysis of variance (ANOVA) followed by Tukey's test at a 95% confidence level. The results showed that Nutrinex EnerC supplementation significantly affected weight growth, ADG, SGR, FCR, and feed efficiency ( $p < 0.05$ ), but did not significantly affect length growth and fish survival. The best treatment was obtained at a dose of 6 g/kg feed which resulted in weight growth of  $8.87 \pm 0.40$  g, ADG  $0.25 \pm 0.01$  g/day, SGR  $4.84 \pm 0.02\%/day$ , FCR  $0.54 \pm 0.02$ , and feed efficiency of  $186.59 \pm 8.50\%$ . The results of this study indicate that Nutrinex EnerC supplementation has the potential to increase feed utilization efficiency and growth performance of Patin Fish in intensive rearing systems.

DOI : <https://doi.org/10.62521/byske238>

### Introduction

Patin Fish (*Pangasius* sp.) is a cultivated fishery commodity with high economic value and growing market demand. According to data from the Central Statistics Agency (2024), Patin Fish production remained stable between 2017 and 2024, ranging from 310,000 to 380,000 tons per year. The high public interest in Patin Fish is

influenced by its good nutritional content, delicious taste, and relatively affordable price. Therefore, rearing technologies that can increase productivity need to be developed (Budiardi *et al.*, 2025).

Patin Fish usually live on the banks of rivers, large rivers, estuaries, and lakes. Because the shape of the mouth of the Patin Fish is located slightly downward, this fish

lives at the bottom of the water (Armanda *et al.*, 2019). Patin Fish are a type of omnivorous fish, meaning they eat a variety of foods. These fish usually eat small fish, worms, insects, seeds, small shrimp, and mollusks. However, during the larval phase, Patin Fish tend to be carnivorous, preferring foods such as *Brachionus* sp., Crustacea, and Cladocera. Additionally, Patin Fish that are still in the larval stage and have just hatched have cannibalistic traits (Fauzi *et al.*, 2023).

Fish growth is a biological process influenced by various factors, including interrelated internal and external factors. Internal factors include the physiological condition of the fish, such as age, genetics, metabolic ability, and nutrient utilization. External factors include feed quality, aquatic environmental conditions, stocking density, and rearing management. The interaction of these two factors significantly determines the success of fish growth in aquaculture systems (Purbomartono *et al.*, 2023; Panjaitan *et al.*, 2024). One very important external factor is the quality of the feed provided. High-quality feed can accelerate fish growth (Purbomartono *et al.*, 2023). Feed acts as a source of energy and nutrients that support metabolic processes, body tissue formation, and maintenance of internal organ function (Novianti *et al.*, 2022). For optimal growth,

fish require a balanced composition of protein, fat, carbohydrates, vitamins, and minerals. Patin Fish require feed with 25-35% protein, with a feed ratio of 3-5% of their body weight (Armanda *et al.*, 2019).

Modern fish farming also uses supplements to increase feed efficiency. Supplements serve to supplement nutritional needs not met by the main feed, thereby increasing feed utilization efficiency. Adding supplements to feed is known to improve the feed conversion ratio (FCR), enhance fish health, and strengthen the body's resistance to environmental stress and disease. Healthy fish conditions promote faster and optimal growth. This is crucial in modern aquaculture, which requires high productivity and efficient costs (Azhanifa *et al.*, 2024).

One supplement product that can be used is Nutrinex EnerC, which is added to feed. Nutrinex EnerC is a supplement product produced by CV. Pradipta Paramita. The main content of Nutrinex EnerC is a multivitamin that includes vitamins A, D3, E, K, B1, B6, B12, C, minerals, and amino acids. According to Mesquita *et al.* (2023), adding supplements containing multivitamins can help improve fish growth performance. Multivitamins play an important role as metabolic cofactors and antioxidants in the fish's body. A

multivitamin can accelerate growth by improving fish metabolism so nutrients in the feed can be absorbed at their best. Moreover, multivitamins provide the fish with a stronger immune system, making it less susceptible to infections (Uniyati & Malik, 2022).

Although the use of multivitamin supplements has been widely reported to improve fish growth performance, information on the effectiveness of using Nutrinex EnerC at various dosage levels in Patin Fish (*Pangasius sp.*) feed is still limited. Therefore, it is necessary to analyze the effect of adding Nutrinex EnerC at various dosages on Patin Fish (*Pangasius sp.*) growth performance. This study is expected to provide information on the best dosage of Nutrinex EnerC in Patin Fish feed, thereby increasing the productivity of Patin Fish rearing in a more optimal and sustainable manner.

## **Materials and methods**

### **Experimental Design**

Patin Fish (*Pangasius sp.*) seeds were obtained from the Fish Farming Group (Pokdakan) in Wonogiri. The average weight of the fish used in the P1 treatment was 16-17 g, and P2 and P3 were 2-3 g. The feed used was CP 781-1 feed with a protein content of 31-33%. The feeding rate used was 3% with a feeding frequency of 3 times a day at 07.00,

11.00, and 15.00. The method used in this study was a completely randomized design (CRD). The study was conducted by adding Nutrinex EnerC multivitamins with 3 treatments and 3 replications with the treatment arrangement P1 (Control), P2 (3 g/kg feed), and P3 (6 g/kg feed). The feed given was mixed with Nutrinex EnerC multivitamins according to the treatment dose and fermented first using MINARAYA Probiotics at a dose of 1 bottle cap/kg feed for 16-24 hours. The culture system uses a biofloc system with Paraqua Biofloc starter bacteria supplemented with sterile molasses. The culture tank is a 4-meter-diameter circular pond with 8 aeration points. Fish weight and length are measured every 7 days. Water quality parameters are measured daily (temperature, pH, and dissolved oxygen) and weekly (nitrite, nitrate, ammonium, and floc count).

### **Growth Parameters**

The observed parameters were growth (weight gain, ADG, SGR, and absolute length growth), survival rate, and feeding data (FCR and Feed Efficiency). The formula used was as follows:

Weight Growth (Ihtifazhuddin *et al.*, 2025)

$$W = W_t - W_o$$

Where:

W = Weight Growth  
 Wt = Average Final Weight  
 Wo = Average Initial Weight  
 Average Daily Growth (Fahrurrozi *et al.*, 2023)

$$ADG = \frac{ABWt - ABWo}{H}$$

Where :

ADG = Growth rate (g/h)  
 H = Age of fish (days)  
 ABWt = Total fish weight (g)  
 ABWo = Initial fish weight (g)  
 Specific Growth Rate (Sarmin *et al.*, 2025)

$$SGR = \frac{\ln Wt - \ln Wo}{T} \times 100\%$$

Where:

SGR = Specific weight growth rate (%)  
 Wt = Average individual weight at the end of maintenance (g)  
 Wo = Average individual weight at the beginning of maintenance (g)  
 T = Length of maintenance (days)  
 Absolute Length Growth (Cahyani & Sukarti, 2026)

$$PM = Lt - Lo$$

Where:

Pm = absolute length  
 Lt = final average length (cm)  
 Lo = initial average length (cm)  
 Feed Conversion Ratio (Wijianto *et al.*, 2023)

$$FCR = \frac{F}{Wt - Wo}$$

Where:

FCR = Feed Conversion Ratio  
 F = Total Amount of Feed Given (kg)  
 Wt = Fish Weight at the Time of Sampling/End of the Rearing Period (kg)  
 Wo = Fish Weight at the Beginning of the Rearing Period (kg)  
 Feed Efficiency (Sofi & Yustiati, 2025)

$$EP = \frac{Bt - Bo}{F} \times 100\%$$

Where:

EP = Feed efficiency (%)  
 Bt = Fish biomass at the end of the rearing period (g)  
 Bd = Biomass of fish that died during the rearing period (g)  
 Bo = Fish biomass at the beginning of the rearing period (g)  
 F = Number of grams of feed consumed during the rearing period (g)  
 Survival Rate (Tani *et al.*, 2025)

$$SR = \frac{Nt}{No} \times 100\%$$

Where:

SR = Survival Rate (%)  
 Nt = Number of live fish at the time of sampling/end of the rearing period  
 No = Number of live fish at the beginning of the rearing period.

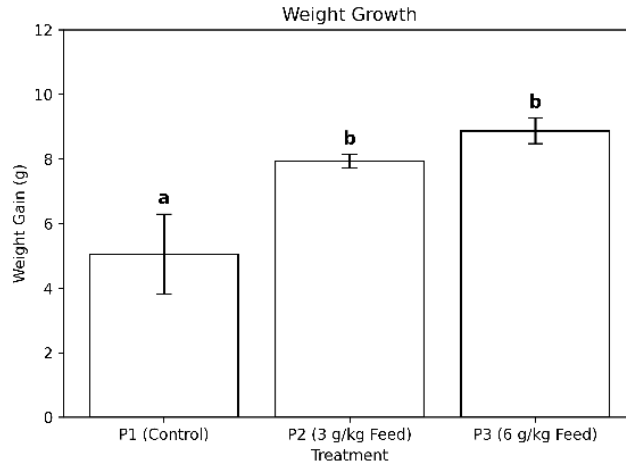


Figure 1. Patin Fish Weight Growth Chart (*Pangasius sp.*)

### Data Analysis

Growth data were analyzed using ANOVA to determine significant differences between treatments. The Tukey test was used to find which treatment had the most significant differences, if there were significant differences. Water quality data were analyzed descriptively and compared to water quality standards for fish farming.

### Results

#### Fish Weight Growth

The chart shows an increase in fish growth along with the addition of treatments to the feed. This trend is seen in the higher weight growth and daily growth rate (ADG) values in the treatment with the addition of Nutrinex EnerC compared to the control. According to the chart of weight growth,

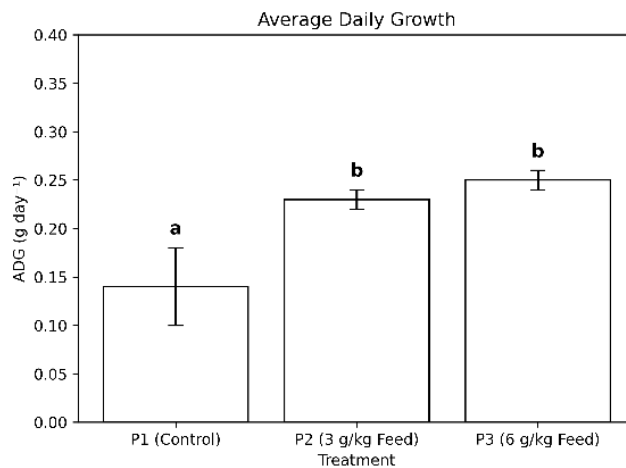
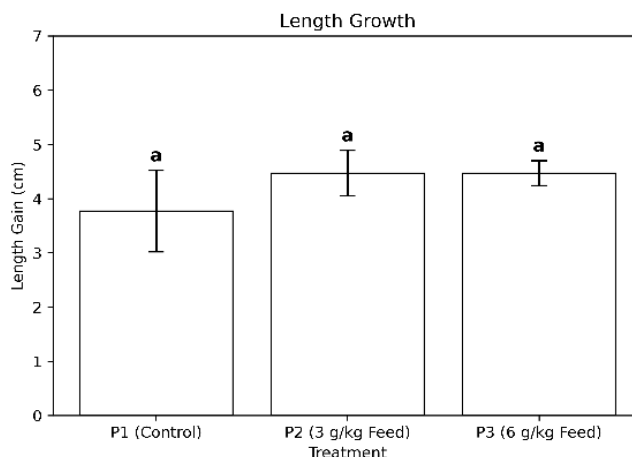


Figure 2. Patin Fish Daily Growth Rate Chart (*Pangasius sp.*)

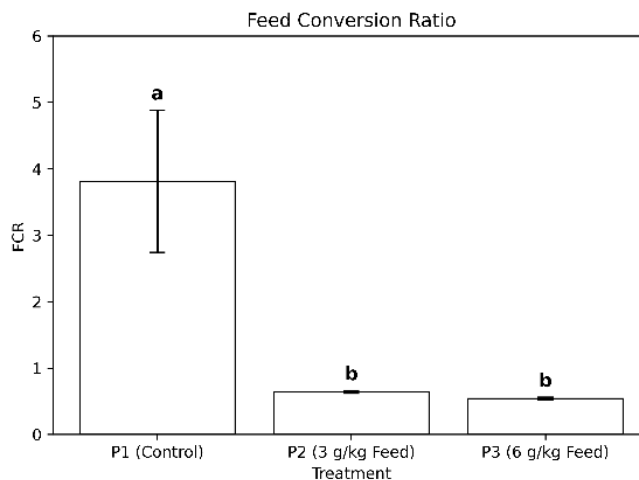


**Figure 3.** Growth Chart of Patin Fish Length (*Pangasius sp.*)

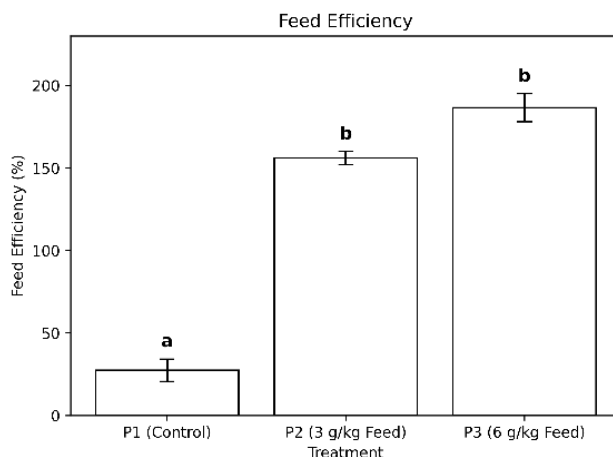
treatment P1 was the control, producing values of  $5.05 \pm 1.24$  g. This value is lower than P2 at  $7.93 \pm 0.21$  g and P3 at  $8.87 \pm 0.40$  g. The results of statistical analysis show that treatments P2 and P3 have significantly different results compared to treatment P1 (control).

The same pattern is seen in Figure 2. The ADG graph shows that treatment P1 produces a value of  $0.14 \pm 0.04$  g/day. This

value is lower than P2 at  $0.23 \pm 0.01$  g/day and P3 at  $0.25 \pm 0.01$  g/day. The results of statistical tests show that treatments P2 and P3 are significantly different from treatment P1 (control). The highest values for both parameters were found in treatment P3, which showed higher weight and ADG growth compared to the other treatments. This indicates that the addition of Nutrinex EnerC to the feed affected absolute weight



**Figure 4.** Patin Fish Feed Conversion Ratio Chart (*Pangasius sp.*)



**Figure 5.** Patin Fish Feed Efficiency Chart (*Pangasius sp.*)

and ADG growth compared to feed without Nutrinex EnerC.

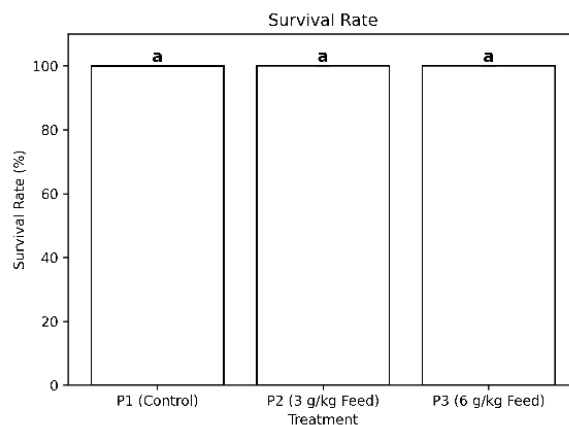
### Length Growth

The length growth graph shows a relatively similar pattern of values across all treatments. This pattern is evident from the length growth values, which were not significantly different between treatments. Treatment P1, as a control, produced a length growth of  $3.77 \pm 0.75$  cm. Treatment P2 showed a value of  $4.47 \pm 0.42$  cm. Treatment P3 also produced a value of  $4.47 \pm 0.23$  cm.

The statistical test results showed that the three treatments had no significant effect on fish length growth. The growth values in P2 and P3 were higher than those in P1, although the difference was not statistically significant.

### Feed Calculation

The Feed Conversion Ratio (FCR) and feed efficiency charts show a mutually related relationship with opposing value patterns. This pattern is evident from the decreasing FCR value and increasing feed



**Figure 6.** Survival Rate Patin Fish (*Pangasius sp.*)

**Table 1.** Growth Data and Calculation of Patin Fish Feed (*Pangasius sp.*)

Parameter	Treatment		
	P1 (Control)	P2 (3 g/ Kg Feed)	P3 (6 g/ Kg Feed)
Weight Growth (g) ± sd	5.05 ± 1.24 <sup>a</sup>	7.93 ± 0.21 <sup>b</sup>	8.87 ± 0.40 <sup>b</sup>
Length Growth (cm) ± s.d	3.77 ± 0.75 <sup>a</sup>	4.47 ± 0.42 <sup>a</sup>	4.47 ± 0.23 <sup>a</sup>
ADG (g/day) ± sd	0.14 ± 0.04 <sup>a</sup>	0.23 ± 0.01 <sup>b</sup>	0.25 ± 0.01 <sup>b</sup>
SGR (%/day) ± sd	0.50 ± 0.32 <sup>a</sup>	4.16 ± 0.53 <sup>b</sup>	4.84 ± 0.02 <sup>b</sup>
FCR ± sd	3.81 ± 1.07 <sup>a</sup>	0.64 ± 0.02 <sup>b</sup>	0.54 ± 0.02 <sup>b</sup>
EP (%) ± sd	27.48 ± 6.77 <sup>a</sup>	156.07 ± 4.10 <sup>b</sup>	186.59 ± 8.50 <sup>b</sup>
SR (%) ± sd	99.98 ± 0 <sup>a</sup>	100 ± 0 <sup>a</sup>	100 ± 0 <sup>a</sup>

Description: Different letters in the same row indicate significantly different treatment effects (P<0.05).

efficiency in the treatment with the addition of Nutrinex EnerC compared to the control. In the FCR chart, treatment P1 as a control produced a value of  $3.81 \pm 1.07$ . This value is higher than P2 at  $0.64 \pm 0.02$  and P3 at  $0.54 \pm 0.02$ . The results of the statistical analysis showed that P1 was significantly different from P2 and P3. Treatments P2 and P3 have the same letter notation, namely b, so they do not show a significant difference.

A similar pattern is seen in the feed efficiency chart. Treatment P1 showed a feed efficiency value of  $27.48 \pm 6.77\%$ . This value is lower than P2 ( $156.07 \pm 4.10\%$ ) and P3 ( $186.59 \pm 8.50\%$ ). The statistical test results showed that P1 was significantly different from both treatments. Treatments P2 and P3 have the same letter notation, so they do not show a significant difference. The highest feed efficiency value was found in treatment P3, indicating better feed utilization compared to the other treatments.

### Survival Rate

The Survival Rate (SR) chart shows relatively similar fish survival rates across all treatments. This pattern is evident from the very high SR values in each treatment throughout the rearing period. Treatment P1, as a control, produced an SR value of  $99.98 \pm 0\%$ . Treatments P2 and P3 each showed a value of 100%. The results of the statistical analysis show that all three treatments have the same letter notation, namely a. This condition indicates there is no significant difference between treatments in fish survival rates. SR values approaching 100% indicate that the rearing conditions were able to support fish survival throughout the study.

### Water Quality

Based on Table 2, water quality, most water quality parameters during maintenance were still within the range that supports fish life, although some values exceeded the standard. Temperature in all treatments

**Table 2.** Water Quality Data

Parameter	Treatment			Water Standards
	P1 (Control)	P2 (3 g/ kg Feed)	P3 (6 g/ kg Feed)	
Parameter (°C)	28-34	28-34	28-34	25-30 °C <sup>a</sup>
pH	7.1-8.4	7.4-8.7	7.4-8.6	6.5-8.0 <sup>a</sup>
DO (ppm)	3.7-5.3	4-6.5	4-5.7	≥ 3 ppm <sup>b</sup>
Nitrite (ppm)	0.02-0.4	0.00	0.00	≤ 0.1 ppm <sup>a</sup>
Nitrate (ppm)	25-100	25-50	25-50	< 40 ppm <sup>c</sup>
Ammonium (ppm)	0.5-1	0.50	0.25-0.5	< 5 ppm <sup>a</sup>
Number of Floccs (ml/liter)	6-20	0-3	0.2-5	20-200 ml/liter <sup>a</sup>

Description: The numbers in red indicate levels or parameters that do not meet the optimum standard.  
References: a. SNI 6484-6:2024 b. Safir *et al.* (2023) c. Ombong & Salindeho (2016).

ranged from 28–34 °C, slightly higher than the standard of 25–30 °C, while pH ranged from 7.1–8.7 with a standard of 6.5–8.0. DO values ranged from 3.7–6.5 ppm and still met the minimum standard of ≥ 3 ppm. Nitrite concentration in P1 reached 0.4 ppm, exceeding the standard of ≤ 0.1 ppm, while in P2 and P3 it was 0.00 ppm. Nitrate ranged from 25–100 ppm, with a standard of <40 ppm, so in some observations the value was higher than the recommended limit. Ammonium was in the range of 0.25–1 ppm, still below the standard of <5 ppm. Meanwhile, the floc count ranged from 0–20 ml/L, lower than the optimal range of 20–200 ml/L. In general, although some parameters were not entirely within the optimum range, water quality conditions still supported fish farming.

## Discussion

Fish growth is one of the main indicators of successful aquaculture activities. Fish weight growth indicates the increase in fish weight over a certain period. The daily growth rate or Average Daily Growth (ADG) describes the average increase in fish weight per day during the rearing period, while the Specific Growth Rate (SGR) indicates the percentage increase in fish body weight per unit time (% per day) (Witoko *et al.*, 2018; Puluhalawa, 2025). These two parameters generally show a consistent trend because they both represent the speed of fish growth. Based on the results of the study, the ADG and SGR values in the supplemented treatment showed an increase compared to the control. This indicates that the addition of supplements to the feed can

improve the growth performance of Patin Fish. Previous research has shown that the addition of vitamins and supplements to the feed can increase the efficiency of nutrient utilization, thus improving the fish growth rate (Devi *et al.*, 2024; Hasri *et al.*, 2023; Zhao *et al.*, 2020). Fish growth is influenced by various factors, including feed quality, environmental conditions, nutrient availability, and the physiological condition of the fish. Feeding with complete nutritional content can increase metabolic efficiency so that nutrients can be utilized optimally for growth (Karimah *et al.*, 2018).

One factor suspected of contributing to this increased growth is the addition of the multivitamin supplement Nutrinex EnerC to the feed. This supplement contains various essential vitamins, such as vitamins A, D3, E, K, B complex, and vitamin C, which play a role in various physiological processes in fish. Vitamins function as cofactors in metabolic processes, aiding protein synthesis and increasing the efficiency of nutrient utilization in the fish's body (Scabra *et al.*, 2025). This increased metabolic efficiency allows for optimal absorption of nutrients from the feed, thus supporting fish growth. Furthermore, the vitamin A content in the supplement is known to play a role in tissue formation and cell development, thus

contributing to increased fish growth (Nuha *et al.*, 2019). Other research has also shown that adding multivitamins to feed can improve fish growth performance by increasing metabolic activity and physiological conditions (Hasri *et al.*, 2023).

This study found that fish length growth did not differ significantly by treatment, in contrast to weight growth. This suggests that supplementation had a greater effect on weight gain than on length gain. Fish length growth is generally influenced by the balance of certain nutrients, particularly minerals and vitamins that play a role in bone formation and structural tissue (Niode *et al.*, 2017). One nutrient that plays a crucial role in this process is vitamin D, which functions in calcium metabolism and bone formation. Vitamin D imbalance, either deficiency or excess, can affect bone mineralization and structural growth in fish (Helmizuryani *et al.*, 2019). Therefore, it is possible that the vitamin composition of the supplements used was not fully optimal in significantly stimulating fish length growth.

Survival Rate (SR) is an important parameter that describes the success of fish maintenance during the rearing period. The results of the study showed that the SR values in all treatments were in the very high range, approaching 100%, and showed no

significant differences between treatments. The high SR values indicate that the maintenance environment, feed quality, and rearing management during the study were in good condition and capable of supporting fish survival. Furthermore, the vitamin content in Nutrinex EnerC is also thought to play a role in increasing fish immunity. Vitamin C contained in the supplement is known to play a crucial role in boosting the immune system and helping fish adapt to environmental changes. This increased immunity can reduce the risk of disease infection and increase the fish's ability to survive during the rearing period (Helmizuryani *et al.*, 2019).

Feed utilization efficiency can also be measured through the Feed Conversion Ratio (FCR) and feed efficiency parameters. FCR is the ratio between the amount of feed provided and the resulting fish weight gain. A low FCR value indicates that the feed is utilized more efficiently by the fish, while a high FCR value indicates that the feed is less effective in supporting growth (Arief *et al.*, 2016). The FCR value in the supplemented treatment was lower than in the control, indicating that the addition of supplements can increase feed utilization efficiency. This is in line with the increase in feed efficiency in the supplemented treatment. Feed efficiency describes the percentage of feed

successfully converted into fish biomass (Mullah *et al.*, 2020). These two parameters have an inverse relationship, where the lower the FCR value, the higher the resulting feed efficiency (Fitriadi *et al.*, 2025). The improved feed efficiency in the supplemented treatment contribute to the ability of multivitamins to increase metabolic activity and improve digestion and nutrient utilization in fish (Agustina *et al.*, 2017)

Water quality is a crucial factor in determining the success of fish farming because it directly impacts the physiological and metabolic processes of fish (Humairah *et al.*, 2024). Generally, water quality parameters in this study remained within or near the standard range, thus supporting the growth of Patin Fish (*Pangasius* sp.), although temperatures were slightly higher than the optimal range, but still tolerable. The main difference was seen in nitrogen compounds, as treatment with the addition of Nutrinex EnerC resulted in lower nitrite and nitrate concentrations compared to the control. These results indicate that Nutrinex EnerC supplementation has the potential to indirectly impact water quality by increasing feed utilization efficiency, allowing fish to utilize nutrients more optimally and producing lower nitrogen waste. This condition reduces the accumulation of toxic

compounds in the water and creates a more stable environment for fish (Wahyuningsih & Gitarama, 2020). Microorganisms such as biofloc also play a role in controlling nitrogen compounds, but their role in this study was not optimal (Rita *et al.*, 2022).

Further research can be conducted by testing physiological mechanisms such as digestive enzyme activity, nutrient retention levels, and fish immune responses in more detail regarding the effect of providing Nutrinex EnerC supplements on growth and feed efficiency.

### **Conclusion**

Based on the research results, the addition of Nutrinex EnerC to feed increased weight growth, daily growth rate (ADG), specific growth rate (SGR), feed conversion ratio (FCR), and feed efficiency in Patin Fish. However, the supplement did not significantly affect the length growth of the fish. Patin Fish growth performance and feed utilization efficiency were improved most by 6 g/kg of feed when compared with other doses of feed tested.

### **Acknowledgements**

This research was funded by CV. Paradipta Paramita Biotechnology Industry. We would like to thank Dra. Agnes Heratri, M.P., for providing the necessary facilities and support to carry out this research. We

also thank Dr. Ren Fitriadi, S.S.T.Pi., M.P., for his guidance and support in writing this article.

### **References**

- Agustina, H., Sasanti, A. D., & Wijayanti, M. (2017). Penambahan Sari Buah Belimbing Wuluh (*Averrhoa bilimbi*) pada Pakan Untuk Mengobati Ikan Lele Sangkuriang (*Clarias sp.*) yang Diinfeksi *Aeromonas hydrophila*. *Jurnal Akuakultur Rawa Indonesia*, 5(2): 155–168.
- Arief, M., Manan, A., & Pradana, C. A. (2016). Penambahan Papain pada Pakan Komersial Terhadap Laju Pertumbuhan, Rasio Konversi Pakan dan Kelulushidupan Ikan Sidat (*Anguilla bicolor*) Stadia Elver. *Jurnal Ilmiah Perikanan Dan Kelautan*, 8(2): 67–76. <https://doi.org/10.20473/jipk.v8i2.11179>.
- Armanda, E. A., Rahim, A. R., & Dadiono, M. S. (2019). Kinerja Pertumbuhan dan FCR Ikan Patin (*Pangasius sp.*) dengan Lama Pemuasaan yang Berbeda. *Jurnal Perikanan Pantura*, 2(1): 25–33. <https://doi.org/10.30587/jpp.v2i1.808>.
- Azhanifa, N. A. S., Sari, Y. A., Ardita, W., Yulianti, E., Maghfiroh, W., & Rousdy, D. W. (2024). Pertumbuhan Benih Ikan Patin (*Pangasius sp.*) Pada Pemberian Pakan dengan Penambahan Asam Humat Tanah Gambut. *JURNAL BIOS LOGOS*, 14(3): 104–114. <https://doi.org/10.35799/jbl.v14i3.56629>.

- Badan Pusat Statistik. (2024). Produksi Perikanan Budidaya Menurut Komoditas Utama (Ton), 2024. [Produksi Perikanan Budidaya Menurut Komoditas Utama - Tabel Statistik - Badan Pusat Statistik Indonesia](#).
- Budiardi, T., Effendi, I., Diatin, I., Hadiroseyani, Y., Vinasyam, A., Wahjuningrum, D., & Astari, B. (2025). Revitalisasi Pendederan Ikan Patin di Kampung Patin, Desa Sukamandijaya, Kecamatan Ciasem, Kabupaten Subang, Jawa Barat. *Jurnal Abdi Insani*, 12(4): 1476–1484. <https://doi.org/10.29303/abdiinsani.v12i4.2346>.
- Cahyani, A. D., & Sukarti, K. (2026). The Effectiveness of the Supplementation of Amino Acid Arginine in Feed Mill on the Survival and Growth of Tinfoil barb (*Barbonymus schwanenfeldii*). *Journal of Aquaculture Development and Environment*, 9(1). <https://doi.org/10.31002/jade.v9i1.2981>
- Devi, N. C., Waikhom, G., Singh, S. K., Das, P., Debbarma, S., Debbarma, R., ... & Irungbam, S. (2024). Effects of Vitamin C on Growth and Non-Specific Immune Response of Labeo gonius Fry in Density-Dependent Biofloc Rearing. *Aquaculture Nutrition*, 2024(1): 9930544. <https://doi.org/10.1155/2024/9930544>
- Fahrurrozi, A., Mardiana, T. Y., Linayati., Ariadi, H., & Wijianto. (2023). Pengaruh Perbedaan Persentase Kebutuhan Pakan Terhadap Pertumbuhan dan Rasio Konversi Pakan Pada Benih Ikan Bandeng (*Chanos chanos*). *Jurnal Penyuluhan Perikanan Dan Kelautan*, 17(2): 101–113. <https://doi.org/10.33378/jppik.v17i2.405>.
- Fauzi, F., Hassan, Z., Puvanasundram, P., & Karim, M. (2023). Gut content, feeding behavior, and gut microbiome of *Pangasius nasutus* (Bleeker, 1863) in natural habitat and captivity environment: A review. *International Journal of Aquatic Biology*, 11(6): 535–550. <https://doi.org/10.22034/ijab.v11i6.2043>.
- Fitriadi, R., Sukardi, P., Riady, R. M., Nurhafid, M., Heratri, A., Irawati, M. S., Pramesi, A., & Qurrotuaini, A. R. (2025). Effectiveness of Minaraya Probiotics on The Growth Rate and Immune Response of Catfish (*Clarias gariepinus*). *Journal Of Artha Biological Engineering*, 3(2): 1–25. <https://doi.org/10.62521/bdxbgh67>.
- Hasri, I., Abdan, M., Putri, L., Fahmi, R., Susanti, Z., & Rhidana, F. (2023). Effect of Different Multivitamins on Growth Performance and Survival of Depik Fish (*Rasbora tawarensis* Weber & de Beaufort, 1916). *Journal of Aquaculture and Fish Health*, 12(3): 421–431. <https://doi.org/10.20473/jafh.v12i3.38759>.
- Helmizuryani, H., Puspitasari, M., & Khotimah, K. (2019). Efektifitas Pertumbuhan Benih Betok (*Anabas testudineus*) Menggunakan Vitamin C dan D sebagai Suplemen Pakan. *Jurnal Lahan Suboptimal*, 7(2): 164–173.

- <https://doi.org/10.33230/JLSO.7.2.2018.327>.
- Humairah, N., Adnan, R. R., Utami, P. N., Istiana, N., Penang, C., & Sahribulan, S. (2024). Faktor-Faktor yang Mempengaruhi Homeostasis pada Tubuh Ikan: Sebuah Tinjauan Literatur. *Jurnal Penelitian Sains*, 26(2): 232. <https://doi.org/10.56064/jps.v26i2.972>
- Karimah, U., Samidjan, I., & Pinandoyo. (2018). Performa Pertumbuhan dan Kelulushidupan Ikan Nila Gift (*Oreochromis niloticus*) yang Diberi Jumlah Pakan yang Berbeda. *Journal of Aquaculture Management and Technology*, 7(1): 128–135. <https://ejournal3.undip.ac.id/index.php/jamt/article/view/20378>.
- Mesquita, E., Hu, S., Lima, T. B., Golo, P. S., & Bidochka, M. J. (2023). Utilization of *Metarhizium* as an insect biocontrol agent and a plant bioinoculant with special reference to Brazil. *Frontiers in Fungal Biology*, 4: 1276287. <https://doi.org/10.3389/ffunb.2023.1276287>.
- Mullah, A., Diniarti, N., & Astriana, B. H. (2020). Pengaruh Penambahan Cacing Sutra (*Tubifex*) Sebagai Kombinasi Pakan Buatan Terhadap Efisiensi Pemanfaatan Pakan dan Pertumbuhan Larva Ikan Lele Sangkuriang (*Clarias gariepinus*). *Jurnal Perikanan Unram*, 9(2): 160–171. <https://doi.org/10.29303/jp.v9i2.163>.
- Niode, A. R., Nasriani, & Irdja, A. M. (2017). Pertumbuhan dan Kelangsungan Hidup Benih Ikan Nila (*Oreochromis niloticus*) Pada Pakan Buatan yang Berbeda. *Akademika*, 6(2): 99–112. <https://dx.doi.org/10.31314/akademika.v6i2.51>.
- Ihtifazhuddin, M. I., Rahmadani, A., Isriansyah, I., & Pagoray, H. (2025). Penambahan Betaine Pada Pakan Buatan Terhadap Performa Pertumbuhan, Sintasan, Dan Pemanfaatan Pakan Pada Benih Ikan Kapiat (*Barbonymus schwanefeldii*). *Chanos Chanos*, 23(2), 97-111. <http://dx.doi.org/10.15578/chanos.v23i2.17190>
- Novianti, N., Umar, N. A., & Budi, S. (2022). Pengaruh Berbagai Konsentrasi Anggur Laut *Caulerpa lentillifera* Pada Pakan Terhadap Pertumbuhan Ikan Nila. *Journal of Aquaculture and Environment*, 4(2): 45–49. <https://doi.org/10.35965/jae.v4i2.1523>
- Nuha, A. K. U., Rahim, A. R., & Aminin. (2019). Pengaruh Pemberian Multivitamin Pada Pakan Terhadap Pertumbuhan dan Kelangsungan Hidup Ikan Patin (*Pangasius pangasius*). *Jurnal Perikanan Pantura (JPP)*, 2(2): 78–86. <https://doi.org/10.30587/jpp.v2i2.995>.
- Ombong, F., & Salindeho, I. R. N. (2016). Aplikasi teknologi bioflok (BFT) pada kultur ikan nila (*Oreochromis niloticus*). *Budidaya Perairan*, 4(2): 16–25.

- <https://doi.org/10.35800/bdp.4.2.2016.13018>.
- Panjaitan, R. J. S., Harwanto, D., & Amalia, R. (2024). Pengaruh Penggunaan Probiotik Terhadap Kualitas Air, Pertumbuhan dan Kelulushidupan Benih Ikan Patin (*Pangasius sp.*). *Ains Akuakultur Tropis: Indonesian Journal of Tropical Aquaculture*, 8(2): 218–228. <https://doi.org/10.14710/sat.v8i2.24442>.
- Puluhulawa, R. (2025). Oxygen Consumption Rate dan Growth of Koi Fish (*Cyprinus rubrofasciatus*) Cultured in Recirculation System with Different Filter Media. *Jurnal Sains Dan Teknologi Perikanan*, 5(1): 104–115. <https://doi.org/10.55678/jikan.v5i1.1981>.
- Purbomartono, C., Pranannisa, S. N., Mulia, D. S., & Suwarsito, S. (2023). Pertumbuhan Ikan Patin dengan Penambahan Suplemen Tepung Jahe Melalui Pakan pada Sistem Bioflok. *JRST (Jurnal Riset Sains Dan Teknologi)*, 7(1): 93–102. <https://doi.org/10.30595/jrst.v7i1.16612>.
- Rita, E., Dewi, S., & Ulfah, M. (2022). Performa Bioflok pada Sistem Bioflok-Akuaponik Ramah Lingkungan. *BIOMA: Jurnal Ilmiah Biologi*, 11(1). <https://doi.org/10.26877/bioma.v11i2.10989>.
- RSNI 6484-6. (2024). Rancangan Standar Nasional Indonesia 3 Ikan lele (*Clarias sp.*) – Bagian 6: Pembesaran dengan Teknologi Bioflok.
- Safir, M., Widyawati, N. M., Rizal, A., & Serdiati, N. (2023). Pertumbuhan Ikan Patin Siam (*Pangasius hypophthalmus*) Dipelihara dalam Sistem Bioflok dengan Frekuensi Pemberian Molase yang Berbeda. *Jurnal Galung Tropika*, 12(2): 148–158. <https://doi.org/10.31850/jgt.v12i2.1065>.
- Sarmin, S., Setyastuti, A. I., Yudistira, D. Indra, & Prasetyo, D. Y. B. (2025). Specific Growth Rate (SGR), Feed Conversion Ratio (FCR), and Survival Rate (SR) of Nile tilapia (*Oreochromis niloticus*) fed probiotics (Probio-7) with different concentrations. *Acta Aquatica: Aquatic Sciences Journal*, : 331–336. <https://doi.org/10.29103/aa.v12i3.21970>.
- Scabra, A. R., Azhar, F., Muahiddah, N., Affandi, R. I., & Hafizah, I. (2025). Upaya Peningkatan Produksi Udang Vannamei pada Kolam Bundar di Desa Rempek Kabupaten Lombok Utara Melalui Suplementasi Vitamin Kompleks. *Jurnal Pepadu*, 6(2): 235–248. <https://doi.org/10.29303/pepadu.v6i2.7479>.
- Sofi, N., & Yustiati, A. (2025). Penerapan Polikultur Ikan Mas (*Cyprinus carpio*) dan Ikan Nila (*Oreochromis niloticus*) dalam Kolam Air Deras untuk Meningkatkan Efisiensi Pakan dan Produksi di Kelompok Upaya Mina, Sumedang. *Jurnal Gema Ngabdi*, 7(2): 186–192. <https://doi.org/10.29303/jgn.v7i2.565>.

- Tani, F. C. D., Maidie, A., Isriansyah, I., & Ihtifazhuddin, M. I. (2025). Pengaruh Pemberian Pakan Komersil Dengan Kadar Protein Berbeda Dari Produsen Berbeda Terhadap Kelangsungan Hidup Dan Pertumbuhan Benih Ikan Jelawat (*Leptobarbus hoevenii*). *Journal of Fish Nutrition*, 5(2), 129-141. <https://doi.org/10.29303/jfn.v5i2.8903>
- Uniyati, A., & Malik, A. A. (2022). Penambahan Multivitamin Pada Pakan Terhadap Pertumbuhan, Sintasan, Konversi Pakan Pada Benih Ikan Nila (*Oreochromis avicennia sp.*) pada Pakan Terhadap Pertumbuhan Bobot dan FCR ikan bandeng (*Chanos chanos*). *Jurnal Penyuluhan Perikanan Dan Kelautan*, 17(1): 27–38. <https://doi.org/10.33378/jppik.v17i1.391>.
- Witoko, P., Purbosari, N., Mahmudah Noor, N., Hartono, D. P., Barades, E., Rietje, D., & Bokau, J. (2018). Budidaya Udang Vaname (*Litopenaeus vannamei*) di Keramba Jaring Apung Laut. *Prosiding Seminar Nasional Pengembangan Teknologi Pertanian*, 410–418.
- niloticus*). *SIGANUS: Journal of Fisheries and Marine Science*, 4(1), 246-250. <https://doi.org/10.31605/siganus.v4i1.1577>.
- Wahyuningsih, S., & Gitarama, A. M. (2020). Amonia pada Sistem Budidaya Ikan. *Syntax Literate : Jurnal Ilmiah Indonesia*, 5(2): 112–115. <https://doi.org/10.36418/syntax-literate.v5i2.929>.
- Wijianto, W., Fahrurrozi, A., Firstiany, D., & Khoiroh, N. (2023). Pengaruh Pemberian Ekstrak Daun Mangrove Api-api <https://doi.org/10.25181/prosemnas.v2018i0.1196>.
- Zhao, H., Chen, B., Huang, Y., Cao, J., Wang, G., Chen, X., & Mo, W. (2020). Effects of dietary vitamin B1 on growth performance, blood metabolites, body composition, intestinal enzyme activities and morphometric parameters of juvenile yellow catfish (*Pelteobagrus fulvidraco*). *Aquaculture Nutrition*, 26(5), 1681-1690. <https://doi.org/10.1111/anu.13113>.