Evaluation of Frequency of Feeding Silkworms (*Tubifex* sp.) on the Survival Fish Larvae of *Puntius denisonii*

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Abstrak

Puntius denisonii merupakan ikan hias bernilai ekonomi tinggi yang banyak diminati dalam perdagangan internasional. Namun, eksploitasi berlebihan dan degradasi habitat menyebabkan penurunan populasi spesies ini di alam. Upaya budidaya dengan strategi pemberian pakan yang optimal diperlukan untuk meningkatkan kelangsungan hidup dan pertumbuhan ikan dalam lingkungan terkontrol. Penelitian ini bertujuan untuk menganalisis pengaruh frekuensi pemberian pakan cacing sutra (*Tubifex* sp.) terhadap pertumbuhan dan kelangsungan hidup larva *P. denisonii* serta waktu pemberian pakan yang paling optimal. Penelitian ini dilaksanakan pada 20-29 Januari 2025 di Bogorian Aquatics Farm, Kota Bogor, dengan rancangan acak lengkap (RAL) yang terdiri dari tiga perlakuan frekuensi pemberian pakan, yaitu tiga kali sehari (A), empat kali sehari (B), dan lima kali sehari (C), dengan sembilan ulangan untuk setiap perlakuan. Parameter yang diamati meliputi tingkat kelangsungan hidup dan kualitas air. Data dianalisis menggunakan uji ragam (ANOVA) pada tingkat kepercayaan 95%, dilanjutkan dengan uji Beda Nyata Terkecil (BNT). Hasil penelitian menunjukkan bahwa frekuensi pemberian pakan berpengaruh signifikan terhadap pertumbuhan dan kelangsungan hidup larva *P. denisonii*, tetapi tidak berpengaruh signifikan terhadap kualitas air. Parameter oksigen terlarut (5,35-5,37 mgL^{-1}), suhu (27,30-27,41°C), dan pH (7,97-8,00) tetap stabil di seluruh perlakuan. Perlakuan dengan frekuensi pemberian pakan lima kali sehari memberikan hasil terbaik dalam meningkatkan pertumbuhan dan kelangsungan hidup larva dibandingkan perlakuan lainnya. Peningkatan frekuensi pemberian pakan dapat diterapkan dalam budidaya *P. denisonii* untuk meningkatkan kelangsungan hidup tanpa menimbulkan dampak negatif terhadap kualitas air.

Kata kunci: frekuensi pemberian pakan, *Puntius denisonii*, *Tubifex* sp., kelangsungan hidup, kualitas air.

Abstract

Puntius denisonii is a highly valuable ornamental fish that is in great demand in the international trade market. However, overexploitation and habitat degradation have led to a decline. Cultivation efforts with an optimal feeding strategy are necessary to enhance the Survival and growth of this species in a controlled environment. This study aims to analyze the effect of different feeding frequencies of Tubifex sp. worms on the growth and survival rate of P. denisonii larvae and determine the optimal feeding frequency and timing. This research was conducted from January 20 to 29, 2025, at Bogorian Aquatics Farm, Bogor City, using a completely randomized design (CRD) with three feeding frequency treatments: three times per day (A), four times per day (B), and five times per day (C), with nine replications for each treatment. The observed parameters included survival rate and water quality. Data were analyzed using ANOVA at a 95% confidence level, followed by the Least Significant Difference test. The results showed that feeding frequency significantly affected the growth and survival rate of P. denisonii larvae but did not significantly affect water quality. Parameters of dissolved oxygen (5.35-5.37 mgL^{-1}), temperature (27.30-27.41°C), and pH (7.97-8.00) remained stable across all treatments. The treatment with a feeding frequency of five times per day yielded the best results in enhancing larval growth and Survival compared to other treatments. Increasing feeding frequency in P. denisonii aquaculture can improve survival rates without adversely affecting water quality if the aeration system is properly managed.

Keywords: Feeding frequency, Puntius denisonii, Tubifex sp*., survival rate, water quality.*

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Introduction

Ornamental fish are one of the commodities in great demand by the public. Indonesia ranked as one of the five largest countries in the world regarding the production and export of ornamental fish. This country is often called "home to hundreds of ornamental fish species" because of its biodiversity (Langlois *et al*., 2022). Based on data from the Ministry of Maritime Affairs and Fisheries (KKP), the value of Indonesian ornamental fish exports until October 2024 reached US$39.06 million, or equivalent to IDR 624 billion (RRI, 2024). Indonesia can already produce its ornamental fish, both foreign and domestic ornamental fish, such as *tiger fish, Corydoras sterbai, silver dollar, Synodontis eupterus,* and *Puntius denisonii* (Meyliana & Widjaja, 2015; Nurlaili *et al*., 2021). Puntius denisonii, commonly known as Denison barb or Red Line Torpedo Barb, is an endemic ornamental fish originating from fast-flowing rivers in the Western Ghats, India. This species has high economic value in the international ornamental fish trade, at the peak of its exports (Jain *et al*., 2022). Research by Raghavan *et al*. (2009) stated that captive breeding technology has been developed and has begun to be applied commercially in India and Indonesia as an alternative to reducing direct exploitation of nature.

The success of this breeding system is highly dependent on the availability of quality feed, both in quantity and nutritional content. Feed is one of the main aspects of fish farming activities because it acts as a source of energy to support the growth and development of fish. The availability of quality feed in sufficient quantities greatly determines the success of fish farming, especially in efforts to breed endangered species (Munguti *et al*., 2021; Volkoff & London, 2018). Optimal feed is feed that meets the physiological needs of fish, is given in sufficient quantities at the right time and has adequate nutritional content to support growth (Alfonso *et al*., 2023; Nugroho & Nur, 2018).

In general, fish feed is divided into two types, natural feed and artificial. Natural feed is a source of feed available in the aquatic environment, while artificial feed is mixed from various ingredients to meet the nutritional needs of certain fish (Conceição *et al*., 2010; Jung *et al.,* 2015). Silkworms (*Tubifex* sp.) are one type of natural feed that is often used in fish farming because of their high nutritional content (Febrianti *et al*., 2023), which has a high protein content of up to 57.50% so that it can support optimal fish growth (Yeruva *et al*., 2023). This study aims to examine the effect of feeding frequency on the growth and development of *Puntius denisonii* fish and to determine the optimal feeding frequency and time.

Method

The research activity was carried out on January 20-29, 2025. The research location was at Bogorian Aquatics Farm, coordinates 6°34'09.48" SL, 106°45'58.32" EL, Bogor City, West Java. This study used a completely randomized design (CRD) with three treatments and nine replications. The treatments given were feeding frequency, namely feeding 3 times a day, (A), feeding 4 times a day, (B), and feeding 5 times a day, (C). The placement of the experimental container was carried out randomly to facilitate observation. The layout of the experimental container after the randomization process is in Figure 1. This study used 27 bucket-shaped containers, each filled with 5 liters of water. The seed stocking density applied was 5 per liter of water, with container equipped with one aeration to maintain dissolved oxygen levels.

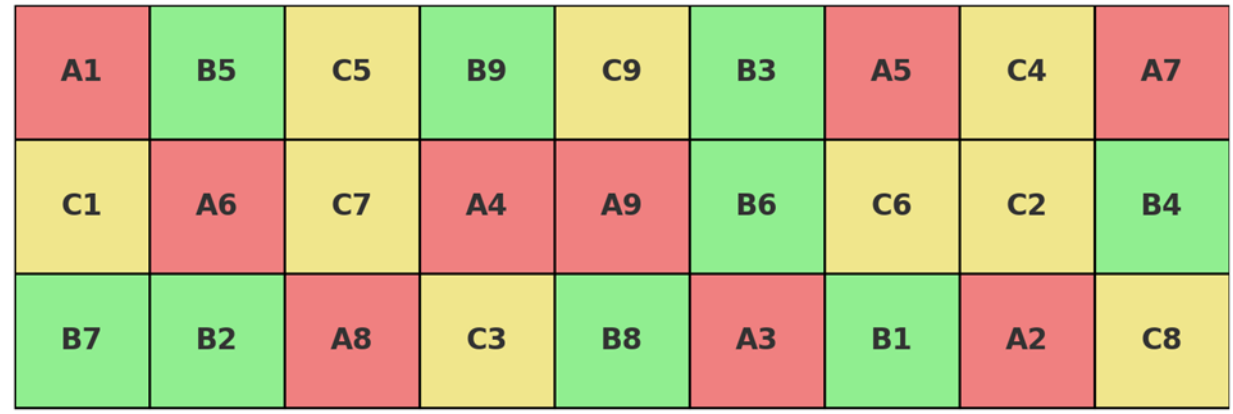

Figure 1. Experimental layout

To ensure optimal water circulation, the container was cleaned every seven days. The test fish used in this study were 30-day-old Denisoni fish (*Puntius denisonii*) seeds obtained from Bogorian Aquatic, Bogor Regency, West Java. The stocking density applied in this study was 25 fish per bucket. Maintenance was carried out for 10 days, with natural feed in silkworms (*Tubifex* sp.), which have a protein content of around 57%. The feed given (feeding rate) was set at 10% of the fish biomass per day, referring to the study. Feed was shown in the time range from 07.00 to 16.00 WIB, based on guidelines from Malik (2021).

The data collected included the number of fish deaths, water quality parameters such as temperature, dissolved oxygen (DO) levels, pH, and fish behavior. The number of fish was counted on the 10th day at 07.00 WIB, where 30% of the fish population was taken as samples, referring to the method (Arifin *et al*., 2015). The number of fish that died was recorded, and fish behavior was analyzed evaluate to of Denisoni fish growth and survival. The parameters used in this study included production performance and water quality, primarily focusing on the seeds survival rate (SR) of the fish seeds. The survival rate of fish during the rearing period was calculated using the following formula (Kotani *et al*., 2011):

$$SR = \left(\frac{Nt}{No}\right) \times 100\%$$

Information:
SR = Survival Rate
Nt = Total number of fish seeds alive at the end of the study
No=Total number of fish seeds at the beginning of the study

This calculation,shows the percentage of fish seeds that can to survive during the maintenance period. This survival rate is an essential indicator in assessing the success of the cultivation method used and the effectiveness of environmental conditions during the study. Production performance was analyzedusing analysis of variance (ANOVA) at a 95% confidence level. If significant differences were found, the analysis was followed by the Least Significant Difference (LSD) test. The data analysis process was conducted using Microsoft Excel 2019 and RStudio software.

Result and Discussion

Survival of Denisoni fish seeds

Survival rate is a key parameter in evaluating the success of fish cultivation and is influenced by differences in feeding frequency (Fatchurochman *et al*., 2017). The results showed that increasing feeding frequency positively impacted fish survival, with a total number of live fish of 170, 180, and 186 in treatments A, B, and C, respectively (Figure 2). Likewise, the survival rate showed an increasing trend, with 75%, 80%, and 83% values in

treatments A, B, and C, respectively. This refers to the research of Palupi *et al*. (2024), which showed that higher feeding frequency helps create a more stable environment for fish growth and Survival, thus potentially being adopted in aquaculture optimization strategies (Figure 2). This study proves that feeding 5 times a day (C) produces the highest survival rate, which is 20.5%, compared to feeding 4 times a day (B), which reaches 20.1%, and feeding 3 times a day (A), which only reaches 18.9%.

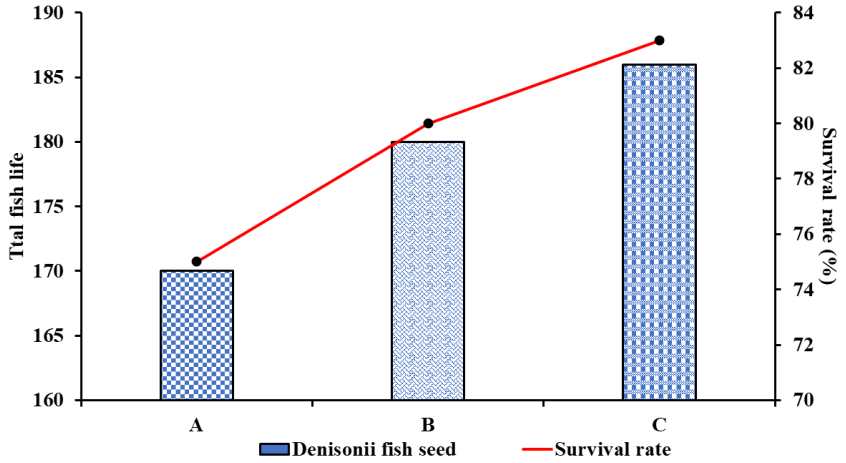

Figure 2. Relationship between total life of Denisoni fish fry and survival rate (%).

The results of the statistical analysis shown in Figure 3 show that feeding 5 times a day increases the survival of fish seeds by 7.8% compared to feeding 3 times a day and 2.0% compared to feeding 4 times a day.

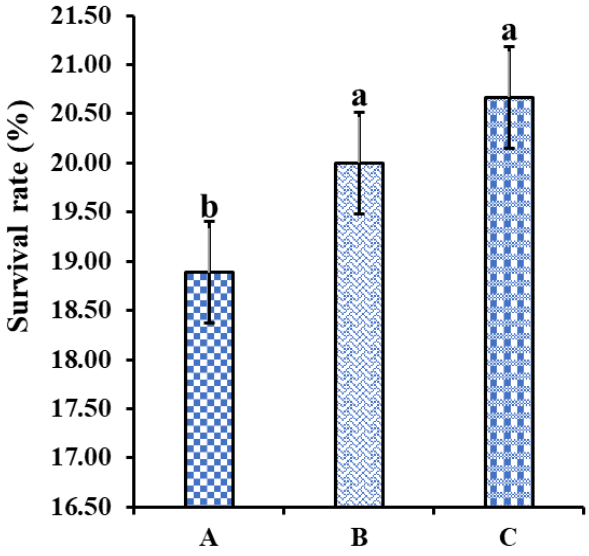

Figure 3. Effect of feeding frequency on the survival of Denisoni fish seeds. Mean values ± Standard error followed by different letters indicate significant differences based on the Least Significant Difference Test (LSD) at $p < 0.05$.

Higher feeding frequencies provide more optimal maintenance conditions than lower frequencies, thus more effectively supporting the growth and Survival of fish seeds (Syahputra *et al*., 2019). According to Asuwaju *et al*. (2014) feeding 5 times a day can be used as a more efficient strategy in increasing the success of Denisoni fish cultivation than feeding 3 or 4 times a day.

Dissolved oxygen levels

Dissolved oxygen (DO) levels are an essential parameter in aquaculture water quality and are not significantly affected by differences in feeding frequency (Chatziantoniou *et al*., 2022; Jeong *et al*., 2023). The results showed that feeding three, four, and five times dayly maintained relatively stable DO concentrations, ranging from 5.35 mg L^{-1} to 5.37 mg L^{-1} (Figure 4).

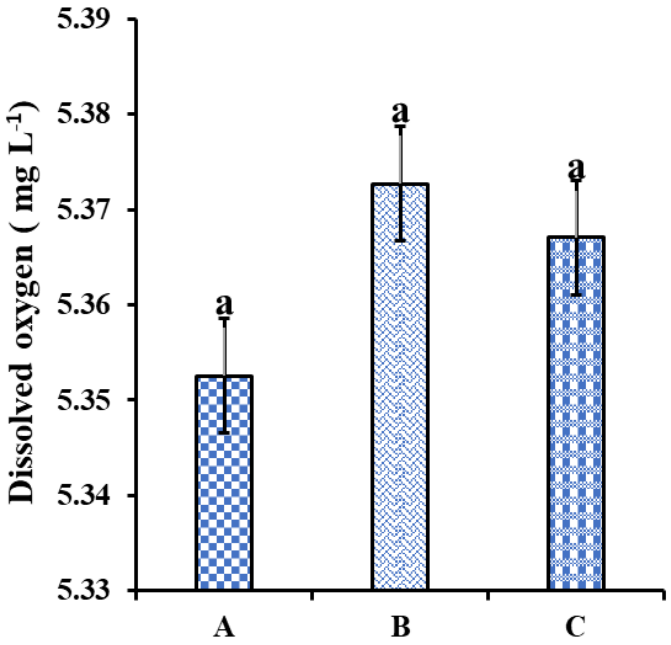

Figure 4. Effect of feeding frequency on dissolved oxygen of Denisoni fish seeds. Mean values ± Standard error followed by different letters indicate significant differences based on the Least Significant Difference Test (LSD) at $p < 0.05$.

Although treatment B showed the highest DO levels, followed by treatment C and treatment A, statistical analysis showed no significant differences between treatments ($p > 0.05$). This significant lack of variation indicates that oxygen availability remained sufficient across treatments, most likely due to the consistent aeration system in this study. Despite differences in feeding frequency, adequate aeration prevented decreased oxygen levels, thus creating stable conditions for fish survival (Heriyati *et al*., 2022). Variations in feeding frequency did not negatively impact dissolved oxygen levels, confirming the importance of aeration efficiency in intensive culture systems (Xu *et al*., 2023).

Potential of hydrogen

Water quality stability, especially pH balance, is essential to maintaining optimal conditions in aquaculture systems (Maulini *et al*., 2021). The results showed that differences in feeding frequency did not significantly affect water pH, with values ranging from 7.978.00 (Figure 5).

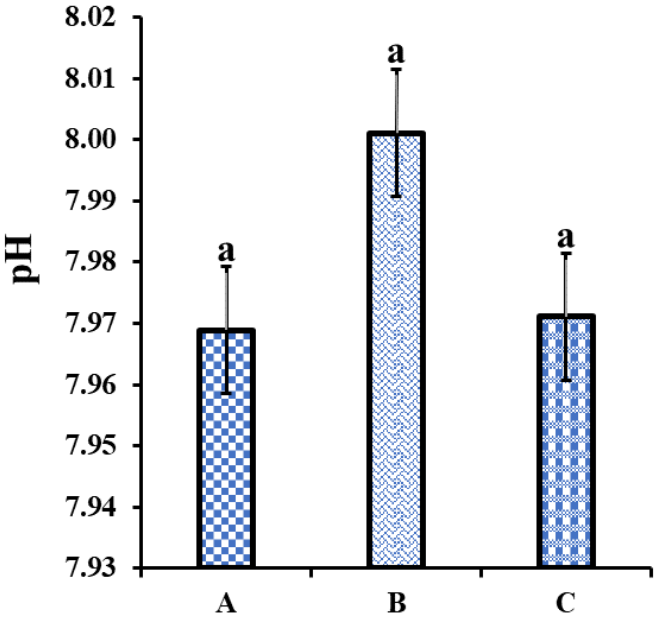

Figure 5. Effect of feeding frequency on pH of Denisoni fish seeds. Mean values ± Standard error followed by different letters indicate significant differences based on the Least Significant Difference Test (LSD) at $p < 0.05$.

Although treatment B showed the highest pH, followed by treatments A and C, statistical analysis showed no significant difference between treatments ($p > 0.05$). In contrast, variations in feeding frequency have been reported to affect other water quality parameters, but pH remained stable across treatments. The difference in pH between treatments was minimal, with an increase of only 0.38% in treatment B compared to treatment A and a decrease of 0.25% in treatment C. This stability indicates that the buffering capacity in water is can regulate pH effectively, regardless of feeding frequency. Variations in feeding frequency did not significantly affect water pH, thus ensuring a stable environment for fish survival (Daudpota *et al*., 2016; de Sousa *et al*., 2019).

Temperature

Water temperature is an important environmental factor affecting fish metabolism and aquaculture growth (Kuroski *et al*., 2025). The effect of different feeding frequencies on water temperature in the rearing system showed that water temperature remained relatively stable across treatments, with values of 27.41°C, 27.30°C, and 27.31°C in treatments A, B, and C, respectively (Figure 6). Although treatment A had the highest temperature, statistical analysis showed that there was no significant difference between treatments ($p > 0.05$). The stability of water temperature across treatments indicated that feeding frequency did not have a significant impact on thermal conditions in the rearing system (Carraro *et al*., 2020; Zakęś *et al*., 2006).

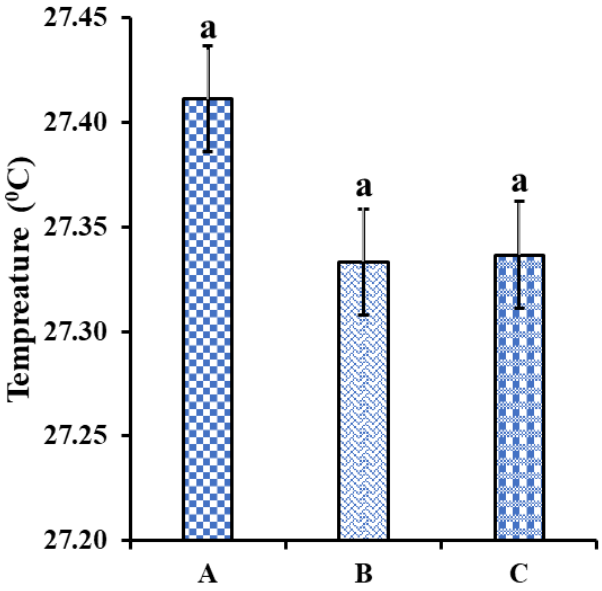

Figure 6. Effect of feeding frequency on the temperature of Denisoni fish seeds. Mean values ± Standard error followed by different letters indicate significant differences based on the Least Significant Difference Test (LSD) at $p < 0.05$.

This consistency most likely due to the aeration the controlled environmental conditions during the study. Thus, variations in feeding frequency did not affect water temperature, ensuring that thermal conditions remained optimal for fish growth and Survival (Azzaydi *et al*., 2007).

Conclusion

This study demonstrated that increasing feeding frequency significantly improved fish survival rate (SR). Statistical analysis revealed significant differences in SR across treatments. Meanwhile, water quality parameters, including dissolved oxygen (5.35–5.37 mg L^{-1}), temperature (27.30–27.41°C), and pH (7.97–8.00), remained stable and were not significantly affected by the different feeding frequencies. These findings suggest that feeding frequency can be increased to enhance SR without negatively impacting water quality, provided the aeration system is well managed.

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