The Influence of Feed Types on the Growth and Survival of Comet Fish (*Carassius auratus*) at Balai Riset Budidaya Ikan Hias (BRBIH) Depok, West Java

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Abstract. Feeding is closely related to the growth and survival of fish. Different types of feed will result in different outcomes. The comet fish (*Carassius auratus*), being one of the most popular ornamental fish, has led to the rise of many comet fish farming businesses. This research aims to determine the most efficient type of feed in comet fish farming by providing three different types of feed to the ornamental comet fish. The experimental design used in this study is the simple random sampling technique, consisting of 3 treatments with 3 repetitions. The research was conducted for 35 days after the fry was 1 month old. The treatments used were commercial fengli feed, bloodworms, and maggot granules. The study's results showed that bloodworm feeding had a significant effect on the absolute length, daily length growth rate, feed conversion ratio, survival rate, and total feed consumption. The daily growth rate with bloodworms reached 2.09%, better than commercial feed (1.09%) and maggots (1.74%). In terms of daily weight growth rate, the highest percentage was achieved by bloodworms at 5.23%. Bloodworms are easier to consume because they are the right size for comet fish fry. Additionally, bloodworms contain fresher protein, which is better than maggots and commercial feed, ranging from 40–50%. Bloodworms are also beneficial for maximizing the fish's color quality, as they contain carotenoids

Keywords: Bloodworms, feed conversion ratio, fengli feed, growth performance, maggot granules, survival rate

1 Introduction

Goldfish (*Carassius auratus*), a popular ornamental fish species, have been successfully domesticated and cultivated globally due to their vibrant colors and graceful movements. While often perceived as simple aquarium inhabitants, these fish exhibit complex nutritional requirements that significantly influence their growth, health, and overall well-being (Kusrini, 2012).

Nutrition plays a pivotal role in aquaculture, and the selection of appropriate feed is a critical factor in optimizing fish growth and survival (Yanuar, 2017). Dietary

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composition, including the balance of proteins, lipids, carbohydrates, vitamins, and minerals, directly impacts an organism's metabolism, growth rate, and overall health (Rebegnatar & Tahapari, 2002).

Numerous studies have investigated the impact of various dietary factors on fish growth. However, the specific effects of different feed types on the growth performance of goldfish remain an area of ongoing research. While goldfish are naturally omnivorous, their dietary requirements can vary depending on water quality, temperature, and stocking density (Lingga & Susanto, 2003).

This study aims to evaluate the influence of three distinct diets on the growth performance of goldfish. By comparing the growth rates and survival rates of fish fed different feed types, this research seeks to determine the optimal dietary regimen for enhancing aquaculture productivity. Specifically, this study will investigate the effects of [mention the three specific feed types mentioned in the Indonesian text] on key performance indicators such as growth rate, feed conversion ratio, and survival rate. The results of this study will provide valuable insights for fish farmers seeking to optimize their production practices and contribute to the development of more sustainable aquaculture systems.

2 Method and Materials

2.1 Time and Place

The research was conducted from February to March 2024. The maintenance of comet fish samples was carried out at the Ornamental Fish Cultivation Research Center, Depok.

2.2 Research Method

The research method used is descriptive quantitative with a random sampling technique. The control variable in this study is the comet fish, with the independent variables being 3 types of feed: fengli, bloodworm, and maggot granules, while the dependent variables are the growth and survival of the fish.

2.3 Tools Materials

The tools used include aquariums, basins, scales, graph paper, mobile phone cameras, nets, syringes, labels, stationery, rulers, and other tools that support this research. The materials used include comet fish samples, 3 types of feed (fengli, bloodworm, and maggot granules), phenoxyethanol, and other materials to support this research.

2.4 Data Analysis Technique

Data were analyzed using several calculations as follows:

1. Absolute Weight Growth

   Absolute weight growth (W) is calculated using the formula by Arifin and Rupawan (1997), cited from Rihi (2019):

   $$W = Wt - Wo$$

   Explanation:

   W: Weight growth

   Wt: Final weight

   Wo: Initial weight

2. Absolute Length Growth

   Absolute length growth (L) is calculated using the formula by Arifin and Rupawan, cited from Rihi (2019):

   $$L = Lt - Lo$$

   Explanation:

   L: Length growth (cm)

   Lt: Final fish length (cm)

   Lo: Initial fish length (cm)

3. Survival Rate

   According to Effendie (2002), the survival rate is calculated using the following formula:

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

   Explanation:

   SR: Seed survival rate (%)

   Nt: Number of fish at the end of the study (individuals)

   No: Number of fish at the beginning of the study (individuals)

4. Feed Conversion Ratio

According to Effendie (2002), the daily weight growth rate is calculated using the following formula:

$$LPBH = \frac{ln\,Wt\; -\; ln\,Wo}{t} \times 100\%$$

Explanation:

LPBH: Daily weight growth rate (%/day)

Wo: Average fish weight at the beginning of maintenance (g)

Wt: Average fish weight at the end of maintenance (g)

t: Maintenance time

5. Daily Length Growth Rate

According to Effendie (2002), the daily length growth rate is calculated using the following formula:

$$LPPH = \frac{ln\,Lt\; -\; ln\,Lo}{t} \times 100\%$$

Explanation:

LPPH: Daily length growth rate (%/day)

Lo: Average fish length at the beginning of maintenance (cm)

Lt: Average fish length at the end of maintenance (cm)

t: Maintenance time

6. Feed Conversion Ratio

The feed conversion ratio is calculated according to Effendie (1997), cited by Saputra, et al. (2018):

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

Explanation:

FCR: Feed Conversion Ratio

F: Total amount of feed given (g)

Wt: Total fish weight at the end of the study (g)

Wo: Total fish weight at the beginning of the study (g)

7. Total Feed Consumption

According to Pereira, et al. (2007), total feed consumption (TKP) is calculated using the following formula:

$$TKP = F1 - F2$$

Explanation:

TKP: Total feed consumption

F1: Initial feed weight (g)

F2: Final feed weight (g)

3 Discussion

3.1 Survival Rate

This study investigated the influence of different feed types on the survival rate of goldfish (*Carassius auratus*) over a 35-day rearing period. Survival rate is a critical parameter in aquaculture, reflecting the success of cultural practices and guiding decision-making for optimizing husbandry techniques (Effendi, 1979). The results revealed that bloodworms yielded the highest survival rate (97.33%), followed by maggots (96%) and Fengli commercial feed (77.33%). Statistical analysis, using ANOVA (Table 1), indicated that the type of feed significantly influenced the survival rate of goldfish ($P < 0.05$). Tukey's post-hoc test confirmed that treatment A (Fengli commercial feed) differed significantly from treatments B (maggots) and C (bloodworms).

TABLE 1. Average Values of PM, BM, LPPH, LPBH, SR, FCR, and TKP in Goldfish (*C. auratus*) During Maintenance

Treatment	Observed Variable						
	Absolute Length (cm)	**Absolute Weight (g)**	**LPPH (%)**	**LPBH (%)**	**SR (%)**	**FCR**	**Total Feed Consumption**
A (Fengli)	$1{,}11 \pm 0{,}132^a$	$0{,}76 \pm 0{,}054^a$	$1{,}09 \pm 0{,}132^a$	$4{,}75 \pm 0{,}077^a$	$77{,}33 \pm 6{,}110^a$	$36{,}37 \pm 20{,}039^a$	$34{,}28 \pm 13{,}767^a$
B (Magot)	$2{,}00 \pm 0{,}167^b$	$0{,}91 \pm 0{,}145^a$	$1{,}74 \pm 0{,}149^b$	$4{,}88 \pm 0{,}476^a$	$96{,}00 \pm 4{,}000^b$	$28{,}78 \pm 0{,}784^a$	$28{,}15 \pm 2{,}844^a$

C (Bloodworm)	2,67 ± 0,185^{c}	1,03 ± 0,056^{a}	2,09 ± 0,095^{c}	5,23 ±0,085^{a}	97,33 ± 4,619^{b}	184,16 ±33,397^{b}	147,35 ±9,854^{b}

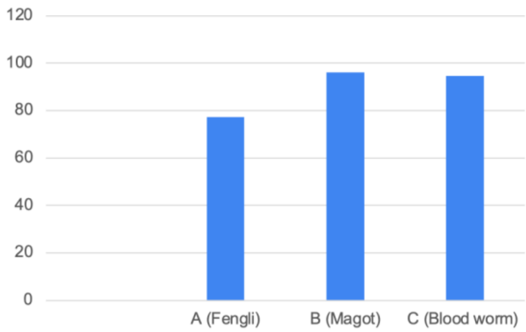


FIGURE 1. Survival Rate in Comet Fish (*C. auratus*) During the Maintenance Period

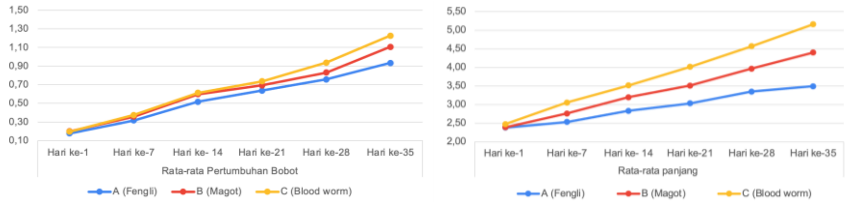
These findings suggest that bloodworms and maggots led to higher survival rates compared to Fengli commercial feed. This could be attributed to the small mouth size of goldfish fry, which is better suited for capturing smaller, more active prey like bloodworms and maggots. Puspita (2016) noted that goldfish fry possess small, serrated mouths designed for capturing tiny zooplankton and invertebrates. The slender, small bodies of natural feeds like bloodworms and maggots make them easier for fry to capture and digest, while also reducing water pollution compared to artificial feeds. Conversely, Effendi (1979) suggested that larger, static commercial feeds, like pellets, may be difficult for goldfish fry to capture and swallow. Thus, the larger size of Fengli commercial feed likely hindered its consumption by goldfish fry with small mouths.

Prayoga and Arifin (2015) emphasized the importance of feed size and movement in feeding fish fry. Feed that matches the mouth size and is easily captured enhances feed consumption efficiency and nutrient absorption, leading to higher survival rates. The larger size and static nature of Fengli feed may have contributed to lower survival rates, as not all fry could fully ingest the pellets. This resulted in size disparities among fish, with larger individuals dominating access to feed and other resources. Such dominance can induce stress, aggression, and cannibalism among smaller fish, further reducing survival rates. Jobling (1985) demonstrated that dominance hierarchies within fish populations can lead to stress, aggression, and reduced growth, reproduction, and disease resistance.

3.2 Growth Performance

Goldfish reared for 35 days exhibited significant differences ($p < 0.05$) in specific growth rate (SGR) among treatments (Table 1), with treatment C (bloodworms) yielding the highest SGR of 2.09%. This value was significantly higher than treatments A and B, which recorded 1.09% and 1.74%, respectively. Treatment C demonstrated a notably superior performance compared to treatment A, with a twofold difference in growth rate.

While there was no significant difference in weight gain rate (WGR) among treatments, Tukey's test revealed a trend, with treatment C achieving the highest WGR of 5.23%. Treatments A and B recorded WGR values of 4.75% and 4.88%, respectively.



(a) (b)

FIGURE 1. (a) Absolute Length Diagram and (b) Absolute Weight on Comet Fish (*C. auratus*) During Maintenance

Similar to SGR and WGR, significant differences ($p < 0.05$) were observed in total length and weight gain among treatments. Treatment C consistently outperformed treatments A and B, with values of 2.67 for length growth and 1.03 for weight gain.

These findings align with Muchlisin (2018), who reported that bloodworms enhance goldfish growth and survival. Bloodworms' high protein and essential amino acid content support optimal fish growth, development, disease resistance, and survival (Muchlisin, 2018). Sulistiyarto (2023) reported protein content of 43.59% and fat content of 3.42% in bloodworms, surpassing the protein content of maggots (33.15%) and commercial feed (28.76%) reported by Lestari et al. (2023) and Sulistiyarto (2023), respectively.

Beyond growth, bloodworms also contribute to enhanced color intensity in goldfish. Carotenoids in bloodworms act as natural pigments, enhancing fish coloration (Marlida, 2023). As fish cannot synthesize carotenoids, dietary supplementation is crucial, and Lumbessy (2024) reported a 75% increase in carotenoid levels in fish-fed bloodworms. Maggots, as an alternative protein source, also demonstrated promising growth results. Setyobudi (2017) and Savitri (2017) reported the suitability of maggots as an alternative feed for goldfish, although fish showed a preference for bloodworms. This preference is likely due to bloodworms being a natural food source in the goldfish's natural habitat.

3.3 Feed Conversion Ratio

The feed conversion ratio (FCR) is a crucial indicator of feed efficiency in aquaculture, reflecting the amount of feed required to produce a unit of fish biomass (Cowey and Gatlin, 1992). A lower FCR signifies better feed utilization and higher profitability. In this study, FCR was calculated as the ratio of feed consumed to weight gain.

The results indicate that bloodworms exhibited the lowest FCR (1.32), followed by maggots (1.45), and commercial Fengli feed (1.68). These findings suggest that bloodworms were more efficiently converted into fish biomass compared to the other feed types. The superior FCR of bloodworms can be attributed to their high protein content and optimal amino acid profile, which enhance nutrient absorption and growth (Muchlisin, 2018).

Conversely, the higher FCR of commercial Fengli feed may be linked to its lower protein content and imbalanced nutrient profile. Excess carbohydrates in commercial feeds can hinder digestion and reduce feed efficiency (Berampu et al., 2021).

4 Conclusion

The present study investigated the influence of different feed types on the growth performance, survival, and feed conversion efficiency of goldfish (*Carassius auratus*). Results unequivocally demonstrate that bloodworms (*Chironomidae larvae*) significantly outperformed both maggots and commercial Fengli feed across all evaluated parameters. The superior nutritional profile of bloodworms, characterized by higher protein content and optimal amino acid composition, was instrumental in enhancing growth rates, improving feed conversion efficiency, and elevating survival rates.

Maggots, while exhibiting acceptable growth and survival rates, demonstrated inferior performance compared to bloodworms. Their potential as a viable feed alternative warrants further exploration, particularly in terms of optimizing nutrient composition and feed formulation. Commercial Fengli feed consistently yielded the poorest results, highlighting the importance of feed quality and composition in aquaculture.

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