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Effects of Different Natural Feed Types on Domestication, Survival Rate, and Growth of Glass Catfish (*Kryptopterus palembangensis*)

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ABSTRACT

Intensive, uncontrolled fishing has primarily reduced glass catfish (*Kryptopterus palembangensis*) populations in Indonesian waters, especially in Sumatra, leading to a steady decline in natural populations through continuous overexploitation. The present study aimed to evaluate the effects of different natural feeds on the growth performance and survival of glass catfish during the domestication phase (process of adapting wild fish to aquaculture conditions using appropriate natural feed types). A total of 150 glass catfish, with an average initial length of 14.62 ± 0.53 cm and an average initial weight of 15.58 ± 0.73 g, were subjected to the present study, using a completely randomized design with five treatment groups and three replications. Each experimental unit contained 10 fish, resulting in 30 fish per treatment. The treatment groups consisted of different natural feed types, namely small live fish (P1), shrimp (P2), earthworms (P3), maggots (P4), and *Tubifex* sp. (P5). Growth performance, survival rate, and digestive enzyme activity of glass catfish were observed after 30 days of rearing. The present results indicated that Group P2 significantly improved the growth performance of glass catfish, including absolute weight (3.61 ± 0.16 g), absolute length (2.85 ± 0.11 cm), specific growth rate (0.85 ± 0.03% day^{-1}), and daily growth rate (0.12 ± 0.01 g day^{-1}) compared to other groups. Additionally, Group P2 exhibited the highest survival rate at 100% and the highest digestive enzyme activities, with amylase at 7.24 ± 0.14 U mL^{-1}, lipase at 0.37 ± 0.01 U mL^{-1}, and protease at 0.69 ± 0.01 U mL^{-1}. The second-best performance was observed in Group P1, followed by P3, P5, and P4. Shrimp was identified as the most effective natural feed for improving the growth performance and survival rate of glass catfish.

Keywords: Digestive enzyme, Domestication, Glass catfish, Growth, Survival rate

INTRODUCTION

Glass catfish (*Kryptopterus palembangensis*) is a freshwater species native to Indonesia, commonly found in the Sumatra rivers, such as the Musi, Lematang, and Ogan (Yonarta et al., 2023a), as well as in the Kalimantan region (Fishbase, 2023; Yonarta et al., 2023b). The population of this species tends to increase during the rainy season, as it is closely associated with food availability, migration patterns, and water levels (Gumiri et al., 2018; Nopiri and Elvyra, 2018). Glass catfish has high economic value and is highly popular among local communities, resulting in intense and uncontrolled fishing activities (Pratiwi et al., 2023). Consequently, natural populations of glass catfish continue to decline. Data from the Ministry of Maritime Affairs and Fisheries (KKP, 2022) indicated that total glass catfish production in South Sumatra decreased markedly from 460,511.78 tons in 2019 to 274,048.54 tons in 2021. This decline in production indicated increasing pressure on natural populations and threatened the long-term survival of glass catfish in its natural habitat. One potential solution to address this issue is domestication, which is defined as adapting wild fish to controlled aquaculture conditions, including feeding management and environmental regulation, to achieve sustainable production outside their natural habitat.

Domestication is a strategic approach in fisheries management that aims to adapt wild fish species to live and reproduce in controlled cultivation environments (Yonarta et al., 2023a). Domestication is a lengthy process that demands careful planning across several aspects, including technical requirements, socio-economic readiness, availability of facilities, technology, and human resources. Furthermore, a thorough understanding of fish biology, such as feeding habits, growth patterns, and survival rates, is essential for successful domestication (Teletchea, 2015; Koniyo and Juliana, 2025). According to Zulfadhli et al. (2023), the fish domestication process comprises three main stages,

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including adaptation to the cultural environment to ensure survival, growth optimization, and reproductive stimulation for successful breeding. Several preliminary studies have been conducted on glass catfish domestication, including natural diet and feeding preferences through stomach content analysis and growth performance (Lukas and Minggawati, 2014), feeding habits to understand dietary behaviour (Lestari et al., 2021), genetic relationships via DNA analysis (Syaifudin et al., 2021), growth patterns to evaluate biological characteristics (Ahmadi, 2022), stocking density to optimize rearing conditions (Agusnimar and Rosyadi, 2013), and reproductive biology to support breeding strategies (Pratiwi et al., 2023). Another key factor influencing the success of domestication is the fish's ability to adapt to cultural conditions and utilize available natural feed sources (Palińska-Żarska et al., 2020). According to Dwitasari et al. (2017), glass catfish are classified as carnivores (meat eaters) that generally rely on animal-based natural feeds; therefore, selecting appropriate feed types is crucial to support their growth in culture conditions. Previous studies have demonstrated that different natural feeds can significantly influence fish growth, such as the use of earthworms for snakehead fry (Herlina, 2016), shrimp for pomfret (Taufiq et al., 2016), maggots for Sangkuriang catfish (Berampu et al., 2021), and silkworms for dumbo catfish fry (Mahendra et al., 2022). These findings indicated that feed type plays an important role in determining growth performance across fish species. However, information regarding the effects of different natural feed types on the growth and survival rate of glass catfish during the domestication process remains limited.

Therefore, the present study aimed to evaluate the effectiveness of different natural feeds in improving growth performance and survival rate of glass catfish, to develop appropriate feeding strategies for successful domestication.

MATERIALS AND METHODS

Ethical approval

The present study was conducted in accordance with the guidelines of the Faculty of Agriculture, Sriwijaya University, Palembang, South Sumatra, Indonesia. All experimental procedures were carried out in compliance with established standards for both laboratory and field experiments. The experimental animals were monitored daily through physical observations, and feeding was administered according to the respective treatment groups.

Location and time

The present study was conducted at the Basic Fisheries Laboratory, Aquaculture Laboratory, and Experimental Pond, Aquaculture Study Program, Fisheries Department, Faculty of Agriculture, Sriwijaya University, Indonesia, from April to June 2025.

Study design

A total of 150 glass catfish with an average initial length of 14.62 ± 0.53 cm and an average initial weight of 15.58 ± 0.73 g were obtained from local fishermen in the Pengumbuk River, Petaling Village, Musi Banyuasin Regency, South Sumatra, Indonesia. The study employed a completely randomized design with five treatment groups and three replications. Each experimental unit contained 10 fish, yielding a uniform stocking density across all treatment groups and a total of 30 fish per treatment. The treatment groups were designed according to the different types of natural feed provided to the glass catfish, including small live fish (P1), shrimp (*Caradina* sp.; P2), earthworms (P3), maggots (P4), and *Tubifex* sp. (P5).

Container preparation

The rearing container used in the present study was a plastic box measuring 35 × 60 × 35 cm^3 with a water volume of 60 L. Before utilization, the plastic box was washed and disinfected with potassium permanganate at a concentration of 2.5 mg L^{-1} (Agustini et al., 2020). Subsequently, the boxes were equipped with an aeration system for oxygen supply and labeled with a random treatment code. Each rearing container contained 10 glass catfish. The fish were stocked in the morning and acclimatized for seven days to adapt to the new environment. After the acclimatization period, initial length and weight were recorded, and water quality parameters for fish rearing were measured.

Fish rearing

Glass catfish were reared for 30 days and fed according to the respective treatments, which included earthworms (30% of crude protein), maggots (50% of crude protein), shrimp (20% of crude protein), *Tubifex* sp. (50% of crude protein), and small live fish (50% of crude protein). The metabolizable energy of each feed was estimated based on crude protein content, following previous studies on nutrient utilization in glass catfish (*Kryptopterus lais*; Rosyadi et al., 2025). An at-satiation feeding regime was applied, with three times per day at 08:00, 12:00, and 16:00 Western Indonesian Time (WIB).

Growth parameters

The absolute weight growth of glass catfish during 30 days of rearing was calculated using Effendie's (2002) formula (Formula 1).

$W = Wt - W_0$ (Formula 1)

Where W represented the absolute weight gain (g), Wt represented the final fish weight at the end of the rearing period (g), and W0 represented the initial fish weight at the beginning of the rearing period (g). The absolute length growth of glass catfish during 30 days of rearing was calculated using the following formula (Formula 2).

$L = L_t - L_0$ (Formula 2)

Where L represented the absolute length growth (cm), Lt represented the final length of fish at the end of the rearing period (cm), and L0 represented the initial length of fish at the beginning of the rearing period (cm). The daily growth rate (DGR) of glass catfish during 30 days of rearing was calculated using Formula 3 (Zonneveld et al., 1991).

$DGR = \frac{Wt - Wo}{t} \times 100$ (Formula 3)

Where DGR represented the daily growth rate (%/day), Wt represented the final average weight (g), Wo represented the initial average weight (g), and t represented the rearing time (days). The specific growth rate (SGR) of glass catfish during 30 days of rearing was calculated using Formula 4 (Zonneveld et al., 1991).

$SGR = \frac{ln\,(Wt) - ln(Wo)}{t} \times 100\%$ (Formula 4)

Where SGR represented the specific growth rate (%), Wt represented the average weight of fish on the final day of rearing (g), Wo represented the average weight of fish on the initial day of rearing (g), and t represented the rearing time (s).

Survival rate

The survival rate of glass catfish was calculated using Formula 5 (Effendie, 2002).

Fish survival (%) = $\frac{Nt}{N0} \times 100$ (Formula 5)

The number of surviving fish was determined by comparing the number of fish at the end of the rearing period (Nt) to the number at the beginning (N0), where Nt and N0 represented the number of fish on the final and initial days of rearing, respectively.

Digestive enzyme activity

The amylase, lipase, and protease activities were analyzed, highlighting the major digestive enzymes involved in carbohydrate, lipid, and protein digestion in fish. Enzyme activity assays were conducted at two sampling points, namely at the beginning of the experiment (day 0) and at the end of the rearing period (day 30). At each sampling time, three fish per treatment were randomly selected and anesthetized using clove oil (50 mg L^{-1}) before dissection. The fish were then humanely euthanized, and the digestive tract was carefully removed. Approximately 0.5-1.0 g of stomach and intestinal tissue was collected, pooled per replicate, and homogenized in cold phosphate buffer for enzyme analysis.

Amylase activity was determined following the method described by Worthington (1993). Briefly, 0.5 mL of enzyme extract was mixed with 1 mL of 1% starch solution and incubated at 95 °C for three minutes. The reaction was terminated by adding 0.5 mL of dinitrosalicylic acid (DNS) reagent (Merck, Germany), followed by further incubation at 95°C for five minutes. Absorbance was measured at 540 nm using a spectrophotometer (Shimadzu, Japan).

Lipase activity was measured according to the method described by Borlongan (1990). A mixture of 1.5 mL of olive oil substrate and 1 mL of 0.1 M Tris-HCl buffer (pH 8.0) was homogenized and incubated at 37°C for six hours. The reaction was stopped by adding 3 mL of 95% ethanol (Merck, Germany), and the released fatty acids were titrated with 0.01 N NaOH (Merck, Germany).

Protease activity was analyzed following the method of Bergmeyer et al. (1983). The reaction mixture contained 1 mL of 0.05 M phosphate buffer (pH 7) and 1 mL of 20 mg mL^{-1} casein solution (pH 7), which was incubated at 37°C for ten minutes. The reaction was terminated by adding 2 mL of 0.1 M trichloroacetic acid (TCA; Merck, Germany), followed by centrifugation at 3,500 rpm for ten minutes. The supernatant was then mixed with 5 mL of 0.4 M Na_2CO_3 (Merck, Germany) and 1 mL of Folin-Ciocalteu reagent (Merck, Germany), and incubated at 37 °C for 20 minutes. Absorbance was measured at 578 nm using a spectrophotometer (Shimadzu, Japan).

Water quality

Throughout the 30-day rearing period, water quality parameters, including temperature, pH, dissolved oxygen (DO), and ammonia, were monitored (Table 1). Temperature and pH were measured daily in the morning, afternoon, and evening. Dissolved oxygen and ammonia were measured at the beginning, middle, and end of cultivation.

Table 1. Water quality parameters measured during the study

Parameter	Unit	Methods/tools
Temperature	ºC	Thermometer
pH	-	pH meter
DO	mg/L	DO meter
Ammonia	mg/L	Spectrophotometer

DO: Dissolved oxygen

Data analysis

The growth data obtained were processed using Microsoft Excel 2021 and IBM SPSS Statistics 25. Data were analyzed using one-way ANOVA at a significance level of p-value less than 5% ($p < 0.05$). Significant differences among treatments were further analyzed using Duncan's multiple range post hoc test.

RESULTS

Absolute weight

The present results indicated that providing different natural feeds significantly affected the absolute weight of glass catfish ($p < 0.05$; Figure 1). The highest absolute weight gain was observed in Group P2 (shrimp feed) at 3.61 ± 0.16 g, which differed significantly from the other four treatments ($p < 0.05$). Additionally, Group P1 (live fish feed) recorded an absolute weight of 3.22 ± 0.25 g, which was significantly higher than the other three treatments ($p < 0.05$). The remaining groups demonstrated progressively lower absolute weights, including 2.71 ± 0.36 g for Group P3, 2.44 ± 0.16 g for Group P5, and 2.28 ± 0.06 g for Group P4. The current results indicated that Group P2 had the greatest potential to increase the growth of glass catfish compared to other natural feed sources.

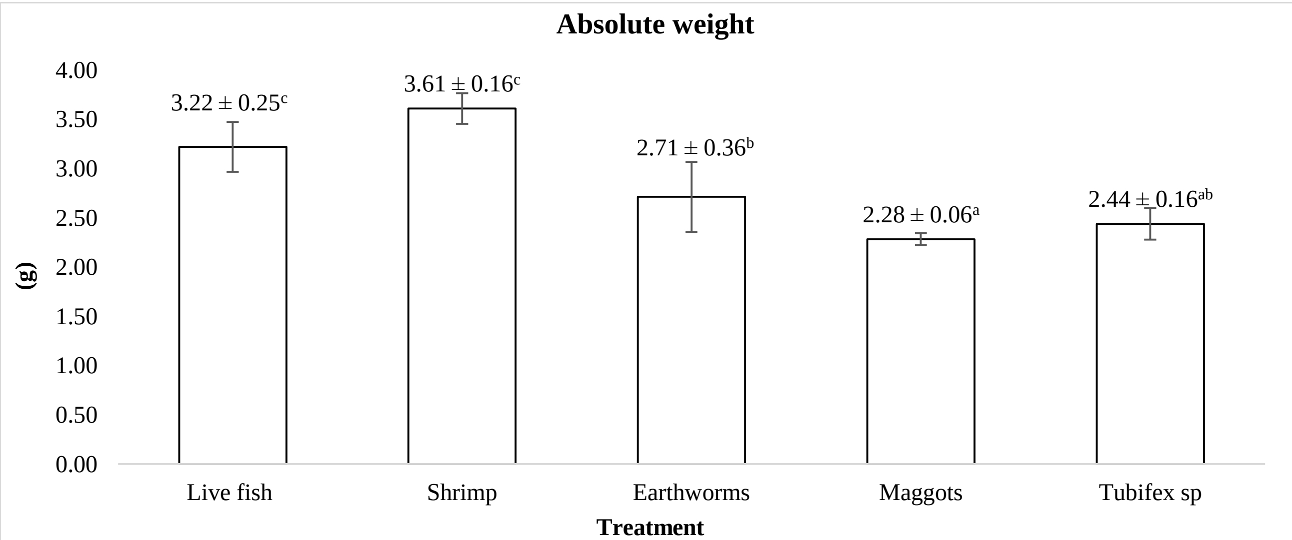

Figure 1. Absolute weight of glass catfish fed different natural feeds for 30 days. Data are expressed as mean ± standard deviation (SD). [a,b,c] The different superscript letters showed a significant difference among treatments ($p < 0.05$).

Absolute length

The current results demonstrated that providing different natural feeds significantly affected the absolute length of glass catfish ($p < 0.05$; Figure 2). Group P2 exhibited the highest absolute length (2.85 ± 0.11 cm), which was significantly different from the other four treatment groups ($p < 0.05$). Group P1 recorded the second-highest absolute length of 2.23 ± 0.20 cm, which was significantly different from the remaining treatment groups ($p < 0.05$). Meanwhile, Group P3 demonstrated the longest absolute length, 1.95 ± 0.16 cm, while the lowest values were recorded in groups P5 and P4, at 1.56 ± 0.13 cm and 1.40 ± 0.06 cm, respectively. These current results indicate that the type of natural feed significantly affected the absolute length of glass catfish, with shrimp and live fish feeds producing the greatest length increases during the rearing period.

Specific growth rate

The current results indicated that different natural feeds significantly affected the SGR of glass catfish during the rearing period ($p < 0.05$; Figure 3). Group P2 demonstrated the highest SGR (0.85 ± 0.03% day^{-1}), which was significantly different from the other treatment groups ($p < 0.05$). Group P1 indicated the second-highest SGR at 0.77 ±

0.05% day⁻¹, which differed significantly from other treatment groups ($p < 0.05$). The remaining groups exhibited progressively lower SGR values, including 0.65 ± 0.08% day^{-1} for Group P3, 0.60 ± 0.03% day^{-1} for Group P5, and 0.56 ± 0.01% day^{-1} for Group P4. The present results indicated that the type of natural feed influenced the SGR of glass catfish, with shrimp and live fish being the most effective feeds in promoting growth rate during the study.

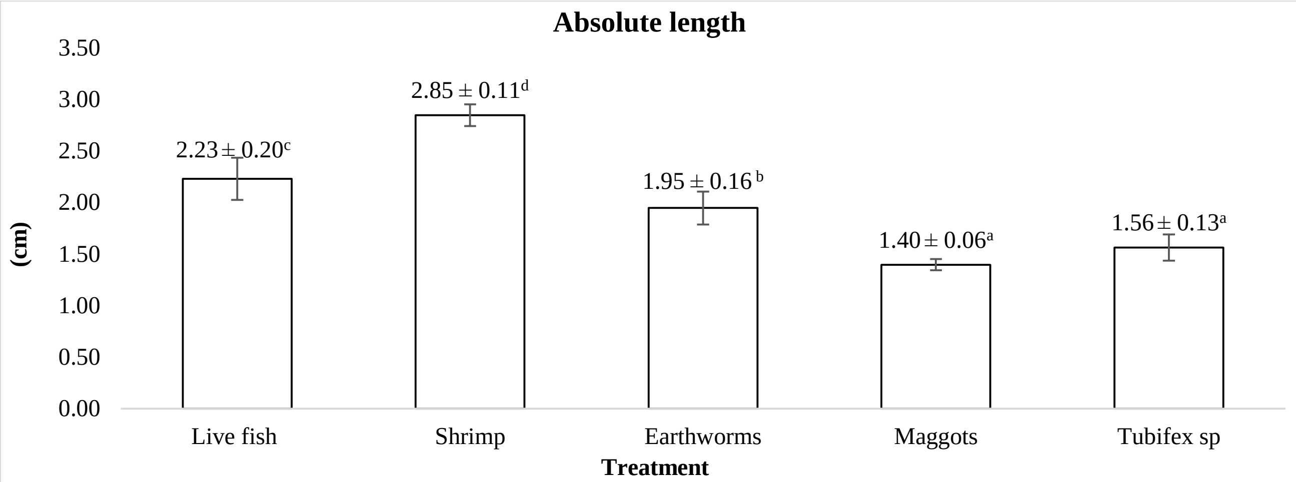

Figure 2. Absolute length of glass catfish fed different natural feeds for 30 days. Data are expressed as mean ± standard deviation (SD). [a,b,c] The different superscript letters showed a significant difference among treatments ($p < 0.05$).

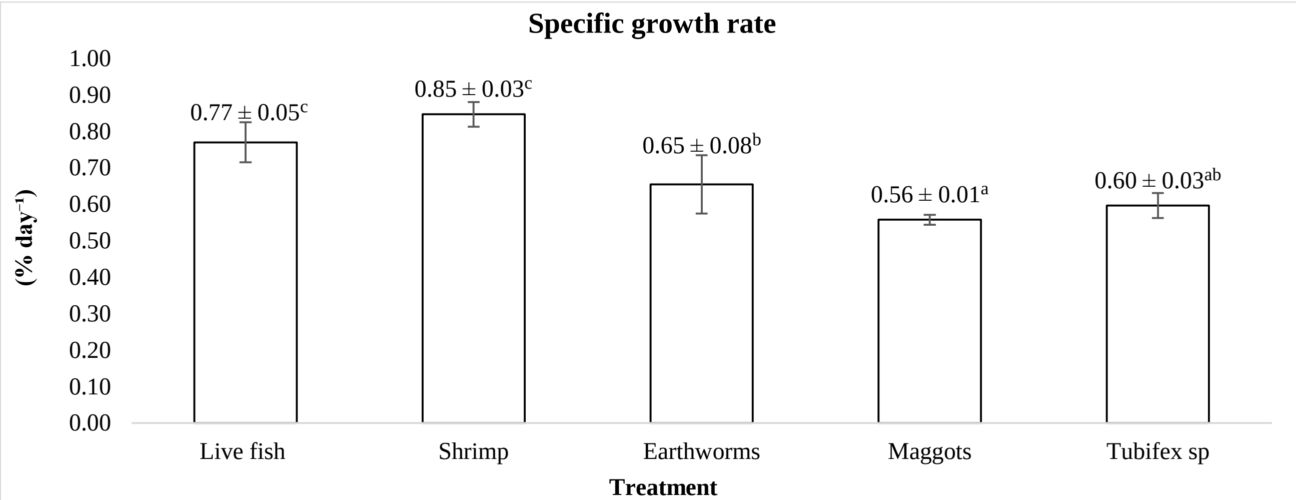

Figure 3. Specific growth rate of glass catfish fed different natural feeds for 30 days. Data are expressed as mean ± Standard deviation (SD). [a,b,c] The different superscript letters showed a significant difference among treatments ($p < 0.05$).

Daily growth rate

The current results indicated that different natural feeds significantly affected the DGR of glass catfish ($p < 0.05$; Figure 4). Group P2 demonstrated the highest DGR (0.12 ± 0.01 g day^{-1}), which was significantly different from the other four treatment groups ($p < 0.05$). Group P1 indicated the second-highest DGR at 0.11 ± 0.01 g day^{-1}, which differed significantly from other treatment groups ($p < 0.05$). Group P3 indicated a DGR of 0.09 ± 0.01 g day^{-1}, while the lowest values were recorded in groups P4 and P5, each at 0.08 ± 0.01 g day^{-1}. The present findings demonstrated that natural feed type significantly influenced the daily growth rate of glass catfish, as shrimp and live fish feeds yielded the greatest DGR over the 30-day rearing period.

Survival rate

The current findings indicated that different natural feeds had different effects on the survival rate of glass catfish (Figure 5). No significant differences in survival rate were observed among groups P1, P3, P4, and P5, with values ranging from 83.33 ± 5.77% to 96.67 ± 5.77% ($p > 0.05$). In contrast, Group P2 demonstrated the highest survival rate of 100 ± 0.00%, which was significantly different from the other treatment groups ($p < 0.05$). All treatments resulted in relatively high survival rates, indicating that the different types of natural feed were effective in supporting the survival of glass catfish during the rearing period.

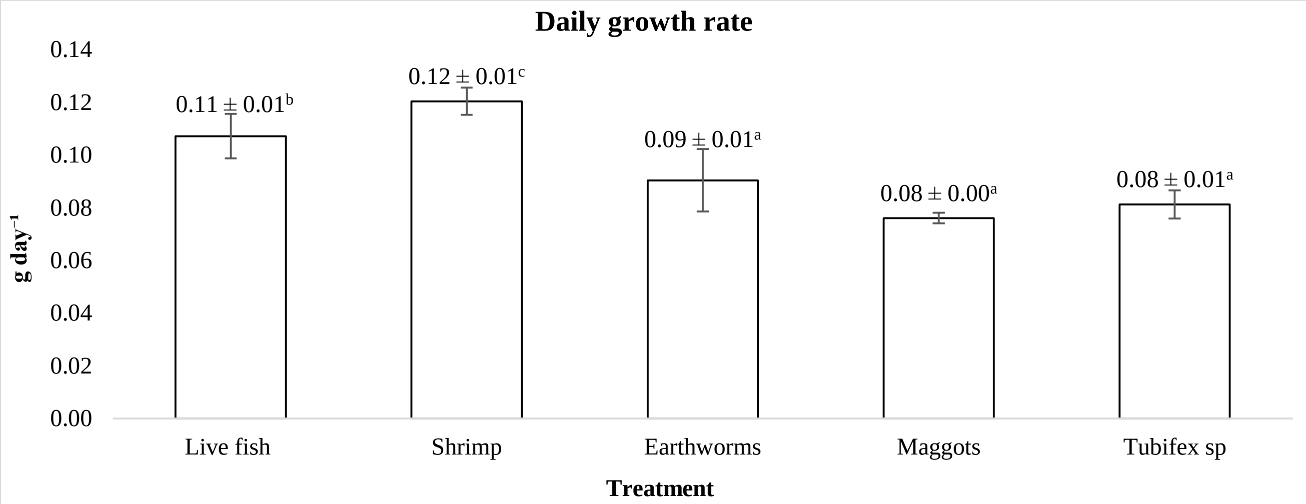

Figure 4. Daily growth rate of glass catfish fed different natural feeds for 30 days. Data are expressed as mean ± standard deviation (SD). [a,b,c] The different superscript letters showed a significant difference among treatments ($p < 0.05$).

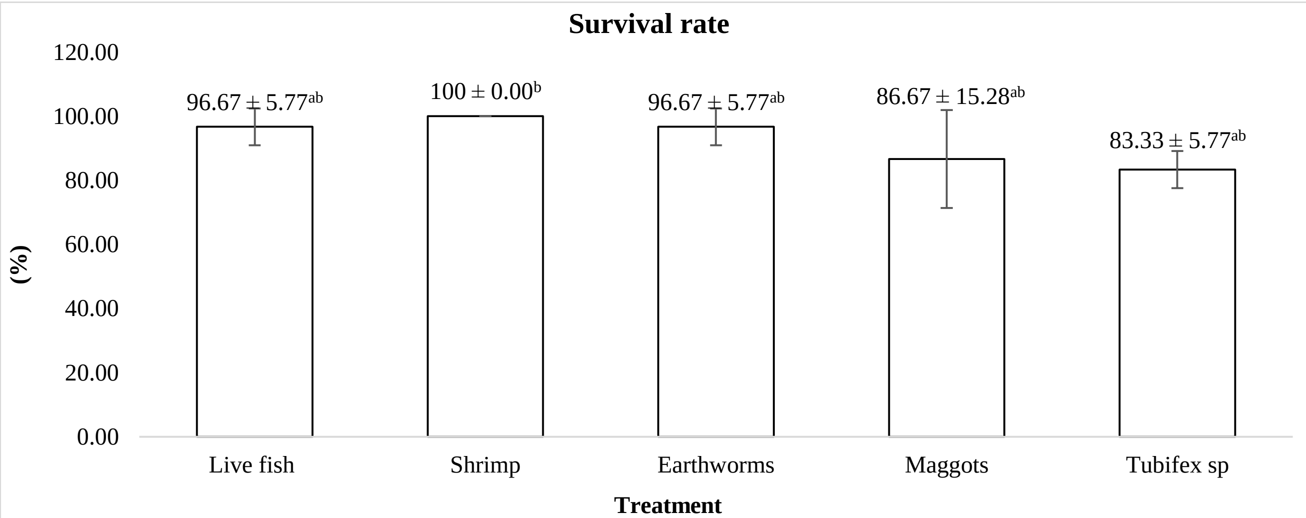

Figure 5. Survival rate of glass catfish fed different natural feeds for 30 days. Data are expressed as mean ± standard deviation (SD). [a,b] The different superscript letters showed a significant difference among treatments ($p < 0.05$).

Digestive enzyme activity

The current results indicated that the different natural feeds significantly affected the digestive enzyme activity of glass catfish, including amylase, lipase, and protease ($p < 0.05$; Figure 6). The highest digestive enzyme activities were consistently observed in Group P2, with amylase at 7.24 ± 0.14 U mL^{-1}, lipase at 0.37 ± 0.01 U mL^{-1}, and protease at 0.69 ± 0.01 U mL^{-1}, all of which differed significantly from the remaining treatment groups ($p < 0.05$). The second-highest amylase (5.70 ± 0.17 U mL^{-1}) and protease (0.55 ± 0.01 U mL^{-1}) activities were observed in Group P3, although its lipase activity (0.28 ± 0.01 U mL^{-1}) did not differ significantly compared with Group P1 ($p > 0.05$). Group P1 demonstrated relatively high enzyme activities, with values of 5.28 ± 0.15 U mL^{-1} for amylase, 0.28 ± 0.01 U mL^{-1} for lipase, and 0.50 ± 0.01 U mL^{-1} for protease. Meanwhile, Group P4 exhibited lower enzyme activities than groups P1, P2, P3, with values of 5.12 ± 0.19 U mL^{-1} for amylase, 0.26 ± 0.01 U mL^{-1} for lipase, and 0.49 ± 0.02 U mL^{-1} for protease, yet still higher than those of Group P5. The lowest enzyme activities were recorded in Group P5, for amylase (4.80 ± 0.16 U mL^{-1}), lipase (0.24 ± 0.01 U mL^{-1}), and protease (0.46 ± 0.01 U mL^{-1}). These findings indicated that shrimp feed was the most effective in stimulating digestive enzyme activity, which in turn improved digestive efficiency and promoted the growth of glass catfish.

Water quality

Based on water quality parameter measurements during the study, pH ranged from 5.43 to 5.75, water temperature from 29.33 to 29.63 °C, DO from 5.40 to 6.10 mg/L, and ammonia from 0.06 to 0.07 mg/L. These findings indicated relatively stable water quality conditions throughout the rearing period. The average values of water quality parameters during rearing are presented in Table 2.

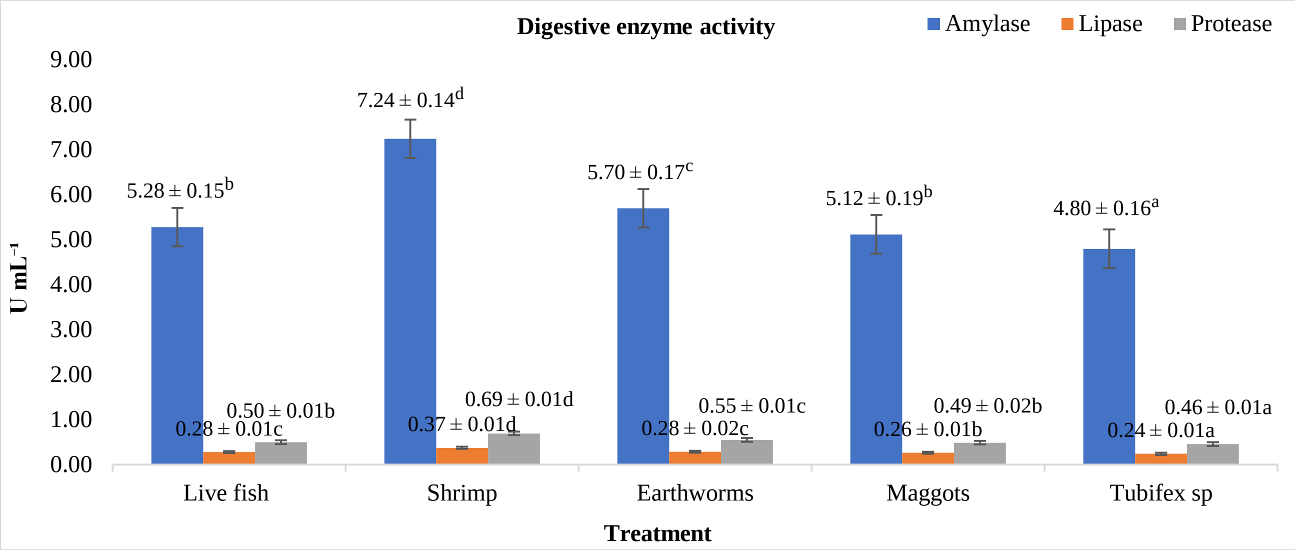

Figure 6. Digestive enzyme activities of amylase, lipase, and protease in glass catfish fed different natural feeds for 30 days. Data are expressed as mean ± standard deviation (SD). [a,b,c,d] The different superscript letters show a significant difference among treatments ($p < 0.05$). Enzyme activities are presented in U mL^{-1}.

Table 2. Average values of water quality parameters during the 30 days of rearing of glass catfish

Treatment	Average water quality parameters			
	pH	**Temperature (°C)**	**DO (mg/L)**	**Ammonia (mg/L)**
Live fish	5.74 ± 0.367	29.63 ± 0.462	6.00 ± 0.400	0.06 ± 0.003
Shrimp	5.52 ± 0.180	29.53 ± 0.451	6.10 ± 0.361	0.07 ± 0.004
Eartworm	5.55 ± 0.197	29.33 ± 0.493	5.53 ± 0.115	0.07 ± 0.013
Maggot	5.75 ± 0.006	29.50 ± 0.500	6.00 ± 0.529	0.07 ± 0.016
Tubifex sp.	5.43 ± 0.173	29.33 ± 0.493	5.40 ± 0.100	0.07 ± 0.021

Data are expressed as mean ± Standard deviation (SD), DO: Dissolved oxygen

DISCUSSION

Domestication is a crucial strategy for increasing fish production from natural waters by rearing wild species in controlled environments, particularly to improve their adaptability, growth performance, and survival under culture conditions (Yonarta et al., 2023b). Successful domestication depends on careful technical and socioeconomic planning, including the provision of facilities, appropriate technology, skilled human resources, and a thorough understanding of fish biology, such as feeding habits, growth performance, and survival. Feed management represented a critical aspect of the domestication process, involving the careful selection of feed type and its suitability during rearing. The feed used in domestication should align with the natural dietary preferences of the species in its habitat (Teletchea, 2015; Koniyo and Juliana, 2025). The carnivorous nature of glass catfish necessitates the use of high-protein natural feeds, such as live fish, shrimp, earthworms, maggots, and *Tubifex* sp. The effectiveness of feeding strategies in supporting domestication can be evaluated through improvements in growth performance, survival rate, and digestive enzyme activity, where growth performance reflects the efficiency of nutrient utilization, survival rate indicates the ability of fish to adapt to culture conditions, and digestive enzyme activity provides insight into the physiological capacity of fish to digest and absorb nutrients from the provided feed (Palińska-Żarska et al., 2020).

The use of different types of natural feed during the domestication of the glass catfish notably increased growth rates, as indicated by parameters such as absolute weight, absolute length, SGR, and DGR during the rearing period. Among the treatment groups, fish fed live shrimp exhibited the highest growth performance. Shrimp is one type of feed that is highly preferred by glass catfish, according to reports by Lukas and Minggawati (2014) and Evi and Rosana (2021). Insects, shrimp, and juvenile fish are the main food for glass catfish in their natural habitat. Treatment with live fish feed yielded favorable growth performance and was the second most effective treatment after shrimp feed in promoting growth in glass catfish. The effectiveness of these two feed types was attributable not only to their compatibility with the feeding habits of glass catfish but also to their live and active form, which naturally stimulated the fish's appetite (Assan et al., 2021). Furthermore, the high nutritional content of shrimp and small fish, including protein, fat, vitamins, and minerals, was an important factor in supporting growth rates (Noreen et al., 2025). According to Koniyo and Juliana (2025), the availability of essential nutrients in the feed plays a crucial role in supporting fish growth and survival during domestication. Live feed provides highly digestible and readily available nutrients that enhance nutrient utilization efficiency and support optimal growth performance (Samat et al., 2020).

The type of natural feed remarkably influenced the survival rate of glass catfish, with the shrimp-fed group exhibiting the highest survival rate. Additionally, other treatment groups resulted in relatively high survival rates. The current findings indicated that the natural feeds used in the current experiment were generally suitable for maintaining fish survival under the rearing conditions. Live feed provides balanced, easily digestible nutrients that enhance growth, survival, and disease resistance (Samat et al., 2020). In addition, live feed is typically consumed directly by fish with minimal waste production, thereby reducing the accumulation of feed residues that may compromise water quality (Hossain et al., 2026). Fish survival and growth are influenced by external factors such as water quality and rearing systems, as well as internal factors including heredity, disease resistance, and the ability of fish to utilize the provided feed (Sumiarsih et al., 2022). Water quality during the rearing period remained within optimal ranges and fell within the recommended ranges for glass catfish aquaculture, including temperature of 25.20-32.00°C, pH of 4.70-7.90, DO of 2.60-8.00 mg/L, and ammonia of 0.010-2.000 mg/L (Yonarta et al., 2023a).

The shrimp-fed treatment group in the present study exhibited elevated digestive enzyme activities, including amylase, lipase, and protease, indicating an enhanced ability of glass catfish to digest and utilize the carbohydrates, lipids, and proteins in the shrimp diet, thereby supporting improved growth performance (Fang et al., 2019). In addition to shrimp, other natural feeds such as *Tubifex* sp., maggots, and earthworms demonstrated potential to support digestive processes, although their enzyme activity levels were comparatively lower, suggesting that their effectiveness depends on the fish's ability to efficiently digest and absorb their nutrient content. High digestive enzyme activity indicated a strong physiological ability in fish to hydrolyze and absorb nutrients, thereby supporting overall growth and development (Mohammadiazarm et al., 2023). In the present study, digestive enzyme activity, specifically amylase, lipase, and protease, served as a key biological indicator for evaluating the ability of glass catfish to utilize different nutrient components, including carbohydrates, lipids, and proteins. Thus, the evaluation of digestive enzyme activities was crucial for determining feed suitability and assessing the efficiency of nutrient utilization in supporting optimal growth (Hoseinifar et al., 2017). Additionally, differences in digestive enzyme activities are influenced by several factors, including physiological condition, temperature, pH, season, feeding habits, feed type, and nutrient composition (García-Meilán et al., 2023).

CONCLUSION

The domestication of glass catfish was evaluated using different natural feed sources, including live small fish, shrimp, *Tubifex* sp., maggots, and earthworms, by comparing the growth performance, survival rate, and digestive enzyme activity. Fish in the shrimp-fed group exhibited the highest overall performance among all treatment groups, achieving a mean absolute weight gain of 3.61 ± 0.16 g, an absolute length gain of 2.85 ± 0.11 cm, a specific growth rate of 0.85 ± 0.03% day^{-1}, and a daily growth rate of 0.12 ± 0.01 g day^{-1}, outperforming all other natural feed treatments. Additionally, the shrimp-fed group resulted in the highest survival rate (100%) and the greatest digestive enzyme activities, including amylase (7.24 ± 0.14), lipase (0.37 ± 0.01), and protease (0.69 ± 0.01), indicating more efficient nutrient digestion and utilization compared to the other diets. The current findings were achieved under stable, optimal water-quality conditions, including pH, temperature, dissolved oxygen, and ammonia, which supported fish physiological performance throughout the rearing period. Live shrimp proved to be the most effective feed among other natural feeds that were used for supporting the domestication of glass catfish. Further studies are recommended to assess long-term culture performance, feed conversion efficiency, and the potential of alternative live feeds such as *Tubifex* sp., maggots, and earthworms under different rearing conditions.

DECLARATIONS

Availability of data and materials

All relevant data generated during the study are included in this published article and are available upon reasonable request from the corresponding author.

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Authors' contributions

Danang Yonarta carried out data collection, prepared the original manuscript, and participated in research implementation. Muslim and Mochamad Syaifudin contributed to data analysis, administration, and conceptualization of the study. Ferdinand Hukama Taqwa and Marini Wijayanti contributed to data interpretation, drafting, and manuscript preparation. All authors have read and approved the final edition of the manuscript.

Competing interests

The authors declared no conflict of interest.

Ethical considerations

Ethical issues, including plagiarism, consent to publish, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy, have been checked by all the authors. The authors confirm that no AI tools were used for preparing and conducting the present study.

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