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Study on the Growth Performance of Indigenous Shrimp from the Batetangnga River, Polewali Mandar, West Sulawesi, Indonesia

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ABSTRACT

This study was conducted as a preliminary investigation aimed at evaluating the growth performance of three local freshwater shrimp species collected from collected from the Batetangnga River, located in Polewali Mandar, West Sulawesi, Indonesia. The aquaculture system used was the recirculating aquaculture system (RAS), engineered with the addition of shelters. This study used a completely randomized design with three treatments and three replications. The treatment applied in this study was: A (*Macrobrachium asperulum*), B (*Macrobrachium australe*), C (*Macrobrachium pilimanus*). The shrimp were reared in aquaria measuring 40x20x25 cm at a density of 4 shrimp per aquarium. Each aquarium was equipped with shelter to serve as a hiding place for the test animals. The shrimp were fed with frozen moina at satiation level, three times per day. i.e. at 7 a.m., 1 p.m., and 7 p.m. The parameters evaluated were feed intake (FI), specific growth rate (SGR), feed efficiency (FE), survival rate (SR), and protein retention (PR). The results showed the shrimp species demonstrated similar growth performance and survival rates. There were no significant differences ($P>0.05$) in specific growth rate (SGR), feed efficiency (FE), survival rate (SR), and protein retention (PR). The feed intake was higher in treatment A (*Macrobrachium asperulum*) than those in treatments B and C ($P<0.05$).

INTRODUCTION

Aquaculture plays an important role in providing animal protein sources **(FAO, 2020; Yue & Shen, 2022)**. The biodiversity of aquatic species provides great opportunities for the development of sustainable aquaculture including crustasean such as shrimp. Shrimp is an important commodity that contributes significantly to the economy. Shrimp is one of the most popular species in international trade **(Boyd & McNevin,**

2015). Freshwater shrimp aquaculture in Indonesia has predominantly focused on the cultivation of the giant river prawn, *Macrobrachium rosenbergii*. Therefore, it is crucial to explore and evaluate the potential of other indigenous freshwater shrimp species as alternative aquaculture candidates. Sulawesi is recognized for its abundant aquatic resources, comprising rivers and ancient lakes that serve as vital habitats for a wide variety of fish and shrimp species **(Ambo-Rappe & Moore, 2019)**.

The Batetangnga River, located in Polewali Mandar Regency, West Sulawesi, is part of the Mandar River system and serves as a crucial habitat for various freshwater species, including shrimp. Despite this richness, indigenous freshwater shrimp species in the rivers of West Sulawesi remain underutilized and are generally harvested only for local consumption. Furthermore, several part of Batetangnga River has been altered for tourism site. The degradation of natural habitats, reclamation of mangroves, water pollution and the use of illegal methods for catching prawn have caused great threats to freshwater prawn and fish populations **(Salim *et al.*, 2021)**. These species have yet to be assessed for their aquaculture potential. Thus, domestication are warranted to support sustainable aquaculture and commercialization. Domestication is the process of taming and adapting fish from their natural habitats to aquaculture environments **(Anggoro *et al.*, 2013; Teletchea, 2016)**. Domestication was developed to enrich the population, prevent degradation, restock aquatic biota, and increase the quality and quantity of fish production **(Sarkar *et al.*, 2017; Thanh & Mather, 2017)**. There are three stages in fish domestication: adapting fish to the culture system to ensure survival, promoting growth, and facilitating reproduction **(Effendi, 2004)**.

The cultivation of local shrimp species for aquaculture purposes requires a scientific foundation, particularly in evaluating biological and ecological parameters. Among these, growth performance is a fundamental criterion used to assess the suitability of candidate species for aquaculture development. According to **Riordan and Webber (1976)** among the biological criteria that must be comprehended is growth rate. However, current knowledge on the growth characteristics of many indigenous freshwater shrimp species remains limited. Thus, this study was conducted as a preliminary investigation aimed at evaluating the growth performance of some local shrimp species from the Batetangnga River, located in Polewali Mandar, West Sulawesi, Indonesia.

MATERIALS AND METHODS

Sample collection

This study was conducted in July – August 2024th, using freshwater shrimp that were collected from natural habitats. The freshwater shrimp collected from the Batetangnga River, located in Polewali Mandar, West Sulawesi, Indonesia. A scoop net was used as fishing gear for collecting freshwater shrimp from the observation sites.

Experimental design

The aquaculture system used was the recirculating aquaculture system (RAS), engineered with the addition of shelters. This study used a completely randomized design with three treatments and three replications. This study employed different species of freshwater shrimp, namely:

A : *Macrobrachium asperulum*
B : *Macrobrachium australe*
C : *Macrobrachium pilimanus*

. .**Fish rearing**

The freshwater shrimp were maintained in the Science Laboratory of PPM Al Ikhlash Lampoko. The shrimp were reared in aquaria measuring 40x20x25 cm at a density of four shrimp per aquarium. Each aquarium was equipped with shelter to serve as a hiding place for the test animals. The shrimp were fed with frozen moina as feed. The shrimp were fed at satiation level, three times daily at 7 a.m., 1 p.m., and 7 p.m.

Growth performance was measured every ten days. The water quality measured parameters measured included temperature, pH, dissolved oxygen, and ammonia. Temperature and pH were measured daily, while other water quality parameters, including dissolved oxygen and ammonia, were measured three times during the rearing period.

Observed Parameter

In this study, several parameters were measured to evaluate the growth performance of freshwater shrimp. The parameters evaluated were feed intake (FI), spesific growth rate (SGR), feed efficiency (FE), survival rate (SR), and protein retention (PR). The parameters of survival rate, feed intake, feed efficiency, and specific growth rate were calculated based on **Halver and Hardy (2002)**. Additionally, protein retention was calculated based on **Takeuchi (1988)**:

$$\text{SGR (\%/day)} = \left(\sqrt[t]{\frac{Wt}{Wo}} - 1\right) \times 100$$

Where, Wt = final mean body weight (g), Wo = initial mean body weight (g), t = Period of trial (days)

$$\text{EP (\%)} = \frac{\text{Weight gain (g)}}{\text{Feed intake (g)}} \times 100$$

Weight gain was calculated by including the biomass of dead fish.

$$\text{SR (\%)} = \frac{\sum \text{Fish harvested}}{\sum \text{Fish stocked}} \text{x}100$$

$$\text{PR (\%)} = \frac{\text{Final body protein (g)} - \text{Initial body protein(g)}}{\text{Total protein intake (g)}} \text{ x } 100$$

Data analysis

The design employed in this research was the completely randomized design with three treatments and three replications. Data were analyzed using SPSS software. To find the effects of treatments, data were tested with ANOVA and followed by Tukey with a 95% confidence level. The difference between treatments was found with a significance value of *P*<0.05.

RESULTS

Growth performance

The growth performance of indigenous shrimp from Batetangnga River during the experimental period is shown in Table (2).

Table 2. Growth performance of indigenous shrimp during experimental period

Parameter	Treatments		
	A	B	**C**
FI (g)	9.73±0.36[b]	8.02±0.09[a]	7.45±0.14[a]
SGR (%/day)	0.54±0.07[a]	1.07±0.26[a]	1.18±0.69[a]
FE (%)	26.14±6.90[a]	28.66±3.65[a]	27.51±7.48[a]
SR (%)	75.00±0[a]	75.00±0[a]	58.33±14.43[a]
PR (%)	21.27±7.45[a]	23.91±3.22[a]	13.77±10.90[a]

Note: different superscript letters show a significant different value among treatments (*P*<0.05).

The results showed that the different species of the indigenous shrimp from Batetangnga River fed with moina had no significant differences (*P*> 0.05) in specific growth rate (SGR), feed efficiency (FE), survival rate (SR), and protein retention (PR). The specific growth rate, feed efficiency, survival rate, and protein retention obtained were as follows: SGR 0.54 %/day – 1.18 %/day, FE 26.14% - 28.66 %, SR 58.33% - 75%, PR 13.77 % – 21.27 %. There was a significant difference in feed intake (FI) (*P*< 0.05). The feed intake was found higher in treatment A (*Macrobrachium asperulum*) than that in treatment B (*Macrobrachium australe*), and treatment C (*Macrobrachium pilimanus*).

Water quality parameters is normal for freshwater shrimp during this study. Water quality data are presented in Table (1).

Table 1. Water quality parameters

Treatment	Water Quality Parameters			
	DO (mg/L)	pH	Temperature (°C)	Ammonia
A (*Macrobrachium asperulum*)	6.1 ± 1.00	8.68 ± 0.02	27.36 ± 0.06	0.00
B (*Macrobrachium australe*)	6.73 ± 0.64	8.76 ± 0.08	27.36 ± 0.06	0.00
C (*Macrobrachium pilimanus*)	5.9 ± 0.17	8.82 ± 0.02	27.36 ± 0.32	0.00

DISCUSSION

Growth performance

This study is a preliminary investigation to assess the growth of several indigenous shrimp species from the Batetangnga River. The results of this research are expected to provide initial information for aquaculture development. This study also provides early-stage scientific data to support the future domestication of indigenous shrimp. The development of local shrimp needs to be initiated to support sustainable aquaculture and commercialization.

There was significant difference in feed intake ($P< 0.05$). and the highest feed intake was found in treatment A (*Macrobrachium asperulum*). The variation in feed intake across treatments was believed to result from differences in feed palatability. The characteristics of the feed will affect the palatability **(Yuniati *et al.*, 2018)**. **Inara (2011)** mentioned that palatability is related to attractability that will influence responses in feed searching, intake, and ingestion or acceptability. In this study, *Macrobrachium asperulum* responded better to feed given compared to other shrimp species.

The data showed that different species of shrimp showed that there was no significant difference in specific growth rate, feed efficiency, and protein retention. Compared to previous study, feed efficiency is lower than other freshwater shrimp species **(Utomo *et al.*, 2019)**. Feeding efficiency is the ratio between shrimp weight gain obtained and the amount of feed consumed by shrimp **(Utomo, 2019)**. The feed efficiency was found low, this indicates that the shrimp exhibited poor utilization of the provided feed, leading to low feed efficiency. Shrimp collected from their natural habitat are still adjusting and may be experiencing stress, which could affect their growth. Protein retention showed similar results across all tested shrimp species. The protein retention of all treatments were influenced by feed intake and feed digestability **(Yuniati *et al.*, 2018)**.

The specific growth rate is lower (0.54 %/day - 1.18 %/day) than that previously recorded on *Macrobrachium rosenbergii*. **Haque *et al.* (2013)** reported that the SGR of *M. rosenbergii* fed supplementary diets ranged from 2.51 %/day to 2.87 %/day. **Khasani *et al.* (2023)** added that the SGR of giant freshwater prawns *M. rosenbergii* ranged from 2.17 – 2.62%/ day. The SGR in this study was much lower, which is suspected to be attributed to the shrimp caught directly from the river being still in the early stages of adaptation. The shrimp were still adapting to environment and provided feed. Therefore, their growth was not yet optimal as the shrimp were still in the process of adjusting to a new and unfamiliar environment. This study was categorized in the first level; this aligns with **Teletchea (2019)** statement. There are five domestication levels of fish species according to **Teletchea (2019)**. The first level is the first trial of acclimatization to captivity, and the top level applied a selective breeding program focusing on specific goals **(Teletchea, 2019)**.

The survival measured in this study ranged from 58.33 to 75% (P>0.05). Moreover, the shrimp demonstrated the ability to survive in new control environment. This may be due to the optimal conditions present in the rearing aquarium that use a recirculating aquaculture system (RAS). RAS are indoor, land-based fish farming systems where fish are kept in tanks under controlled conditions. These systems use filtration to clean the water by removing metabolic waste from the fish before the water is reused within the system **(Ahmed & Turchini, 2021)**. Meanwhile, shrimp mortality during rearing could be caused by stress. Additionally, the SR of shrimps can be affected by the frequency of shrimp molting, cannibalism **(Supono *et al.*, 2022)**.

CONCLUSION

This study reveals that indigenous shrimp collected from the Batetangnga River showed an ability to survive and grow in new control environment. The various shrimp species tested demonstrated similar growth performance and survival rates under the experimental conditions. Based on the growth and survival rate data obtained, it can be concluded that the shrimps have the potential to be developed as a cultured species.

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