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Growth and survival of bronze featherback (*Notopterus notopterus*) adapted on box container and aquarium

Muslim MUSLIM *, Elika PITRIANI and Heni AGUSTINA

Aquaculture Study Program, Department of Fisheries, Faculty of Agriculture, Universitas Sriwijaya, Indralaya, South Sumatra, Indonesia.

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Abstract

The adaptation of wild fish to the cultured environment is basic information in fish farming. The aim of this study was to adapt *N. notopterus* to box containers and aquaria. This study consisted of two experiments. Experiment 1 adapted *N. notopterus* to a box container with different stocking densities of 1 fish and 2 fish per box container. Experiment 2 adapted *N. notopterus* to an aquarium with different feeding rates of 1% and 5%. The results showed that *N. notopterus* successfully adapted to the controlled environment of a box container and aquarium. *N. notopterus* survived and grew in box containers and aquaria. The results of this study provide basic information for the cultivation of *N. notopterus*.

Keywords: Aquaculture system; Aquarium fish; Fish adaptation; Notopteridae

1. Introduction

Aquaculture is the breeding, raising, and harvesting of fish, shellfish, and aquatic plants. Basically, it's farming with water. According to [1], aquaculture is the process of raising, reproducing, and harvesting aquatic species, including animals and plants, in regulated aquatic habitats such as oceans, lakes, rivers, ponds, and streams. Some aquaculture production systems are suitable for freshwater environments, such as land-based freshwater ponds, tarpaulin ponds, running-water ponds, waring cages, floating cages, pen-culture, cement ponds, aquaria, box containers, buckets, and others, while others are suitable for marine environments. Production systems differ in their setup and the species they are suitable for.

The bronze featherback (*Notopterus notopterus*, Pallas 1770) is the only fish species of the genus Notopterus [2]. This species belongs to the family Notopteridae, a species of fish with fan-shaped fins (Class Actinopterygii). The distinctive feature of this species is its knife-shaped back. This species lives in fresh or brackish water. This species has a short dorsal fin, a long caudal fin, and small pelvic fins [3]. South and south-east Asian nations, including Bangladesh, Malaysia, Thailand, Myanmar, Indonesia, India, and Viet Nam, are home to *N. notopterus* [4-8]. Due to overexploitation, pollution, and habitat degradation, the wild population of *N. notopterus* has decreased recently [9,10]. The Indonesian government has listed *N. notopterus* as an endangered species because of its declining population in the wild [11].

In Indonesia, fish is still a staple diet and a major source of protein, which is easily digestible and has high biological value. *N. notopterus* is one of Indonesia's freshwater fish species that has high economic value [12]. This species is used by Indonesian people as a daily side dish and is processed into culinary specialties, namely pempek (fish cake) and kerupuk-kemplang (fish cracker). The increasing demand for this fish has led to increased fishing in the wild. As a result, its population in the wild is declining. In order to preserve this species, it needs to be domesticated. Early domestication is aimed at improving fish survival and growth in aquaculture environments. The adaptation of wild fish to the

* Corresponding author: Muslim MUSLIM

aquaculture environment can cause physiological disorders of growth and development. In the media, cultivation can cause fish not to survive and not to grow. This study aimed to adapt *N. notopterus* in container boxes and aquaria. The results of this study provide basic information for the aquaculture of *N. notopterus*.

2. Material and methods

2.1. Experiment 1 Bronze featherback (*N. notopterus*) adapted on box container

2.1.1. Preparation of the box containers

The rearing container uses 12 box containers (50x32x30 cm). The box containers are black in color. The box containers were cleaned using dug-well water to remove embedded dirt. After cleaning, the box containers were dried, and after drying, they were filled with water as high as 20 cm. The water in the tubs was deposited for 24 hours. The box containers are placed in an open space in the backyard. The box containers are protected with a net to prevent fish-eating animals from entering.

2.1.2. Fish rearing

N. notopterus is put into the box containers in the morning when the weather conditions are not yet hot, so that the fish placed in the box containers do not experience stress. Before being put into the box containers, the fish were weighed using a digital scale (accuracy 0.01 g), and the total length was measured using a ruler (accuracy 0.1 cm). The measurement data of body weight and total length were used as initial data for the experiment. Next, acclimatization was carried out for 15 minutes. Fish rearing is carried out for 30 days. The stocking density of fish in box containers, namely 1 fish per box container and 2 fish per box container, was repeated five times. The feed given is in the form of small swamp shrimp (*Caridina gracillirostris*; Atyidae). Adlibitum feeding. The frequency of feeding is done twice a day at 08.00 and 17.00 WIB. Sampling was carried out at the beginning and end of the experiment to determine fish growth.

2.1.3. Measured parameters

Total length growth

The total length growth was calculated using the formula: $L = Lt - L_0$ (Formula 1). where L is the growth in total length of the fish (cm), Lt is the length of the fish at the end of rearing (cm), and L0 is the length of the fish at the beginning of rearing (cm).

Absolute weight growth

Absolute weight growth was calculated using the formula: $W = Wt - W0$ (Formula 2). where W is the absolute weight growth of the experimental fish (g), Wt is the weight of the experimental fish at the end of the rearing period (g), and W0 is the weight of the fish at the beginning of the rearing period (g).

Specific growth rate

A specific growth rate was calculated using the formula: $SGR = \frac{[\ln Wt - Ln\ Wo]}{t} \times 100$ (Formula 3). where SGR is the specific growth rate (%), Wt is the average weight of fish at the end of the rearing period (g), Wo is the average weight of fish at the beginning of the rearing period (g), and t is the number of days of rearing (days).

Survival rate

Survival rate was calculated using the formula: $SR = \frac{Nt}{No} \times 100$ (Formula 4). Where, SR is the survival rate of fish reared (%), Nt is the number of fish at the end of the rearing period (fish), and No is the number of fish at the beginning of the rearing period (fish).

Water quality

The water quality parameters measured were water temperature, pH, and ammonia. The measurements are carried out periodically. Temperature and pH measurements are carried out daily, while ammonia is measured weekly.

2.2. Experiment 2 Bronze featherback (*N. notopterus*) adapted on aquarium

2.2.1. Preparation of the aquaria

N. notopterus were reared in an aquaria (34x39x25 cm). A total of 12 aquaria were used in this study. The aquarium used is made of glass with a thickness of 5 mm. The aquarium is cleaned of dirt and dust by washing it with clean water. After cleaning, the aquarium is drained and then filled with 20 liters of clean water. Aeration installations were installed in each aquarium. Each aquarium is covered with black plastic on the outside.

2.2.2. Fish rearing

Before *N. notopterus* was put into the aquarium, the fish were weighed using a digital scale (accuracy 0.01 g), and the total length was measured using a ruler (accuracy 0.1 cm). The measurement data of body weight and total length were used as initial data for the experiment. Next, acclimatization was carried out for 15 minutes. Fish rearing is carried out for 30 days. Sampling was carried out at the beginning and end of the experiment to determine fish growth.

2.2.3. Feeding

During the rearing period, *N. notopterus* is given natural food, namely small swamp shrimp (*Caridina gracillirostris*). The feeding rate was between 1% and 5% of the total fish biomass that was maintained. Every week, the body weight of the test fish is measured as a basis for calculating the amount of food that will be given in the next week. The frequency of feeding is twice a day, namely at 08.00 and 16.00 WIB.

2.2.4. Measured parameters

Parameters measured included the total length growth of the experimental fish, absolute body weight growth, specific growth rate, feed efficiency, and survival rate of the experimental fish. The calculation of these parameters refers to the formula used in experiment 1.

3. Results and discussion

3.1. Experiment 1 Bronze featherback (*N. notopterus*) adapted on box container

The results showed that *N. notopterus* reared in box containers successfully survived and grew. The growth of trial fish is reflected in the increase in total length and body weight. The experimental results of rearing *N. notopterus* in box containers are presented in Table 1.

Table 1 Experimental results of rearing *N. notopterus* in box containers

Parameters	Stocking density	
	1 fish/box	2 fish/box
Initial total length (cm)	11.50	9.20
Final total length (cm)	12.94	11.50
Growth in length (cm)	1.44	2.30
Initial body weight (g)	12.00	16.00
Final body weight (g)	13.50	20.00
Growth in body weight(g)	1.50	4.00
Specific growth rate (%)	5.00	13.3
Survival rate (%)	100	100
Water quality		
Temperature (^{o}C)	27-29.7	27-29.7
pH (unit)	6.0-7.2	6.85-7.92
Dissolved oxygen (mg/L)	4.5-6.9	5.3-7.8
Ammonia (mg/L)	0.041-0.055	0.043-0.055

3.2. Experiment 2. Bronze featherback (*N. notopterus*) reared on aquaria

The results showed that *N. notopterus* successfully survived and grew in the aquarium (Table 2).

Table 2 Experimental results of rearing *N. notopterus* in aquaria

Parameters	Feeding rate	
	1%	**5%**
Initial total length (cm)	3.92	4.68
Final total length (cm)	4.14	5.17
Growth in length (cm)	0.22	0.49
Initial body weight (g)	7.86	10.81
Final body weight (g)	8.55	11.96
Growth in body weight(g)	0.69	1.15
Specific growth rate (%)	2.3	3.8
Survival rate (%)	100	100
Water quality		
Temperature (°C)	26–28.9	26–28.2
pH (unit)	6.6–8.0	6.5–7.9
Dissolved oxygen (mg/L)	4.9–7.5	6.0–7.5
Ammonia (mg/L)	0.041–0.050	0.041–0.055

Growth is a physiological process that involves both internal and external physiological factors, such as health, stress, and reproductive status, as well as environmental factors like food quality and quantity, temperature, and water quality. The survival of young fish is frequently correlated with their growth. Growth is the steady growth in average fish weight, which for many species can be depicted by an asymptotic sigmoid curve [13]. Thus, the observed increase can be approximated by exponential, linear, or asymptotic functions depending on the start and end times of an experiment. Aquaculturists often report growth using one of three metrics: absolute growth rate, relative growth rate, and specific growth rate. Aquaculture fish grow through a complicated mechanism that transforms the energy they consume into biomass. The organism's capacity for growth, its trophic level, and a number of abiotic factors, including food availability, temperature, and unfavorable environmental effects brought on by the conditions under which the fish are raised, all influence how effectively this conversion occurs [14].

Several ecological variables, including temperature, dissolved oxygen, salinity, and photoperiod, have an impact on how quickly something grows. Water temperature, food availability, and environmental stressors like decreased oxygen or increased sedimentation all affect the rates at which fish and their scales grow [15]. One of the physical parameters that has the greatest impact on fish production and growth is water temperature [16,17]. The health and subsequent growth of fish are directly related to the quality of water in which the fish are raised. In general, factors affecting fish growth and production in freshwater aquatic systems can be classified as physical, chemical/biochemical, or a combination thereof. The physical properties of water that are important to fish production and growth include temperature and the concentrations of suspended and settleable solids; important chemical parameters include pH, alkalinity, hardness, and metals [17].

4. Conclusion

The adaptation of *N. notopterus* to container boxes and aquaria has been successful. *N. notopterus* was adaptive to the cultural environment so that it could successfully survive and grow. The results of this study are useful as basic information for *N. notopterus* aquaculture.

Compliance with ethical standards

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Disclosure of conflict of interest

We declare that there is no conflict of interest in this study.

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