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Performa Sintasan dan Pertumbuhan Larva Ikan Betok (Anabas testudineus) dengan Pemberian Moina sp. Diperkaya Viterna: Aplikasi Inovatif dalam Perikanan Budidaya

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Abstract:
The Betok fish (Anabas testudineus) is one of the freshwater fish species with potential for aquaculture. Larvae rearing faces challenges, namely low survival rates due to low nutrient content in the feed. Therefore, it is necessary to supplement Moina sp. with viterna. This study aims to determine the optimal dose of viterna in Moina sp. supplementation to improve the survival rate and growth of Betok fish larvae. The method used is an experiment. The experimental design employed is a Complete Randomised Design (CRD) with one factor and three treatments, each repeated three times. The treatments involved enriching Moina sp. with viterna at different doses: D0 = 0 ml/L (control), D20 = 20 ml/L, D40 = 40 ml/L, and D60 = 60 ml/L. The results of the study showed that the enrichment of Moina sp. with different viterna doses affected the survival rate and growth of betok fish larvae. The best treatment was D60, with absolute weight growth of 0.47 g, specific growth rate of 8.01%/day, absolute length growth of 2.64 cm, and survival rate of 93.33%. The water quality parameters obtained included temperature 26–29.1°C, pH 6.3–7.1, and dissolved oxygen (DO) 5.3–6.2 ppm.
Keywords: *Betok fish, Growth, Survival, Viterna, Moina sp.*

INTRODUCTION

Betok fish (Anabas testudineus) is one of the local freshwater fish species with high potential for commercial aquaculture. In Riau Province, its utilization is still largely dependent on wild catches due to the underdeveloped hatchery and aquaculture technologies (Sukendi, 2019). However, this fish possesses physiological advantages, such as the ability to survive in environments with low dissolved oxygen levels thanks to its additional labyrinth breathing organ (Maidie et al., 2015), as well as high nutritional content including protein, phosphorus, and omega-3 (Inara, 2020).

One of the main challenges in betok fish farming lies in the larval phase, where high mortality rates (>80%) often occur due to the limited availability of natural feed that is appropriate in size and nutritional quality (Akbar, 2018; Susila, 2016). Moina sp., as one of the natural zooplankton feeds, has high protein content and can accelerate larval growth (Priyadi, 2010; Esron et al., 2015). However, its nutritional value can still be enhanced through nutrient enrichment techniques—an innovative approach in aquaculture feed technology.

One potential supplement is Viterna, which contains various amino acids, vitamins, minerals, and proteins (Aprilia et al., 2018; Vitaloka et al., 2019). Although it is commonly used in livestock feed, its application as a supplement for enriching natural feed in fish culture is a relatively new approach. Previous studies have shown that enriching natural feed with Viterna can improve the survival and growth of catfish and koi larvae (Mufidah et al., 2009; Vitaloka et al., 2019).

Therefore, this study aims to evaluate the innovative application of Viterna-enriched Moina on the survival and growth of betok fish larvae. This study is expected to contribute to the development of more efficient and practical natural feed-based technology for freshwater aquaculture.

RESEARCH METHOD

Materials and Methods

Time and Location

This study was conducted over 40 days from May to June 2023 at the Fish Breeding and Genetics Laboratory, Department of Aquaculture, Faculty of Fisheries and Marine Science, University of Riau, Pekanbaru.

Materials and Equipment

The materials used in this study included betok fish larvae measuring 0.6 ± 0.005 cm in length, Moina sp., and Viterna. Equipment included 30 x 30 x 30 cm aquaria, aerators, siphoning hoses, weighing scales, dip nets, brushes, pH meters, thermometers, cameras, notebooks, and other essentials.

Experimental Design

This research used an experimental method to examine the survival and growth of betok fish larvae (Anabas testudineus) fed with Viterna-enriched Moina sp. The design used was a Completely Randomized Design (CRD) with one factor—Viterna dosage for Moina enrichment—and three replications. Treatments were:

D0 = Moina sp. enriched with 0 ml/L Viterna
D20 = Moina sp. enriched with 20 ml/L Viterna
D40 = Moina sp. enriched with 40 ml/L Viterna
D60 = Moina sp. enriched with 60 ml/L Viterna

Experimental Procedures

Twelve 30x30x30 cm glass aquaria were used, cleaned with clean water and disinfected using potassium permanganate (0.5 mg/L) for 24 hours, then rinsed and air-dried for two days. Aquaria were then arranged, labeled, and filled with 10 liters of water and aerated.

Betok fish larvae were obtained via semi-artificial breeding from two male and two female broodstock (70 g and 50 g respectively), induced with Ovaprim at 0.3 ml/kg for females and 0.1 ml/kg for males. Spawning took place in 1 x 0.5 x 0.5 m fiber tanks with 18 cm of water. Fertilized eggs floated on the surface and hatched within 20–24 hours at 26–29°C. Larvae were initially not fed due to yolk sac absorption, which completed in 92 hours at 27.0–30.5°C. From days 3 to 5 larvae were fed Chlorella, then Artemia until day 9, after which they were placed in treatment aquaria and fed enriched Moina from day 10 onward.

Preparation of Enriched Moina sp.

Moina sp. were enriched with Viterna by soaking in the supplement for 5 hours at 04:00, 09:00, 14:00, and 19:00. Nine glass beakers were prepared, each containing 200 mL water and Viterna at respective doses. Around 3000–4000 Moina individuals were added per beaker. Each larva required about 113 individuals per feeding. Around 3390 Moina (15 mL) were given per tank. Gut filling was observed under a microscope after 1–5 hours of soaking to confirm Viterna absorption, based on earlier studies indicating full gut content after 4–5 hours of soaking.

Larval Maintenance

Nine-day-old betok fish larvae were acclimated for one day, and the 40-day study started at age 10 days. Larvae were stocked at 3 individuals/L in 10-liter tanks. Feeding occurred four times daily (09:00, 14:00, 19:00, 00:00). Siphoning was done every morning to remove waste and uneaten feed.

Growth and Survival Measurement

Growth and survival measurements began on day 9. Sampling occurred every 10 days (days 10, 20, 30, 40). Fifteen larvae per tank (50%) were weighed (precision 0.0001 g) and measured (precision 0.1 cm) for length.

Water Quality Monitoring
Water quality (temperature, pH, DO) was measured at the beginning, middle, and end of the study, using a thermometer, pH meter, and DO meter respectively.
Measurement Parameters
Weight gain (Effendie, 2002): W = Wt - W0
Length gain: L = Lt - L0
Specific growth rate: SGR = (ln Wt - ln W0)/t × 100%
Survival rate (Effendie, 1997): SR = (Nt / No) × 100%
Where: Wt = final weight; W0 = initial weight; Lt = final length; L0 = initial length; t = time; Nt = number of surviving larvae; No = initial number of larvae.

Data Analysis
A factorial CRD was used with 4 treatments and 3 replications (total 12 units). Data were processed using Excel 2010 and SPSS 23 for ANOVA. If significant differences ($P < 0.05$) were found, post-hoc Student-Newman-Keuls tests were performed. Water quality data were analyzed descriptively.

RESULT AND DISCUSSION

Growth and Survival

Based on the research that has been conducted, the absolute weight growth value (g), absolute length growth (cm), specific growth rate (%/day) and survival (%) of climbing perch larvae are obtained, which are presented in Table 2.

Table 2. Absolute Weight Growth Value (g), Absolute Length Growth (cm), Specific Growth Rate (%/day) and Survival (%) of Catfish Larvae

Viterna Dosage	Absolute Weight (g)	Absolute length (cm)	LPS(%/hari)	SR (%)
D_0	0,30 ± 0,01[a]	1.35 ± 0,14[a]	6.95 ± 0,06[a]	70.00 ± 3.33[a]
D_{20}	0,37 ± 0,03[b]	2.22 ± 0,16[b]	7.43 ± 0,09[b]	74.44 ± 3.85[a]
D_{40}	0,38 ± 0,06[b]	2.35 ± 0,11[b]	7.51 ± 0,03[b]	82.22 ± 1.92[b]
D_{60}	0,47 ± 0,01[c]	2.64 ± 0,12[c]	8.01 ± 0,03[c]	93.33 ± 3.33[c]

Growth of Betok Fish Larvae (Anabas testudineus)
Table 2 shows the highest absolute weight growth value of catfish larvae produced by a dose of 60 ml/l of 0.47 g while the lowest absolute weight growth value was in the control treatment (dose 0 ml/l) which was 0.30 g. Treatment with a dose of 60 ml/l (D60) is the best treatment that can increase absolute weight growth. The high absolute weight growth in this treatment is thought to be because catfish larvae consume Moina enriched with a dose of viterna which will increase the nutritional value of Moina sp so that the nutritional value needed by the larvae can be met, when viewed from observations of the fulfillment of the contents of the digestive system of Moina sp given viterna, it can be seen that if given 60 ml/l the stomach contents are perfectly filled, this indicates that there is a major role for viterna in increasing the growth of catfish. The results of this study are in line with Craig et al. (2017) that the larval stage needs to be given high protein feed and the frequency is often / usually excessive. Small fish have high energy needs and must eat almost continuously and are fed almost every hour. Furthermore, Vitaloka et al. (2019) revealed that providing water fleas enriched with viterna provided more optimal growth of

koi fish larvae, where there was additional nutritional value such as protein, carbohydrates, fat, minerals, vitamins due to viterna enrichment, with the best dose of 50 ml/l.

Dose 0 ml/l (D0) is the lowest treatment. It is suspected that the nutrients needed, especially protein and fat, have not optimally met the nutritional needs of catfish larvae. This is also in line with Erwin (2016) that feed is a determining factor for the growth of fish larvae. The lower the protein content of the feed given, the slower the growth will be and can even inhibit the growth of the larvae. The fish growth process will continue as long as the individual fish is still alive. Growth is the process of increasing the length and weight of an organism which can be seen from changes in length and weight in units of time (Mulqan et al. 2017). Growth can also be interpreted as an increase in the number of cells through mitosis which ultimately causes changes in tissue size (Effendi 1997). According to Sutisna and Sutarmanto (1995), food factors affect the growth rate and survival of catfish larvae, where the nutritional needs for larvae during the development period include protein, fat, carbohydrates, minerals and vitamins. The need for fish larvae for nutrition is quite high, which is used for survival and growth and this need will decrease as the fish grow larger (Effendie in Sukendi et al. 2018). According to Vitaloka (2019), Viterna is a feed supplement processed from various natural animal and plant ingredients that provide substances that are very necessary for growth and health. Viterna is very good for fattening/enlarging fish with functions including increasing daily weight gain, meat quality, fish health, stimulating fish digestive enzymes, providing essential and non-essential minerals, providing various nutrients needed for livestock growth, increasing the content of fatty acids in fish digestion, increasing feed efficiency and effectiveness, containing natural growth hormones to accelerate fish growth, increasing fish appetite, natural products are safe for livestock and the environment. Viterna has a nutritional content of 42.82% protein, 47.31% carbohydrates, 4.5% fat, 2.74% minerals and 2.63% vitamins (Fauzan 2004 in Vitaloka et al. 2019).

Table 2 shows the absolute length growth pattern, where the 60 ml/l treatment produced the highest absolute average length growth of 2.64 cm while the control treatment produced the lowest absolute average length growth of 1.35 cm. The increase in absolute length growth with viterna enrichment in Moina sp. indicates that there is an increase in the nutritional value of Moina sp. The 60 ml/l dose treatment is the best dose treatment that can increase the highest absolute length growth. This is because Moina sp. enriched with a dose of 60 ml/l has perfectly absorbed viterna to fulfill the digestive system of Moina sp. therefore, this affects the increase in the nutritional value of Moina sp., which will then be utilized by the larvae for metabolic activities and growth. The growth of the larvae will experience a better increase than other treatments. According to Sundari and Laila (2020), the nutritional needs at the larval stage are higher than those of adult fish so that the feed given must have a very high protein content. So that the more optimal the nutrition given will provide optimal growth values too. Irfan et al. (2020) added that the fish's eating response with feed treatment supplemented with viterna experienced an increase in appetite compared to the control feed. This is thought to be influenced by the nutritional value of the feed, generally from the composition of nutrients and important nutritional components that must be available in the feed, including protein, fat, carbohydrates and vitamins that are fulfilled. So that fish that are added with viterna in their feed can meet their nutritional needs. Kurnia (2008) stated that the energy produced can be used by fish to find food and other activities.

Other supporting research results regarding the provision of Moina sp enriched with nutritional ingredients to freshwater fish larvae were also studied by Pratiwi et al. (2016) stating that Moina sp. which has been enriched with fish meal, its nutritional value, especially protein, increases. Its protein content increased from 2.51% (Moina sp. without added fish meal) to 5.07% in the treatment of adding 6 gr/L of fish meal so that it can maximize the growth and survival of catfish larvae being raised. In addition, this is also supported by research by Erwin et al. (2016) where being fed water fleas enriched with viterna provided more optimal growth of catfish larvae, where there was additional nutritional value such as protein, carbohydrates, fat, minerals, vitamins due to the enrichment of viterna. In addition, this viterna application was also carried out in Erwin's (2016) research on the provision of water fleas enriched with viterna to catfish larvae with the best dose of 30 ml/l and 40 ml/l.

In addition, low growth in the control treatment with a dose of 0 ml/l (D0). It is suspected that Moina sp. which is not enriched with viterna does not experience any increase in protein at all or its protein is not yet optimal to be able to meet the nutritional needs of catfish larvae until the end of maintenance. This is supported by Pratiwi et al. (2016) the nutritional content in the form of protein in Moina sp. is less able to meet the needs of larvae for their growth. because the protein contained in Moina sp. is not optimal for

the growth of fish larvae. So that the energy that has been produced is used up for its survival. Growth is inhibited if the protein contained in food is lacking or low (Hartoyo and Sukardi, 2007).

According to Hendrasaputro et al. 2015 in Akmal et al. (2020), viterna is an additional ingredient (supplement) given to feed because it contains a lot of essential amino acids. This supplement can increase appetite, accelerate growth, and increase endurance. Viterna is a supplement made from various natural ingredients that are useful for increasing nutritional content and accelerating growth. Viterna plus supplement contains the amino acids Serine, Tyrosine, Histidine, Iso Leucine, Leucine, Lysine, Methionine, Phenyl Alanine, Tryptophan, Valine, Arginine, Threonine. Aspartate and Glutamate fatty acids. Vitamins A, D, E and K and minerals N, P, K, Ca, Mg, Na, Cl, S, Fe, Zn, Cu, Mn, I, Co, Mb, Se, Cr and F (Aprilia et al., 2018).

The specific growth rate explains that fish are able to utilize feed nutrients to be stored in the body and converted into energy (Widyati 2009 in Erwin et al. 2016). From Table 2. shows that the provision of viterna has a positive impact on the specific growth of catfish larvae, where the best dose is 60 ml / l which is 8.02% while the lowest treatment in the control is 6.95%. Based on these results, it strengthens that the provision of viterna has a positive impact on growth. This strengthens the previous assumption that natural Moina sp feed enriched with viterna has increased nutritional content. Thus, it increases the nutritional value of Moina sp, thus providing a better increase in specific growth rate when compared to the control treatment.

Moina sp enriched with viterna will increase the nutritional content of Moina sp. This is in line with the opinion of Hendrasaputro and Tuiyo (2015), viterna that has been mixed into the feed has a content such as protein and fat that will be digested by fish for energy and growth needs. According to Hartoyo and Sukardi 2007 in Mufidah et al. (2009) water fleas that have been enriched with viterna, the nutritional value, especially protein, increased from 73.3945% (water fleas without viterna enrichment) to 73.5647% in the treatment of adding viterna at a dose of 10 ml/l of water. So that in the study with the increase in the growth of climbing perch given viterna, it showed that there was an increase in the nutritional value of water fleas. Subandiyono (2009), also added that protein and fat will be digested, absorbed and metabolized after being converted into useful energy. Nutrients consumed by fish are digested in the digestive tract, absorbed by the walls of the digestive tract, and appear in the bloodstream as component molecules. Proteins are hydrolyzed into various types of amino acids, and fats are broken down into various types of fatty acids and various other components. These molecules flow in the body and are taken up by various types of tissues to then undergo various chemical reactions, both molecular breakdown or catabolism and molecular synthesis or anabolism. The end result of these reactions is degradation to release the energy contained in the molecule or growth of the organism. According to Hoar (1979) in Royani (2015), if the energy produced from feed breakdown exceeds the amount for body maintenance and daily activities, the remainder will be used for growth.

The results of this study are better than Vitaloka's study (2015) on the provision of water fleas enriched with viterna on early 10-day-old koi larvae for 40 days of maintenance, namely 6.13%/day. This is suspected that in this study the dose of Moina sp. was higher, the ability of the betok fish larvae to eat was quite good and more aggressive, and the frequency of feeding was greater.

Survival Rate of Climbing Perch (Anabas testudineus)
Larvae
Based on Table 2, the best treatment dose was 60 ml/L, which resulted in the highest survival rate of 93.33%, while the lowest survival rate was found in the control group at 70%. The 60 ml/L treatment (D60) proved to be the most effective in enhancing the survival rate of climbing perch larvae, reaching 93.33%. This high survival rate is presumed to be due to the increased nutritional content in Moina sp. that had been enriched with Viterna. This enrichment fulfills the nutritional needs of the larvae and optimizes their physiological activities during the rearing period, including survival and overall health. This finding is also supported by Todolo et al. (2022), who stated that survival is influenced by the availability of feed with high nutritional value.

Survival rate is closely related to mortality, which refers to the death within a population of organisms, thereby reducing the number of individuals (Erwin et al., 2016). Survival rate is defined as the percentage of a population that remains alive over a certain maintenance period (Boer, 2000). It is influenced by

internal factors such as sex, genetics, age, reproductive condition, and disease resistance, as well as external factors including water quality, stocking density, and the quantity and composition of essential amino acids in the feed (Hepher, 1990, in Shofura et al., 2018). The larval stage is considered a critical phase, as it marks the depletion of yolk reserves and the transition to exogenous feeding (Effendie et al., 1997). According to Effendie (2002), larval mortality is largely due to insufficient availability of planktonic food when larvae begin feeding externally after the yolk sac is depleted.

The survival rate of climbing perch larvae in this study was higher than that reported by Susanti (2015), who observed survival rates ranging from 68.00% to 90.67% when Daphnia sp. enriched with corn oil was provided to 10-day-old larvae over a 30-day rearing period. Furthermore, the survival rate in this study, ranging from 70% to 93.33%, can be considered optimal. According to Sukendi (2016), larval survival rates can be categorized into three criteria: survival rates above 50% are considered good, between 30% and 50% are moderate, and below 30% are low.

Water Quality Parameters

Water quality is defined as the suitability of water to support the survival and growth of fish (Ahmad, 2004, in Pramleonita et al., 2018). Fish require water with good conditions in order to live healthily and grow optimally, which in turn enhances their survival and growth (Pramleonita et al., 2018). The results of water quality measurements throughout the study are presented in Table 3.

Table 3. Results of Water Quality Improvement during Research

Parameter	Research Range		
	Early	Day 20	Day 40
Temperature (°C)	26-27,1	27,3-28,2	28,4-29,1
pH	7,0-7,1	6,6-6,8	6,3-6,5
DO (ppm)	6,1-6,2	5,7-5,9	5,3-5,6

Based on Table 3, the water temperature during the study ranged from 26 to 29.1°C, pH ranged from 6.3 to 7.1, and dissolved oxygen (DO) levels ranged from 5.3 to 6.2 ppm. These water quality parameters were still considered optimal for the survival of climbing perch (Anabas testudineus) larvae.

The water temperature in the rearing containers for climbing perch larvae ranged from 26 to 29.1°C. This range is still within the optimal limits for larval maintenance. This is supported by Kordi (2004) in Susila (2016), who stated that the optimal temperature range for fish life is between 25–32°C. Furthermore, Widodo et al. (2007) in Susila (2016) noted that the ideal water temperature for the growth of climbing perch is around 25–30°C.

The water pH ranged from 6.3 to 7.1, which is still optimal for the maintenance of climbing perch larvae. According to Huwoyon and Rudhy (2013), climbing perch can tolerate a wide range of pH values, from 3 to 8, and are even capable of surviving in nearly dry aquatic environments. The optimal pH range for climbing perch culture is between 6 and 7 (Sembiring, 2011, in Miranti, 2017).

The dissolved oxygen (DO) content in the rearing water ranged from 5.3 to 6.2 ppm, which is also considered optimal for larval survival. DO levels between 1.0 and 5.0 mg/L may disrupt fish growth but still allow survival, while DO levels above 5.0 mg/L are considered optimal conditions (Boyd, 1982).

CONCLUSION

The administration of Moina sp. enriched with different doses of Viterna had a significant effect on the survival and growth of climbing perch (Anabas testudineus) larvae. The best treatment in this study was D60 (Viterna dose of 60 ml/L of water), which resulted in an absolute weight gain of 0.47 g, an absolute length gain of 2.64 cm, a specific growth rate of 8.01%/day, and a survival rate of 93.33%. The water quality parameters observed during the study remained within the optimal range for the rearing of climbing perch larvae, with temperatures of 26–29.1ºC, pH values between 6.3–7.1, and dissolved oxygen levels of 5.3–6.2 ppm.

These findings indicate that the enrichment of live feed with supplements such as Viterna represents a promising applied technological innovation for enhancing the efficiency of the freshwater fish hatchery phase, particularly for local species such as climbing perch. The use of Viterna, commonly utilized in terrestrial livestock farming, shows potential for adaptation in aquaculture systems that rely on natural feed. This study contributes to the development of more sustainable aquaculture strategies based on local resource utilization.

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