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The Optimatization of Kissing Gourami (*Helostoma temminckii*) Fry Density in Recirculation System Culture

Optimasi Densitas Benih Ikan Tambakan (Helostoma temminckii) dengan Budidaya Sistem Resirkulasi

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ABSTRAK

Ikan tambakan (*Helostoma temminckii*) adalah jenis ikan rawa yang berpotensi untuk dibudidayakan. Peningkatan hasil produksi ikan tambakan dapat dilakukan dengan meningkatkan densitas. Permasalahan budidaya dengan densitas yang tinggi yaitu menurunnya kualitas air sehingga kelangsungan hidup dan pertumbuhan ikan tidak maksimal. Salah satu upaya untuk mengatasi masalah tersebut yaitu melalui pengelolaan lingkungan budidaya menggunakan sistem resirkulasi. Tujuan penelitian ini adalah untuk menentukan densitas optimal benih ikan tambakan pada sistem resirkulasi. Metode penelitian ini menggunakan rancangan acak lengkap (RAL) dengan menggunakan 4 perlakuan densitas ikan tambakan yaitu masing-masing 2, 3, 4, dan 5 ekor/L yang dilakukan dengan 3 ulangan. Parameter yang diamati meliputi kualitas air, pertumbuhan, tingkat kelangsungan hidup, dan kadar glukosa darah ikan. Hasil penelitian menunjukkan bahwa densitas terbaik ialah 2 ekor/L dengan pertumbuhan bobot mutlak 0,55 ± 0,02 g dan panjang mutlak 0,53 ± 0,04 cm, kelangsungan hidup 86,67%, kadar glukosa darah 50,67−52,55 mg/dL dan rasio konversi pakan 1,29. Nilai kualitas air selama pemeliharaan berada pada kisaran yang layak untuk kehidupan ikan tambakan, yaitu suhu 28,4−30,4°C, pH 6,6−7,4, oksigen terlarut 5,08−6,54 mg/L dan amonia 0,12−0,25 mg/L.

Kata kunci: kelangsungan hidup, kualitas air, pertumbuhan, stres

ABSTRACT

Kissing gourami (*Helostoma temminckii*) is a type of swamp fish that has the potential to be cultivated. The increasing of yield for this fish can be done by optimization of stocking density. The problem of aquaculture with high stocking density is decreased water quality, growth and fish survival. One of the efforts to overcome this problem is through the management of the cultivation environment using a recirculation system. The purpose of this study was to determine the optimal density of kissing gourami fry on a recirculation system. This research method used a completely randomized design (CRD) using 4 treatments of fish stocking density (2, 3, 4, and 5 fish/L, respectively), which was carried out with 3 replications. The parameters observed included water quality, growth, survival rate, and fish blood glucose level. The results of this study indicated that the best density was 2 fish/L with absolute weight growth was 0.55 ± 0.03 g, absolute length growth was 0.53 ± 0.05 cm, survival rate was 86.67 %, blood glucose levels were 50.67−52.56 mg/dL and food conversion ratio was 1.29. The water quality value during the fish rearing was in the appropriate range, i.e. temperature 28.4−30.4°C, pH 6.6−7.4, dissolved oxygen 5.08−6.54 mg/L and ammonia 0.12−0.25 mg/L.

Keywords: growth, stress, survival, water quality

INTRODUCTION

Kissing gourami (*Helostoma temminckii*) is one of the freshwater fish that is often found in several areas of Southeast Asia (Sugihartono, 2014). Kissing gourami have a high economic value because apart from being used as consumption fish (fresh and processed), they also have the potential to be traded as ornamental fish in several countries. This fish is easy to breed, grow fast, and is one type of ornamental fish that has a potential demand in Bangladesh (Hossain & Mohsin, 2021), Australia, North America, Europe, Japan (Wildayana & Armanto, 2021), India (Jena et al., 2019), as well as Thailand, Philippines and Malaysia (Kottelat, 2013).

To meet the increasing demand for human consumption of fishery products, especially kissing gourami commodities, aquaculture activities are needed. Kissing gourami farming with high density is able to produce higher fish production. However, the problem faced in high density aquaculture is a decrease in water oxygen levels and an increase in fish metabolic products. Metabolic products and excess feed residue, especially in high density fish culture, can cause a decrease in water quality in the culture media. Poor water quality causes the fish's appetite to decrease so that fish growth will be slow and can result in fish death (Raharjo et al., 2016).

In addition, the high fish density will have an impact on changes in the behavior and physiological conditions of fish due to competition in space utilization (Sukmawantara et al., 2021). If this condition continues, it can cause changes in fish health conditions so that survival and growth will be hampered (Raharjo et al., 2016). High fish density during rearing can cause fish stress, resulting in a decrease in body resistance and the long term can cause death. Segovia et al. (2012) declared that in the high density culture is required water quality management to remove metabolic waste and reduce the risk of oxygen depletion.

One alternative in managing water quality in fish culture media is to use a recirculation system. This is in accordance with the statement of Jubaedah et al. (2020) that the recirculation system could minimize water changes and maintain water quality. The water recirculation system can be supported through physical, chemical, and biological filtration, which functions to maintain water quality (Hastuti et al., 2017). One of the filter materials used is charcoal. The use of charcoal can significantly improve water quality by reducing the content of nitrogen, ammonia, nitrite, phosphate. (Schmidt et al., 2019). Research conducted by Raharjo et al., (2016) showed that the optimal density for kissing gourami with a size of 3−5 cm and a weight of 1.4 g is 2 fish/L.

In that study, the density of more than 2 fish/L showed a lower value of growth and survival rate of fish. Therefore, it is necessary to do further research to increase the production of aquaculture with higher density optimization, so that it still supports the growth of kissing gourami (*H. temminckii*) in the recirculation system. This study aimed to determine the optimal density of kissing gourami (*H. temminckii*) size of 4.05 ± 0.5 cm in a recirculation system, so that water quality can be maintained in a proper condition, and it can still support the survival and growth of kissing gourami optimally.

MATERIALS AND METHODS

Materials

The materials used in this study included kissing gouramy fry (length of 4.0 ± 0.5 cm), potassium permanganate, charcoal as a filter medium and commercial pellets with a protein content of 40%. The tools used in this study include an aquarium (measuring 23 x 23 x 23 cm^3), thermometer, water pump, PVC pipe (⌀ 0.5 and 4 inch), DO meter, pH meter, digital scale, aeration hose, aeration stone, filter, aquarium pipe (⌀ 16 mm), pipe connector (⌀ 16 mm to 0.5 inch), blower, spectrophotometer and Gluco kit test.

Research Methods

This study was designed using a completely randomized design with four treatments and three replications. The treatment applied was as follows:

P1 : Rearing of kissing gourami fry with a density of 2 fish/L

P2 : Rearing of kissing gourami fry with a density of 3 fish/L

P3: Rearing of kissing gourami fry with a density of 4 fish/L

P4 : Rearing of kissing gourami fry with a density of 5 fish/L

Procedure

Preparation of Fish Rearing Containers

The container used were 12 glass aquariums which were arranged according to a random treatment code. The prepared aquarium was filled with 10 L of water, then a filter unit was installed and aeration was given. The filter used was a charcoal with a volume of 1.6 L based on the modification of Tanaya and Prihatmo, (2021). After that, the system was stabilized by flowing water for 1 week, so that the nitrifying bacteria increased in the filter media. The filter design in this study was presented in Figure 1.

Rearing

Fish were stocked into the aquarium according to the density treatment. Before stocking the fish, the fish were acclimatized for 5 minutes to adjust the water temperature in the plastic bag and the aquarium. The rearing of fish was carried out in a controlled system by feeding 5% of body weight with a frequency of feeding three times a day, at 08.00, 12.00, and 16.00 in local time for 30 days. A sampling of fish length and weight was carried out once a week. Blood glucose levels were measured at the beginning and the end of the study by taking 2−4 µL of fish blood samples from 10% of the number of fish from each treatment container and then tested using the Gluco kit Test.

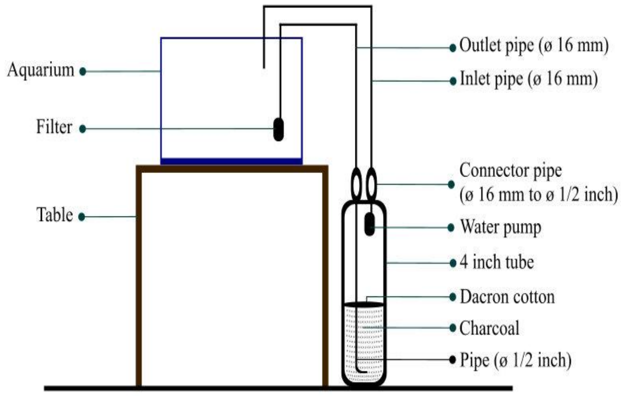

Figure 1. Recirculation system unit

Data collection

Absolute Length Growth

The formula used to calculate the absolute length growth of fish was (Firdaus & Mukti, 2021):

$$L = L_t - L_0$$

Note:

L : Absolute length growth of fish (cm)

Lt: Fish length at the end of rearing (cm)

L_0: Fish length at the beginning of rearing (cm)

Absolute Weight Growth

The formula used to calculate the absolute weight growth of fish based on Firdaus and Mukti (2021) was:

$$W = W_t - W_0$$

Note:

W : Absolute weight growth of fish (g)

Wt: Fish weight at the end of rearing (g)

W_0: Fish weight at the beginning of rearing (g)

Survival Rate

The calculation of the percentage of fish survival based on Firdaus and Mukti (2021) was:

$$SR = \frac{Nt}{N} \text{ x } 100$$

Note:
SR : Survival rate (%)
Nt : Number of fish at the end of rearing
N_0 : Number of fish at the beginning of rearing

FCR (*Feed Conversion Ratio*)

Calculation of feed conversion ratio based on Azaza et al. (2014) was:

$$FCR = \frac{F}{(Wt+D)-W}$$

Note:
FCR : Feed Conversion Ratio
Wt : Final fish weight (g)
W_0 : Initial fish weight (g)
D : Total of dead fish weight (g)
F : Amount of feed given (g)

Fish Blood Glucose Levels

Measurement of blood glucose levels of fish using the Gluco kit Test.

Data analysis

The water physical and chemical values obtained from each treatment include temperature, pH, dissolved oxygen, and ammonia were analyzed descriptively. Data on growth, survival, blood glucose levels, and feed conversion ratio were analyzed by analysis of variance test at a 95% confidence level. A further test of Honestly Significant Difference (HSD test) was carried out if there was a significant difference between the mean treatment values.

RESULTS

Data on absolute weight and length growth of kissing gouramy fry during the rearing period with a recirculation system were presented in Table 1. The data in Table 1 showed that the highest absolute growth of cultured fish was found in treatment P1 with an average absolute weight growth of 0.55 ± 0.02 g and an absolute length growth of 0.53 ± 0.04 cm. Based on the results of growth, it is known that rearing kissing gourami with a density of 2 fish/L produces the best growth and is significantly different when compared to treatments P3 and P4 (4 and 5 fish/L).

Table 1. Growth of absolute weight and length of kissing gouramy fry

Treatment	Average Value of Absolute Growth	
	Weight (g) ($HSD_{0.05}$ = 0.040)	Length (cm) ($HSD_{0.05}$ = 0.10)
P1	0.55 ± 0.02^c	0.53 ± 0.04^b
P2	0.49 ± 0.01^b	0.47 ± 0.03^{ab}
P3	0.44 ± 0.01^a	0.41 ± 0.03^a
P4	0.43 ± 0.00^a	0.38 ± 0.03^a

Note: Means followed by different superscript letters in the same column show significantly different results at the 5% level.

The survival rate of kissing gourami at the end of the rearing period showed that the treatment with a density of 2 fish/L gave a higher survival rate than the other treatments (Table 2). However, the results of the analysis of variance showed that the treatment had no significant effect on the survival rate of kissing gourami.

Table 2. The survival rate of kissing gourami fry

Treatment	Survival Rate (%)
P1	86.67 ± 2.35
P2	85.56 ± 1.57
P3	83.33 ± 1.17
P4	82.00 ± 0.00

The feed conversion ratio at the end of the rearing showed that the treatment with a density of 2 fish/L resulted in a low feed conversion ratio value of 1.29 and the highest feed conversion at P4 (5 fish/L) with a value of 2.03 (Table 3). The results of the HSD test showed that the treatment of P4 was significantly different from the other treatment.

Table 3. Feed conversion ratio

Treatment	Feed Conversion Ratio (HSD $_{0.05}$ = 0.54)
P1	1.29 ± 0.057^{a}
P2	1.55 ± 0.13^{ab}
P3	1.82 ± 0.09^{ab}
P4	2.03 ± 0.34^{b}

Note: Means followed by different superscript letters in the same column show significantly different results at the 5% level.

The blood glucose level of the kissing gourami fry at the end of the rearing showed that the treatment with a density of 2 fish/L resulted in the lowest blood glucose level of 52.55 mg/dL and was significantly different from the other treatments (Table 4). The highest blood glucose levels were found in the treatment with a density of 4 fish/L (P4) which reached 95.66 mg/dL.

Table 4. Blood glucose level of kissing gourami fry

Treatment	Blood Glucose Level (mg/dL)	
	Initial	End Rearing (HSD$_{0.05}$ = 11.78)
P1	50.67	52.55 ± 0.955^{a}
P2		65.22 ± 3.55^{b}
P3		85.33 ± 1.44^{cd}
P4		95.66 ± 7.24^{d}

Note: Means followed by different superscript letters in the same column show significantly different results at the 5% level.

The results of water quality measurements which include temperature, pH, dissolved oxygen, and ammonia are presented in Table 5.

Table 5. Water quality during the rearing of aquaculture fry

Variable	Range Value	Optimum Range*
Temperature (^{OC})	28.3−30.5	20−35
pH	6 −7.9	5−9
Dissolved oxygen (mg/L)	3.11 – 6.54	>3
Ammonia (mg/L)	0.10− ≤ 0.25	<1

Note: *: Arifin et al. (2017)

DISCUSSION

Differences in fish density during the rearing period caused a significant effect on the growth of absolute weight and length of kissing gourami. An increase in the density of kissing gourami during rearing showed the opposite pattern to the growth of absolute weight and absolute length of kissing gourami at the end rearing. This is related to the competition for higher space utilization so that it will trigger higher stress levels. According to Rahmawan et al. (2020) stress from high stocking densities can increase energy requirements for maintenance so as to reduce energy for growth. The energy used by fish to maintain this homeostatic condition will be higher if the physiological load is greater due to the higher density of fish. Mukti et al. (2019) stated that growth occurs when there is an excess of energy from the feed consumed by fish after the needs for metabolism are met. As the density increased, the growth of absolute weight and absolute length of kissing gourami fry decreased.

The existence of competition in the utilization of higher space and feed capacity in fish culture with higher density will cause the allocation of energy needed in the homeostatic process is greater. Such conditions can trigger stress in fish that will cause a decrease in survival. Raharjo et al. (2016) stated that high density makes the space for the fish narrower, thus placing an excessive burden on the fish. The impact of this stress can cause decreasing physiological performance until the death.

Based on observations during the rearing period, it was shown that the feed conversion ratio increased with increasing density. Raharjo et al. (2016) stated that at a lower density will result in higher growth due to lower feed competition, so that the energy allocation for growth will be greater. This is associated with a lower feed ratio value. The lower of the feed conversion ratio value showed the better utilization of feed for growth. According to Fry et al.

(2018) the value of a fairly good feed conversion ratio in cultured fish generally ranges from 1.0 to 1.4.

On the other hand, the growth of cultured fish is closely related to the physiological conditions and aquaculture environment. The results of the measurement of blood glucose levels of kissing gourami showed that it increased with increasing density. Prihadi et al. (2017) stated that an increase in density can cause stress, which is indicated by an increase in blood glucose levels, so that it can inhibit growth and even death. According to Andrade et al. (2015) fluctuations in blood glucose levels in fish indicated the ability of fish to use energy sources from glucose to maintain their ideal conditions against the burden of changing environmental conditions. This is influenced by several factors, including the duration and intensity of the stressor, species, stadium, and endurance of the fish itself.

The results of the physical and chemical water measurement showed that the management of the water quality of the culture media during the rearing period had been able to support the survival of kissing gourami which was quite high. Arifin et al. (2017) stated several physical and chemical water values in kissing gourami culture media that can support optimal survival, for temperature was 25−30ºC, pH was 5−9, dissolved oxygen was > 3 mg/L, and ammonia was < 1 mg/L.

CONCLUSSION

The optimum density for rearing kissing gourami fry (size 4.0 ± 0.5 cm) with a recirculation system for 21 days, which resulted in the highest survival and growth as well as the lowest glucose level and feed conversion ratio was 2 fish/L.

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REFERENCES

Andrade T, Afonso A, Jimenez AP, Teles AO, Heras V, Mancera JM, Serradeiro R, Costas B. 2015. Evaluation of different stocking densities in a Senegalese sole (*Solea senegalensis*) farm: Imlicationa for growth. humoral immune parameters and oxidative status. *Aquaculture*. 438: 6−11. DOI: 10.1016/j.aquaculture.2014.12.034.

Arifin OZ, Wahyulia C, Jojo S, Anang HK. 2017. Resilience of kissing gouramy (*Helostoma temminkii*) on several water quality parameters in aquaculture environment. *Jurnal Riset Akuakultur*. 12 (3): 241−251. DOI: 10.15578/jra.12.3.2017.241-251.

Azaza MS, Assad A, Maghrbi W, El-Cafsi M. 2013. The effects of rearing density on growth, size heterogeneity and inter-individual variation of feed intake in monosex male Nile tilapia Oreochromis niloticus L. *Animal*. 7 (11): 1865−1874. DOI: 10.1017/S1751731113001493.

Firdaus MSI, Mukti R C. 2021. Utilization of papaya leaves (*Carica papaya*) in feed on growth of catfish (*Clarias* sp.) in Muara Enim, South Sumatera. *IJOTA* (*Indonesian Journal of Tropical Aquatic*). 4 (1): 50−56. DOI: 10.22219/ijota.v4i1.14453.

Fry JP, Mailloux NA, Love DC, Milli MC, Cao L. 2018. Feed conversion efficiency in aquaculture: do we measure it correctly?. *IOP Environmental Research Letters*. 13 (2): 024017. DOI: 10.1088/17489326/aaa273.

Hastuti YP, Nirmala K, Rusmana I, Affandi R, Kuntari WB. 2017. Optimization of stocking density in intensification of mud crab *Scylla cerrata* cultivation in the recirculation system. *Jurnal Akuakultur Indonesia*. 16: 53−260. DOI: 10.19027/jai.16.2.253-260.

Hossain MN, Mohsin ABM. 2021. Native and non-native ornamental aquarium fishes of Bangladesh. *IJOTA* (*Indonesian Journal of Tropical Aquatic*). 4 (1): 1–13. DOI: 10.22219/ijota.v4i1.14023.

Jena AK, Biswas P, Pattanaik SS. 2019. Recent trends in breeding and trade of ornamental gourami in India. *Word Aquaculture* [online], 9 March 2019.

Jubaedah D, Marsi M, Wijayanti M, Yulisman Y, Mukti RC, Yonarta D, Ffitriana EF. 2020. Application of recirculation system using filter in the management of catfish water quality. *Jurnal Akuakultura Universitas Teuku Umar.* 4 (1): 1−5. DOI: 10.35308/ja.v4i1.2436.

Kottelat M. 2013. *The fishes of the inland waters of Southeast Asia: A catalogue and core bibliography of the fishes known to occur in freshwaters. mangroves and estuaries.* Raffles Museum of Biodiversity Research, Department of Biological Sciences, National University of Singapore, Singapore.

Mukti RC, Yonarta D, Pangawikan AD. The use of Indigofera zollingeriana leaves as feed ingredient of patin Pangasius sp. *Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan.* 8: 18−25. DOI: 0.24815/jts.v%25vi%25i.13056.

Prihadi TH, Saputra A, Huwoyon GH, Pantjara B. 2017. The effect of stocking density on survival rate, growth, and hematological parameters of sand goby *Oxyeleotris marmorata juvenile. Jurnal Riset Akuakultur*. 12: 341−350. DOI: 10.15578/jra.12.4.2017.341-350.

Raharjo EI, Rachmini, Riduan A. 2016. The effect of different rearing density on growth and survival of fish fry biawan (*Helostoma temmincki*). *Jurnal Ruaya.* 4 (1): 45−53. DOI: 10.29406/rya.v4i1.693.

Rahmawan YH, Hakim RR, Sutarjo GA. 2020. Effect of differences in stocking density in round tarpaulin ponds on growth and survival of *Osphronemus gourami. IJOTA (Indonesian Journal of Tropical Aquatic*). 3 (1): 14-20. DOI: 10.22219/ijota.v3i1.5973.

Schmidt HP, Hagemann N, Draper K, Kammann C. 2019. The use of biochar in animal feeding. *PeerJ,* 7, 1-54. DOI: 10.7717/peerj.7373.

Segovia E, Muñoz A, Flores H. 2012. Water flow requirements related to oxygen consumption in juveniles of *Oplegnathus insignis*. *Latin American Journal of Aquatic Research*. 40 (3): 766. DOI: 103856/vol40-issue3-fulltext-23.

Sugihartono M, David D. 2014. Survival and growth response of kissing gourami larvae toward stocking densities (*Helostoma temminckii*). *Jurnal Ilmiah Universitas Batanghari Jambi.* 14 (4): 103−107. DOI: 10.33087/jiubj.v14i4.232.

Sukmawantara GD, Arthana IW, Kartika GAR. 2021. Performance of milkfish (*Chanos chanos*) cultured by different stocking density in floating net Cages Lake Batur, Trunyan Village, Bali. *Advances in Tropical Biodiversity and Environmental Sciences*. 5 (1): 29−33. DOI: 10.24843/ATBES.v05.i01.p05.

Tanaya FY, Prihatmo G. 2021. Combination of zeolite, charcoal and water spinach as integrated filters to reduce ammonia level in aquaponic System. *Sciscitatio*. 2 (1): 7−15. DOI: 10.21460/sciscitatio.2021.21.

Wildayana E, Armanto ME. 2021. Empowering Indigenous Farmers With Fish Farming on South Sumatra peatlands. *Habitat.* 32 (1): 1−10. DOI: 10.21776/ub.habitat.2021.032.1.