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Growth Performance, Survival Rate and *p38 Mitogen-Activated Protein Kinase* of Giant Gourami Juvenile (*Osphronemus goramy*) on Different Temperature Levels

Laju Pertumbuhan, Kelangsungan Hidup dan Kadar *p38 Mitogen-Activated Protein Kinase* Benih Ikan Gurami (*Osphronemus goramy*) yang Dipelihara pada Suhu yang Berbeda

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Abstract

The low survival value of gourami fish juvenile is because gourami is easily stressed. Changes in temperature in the rearing media environment can affect fish life and can even cause stress. Cortisol and blood glucose are indicators of early stress in fish which then naturally respond to the presence of environmental stressors by producing stress proteins such as mitogen-activated protein kinases (MAPKs). The purpose of this study was to analyze changes in growth, survival and p38 MAPKs of gourami fish juvenile reared at different temperatures. The working method used in this research is the experimental method. This research was conducted with 3 treatments and 3 replicates. The treatments given include (A) 27°C temperature treatment, (B) 29°C temperature treatment, (C) 31°C temperature treatment. Observations made were measurements of growth, survival, and p38 MAPK levels as well as physical and chemical parameters. The results of this study indicate that 31°C is the best temperature for gourami, the expression of p38 MAPK shows low distribution characterized by little brown color, survival rate of 80%, length growth of 1.8-2cm and daily growth rate of 0.21 g/day. During the study the pH in the treatments ranged from 7.3-8.1, while oxygen levels ranged from 4.2-7.7mg/l.

Keywords: Gourami, p38 mapk, growth, survival, temperature

Abstrak

Rendahnya nilai kelulushidupan benih ikan gurami disebabkan karena ikan gurami mudah mengalami stres. Perubahan suhu di lingkungan media pemeliharaan dapat mempengaruhi kehidupan ikan bahkan dapat menyebabkan stres. Kortisol dan glukosa darah merupakan indikator stres awal pada ikan yang kemudian secara alami sel-sel pada ikan merespon kehadiran stressor lingkungan dengan memproduksi protein stress seperti mitogen-activated protein kinases (MAPKs). Tujuan dari penelitian ini adalah Menganalisa perubahan pertumbuhan, kelangsungan hidup dan p38 MAPKs benih ikan gurami yang dipelihara pada suhu yang berbeda. Metode kerja yang digunakan dalam Penelitian ini adalah metode experimen Penelitian ini dilakukan dengan 3 perlakuan dan 3 kali ulangan. Perlakuan yang diberikan antara lain (A) perlakuan suhu 27°C, (B) perlakuan suhu 29°C, (C) perlakuan suhu 31°C. Pengamatan yang dilakukan yaitu pengukuran pertumbuhan, kelangsungan hidup, dan kadar p38 MAPK serta parameter fisika dan kimia. Hasil penelitian ini menunjukkan bahwa suhu 31°C merupakan suhu terbaik bagi ikan gurami, ekspresi p38 MAPK menunjukan rendahnya sebaran ditandai dengan sedikitnya warna coklat, tingkat kelangsungan hidup sebesar 80%, pertumbuhan panjang sebesar 1,8-2cm dan laju pertumbuhan harian sebesar 0,21 g/hari. Selama penelitian pH pada perlakuan berkisar antara 7,3-8,1, sedangkan kadar oksigen berkisar antara 4,2-7,7mg/l.

Kata Kunci: Gurami, p38 mapk, pertumbuhan,kelulushidupan suhu

1. Introduction

Gourami (*Osphronemus gouramy Lac*) is a fish that lives in stagnant water. This fish is susceptible to low temperatures and has additional respiratory organs to take oxygen from outside the water (Pratama & Akhmad, 2018).

Despite their high economic value, gourami's productivity is lower than other freshwater fish species. This is due to the obstacles often faced, namely the high mortality rate at the larval and juvenile stages, up to 50-70%, and the slow growth rate (Laksono *et al*., 2023).

The low survival value of gourami fish juveniles is because gourami is easily stressed. Changes in temperature in the rearing media environment can affect fish life and cause

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stress. Although fish can acclimatize to relatively high temperatures, to a certain degree, an increase in temperature can cause fish death. According to (Nasution *et al*. 2023), fish that experience stress due to temperature changes will increase the frequency of operculum openings. The frequency of fish operculum opening tends to increase. Fish move the operculum faster as a physiological response to maintain oxygen concentration. When fish are continuously exposed to stress, the immune system weakens, and the fish's resistance to disease decreases.

According to Jailani *et al.* (2020), stressed fish will avoid anabolic activities such as growth and reproduction, which in the long term can decrease growth, disease resistance, reproductive success, swimming display, and other characteristics of the entire biota or population.

Fish cells naturally respond to environmental stressors by producing stress proteins such as mitogen-activated protein kinases (MAPKs). MAPKs are one of the essential cellular signaling systems in fish in response to the presence of environmental stressors, so these stress proteins have the potential to be used as molecular biomarkers (Saputra, 2020). The application of molecular biomarkers is essential in the aquaculture business for biomonitoring the waters that are the medium for raising cultured organisms. Early detection of aquatic environmental stressors can prevent aquaculture business failure due to decreased production.

2. Materials and Methods

This study used test fish in the form of *gourami* soang fish juvenile (*Osphronemus gouramy*), size 7 cm, as many as 90 fish. The feed used is commercial feed. Feeding is done by satiation. Fish were kept for 42 days in aquariums with a size of 100 × 40 × 50 $cm^{3,}$ as many as 9 pieces.

This study was conducted with three treatments and three replications. The treatments given were (A) 27°C temperature treatment, (B) 29°C temperature treatment, and (C) 31°C temperature treatment. Observations were measurements of p38 MAPK levels, growth, survival, and physical and chemical parameters. The p38 MAPK was measured using the immunohistochemical method. Furthermore, the data obtained were analyzed using Analysis of Variance (ANOVA) and F test with a 95% confidence interval.

3. Results and Discussion

Results

Observation of p38 MAPK expression using the scoring method to determine color distribution. A strong positive reaction is indicated by a dark brown to blackish color (+++), a moderate reaction is light brown (++), and a weak reaction is light brown mixed with blue. At 27°C, the average color percentage is 3.7% strong positive reaction, 14.4% medium positive reaction, and 15.1% weak positive reaction. At a temperature of 29^{o} C, the average percentage of color is 3.9% strong positive reaction, 16.9% medium positive reaction, and 6.4% weak positive reaction. At 30^{o} C, the average color percentage was 2.9% strong positive reaction, 1.75% moderate positive reaction, and 2.2% weak positive reaction, presented in Figure 1.

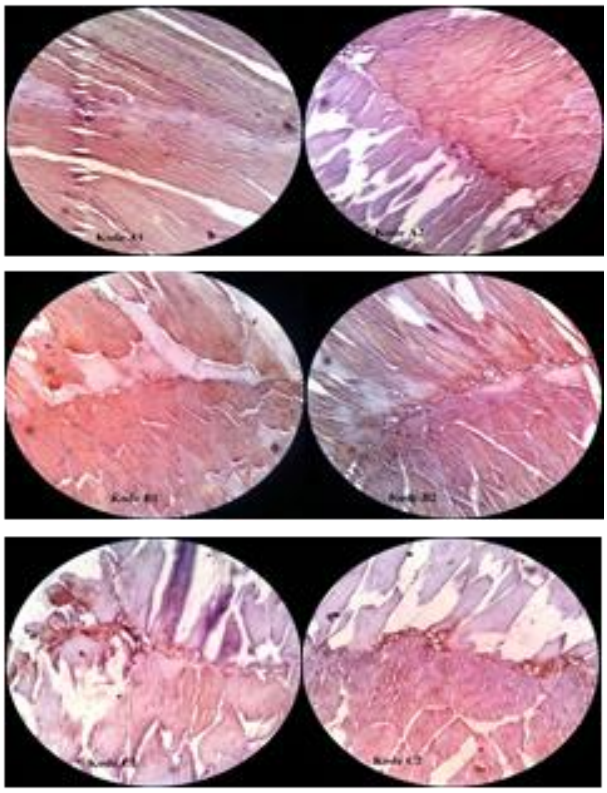

Figure 1. Expression of p38 MAPK in tissues with IHK staining at 1000x magnification. (code A = temperature 27°C, code B = temperature 29°C, code C = temperature 31°C)

Gourami seed survival showed the highest results in the 29 and 31 temperature treatments, at 80%, and the lowest in the 27 temperature treatment, at 76.66%, as presented in Figure 2.

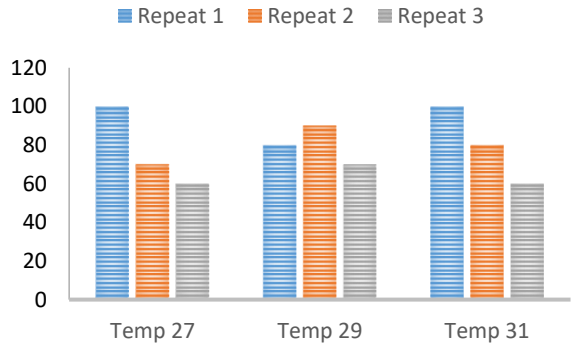

Figure 2. Survival (%) of *gourami* (*Osphronemus gouramy*) juvenile during the study.

The highest average length growth was at 31°C, as presented in Figure 3.

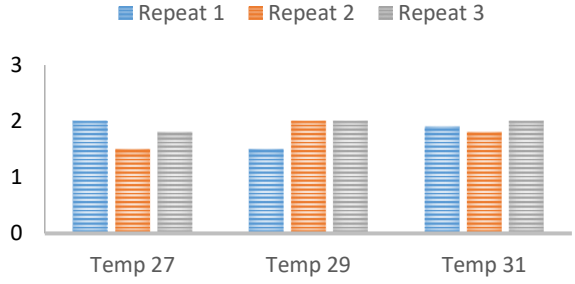

Figure 3. Absolute length growth (cm) of gourami (*Osphronemus goramy*) juvenile during the study

As presented in Figure 4, the highest daily individual growth rate of gourami fish juveniles was obtained in the 31°C temperature treatment at 0.21 g/day, and the lowest was obtained in the 27°C temperature treatment at 0.15 g/day.

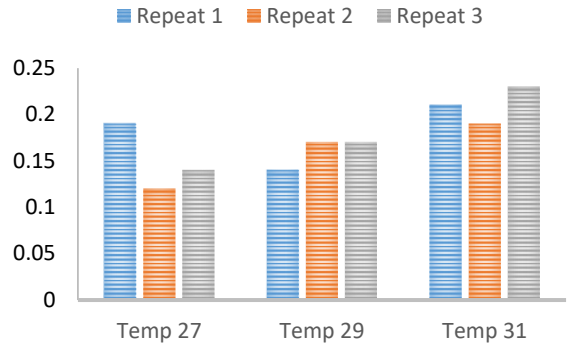

Figure 4. Daily growth rate (g/hr) of gourami (*Osphronemus gouramy*) juveniles during the study.

The water quality parameters measured in this study were pH, temperature, and DO. These parameters support growth, so water quality must be maintained optimally. Water quality parameters in all treatments in this study were relatively normal, as presented in Table 1.

Table 1.
Average water quality during the study

Parameters	Temperature (°C)		
	27	29	31
DO	4,5-7,4	4,6-7,7	4,2-7,2
pH	7,5-8,1	7,3-8,1	7,4-8,0

Discussion

Amrullah *et al*. (2015) stated that each organism has a resistance or tolerance level to environmental changes within certain limits. According to Hasanalipour (2013), non-optimal environmental conditions will cause stress. Radoslav *et al.* (2013) added that fish can adapt to temperature changes to a certain extent, but if the temperature change exceeds the threshold, stress will occur. Soltanian (2014) added that natural temperature changes, such as daily temperature changes, do not cause stress, while temperature shock has a negative effect on fish.

In a state of stress, there will be an increase in the excretion of catecholamine hormones, glucagon, glucocorticoids, β-endorphins, and growth hormone. Stress causes the overproduction of cortisol, a hormone that counteracts the effects of insulin and causes high blood sugar levels (Fitri, 2021). The performance of insulin determines the successful supply of glucose into cells. Meanwhile, insulin inactivation occurs during stress, thus closing the use of glucose by cells (Wendelaar, 1997 in Sulmartiwi, 2013). Increased glucose input to endothelial cells through GLUT-1 (*glucose transporter-1*) will cause increased glucose metabolism, resulting in hyperactivation of the electron transport chain in mitochondria and the overproduction of ROS (Brownlie, 2005). ROS can affect many cellular signaling pathways, such as protein kinases (MAPK), ion channels, and transcription factors (Van den Oever et al., 2010). Activated p38 MAPK enzymes can affect several cellular processes, including cell growth and apoptosis, inflammation, and tissue-specific responses to stress through regulation of gene expression and various pathological effects (Evans *et al*., 2002).

Gourami seed survival showed the highest results in the 29 ° C and 31 ° C temperature treatments at 80% and the lowest in the 27 ° C temperature treatment at 76.66%. The absence of significant differences in results between treatments is due to the temperature difference used, a temperature range that gourami fish seeds can still tolerate, and the absence of significant temperature fluctuations during the maintenance period. Gourami fish will grow well at 27 - 30.5 ° C (Amornsakun *et al.*, 2004). A good temperature for the growth of aquatic animals in the tropics ranges from 25 - 32°C (Boyd and Lichkoppler, 1979). The lower temperature of the fish environment can make the fish become stressed, which will cause death to the fish (Nugraha, 2022).

The highest average length growth was found in the 31°C temperature treatment, where during maintenance, there was a rapid increase in growth of 1.8-2 cm. Each fish species has an optimum temperature, where growth can reach its optimum; temperatures outside this range continuously cause stress and even death. At a temperature of 30^{o} C, it is the best temperature for maintaining gourami fish seeds. These conditions cause the digestive process to run smoothly and spur food absorption so that the rate of gastric emptying will run quickly. This will cause feed consumption to increase so that the feed consumed will be more and the growth will be more optimal. Wulansari et al. (2022) believe an increase in temperature positively changes the respiratory rate, feed consumption, enzyme activity, oxygen consumption, and feed metabolism, so it affects growth. At low temperatures, gourami experience decreased growth. Low water temperatures cause reduced oxygen and fish stress. The metabolic process of fish will also experience inhibition, and fish appetite will decrease, causing several factors that can occur, namely slow growth rates, decreased fish weight, and a lot of unutilized feed (Sianturi, 2018).

During the study, the pH level of the treatment ranged from 7.3 to 8.1. This value is still at the standard water quality limit for freshwater fish. The optimal pH of the water to support fish growth is between 6.5 and 9, while the pH range of 5-6 can cause fish growth to slow. Deadly pH value for fish is less than 4 and more than 11. A pH of less than 6.5 or more than 9.5 for a long time will affect fish growth and reproduction (Boyd 1990). The pH value of the gourami cultivation range is 7.12 - 7.60 (Effendi *et al.*, 2006).

The oxygen range during the study was still between 4.2-7.7 mg/L by providing aeration to stabilize dissolved oxygen. Following Boyd's (1990) statement, fish growth and survival are good at DO values > 3.5 mg/L. Sarwono and Sitanggang (2007) stated that the best dissolved oxygen content for carp rearing is between 4-6 mg/l. Although DO levels in the maintenance media are below 4 mg/l, carp do not experience oxygen deficiency.

4. Conclusion

Temperature treatment does not significantly affect the growth, survival, and p38 mark levels of gourami (*Osphronemus goramy*). The best results were obtained in the 31°C temperature treatment.

Bibliography

Amrullah R, Rosmawati,dan Mulyana. 2015. Gula Darah dan Mortalitas Benih Ikan Nilem (Osteochilus hasselti) yang Dipelihara pada Media Salinitas Berbeda. Jurnal Mina Sains. 1(2):49-57.

Amornsakum T, Wasan S, dan Ponpanom P,. 2004. Some Aspects In Early Life Stage of Siamese gourami. Songklanakarin J. Sci. Technol. 26(3): 357-356.

Boyd dan Lichkopler.1979. Water Quality Management in Pond Fish Culture. International Centre for Aquaculture Agricultural Experiment Station, Auburn University, Alabama.

Boyd, C. E. 1990. Water Quality in Ponds for Aquaculture. Alabama Agricultural Experiment Station. Auburn Station. Birmingham Publishing Co.

Effendi. 2006. Pengantar Akuakultur. Penebar Swadaya, Jakarta.

Evans JL, Goldfine ID, Maddux BA, and Grodsky GM. 2002. Oxidative Stress and Stress-Activated Signaling Pathways: A Unifying Hypothesis of Type 2 Diabetes. Endocrine Reviews. 23(5):599–622.

Saputra Fredo, Maheno S. W, dan Eric A. 2020. The Effect Of Different Temperature On Survival Rate And P38 Mapk (Mytogen Activity Protein Kinase) Of Pangasius Djambal. Journal Of Aquaculture Development And Environment. 3(1):148-151.

Hasanalipour, A. Soheil E., Hadi P., dan Mahmoud B. 2013. Effects of Stocking Density on Blood Cortisol, Glucose and Cholesterol Levels of Immature Siberian Sturgeon (Acipenser baerii Brandt, 1869). Turkish Journal of Fisheries and Aquatic Sciences. 13:27-32.

Jailani, A. Q., Muhammad T dan Eric A. 2020. Laju Pertumbuhan Dan Kelangsungan Hidup Ikan Lele Dumbo (Clarias gariepinus) Yang Dipelihara Pada Topografi Yang Berbeda. GROUPER. 11(2):7-10.

Laksono, Pramono Tedjo ., Sumaryam dan Muhajir. 2023. Pengaruh Penambahan Tepung Kulit Manggis (Garcinia mangostana) Dalam Pakan Untuk Meningkatkan Kelangsungan Hidup Benih Ikan Gurami (Osphronemus gouramy) Ukuran 3-4 cm. Journal Perikanan, 13 (4), 1065-1073

Nasution, D Y., Nadya W. H, Rusdiah M N, Ferby R. 2023 Pengaruh Perubahan Suhu Panas Media Air Terhadap Membuka Dan Menutup Operkulum Pada Ikan Mas. Journal Scientific of Mandalika (JSM), 4(2):1-5.

Nugraha R, Ruddy S, Firda A M, dan Rizsa M P. 2022. Perubahan Suhu Media Air Berpengaruh Terhadap Survival Rate Dan Glukosa Darah Ikan Mas (Cyprinus carpio) Yang Dibekukan. JPHPI 2022, 25(2):322-330.

Radoslav, D, Ivanc A, Gnjato R, Trbic G, Cetkovic D, dan Lolic S. 2013. Effect of Thermal Stress of Short Duration on the Red Blood Cell Parameters of Barbus balcanicus Kotlik, Tsigenopulos, Rab, Berrebi, 2002. African Journal of Biotechnology. 12(18):2484-2491.

Pratama, N. A dan Akhmad Taufiq M. 2018. Pembesaran Larva Ikan Gurami Osphronemus gourami Secara Intensif Di Sheva Fish Boyolali, Jawa Tengah. Journal of Aquaculture and Fish Health. 7(3):102-110.

Sarwono, B., Sitanggang, M., 2007. Budidaya Gurami. Penebar Swadaya. Jakarta.

Sianturi, A. (2018). Pengaruh Waktu Pemberian Pakan Buatan Terhadap Pertumbuhan dan Kelangsungan Hidup Ikan Lele (Clarias sp.). Skrpsi. Universitas Sumatera Utara: Program Studi Manajemen Sumberdaya Perairan Fakultas Pertanian.

Soltanian S, M.N Adloo, M. Hafeziyeh dan N Ghadim. 2014. Effect of B-Glucan on Cold Stress Resistance of Striped Catfish, Pangasianodon hypophtalmus (Sauvage,1878). Veterinaria Medicina. 59(9):440-446.

Sulmartiwi, L., Harweni, S., Mukti, A. T., & Triastuti, J. (2013). Pengaruh Penggunaan Larutan Daun Bandotan (Ageratum Conyzoides) terhadap Kadar Glukosa Darah Ikan Koi (Cyprinus Carpio) Pasca Transportasi. Jurnal Ilmiah Perikanan dan Kelautan, 5(1), 73-76.

Van den Oever, Inge A.M., Hennie G Rayerman, Mike T Nurmohamed dan Suat Simsek. 2010. Endothelial dysfunction, inflammation, and apoptosis in diabetes mellitus. Article Mediators of inflammation.

Wulansari .K., Abdul R., dan Vauziah. 2022. Pengaruh Suhu Terhadap Pertumbuhan Ikan Lele Sangkuriang (Clarias Gariepinus) Dan Ikan Lele Dumbo (Clarias gariepinus X Clarias fiscus). Konservasi Hayati, 18 (1): 31-39.