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Physiological Response of Gouramy Fry (*Osphronemus Gouramy*) to Different Temperatures

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Abstract : The low survival rate of gouramy fry is caused by high stress risk . Temperature is one of the factor which can cause stress. Cortisol and blood glucose are indicators of stress on the fish. This study aims to investigate the physiological response of gouramy fry on different temperatures. This study used 27^{o}C, 29^{o}C, 31^{o}C as treatment. Ninety Gouramy fry sized 7 cm were used and kept at aquariums for 42 days. The results of the observation showed that 31^{o}C was the most appropriate temperature for gouramy which provided 70 mg/dl blood glucose level and 55.44 ng/ml cortisol level. The results of the variance analysis of blood glucose level showed that F test = 5,33 was greater than F table 5%, whereas the cortisol level indicated thast F test = 25.01 was greater than F table 5% and 1%. It can be concluded that a temperature difference in each treatment influence blood glucose and cortisol level. In this research, the pH was ranging from 7.3 to 8.1, while the oxygen level was ranging from 4.2 to 7.7mg/l.
Keywords : Gouramy, temperature, blood glucose, cortisol.

Introduction

Gouramy (*Osphronemus Gouramy*) is a type of freshwater fish living in stagnant water. These fish are very sensitive to low temperatures and have additional respiratory organs so as able to take oxygen from outside air[1].

Gouramy productivity is lower compared to other freshwater fish species.This occurs because of some obstacles such as the high rate of mortality in the larval stage and slow growth rate which reaches 50-70% [2].

The low survival rate of the gourami fry is due to stress sensitiveness. Temperature changes in the media affect fish life or cause stress. Although fish can acclimate at relatively high temperature, a certain degree rise of temperature can lead to fish dead. A drastic change which reaches 5°C can cause stress on fish or kill the fish[3]. Kubilay and Ulukoy[4] states that stress is the inability of an organism to maintain homeostasis condition due to individual disruption as a result of outside stimulation called as stressor.

According to Iwama et, al.[5], fish suffering from stress will avoid anabolic activities such as growth and reproduction, and in the long term it can lead to decrease in growth, disease resistance, reproductive success, swimming performance and other characteristics of the whole organism or population.

Hematology is often used to detect physiological changes caused by environmental stress and is also associated with the health status of fish[6]. The parameters used to determine health status of fish are total red blood cells, white blood cells, and hematocrit, whereas the stress level is normally measured by cortisol level

and blood glucose. Cortisol, blood glucose, hematocrit, red blood cell and white blood cell are indicators of stress on fish[7].

Methodology

This study used 90 gouramy fry (*Osphronemus Goramy*) with 7 cm length as the samples. This research was conducted in UPT BBI Pandaan, Pasuruan in August-October 2016. The food used was commercial food. The feeding is done by adlibitum. Fish was farmed for 42 days in 9 aquariums, at the size of 100 x 40 x 50 cm3.

This research was conducted with three treatments and three replications which included (A) treatment 27°C, (B) treatment 29°C, (C) treatment 31°C. Observation was conducted to measure blood glucose level, cortisol level as well as physical and chemical parameter.

The blood glucose and cortisol level were measured using a method developed by Wedemeyer and Yasutake[8]. Blood glucose level was measured using glucose oxydase peroxidase method, while the measurement of cortisol level in serum was conducted using enzymeimmunoassay cortisol kit. The results were read using enzymelinked immuno-sorbant assay (ELISA) (Bio-Rad 550) at a wavelength of 450 nm. These measurements were conducted at the Laboratory of Physiology of Brawijaya University.

Furthermore, the data obtained were analyzed using Analysis of Variance (ANOVA) with F-test at 95% interval confidence.

Findings and Discussions

Findings

Temperature affects blood glucose levels of the gouramy (*Osphronemous Gouramy*) fry farmed for 42 days with a density of 10 fish/aquarium. The highest blood glucose level was obtained at 27°C which reached 100.9 mg/dl and the lowest obtained at 31°C temperature which reached 70 mg/dl, as shown in figure 1.

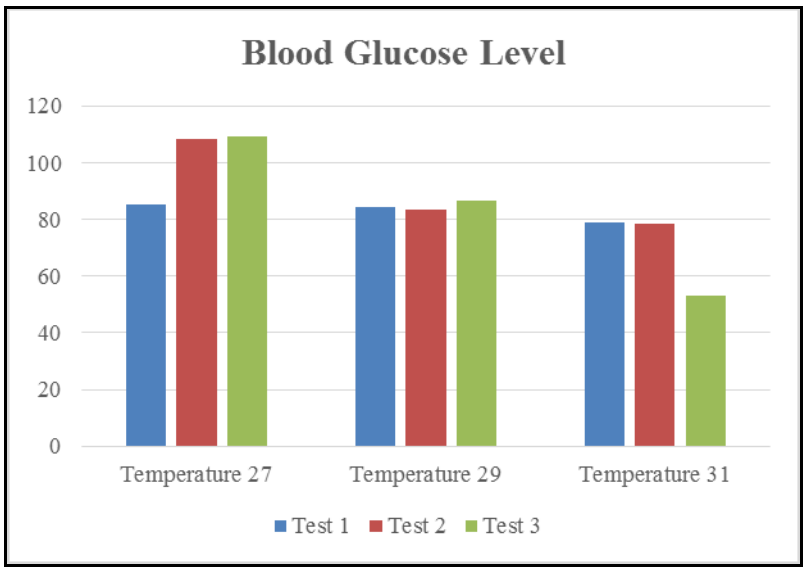

Figure 1. Blood Glucose Levels (mg/dl) of Gouramy Fry (Osphronemous Gouramy) Used in the Study.

Results of variance analysis of blood glucose level showed that F test = 5.33 was greater than F table 5%. It can be concluded that temperature difference in each treatment give significantly different effect on blood glucose level.

Temperature affects cortisol level of gouramy (Osphronemous gouramy) fry which was farmed for 42 days at a density of 10 fish/aquarium. The highest cortisol level of gouramy fry was obtained at 27°C which reached 83.55 ng/ml and the lowest was obtained at 31°C which amounted to 55.44 ng/ml, as shown in figure 2.

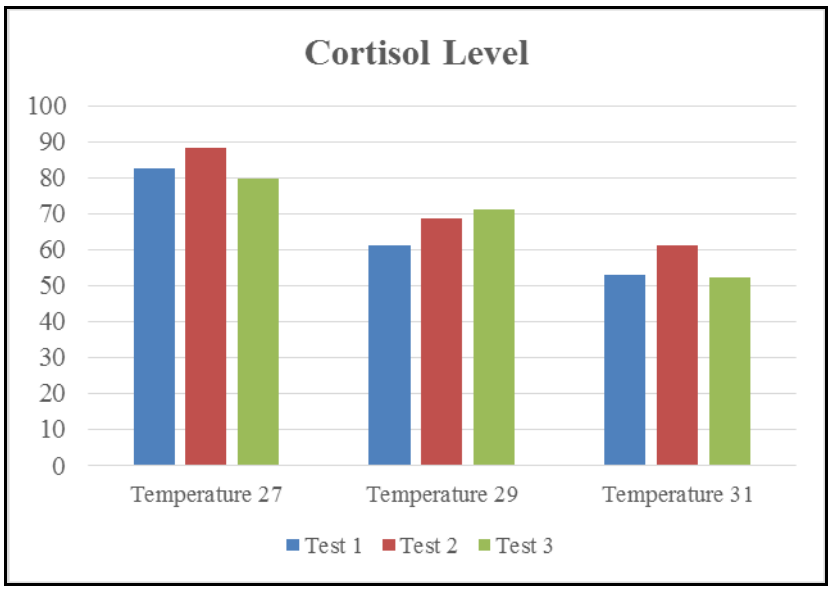

Figure 2. Cortisol Level (ng/ml) of Gourami Fry (Osphronemous Gouramy) During the Study.

Results of variance analysis on cortisol level showed that F test = 25.01 was greater than F table 5%. It can be concluded that temperature difference in each treatment provides highly significant effect on cortisol level.

In this study, the water quality parameters measured were pH, temperature, and DO. The water quality parameters are impoertant to support growth. Therefore, the water quality must be maintained optimally. Water quality parameters in all treatments were relatively normal, as presented in Table 1.

Table 1. The Mean of Water Quality Parameters in this Research.

Parameters	Temperatures		
	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

Discussions

Glucose levels of gouramy fry showed the highest level at 27°C which reached 100.9 mg/dl and the lowest level was obtained at 31°C which reached 70 mg/dl. Blood glucose level of gouramy fry at 27°C exceeded the normal limit which according to Patrice[9] is 40-90 mg/dl. Amrullah et. al.[10], stated that in a certain limit, every organism has a level of resistance or tolerance to environmental change. The temperature difference will cause stress which induces high level of blood glucose. According to Hasanalipour[11], unoptimum environmental conditions will lead to stress. Radoslav et. al.[12], argued that fish is able to adapt to the temperature change at a certain extent, but if the change exceeds the threshold temperature, stress will occur. Soltanian[13] also stated that natural temperature changes such as daily temperature changes do not cause stress, while the temperature shock has a negative effect on the fish.

According to Rahmawati et. al.[14], in a stresfull condition, glucocorticoid increases and it causes an increase of blood glucose level which is needed to cope with high needs of energy in times of stress. Energy demanded to handle stress can be met if the blood glucose can immediately enter the cell. Glucose which has been entered into the cell will soon be metabolized to meet the physiological and energy needs of the body. After high glucose demand is fulfilled, it will stimulate the process of glikogenesis and lypogenesis[15]. The

success of glucose to supply the cell is determined by the work of insulin. When stress occurs, inactivation of insulin will happen, and it will stop the use of glucose by cells[16].

Cortisol of gouramy fry reached the highest level, 83.55 ng/ml, at 27oC and the lowest level amounted to 55.44 ng/ml obtained at 31^{o}C. This indicates a mismatch of farming temperature, so that fish respond to the temperature changes as a stressor. In times of stress, the receptor organ receives information which will be delivered to the hypothalamus of the brain. The hypothalamus produces CRF (Corticoid Releasing Factor) which regulates the pituitary gland to secrete ACTH (Adenocortico-Tropic Hormone), MSH (Melanophore-Stimulating Hormone) and p-End (p-Endorphin). These hormones regulate the cortisol hormone from interenal. Cortisol will bully the enzymes involved in gluconeogenesis resulting in an increase of blood glucose which comes from noncarbohydrate sources[17].

Cortisol stimulates gluconeogenesis (the formation of carbohydrate by protein and some other substance) of the liver, and increases the speed of gluconeogenesis by 6 to 10 fold. This situation is mainly due to two effects of cortisol. First, cortisol increases all enzymes needed to convert amino acids into glucose in the liver cells. It is produced when glucocorticoid activates the transcription of DNA in the nucleus of liver cells in a manner similar to the function of aldosterone in the kidney tubule cells, accompanied by the formation of RNA messenger which can then be used to construct the enzymes needed in the process of gluconeogenesis. Second, cortisol causes amino acids transported from extrahepatic tissues, especially from muscles. As a result, a growing number of amino acids available in the plasma enter the process of gluconeogenesis in the liver and therefore would increase the glucose numbers. One of the effects of increased gluconeogenesis is a risein the amount of glycogen storage in the liver cells[18].

In this research, pH of the treatment was ranged from 7.3 to 8.1. This value was within normal water quality limit for freshwater fish. According to Boyd[19], the water pH which can optimally support the fish growth is between 6.5 to 9, while the water pH between 5- 6 can reduce fish growth speed.

The oxygen during the study is still in the range of 4.2 to 7.7 mg/L with aeration provision so that the dissolved oxygen remains stable. According to Boyd[19], the growth and survival of fish can be categorized as good when the DO value > 3.5 mg/L.

Conclusion

Temperature affects blood glucose level and cortisol hormone of gouramy (Osphronemus goramy) fry. The best treatment was obtained at 31^{o}C temperature with blood glucose level by 70 mg/dl and cortisol level of 55.44 ng/ml.

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