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Acute Toxicity Test of Laundry Detergent Waste and Sublethal Test to Gourami Fingerlings *(Osphronemus gouramy)*

Uji Toksisitas Akut Limbah Detergen dan Uji Sublethal Terhadap Ikan Gurami (Osphronemus gouramy)

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Abstract

Laundry detergent waste is toxic and can harm the environment and aquatic life. This study aims to find out the effect of detergent waste on the growth and mortality of gourami (*Osphronemus gouramy*) seeds and the threshold value of laundry detergent waste that can still be tolerated by gourami seeds. This research was carried out from December 2020 to January 2021 at the Aquaculture Environmental Quality Laboratory, Faculty of Fisheries and Marine Science (FPK) University of Riau. This research method used an experimental method using a completely randomized design (CRD) method with three tests namely the preliminary test, acute toxicity test, and sublethal test. Observation of fish behavior and morphology during the test is described descriptively. In the preliminary test, the lower and upper threshold values were 10 ml L^{-1} and 100 ml L^{-1}. Then in the acute toxicity test, the value LC_{50}-96 hour was obtained at 30.1 ml L^{-1} with a biological safe limit value of 0.301 ml L^{-1}. The best treatment obtained from the sublethal test was P1 with a concentration of 0.3 ml L^{-1} resulting in an absolute weight gain of 1.03 g, a specific growth rate of 1.56%, and a survival rate of 83.33%. The mortality rate is influenced by the concentration of detergent waste, the higher the concentration of detergent waste, the higher the mortality rate. Detergent waste that enters the waters affects the surface tension of the water so that the oxygen diffusion process is hampered, the reduced dissolved oxygen stresses the fish. Detergent waste can also enter the fish's body, irritating the gills and other organs, which can lead to death.

Keywords: *Osphronemus gouramy*, Acute toxicity, Subchronic, Surfactant

Abstrak

Limbah detergen laundry bersifat toksik dan dapat membahayakan lingkungan dan kehidupan biota perairan. Penelitian ini bertujuan untuk mencari tahu pengaruh dari limbah detergen terhadap pertumbuhan dan mortalitas benih ikan gurami (*Osphronemus gouramy*) dan nilai ambang batas dari limbah detergen laundry yang masih bisa ditolerir benih ikan gurami. Penelitian ini dilaksanakan pada bulan Desember 2020 sampai dengan Januari 2021 di Laboraturium Mutu Lingkungan Budidaya, Fakultas Perikanan dan Kelautan (FPK) Universitas Riau. Metode penelitian ini menggunakan metode eksperimen dengan menggunakan metode Rancangan Acak Lengkap (RAL) dengan tiga uji yakni uji pendahuluan, uji toksisitas akut, dan uji sublethal. Pengamatan tingkah laku dan morfologi ikan selama uji dijelaskan secara deskriptif. Pada uji pendahuluan, diperoleh nilai ambang batas bawah dan ambang batas atas adalah 10 ml L^{-1} dan 100 ml L^{-1}. Kemudian pada uji toksisitas akut diperoleh nilai LC_{50}-96 jam yakni 30,1 ml L^{-1}

dengan nilai batas aman biologi sebesar 0,301 ml L^{-1}. Perlakuan terbaik yang didapat dari uji sublethal adalah P1 dengan konsentrasi 0,3 ml L^{-1} menghasilkan pertambahan bobot mutlak 1,03 g, laju pertumbuhan spesifik 1,56%, dan kelulushidupan 83,33%. Tingkat mortalitas dipengaruhi oleh konsentrasi limbah detergen, semakin tinggi konsentrasi limbah detergen maka semakin tinggi pula tingkat mortalitasnya. Limbah detergen yang masuk ke dalam perairan mempengaruhi tegangan permukaan air sehingga proses difusi oksigen terhambat, berkurangnya oksigen terlarut membuat ikan stress. Limbah detergen juga bisa masuk ke tubuh ikan sehingga menyebabkan iritasi pada insang dan organ lain hingga menyebabkan kematian.

Kata kunci : *Osphronemus gouramy*, Toksisitas akut, Sublethal, Surfaktan

1. Introduction

Detergents on the market contain 20-30% of the main cleaning ingredients in the form of surfactants. The surfactants that are widely used in detergents are Alkyl Benzene Sulfonate (ABS) and Linear Alkyl Sulfonate (LAS) types (Mugirosani, 2011). ABS surfactant is a type of detergent that is difficult for microorganisms to decompose so it can cause environmental pollution, while LAS is more environmentally friendly (Yuliani, 2016). However, the foam produced by ABS or LAS can cover the surface of the water, thereby disrupting the life of organisms at the bottom of the water and on the surface of the water (Garno, 2000).

Detergent waste is quite a lot in public waters and it is feared that it can interfere with fish life. Waste that enters the waters can interfere with the function of fish organs, one of which is the gills; because gills are respiratory organs and function as a place for water and salt exchange so the gills are sensitive to changes in the polluted aquatic environment (Solikhah & Trianik, 2015) and will have an impact on organ function.

Measuring the level of toxicity of pollutant substances can be done using test organisms as indicators, one of which is the gourami (*Osphronemus gouramy*). Gourami inhabits calm and stagnant waters such as swamps, lakes, and lakes (Sitanggang & Sarwono, 2007). Gourami was chosen because it is a freshwater fish that is widely cultivated, has high economic value, and is in great demand.

Until now, there is still a lot of detergent waste discharged directly into public waters and the entry of detergent waste can cause toxic effects on the aquatic environment and the organisms in it. This study aims to determine the effect of giving detergent waste on the toxicity test and sublethal test of gourami seeds and to obtain the concentration of detergent waste that affects the growth and survival of gourami seeds.

2. Material and Method

2.1. Time and Location

This research was conducted in December 2020-January 2021 at the Aquaculture Environmental Quality Laboratory, Faculty of Fisheries and Marine Science, University of Riau.

2.2. Method

The method used in this study is an experimental method using a completely randomized design (CRD) with one factor. A preliminary test was carried out with seven treatments and two replications, an acute toxicity test with five treatment levels and three replications, then a sublethal test with four treatment levels and three replications. Preliminary tests, acute and sublethal toxicity are presented with a static system. During the preliminary test, acute toxicity, and sublethal, fish behavior was observed and described descriptively.

2.3. Procedure

2.3.1. Preparation and Acclimatization

Preparation is done by preparing the aquarium for the test. The aquarium is cleaned and soaked with PK solution for 24 hours. The gourami fry was acclimatized first so that the gourami fish could adapt to the new environment for 1 day before being observed. Each aquarium was filled with 10 fish/aquariums with a volume of 10 liters of water for the three tests. The total volume of detergent waste used is 100 L and is taken from the direct disposal of the washing machine.

2.3.2. Preliminary Test

The preliminary test is useful to determine the concentration range of the upper threshold (A) and lower threshold (B) of the toxicity of laundry detergent waste to gouramy seeds. The concentration used in the preliminary test refers to Rand & Petrocelli (1985), namely: 0.00; 0.01; 0.1; 1.0; 10.0; 100.0, and 1000.0 ml L^{-1}.

This preliminary test was carried out for 96 hours with observations of every exposure period of 0, 12, 24, 36, 48, 60, 72, 84, and 96 hours. What was observed during the preliminary test were fish mortality, behavior, and clinical symptoms of fish.

2.3.3. Acute Toxicity Test

The acute toxicity test was used to determine the toxicant concentration of the detergent on the tested fish, in this case, the gourami to determine the fish mortality rate of 50% for 96 hours (LC_{50}-96 hours) and to determine the Biological Safe Limit Value. Determination of the concentration of the acute toxicity test refers to Syafriadiman (2006) as follows:

$$\mathbf{Pn = B + (n - 1)} \left[\frac{A-B}{N-1}\right]$$

Where :

Pn : Treatment concentration to n (ml L^{-1})
B : Lower threshold concentration value (ml L^{-1})
A : Upper threshold concentration value (ml L^{-1})
n : Number of treatments desired concentration
N : 1, 2, 3, and so on, $n \neq 0$

Observations made on gourami seeds were changes in behavior and clinical symptoms of fish which were observed descriptively over some time of 0, 12, 24, 36, 48, 60, 72, 84, and 96 hours. The concentrations obtained, were P0 (0.0 ml L^{-1}), P1 (10 ml L^{-1}), P2 (40 ml L^{-1}), P3 (70 ml L^{-1}), and P4 (100 ml L^{-1}).

2.3.4. LC50 determination 96 hours and NBAB

Determination of the LC50 value at 96 hours used the EPA Probit method with a statistical approach to making the best line made from the mortality data of the tested fish and the length of time of exposure. Then it is done with the EPA Probit Program Analysis software using the Denton and Buldoman formula in Syafriadiman (2009):

Biological Safe Limit Value (NBAB) = LC50- 96 hours x AF

Where: AF = Application Factor is 0.01

2.3.5. Sublethal Test

The sublethal test was carried out after obtaining the LC50 value for 96 hours, carried out to observe the growth in absolute weight, specific growth rate, and survival of gourami fry. The study was conducted for 30 days. During the study, behavioral observations were also made in each experiment and clinical symptoms in fish were observed. The concentration of detergent waste in the sublethal test in this study refers to Rand & Petrocelli (1985), were 0 x LC_{50}-96 hours, 0.01 x LC_{50}-96 hours, 0.1 x LC_{50}-96 hours, 1.0 x LC_{50}-96 hours with 3 times test. The concentrations obtained were P0 (0.0 ml L^{-1}), P1 (0.3 ml L^{-1}), P2 (3.01 ml L^{-1}), and P4 (30.1 ml L^{-1}).

The observed growth parameters are:

a. Absolute Weight Gain, according to (Effendie, 1992), is calculated as:

$$\mathbf{W = Wt - Wo}$$

b. Specific Growth Rate, referring to the NRC formula (1993), calculated as:

$$LPS = \left[\frac{LnWt - LnWo}{t}\right] \text{ x } 100\%$$

c. Survival Rate (SR), referring to Effendie (1992), is calculated as:

$$SR = \frac{Nt}{No} \; x \; 100\%$$

2.3.6. Water Quality Parameters

Water quality is measured by measuring temperature, pH (Power Hydrogen), Dissolved Oxygen (DO), Free Carbon Dioxide (CO_2), Ammonia (NH_3), Biological Oxygen Demand (BOD), and Chemical Oxygen Demand (COD).

2.4. Data Analysis

Determination of the value of lethal concentration (LC50-96 hours) was carried out using the EPA probit method, namely a parameter statistical procedure with a 95% confidence interval (Finney, 1978). Then to find out whether the detergent waste affected the mortality of gourami during the toxicity test carried out by analysis of variance (ANOVA), using SPSS software. Then the basis for decision-making in this study refers to the steps suggested by Syafriadiman (2006), namely, if the probability value (p) <0.05 then proceed with the Newman-

Keuls test to determine the differences in each treatment and then the water quality data is tabulated in tabular form and then analyzed descriptively.

3. Result and Discussion

3.1 Preliminary Test

Mortality in the preliminary test of laundry detergent waste on gourami fry only occurred at P3 (1.0 ml L^{-1}) with a mortality rate of 10%. The mortality rate of gourami fingerlings increased with increasing concentrations of detergent waste (Table 1).

Table 1. Percentage of Gurami (*Osphronemus gouramy*) Seed Mortality

Treatment	Concentration (ml L^{-1})	Mortality rate (%)
P0	0.00	0
P1	0.01	0
P2	0,1	0
P3	1.0	10
P4	10	40
P5	100	90
P6	1000	100

Description: Lower Threshold Value = 10 ml L^{-1} (Treatment P4); Upper Threshold Value = 100 ml L^{-1} (Treatment P5)

In Treatment P4 (10 ml L^{-1}) the mortality rate was 40%, at P5 (100 ml L^{-1}) was 90%, and the highest mortality rate occurred at P6 (1000 ml L^{-1}) with a 100% mortality rate. Based on the preliminary test, the lower threshold value was obtained at P4 (10 ml L^{-1}) and the upper threshold at P5 (100 ml L^{-1}). Mortality that occurred in gourami fry was thought to be due to the inclusion of detergent waste in the research vessel. Detergent waste in the water is thought to enter the fish's body through respiration and ingestion. Surfactants, which are the main cleansers in detergents, hurt the aquatic environment and fish. According to Haq (2019), the concentration of surfactants that are toxic when decomposed in waters will cause organ damage, endanger fish life, and cause death. Myers (2006) added that surfactants could damage gills, irritate the skin and eyes, and destroy the mucus layer of fish.

Treatment P6, it can be seen that the foam produced by detergent waste covers the surface of the water. The appearance of foam on the surface of the water will inhibit the entry of oxygen from the free air into the water, so the dissolved oxygen content in the water will be depleted. Incoming detergent waste also affects water quality such as dissolved oxygen, free carbon dioxide, and ammonia. Deteriorating water quality will also cause fish to experience stress. Faumi & Radhi (2019) stated that the various effects of detergent waste would disrupt the fish growth process and could even lead to an increase in fish mortality.

3.2. Acute Toxicity Test

3.2.1. Gourami (O.gouramy) Seed Mortality

Table 2. Percentage of Gurami (*O. Gouramy*) Seed Mortality in the Acute Toxicity Test for 96 Hours

Treatment	Mortality rate (%)
P0 (0 ml L^{-1})	0
P1 (10 ml L^{-1})	26
P2 (40 ml L^{-1})	43
P3 (70 ml L^{-1})	73
P4 (100 ml L^{-1})	93

Based on Table 2, the average mortality that occurred at P0 was 0%, P1 was 26%, P2 was 43%, P3 was 73%, and P4 was 93%. The mortality of gourami fry is thought to be due to the active ingredient contained in the laundry detergent. The increase in the concentration of toxicants will be directly proportional to the increase in the mortality value of gourami fry. The surfactant content in detergents can produce foam that covers the surface and can inhibit the entry of oxygen from the air into the water. Surfactants also can damage fish gills and can irritate the skin and eyes, according to Myers (2006). Incoming detergent waste also affects water quality such as dissolved oxygen, free carbon dioxide, and ammonia. Deteriorating water quality will also cause fish to experience stress and even death. Then high levels of stress can cause inhibition of the growth of fish seeds. The behavior and symptoms of gourami fry during the Acute Toxicity Test study can be seen in Table 3.

Laundry detergent waste is thought to affect the behavior and morphology of gourami fry. Observation of behavior in the acute toxicity test was carried out every 6 hours for 96 hours by observing the movement of fish, the number of mouth openings and operculum openings, scales and fins, and body and eye color.

Table 3. Observation of the behavior and morphology of gouramy (O. *gouramy*) in the acute toxicity test

Concentration	Gourami Behavior
P0 (control) The initial number of fish = 10 fish The final number of fish = 10 fish	1) Mouth opening 118 times per minute 2) The operculum opens 112 times per minute 3) Bright eyes 4) Active movement in the base and middle 5) Whole scales 6) Fin intact 7) Bright body color
P1 (10 ml L^{-1}) The initial number of fish = 10 fish The final number of fish = 8 fish	1) Mouth opening 104 times per minute 2) The operculum opens 102 times per minute 3) Bright eyes 4) Active movement in the base and middle 5) Whole scales 6) Fin intact 7) Bright body color
P2 (40 ml L^{-1}) The initial number of fish = 10 fish The final number of fish = 6 fish	1) Mouth opening 101 times per minute 2) The operculum opens 96 times per minute 3) Bright eyes 4) Active movement in the base and middle 5) Whole scales 6) Fin intact 7) Bright body color
P3 (70 ml L^{-1}) The initial number of fish = 10 fish The final number of fish = 3 fish	1) Mouth opening 94 times per minute 2) The operculum opens 92 times per minute 3) Bright eyes 4) Active movement in the base and middle 5) Whole scales 6) Fin intact 7) Bright body color
P4 (100 ml L^{-1}) The initial number of fish = 10 fish The final number of fish = 1 fish	1) Mouth opening 94 times per minute 2) The operculum opens 88 times per minute 3) Bright eyes 4) The movement is very active up and down 5) Whole scales 6) The fins are grippy 7) Bright body color

Based on Table 3, it can be seen that the low detergent waste concentration allegedly had a small effect on the behavior and morphology of the gourami, this was seen in the control treatment, P1 (10 ml L^{-1}) and P2 (40 ml L^{-1}). Gourami fry in the low toxicant treatment swam actively at the bottom and middle of the surface, fins and scales were intact, eye and body colors were still bright, and mouth and operculum openings were stable at around 110 times per minute. However, high concentrations can have a direct effect on fish morphology such as damage to the fins of the fish and slowing down the opening of the operculum and mouth opening of the fish. It can be seen that the gourami fry that was given a concentration of 100 ml L^{-1} (P4) moved very actively up and down to the surface. The up and down movement is thought to be due to the depletion of dissolved oxygen in the water due to the ingress of detergent waste so that gourami fry tries to take oxygen directly to the surface. The movement of the fish is very active until it hits the aquarium wall and aeration stone, and bumps into other fish so that the fins look grippy. These very active movements gradually slowed down, including the opening of the mouth and the opening of the operculum which also slowed down. The mouth opening of gourami fry at P4 (100 ml L^{-1}) was 94 times per minute and the operculum opened 88 times per minute.

3.2.2. Lethal Concentration 50 (LC_{50}-96 hours)

Table 4. Calculation results of the 96-hour LC_{50} value using the EPA Probit analysis

Test	LC_{50} - 96 hours
1	29.947
2	32.443
3	27.939
Amount	90.329
Average	30.109

Based on Table 9, it can be seen that the LC_{50} - 96 hours of laundry detergent waste on gourami seeds during the acute toxicity test on repeat 1 was 29.947 ml L^{-1}. Then the LC_{50} - 96 hours in repetition 2 was 32.443 ml L^{-1}, and in repetition 3 was 27.939 ml L^{-1}. The average value of LC_{50} from the three replicates was 30.109 ml

L^{-1}. This means that this concentration can cause as much as 50% death in gourami caused by the ingress of laundry detergent waste into the waters for 96 hours.

3.2.3. Biological Safety Level

The Biological Safety Level value obtained based on the results of research that has been carried out is 0.301 ml L^{-1}. The Biological Safe Limit or NBAB value tends to follow the LC_{50} value, the smaller the LC50 value, the smaller the NBAB value, and vice versa if the LC_{50} value is greater, the NBAB value will also be large. The NBAB of gourami seeds is not much different when compared to other test animals, such as common carp (*Cyprinus carpio)* which was carried out by Lubis *et al*. (2013) using detergent liquid waste, obtained a Biological Safe Limit Value (NBAB) of 0.46 ml L^{-1}.

3.3. Sublethal Toxicity Test

3.3.1. Gouramy Absolute Weight Growth

Table 5. Growth of absolute weight of gouramy (O. *gouramy*) during the sub-lethal test

Treatment	Average Weight Absolute (g)
P0 (0.0 ml L^{-1})	1.13±0.06^{a}
P1 (0.3 ml L^{-1})	1.03±0.06^{b}
P2 (3.01 ml L^{-1})	0.77±0.11^{c}
P3 (30.1 ml L^{-1})	0.40±0.10^{c}

Note: The average value followed by a different letter in the column indicates that each treatment is significantly different

Based on Table 5, it can be seen that the average absolute weight growth of gourami in each treatment was significantly different. The growth in absolute weight at P0 was 1.13 g, P1 was 1.03 g, P2 was 0.77 g, and P3 was 0.4 g. The results of the Analysis of Variance (ANOVA) showed that the concentration of laundry waste had a significant effect on the absolute weight growth of gourami seeds. The decrease in absolute weights at P1, P2, and P3 is thought to be due to the influence of toxicants that enter the research vessel. Maqfirah *et al*. (2015) explained, surfactants in laundry detergent waste can cause irritation to the eyes and skin of fish and can harm the gills of gourami fry. The included detergent also lowers the DO content and has implications for high CO_2 values and ammonia values. A result of poor water quality and disruption of fish organs, cause fish to experience stress that inhibits growth. Nirmala (2012) argues the effect of toxicants can reduce fish growth because the energy that should be used for growth is more used to defend itself from environmental pressures and replace damaged cell parts due to toxic substances.

3.3.2. Gourami Specific Growth Rate (O. gouramy)

Table 6. Specific growth rate of gourami (O. *gouramy*) fry during sub-lethal toxicity test

Treatment	Average Specific Growth Rate (%)
P0 (0.0 ml L^{-1})	1.68 ± 0.09a
P1 (0.31 ml L^{-1})	1.56 ± 0.10b
P2 (3.01 ml L^{-1})	1.19 ± 0.14c
P3 (30.1 ml L^{-1})	0.67±0.14c

Note: The average value followed by a different letter in the column indicates that each treatment is significantly different

Based on Table 6, the highest specific growth rate for gourami was in the control or P0 treatment (0.0 ml L^{-1}) at 1.68%, followed by P1 (0.31 ml L^{-1}) at 1 .56%, P2 (3.01 ml L^{-1}) of 1.19%, and finally P3 (30.1 ml L^{-1}) of 0.67%. The decrease in the specific growth rate at P1 to P3 was due to the higher concentration of detergent in each treatment, with the introduction of toxic substances into the waters causing the function of fish organs to be disrupted so that the fish experienced stress. Fish stress can also reduce appetite, so it will inhibit the growth of gourami seeds. This can be seen from the decreased response of fish to the feed given, at P4 (30.1 ml L^{-1}) gourami fry only ate a little of the feed given, different from the control treatment whereas gourami fry ate heartily. Haq (2019) argues disruption to the function of fish organs reduces fish appetite, besides that the energy used for growth is used to survive so that fish growth is hampered.

3.3.3.

3.3.4. Gourami (O. gouramy) Seed Passability During Sub-lethal Test

Table 7, it can be seen that the highest survival rate for gourami until the end of the study was at P0 (0.0 ml L^{-1}) of 96.67%, followed by P1 (3.97 ml L^{-1}) at 83%, P2 (3 .01 ml L^{-1}) 73% and P3 (30.1 ml L^{-1}) 23%. It can be concluded that the treatment that was not given laundry detergent waste produced the highest survival, while the treatment that was given the highest waste would produce the lowest survival

Table 7. Survival rate of gourami (*O. gouramy*) seeds during the sub-lethal toxicity test (%)

Treatment	Gourami survival rate (%)
P0 (0.0 ml L^{-1})	96.67 ± 0.58^a
P1 (0.31 ml L^{-1})	83.33 ± 0.58^a
P2 (3.01 ml L^{-1})	73.33 ± 0.58^a
P3 (30.1 ml L^{-1})	23.33 ± 20.82^b

Note: The average value followed by a different letter in the column indicates that each treatment is significantly different

The decrease in the survival rate of gourami fry is thought to be related to the level of toxicity from laundry detergent waste. Incoming detergent waste also affects water quality such as dissolved oxygen, free carbon dioxide, and ammonia. Deteriorating water quality will also cause fish to experience stress. Dissolved oxygen in this study was at a value of 3.2 to 4 mg L^{-1}, this value is quite low for the maintenance of gourami seeds where dissolved oxygen levels are optimal for growing gourami seeds according to Sulistyo *et al*. (2016) ranged from 4-7 mg L^{-1}. The values of CO_2 and NH_3 in the sublethal test are also quite high, thus deteriorating water quality. Deteriorating water quality will also cause fish to experience stress and even death. Surfactants in detergents can irritate the eyes and skin of fish and can disrupt the function of fish gills. Surfactants are the main cleaning agents in detergents that make up 20-30% of the total detergent content. Damage due to surfactants, according to Myers (2006) occurs in fish gills. In addition, surfactants can cause rough skin and irritation to the skin and eyes.

3.4. Water Quality Parameters

Table 8. Water quality during sub-lethal toxicity test

Parameters	Water quality in treatment				Quality standards
	P0 (control)	P1 (0.3 ml L^{-1})	P2 (3.01 ml L^{-1})	P3 (30.1 ml L^{-1})	
Temperature (^{O}C)*	26-27	26-27	26-27	27-28	25-30
pH*	5.9-6.1	6.0-6.2	6.0-6.3	6.6-6.7	6.5-8.5
DO**	3.8-4.2	3.7-4.1	3.5-3.8	3.2-3.5	4-7 mg L^{-1}
CO_2*	2.01-2.23	2.08-2.19	2.52-2.68	3.03-3.41	2-3 mg L^{-1}
BOD***	1.01-1.04	1.21-1.26	1.4-1.44	1.58-1.65	125 mg L^{-1}
COD***	2.10-2.14	2.16-2.20	2.77-2.78	5.41-5.60	300 mg L^{-1}
NH_{3*}	0.004-0.013	0.004-0.012	0.014-0.026	0.026-0.038	0.02 mg L^{-1}

Note: *SNI 01-7241-2006 concerning Gourami (O. *gouramy*) Production ** Sulistyo *et al*. (2016) ***KepMenLH No. 51 of 1995 concerning Quality Standards for Soap Industry Waste, Detergent, and Vegetable Oil Products

Based on Table 8, it can be seen that the water quality in the study of the toxicity test of laundry detergent waste on gourami fry was not optimal for fish life. The water temperature observed during the study was quite good for gourami life which was in the range of 26-28 ^{O}C. Then the pH value, which is a measure of the concentration of hydrogen ions in water, generally ranges from 4-9 (Syarifuddin, 2016). Based on Table 8 it can be seen that the pH value tends to increase along with the increasing concentration of detergent waste in the research container. According to Sulistyani & Fitrianigtyas (2010), this is because detergent waste is alkaline with a value of 9.6. Dissolved oxygen values tend to decrease with increasing concentrations of toxicants. The highest DO values were at P0 and P1, starting from 3.8-42 and 3.7-4.1 ml L^{-1}, while P2 and P3 had quite low values, it was 3.5-3.8 and 3.2-3.5 ml L^{-1}. According to Sulistyo *et al*. (2016), dissolved oxygen in this study was considered low enough for the maintenance of gourami fry. The optimal dissolved oxygen level for the life of gourami fry is 4.0-7.1 mg L^{-1}. The low DO value is thought to be due to the inclusion of detergent waste in the research vessel.

The CO_2 value in Table 8 shows a tendency to increase in each treatment. Excess CO_2 in the waters will have an impact on the function of fish organs. In treatment P0, the CO_2 concentration of 2.01-2.23 ml L^{-1}, P1 (2.08-2.19 ml L^{-1}), P2 (2.52-2.68 ml L^{-1}), and highest at P3 (3.03-3.41 ml L^{-1}). It is also seen that the CO_2 concentration that can still be tolerated by gourami is below 3 mg L^{-1}, Excess CO_2 in the waters will have an impact on the function of fish organs. Nirmala *et al*. (2012) explained, with high CO_2 and NH_3 in water, it is difficult for CO_2 and NH_3 that are excreted by fish to diffuse out of the gills and reduce the rate of excretion. The CO_2 concentration in the blood accumulates and causes acidosis. According to Boyd & Tucker (1998), high CO_2 can cause acidosis. Acidosis will reduce the affinity of hemoglobin in binding oxygen (Bohr Effect) and reduce the oxygen content in the blood (Root effect), including a decrease in blood pH value. Then the value of ammonia in this study is also quite high. This will have an impact on fish in the long term according to Levit (2010), ammonia has a sub-lethal effect on fish where low concentrations can kill and damage aquatic life for a long time. Based on Table 8, it can be seen that the ammonia content during the study varied from P0 (0.004-0.013 ppm), P1 (0.004-0.012 ppm), P2 (0.014-0.026 ppm), and P3 (0.026-0.038 ppm). In treatments P0 and P1, the ammonia value is still within safe limits. Whereas in P2 and P3 the value of ammonia has passed the quality standard. Referring to Effendi (2003), the safe ammonia value for fish growth is 0.02 ppm. According to Colt (2006), NH_3 concentrations in ponds of 0.02-0.07 have been shown to inhibit growth and cause tissue damage in several fish species. Nirmala *et al.* (2012), said that increasing the level of ammonia in the blood will reduce the affinity of hemoglobin in binding oxygen.

Based on Table 8 it can be seen that the BOD and COD values tend to be safe for water. BOD value at P0 (1.01-1.04 mg L^{-1}), P1 (1.21-1.26 mg L^{-1}), P2 (1.40-1.44 mg L^{-1}), and P3 (1.58-1.65 mg L^{-1}). The COD value in this study was P0 (2.10-2.13 mg L^{-1}), P1 (2.16-2.20 mg L^{-1}), P2 (2.77-2.78 mg L^{-1}), and P3 (5.41-5.50 mg L^{-1}). Even though COD and BOD are the parameters for wastewater quality standards, their presence together with other key parameters such as DO, CO_2, ammonia, pH, temperature, and others. Atima (2015) argues, if the BOD and COD values in water are still normal, it cannot be concluded that the water is not polluted; other parameters need to be known, because if other parameters show a value that exceeds the quality standard then it means there is an indication of contamination.

4. Conclusions

Giving detergent waste affects the growth and mortality rate of gourami fry. The entry of detergent waste into the waters damages fish organs such as gills and liver, thus causing a decrease in the ability to function of these organs. The higher the concentration of detergent waste, the higher the mortality rate and the lower the growth rate of gourami fry. A concentration of 30.109 mg L^{-1} laundry detergent waste can kill 50% of gourami for 96 hours. Then the concentration of 0.3 mg L^{-1} in the gourami rearing medium can produce an absolute weight gain of 1.03 g, a specific growth rate of 1.56%, and a survival rate of 83.33%.

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