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Research Article

The Effect of Different Doses of Citronella Oil (*Cymbopogon citratus*) as Anesthetic for Prospective Tilapia Broodstock (*Oreochromis niloticus*) in Closed Transportation System

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ABSTRACT

Anesthesia of fish with citronella oil in a closed transportation system has never been tested on prospective tilapia broodstock. The broodstocks transportation activities are to ensure survival and keep the reproductive stages undisturbed and safe to the destination. This study aims to determine the effect and the best dose on anesthesia with citronella oil for prospective tilapia broodstock in closed transportation systems. The research was conducted on 27 April – 4 May 2021 at Fish Seed Hall Potrobangsan, Magelang. The test material used citronella oil with a fish density of 10 fish/6 liters per bag. The experimental design used was a completely randomized design with five treatments and three replications with doses of citronella oil, namely A (0 mL/L as control); B (0,05 mL/L), C (0,10 mL/L); D (0,15 mL/L); and E (0,20 mL/L). Fish were transported for 13 hours with artificial simulation. Parameters observed were fish behavior during anesthesia, time to faint and recover, survival, water quality, blood glucose, blood profile (erythrocytes, leukocytes and hemoglobin), Hepatosomatic Index and Gonadosomatic Index. Behavior during anesthesia showed that the operculum slowed down, response weakened and swimming balance was lost. Different dose of citronella oil had a significant effect on survival, blood glucose, erythrocytes, and leukocytes, but had no significant effect on hemoglobin, Hepatosomatic Index (HSI) and Gonadosomatic Index (GSI). The best dose of citronella oil was 0.10 mL/L with an average survival of 93.33%.

Keywords: anesthesia, citronella, tilapia, broodstock, transportation

ABSTRAK

Anestesi ikan dengan minyak sereh dalam pengangkutan sistem tertutup belum pernah diujicobakan pada calon induk ikan nila. Kegiatan transportasi induk adalah untuk menjamin kelangsungan hidup dan menjaga tahapan reproduksi tidak terganggu sampai di tujuan. Penelitian ini bertujuan untuk mengetahui pengaruh dan dosis terbaik minyak sereh untuk pembiusan calon induk ikan nila dengan transportasi sistem tertutup.Penelitian dilaksanakan pada tanggal 27 April–4 Mei 2021 di Balai Benih Ikan Potrobangsan, Magelang. Bahan uji menggunakkan minyak sereh dengan kepadatan ikan setiap kantong 10 ekor/6 liter. Rancangan percobaan yang digunakan adalah Rancangan Acak Lengkap dengan lima perlakuan dan tiga ulangan dengan dosis minyak sereh yaitu A (0 mL/L sebagai control); B (0,05 mL/L), C (0,10 mL/L); D (0,15 mL/L); dan E (0,20 mL/L). Ikan diangkut selama 13 jam dengan simulasi buatan. Parameter pengamatan adalah tingkah laku ikan selama pembiusan, lama waktu pingsan dan pulih, kelangsungan hidup, kualitas air, glukosa darah, profil darah (eritrosit, leukosit dan hemoglobin), Hepatosomatik Indeks dan Gonadosomatik Indeks. Tingkah laku selama pembiusan menunjukkan operculum melambat, respon ikan melemah dan keseimbangan renang hilang. Dosis minyak sereh yang berbeda berpengaruh nyata terhadap kelulushidupan, glukosa darah, eritrosit, dan leukosit, tetapi tidak berpengaruh nyata terhadap hemoglobin, Hepatosomatik Indeks (HSI) dan Gonadosomatik Indeks (GSI). Dosis minyak sereh terbaik adalah 0,10mL/Ldengan kelulushidupan rata-rata 93,33%.

Kata kunci: anestesi, induk, nila, minyak sereh,sistem pengangkutan

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1. Introduction

The supply of tilapia broodstock currently still depends on government agencies or tilapia brood stock centers because the availability of seeds must also be accompanied by the availability of broodstock. One of the stages in providing broodstock is transportation activities. The transportation of prospective tilapia broodstock aims to maintain survival and ensure that the reproductive stages are not disturbed and safe to destination. However, fish that are transported densely in a container will easily experience stress. According to Lakani et al. (2018), stressors such as grading, handling, crowding and poor water quality can have deleterious effects on growth and welfare.

Efforts to anticipate fish stress is to reduce the metabolic activity of fish. Coyle et al. (2004) stated that in aquaculture, anesthetics are used during transportation to prevent physical injury and reduce metabolism. One of the effort on application of anesthesia in closed transportation system. The use of chemicals as fish anesthetic has an adverse effect on the quality and health of fish. Therefore, natural ingredients are needed that are effective for anesthetizing fish. Barbas et al. (2017) mentioned that essential oil of citronella, induced deep anaesthesia and calm. Geraniol and citronellol compounds play an important role in the anesthetic mechanism through respiratory tissue. Nakahara et al. (2003) reported that the components of citronella oil were geraniol (35.7% of total volatiles), trans-citral (22.7%), cis-citral (14.2%), geranyl acetate (9.7%), citronellal (5.8%) and citronellol (4.6%). Based on this, it is necessary to conduct research on the potential use of citronella oil as an anesthetic. This study aims to determine the best dose of citronella oil for anesthesia of prospective broodstock tilapia in order to produce healthy and high survival after transportation which can be observed from physical and physiological conditions (blood profile, blood glucose, GSI and HSI).

2. Material and methods

The test fish used were tilapia broodstock with an average weight of ± 100 grams originating from Magelang, Central Java. The test fish were selected according to size and then fasted for 24 hours before transportation. The natural anesthetic used is citronella oil. The tools used are 0.01 gram scale, large size drain, polyethylene plastic, rubber band, thermometer, pH indicator, DO meter, 1 mL One Med syringe, Nesco Multicheck glucose test strip, EDTA K3 One Med tube, aerator and Yasuniaga blower. (220/230 V). The transportation container used in the study was a plastic bag containing 6 liters of water. Packing is done using polyethylene (PE) plastic with a size of 40x70 cm.

The density used in this study was 10 fish per plastic bag. The study used a Completely Randomized Design consisting of five treatments and three replications. The treatment was the difference in the dose of citronella oil on the transportation of prospective tilapia broodstock for 13 hours. The treatment refers to the results of the preliminary test with the best doses of 0.10 and 0.15 mL/L. So the Citronella oil dose used in this study for treatment A, B,C D, and E were 0.00; 0.05; 0.10; 0.15 and 0.20 mL/L, respectively.

2.1. Citronella oil Preparation

Citronella oil used in the main test was prepared according to their respective doses of 0.00 mL/L, 0.05 mL/L, 0.10 mL/L, 0.15 mL/L, and 0.20 mL/L. The origin of the citronella oil that is used comes from commercially pure citronella oil

2.2. Test Fish Preparation

Tilapia that had been selected with a size of ± 100 grams were fasted for 24 hours. According to De Tolla et al. (1995), the fish should be taken off food for 2-3 days prior to transport, so they will void their digestive tracts and not foul their shipping water. After that, the fish are placed in a plastic bucket filled with water. The next process is packing the tilapia in plastic bag with a density of 10 fish/6 liters of water mixed with citronella oil in certain dose. The material of plastic bag is polyethylene (PE) with a size of 40x70 cm.

2.3. Fish Transport

The transportation process is carried out for 13 hours using an simulation of closed transportation system. Closed transportation system with artificial simulation is done by placing 15 plastic packings in the pond, then placing the aerator and blower under the plastic packing so that the water can maximally shake the plastic packing containing fish. After that, at the end of the transportation, the plastic bag was opened and the fish recovery time and survival rate were observed by transferring the tilapia into a plastic bucket filled with new aerated water media

2.4. Data analysis

The behavioral response data of tilapia were analyzed descriptively. The research data will be tested for normality, then homogeneity test and additivity test to find out that the data are normal, homogeneous and additive which will then be further tested. The data will then be analyzed using ANOVA followed by Duncan's test to determine the differences between treatments.

Parameters observed:

Fish Behavior During Anesthesia

The observed behavior included: operculum movement, response to external stimuli, and fish swimming motion.

Stunning Time

Observation of the duration of the fish's stunning time begins since the fish is put into water that has been given citronella oil. This is observed until there is no longer a response to external stimuli such as slowed (inactive) movements, loss of body balance and slowed operculum movements.

Recovery Time

The length of time for fish to recover (sedative) was observed and calculated when the test fish were in an aerated resuscitation vessel, where the calculated time ended until the fish had regained consciousness from fainting. The characteristics of fish that have been aware are that the fish begin to swim normally and receive a response to external stimuli with a body condition that does not look weak.

Fish Survival Rate

The survival rate of fish (Survival rate, SR) was observed after the treatment was completed to find out how many fish were still alive. The survival rates used in the Opasola et al. (2013) study are:

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

Note:
SR = Survival rate (%),
Nt = Number of live fish at the end of treatment
No= Number of fish at the beginning of treatment

Water quality

Water quality analysis such as pH was measured using a pH-meter, Dissolved Oxygen (DO) using a DO-meter and temperature using a thermometer. Water quality parameters such as DO, temperature and pH were measured before and after treatment or maintenance.

Blood Profile

The blood profile of tilapia in this study included erythrocytes, leukocytes and hemoglobin. The blood profile will be observed after treatment which will then be taken to the Animal Health Laboratory, Semarang City to be observed.

Blood Glucose

Blood glucose will be observed before treatment and after treatment with a blood glucose test strip.

GSI and HSI

Calculations of Gonado Somatic Index (GSI) and Hepatosomatic Index (HSI) were calculated after treatment by sectio fish.

Gonadosomatic index was obtained by dividing the gonad weight by the total weight of the fish and multiplied by 100%. Gonadal weight data was taken by taking the gonads and weighed using a 0.01 g digital scale. Then calculated the GSI with the formula used in the study of Amtyaz et al. (2013):

$$GSI = \frac{\text{Gonad Weight (Wg)}}{\text{Fish weight(W)}} X\ 100\%$$

Note:
GSI = GonadoSomatic Index (%)
Wg =Gonad Weight (g)
W =Fish weight (g)

The hepatosomatic index was obtained by weighing the total weight of the fish samples and then carefully dissecting them so the liver would not be damaged. Liver was weighed using a digital scale of 0.01 g. Then calculated HSI with the formula used in the study of Sadekarpawar and Parikh (2013):

$$HIS = \frac{\text{Weight of heart (Wh)}}{\text{Fish weight (W)}} X\ 100\%$$

Note:
HIS = HepatoSomatic Index (%)
Wh = Weight of heart (g)
W = Fish weight (g)

3. Results and Discussion

Fish Behavior During Anesthesia

When the fish were put into plastic containers filled with water media which had been mixed with citronella oil at different doses, they showed different behavior at each treatment and time of observation (Table 1). The criteria for each fish behavior is for normal operculum movement, which is seen from the number of operculum openings.

Zidni et al. (2018) observed that the average of red tilapia fish operculum ranged between 102.43-138.33/minute. The active swimming of the fish is indicated by the fish still actively moving. The response to high external stimuli is indicated by when the fish is touched from outside the plastic packing, the fish is still actively

Table 1. Response and Behavior of Prospective Tilapia Broodstock During Anesthesia

Treatment (Dose of Citronella Oil; mL/L)	Observation Time (minutes)	Response and Behavior
A (0.00)	0-10	➢ Normal operculum movement ➢ Active swimming ➢ High response to external stimuli
B (0.05)	0-6	➢ Normal operculum movement ➢ Active swimming ➢ High response to external stimuli
	7-8	➢ Fish response starts to weaken ➢ Slow movement of the operculum ➢ Fish swimming balance is starting to disappear
	9th	➢ Dead fish
C (0.10)	0-4	➢ Normal operculum movement ➢ Active swimming ➢ High response to external stimuli
	5-7	➢ Fish response starts to weaken ➢ Slow movement of the operculum ➢ Fish swimming balance is starting to disappear completely
	8th	➢ Dead fish
D (0.15)	0-3	➢ Normal operculum movement ➢ Active swimming ➢ High response to external stimuli
	4-5	➢ No more response from outside ➢ Slow movement of the operculum ➢ Fish swimming balance is starting to disappear completely
	6th	➢ Dead fish
E (0.20)	0-2	➢ Normal operculum movement ➢ Swimming is quite active ➢ Response to external stimuli is quite high
	3-4	➢ No more response from outside ➢ The movement of the operculum slows down with the undirected movement of the fish ➢ Fish swimming balance is starting to disappear completely
	5th	➢ Dead fish

avoiding, whereas when touched again the fish is weak and dodges slowly or does not avoid at all, the fish response begins to weaken. The swimming balance of the fish is lost, presumably because the effect of citronella oil has started to work, the fish will swim sideways or when it is lying at the bottom of the container the fish will rise again but after a few seconds the fish starts lying again. The fainting fish is counted when 50% of the fish in the plastic are already at the bottom of the container.

Water quality

The temperature increased in the control and treatment with citronella oil ranged from 26.1°C 27.7°C at the beginning of the study and 26.72 – 28.20°C at the end of the study (Table 2). This is in accordance with SNI (2009), that the normal range for transportation is 25-30°C. The increase in temperature that occurs is still within the normal range.

Dissolved oxygen decreased after transportation compared to before transportation. However, the range of dissolved oxygen is still in the normal range. According to Choudhary and Salma (2018), suitable dissolved oxygen for tilapia ranges from 2-5 mg/L. The highest dissolved oxygen after transportation was obtained in treatment E (0.20 mL/L) which was 3.70-4.00 mg/L. The pH range of the test medium at the beginning of the study was 7.40 - 7.65 and at the end of the study was 7.06 - 7.53. According to SNI (2009), the degree of acidity (pH) of good water quality for the production of rearing tilapia is 6.5-8.5.

Table 2. Water Quality Before and After Transportation of Prospective Tilapia Broodstock

Observation	Treatment (mL/L)	Temperature ºC	DO(mg/L)	pH
Before	0.00	26.30-26.50	3.40-4.90	7.40-7.53
	0.05	26.40-26.50	3.40-3.70	7.42-7.49
	0.10	26,20-26,70	3.70-4.60	7.50-7.58
	0.15	26.10-26.50	3.60-5.60	7.50-7.52
	0.20	26.70-27.20	4.30-5.30	7.56-7.65
After	0.00	27.10-27.40	3.50-3.70	7.06-7.22
	0.05	27.30-27.90	3.40-3.10	7.09-7.12
	0.10	27,20-28,20	3.40-4.60	7.16-7.53
	0.15	26.72-27.30	3.10-4.90	7.31-7.38
	0.20	27.10-27.30	3.70-4.00	7.09-7.14
Optimum*		19.8 -29.0ºC	2 -5 mg/L	7.00-8.50

Faint, recovery time, survival rate, and blood profile of tilapia broodstock

The duration of fainting time for tilapia broodstock if sorted from the fastest was in treatments E (4.50 minutes), D (6.05 minutes), C (7.60 minutes), B (8.91 minutes), and A (0.00 minutes) (Table 3). The duration of fainting is also related to the anesthetic mechanism of citronella oil. Based on study of RamLochansingh et al. (2014), an anesthetic agent that accesses all the nervous elements immobilized the animal by relaxing the muscles and performing general anesthesia through the cellular elements that comprise the neuromuscular system (brain and muscles).

Recovery Time

The length of time for the recovery of prospective tilapia broodstock if sorted from the fastest in treatments B (4.69 minutes), C (7.19 minutes), D (10. minutes), E (12.89 minutes), and A (0. 00 minutes) (Table 3). The recovery process in fish is thought to be related to the release of anesthetic substances from the fish's body. According to Neiffer and Stampper (2009), during recovery it is necessary to manually move animals through water in a forward motion or hold them in sufficient flow. The recovery water is aerated and the fish's mouth oriented toward water flow. In an artificial ventilation system, anesthetic-free water is passed over the gills until spontaneous ventilation resumes; alternatively, the fish is pulled forward through the water with its mouth open.

The recovery process at low concentrations requires a fast time to transport anesthetic substances from the fish's body. The long recovery process is thought to be caused by the inability of the fish's metabolism to tolerate high doses of citronella oil, thus hampering the recovery process.

Survival Rate

The results of observations show that the lowest tilapia broodstock survival is in treatment E (dose of citronella oil 0.20 mL/L) with an average of 40% (Figure 1). According to a research study by Chen and Viljoen (2008), geraniol appears as a clear to pale-yellow oil which is insoluble in water, but soluble in most organic solvents and the smell is very strong.

The highest survival was in treatment A (control) with a value of 86.67%, B (citronella oil 0.05 mL/L) with a value of 90.00% and C (citronella oil 0.10 mL/L) with a value of 93, 33%. This shows that the lower the dose of citronella oil used, the higher the survival of the fish. A good SR value is in accorandce with SNI (2010), that is, after transportation activities, tilapia make new environmental adjustments for 10-15 minutes and the calculated survival rate is at least 90%. Thus, doses of 0.05 mL/Land 0.10 mL/Lwere able to provide SR values that were in accorandce with SNI and better than without citronella oil administration (control).

Table 3. Time to faint, length of time to recover, blood profile of erythrocytes, leukocytes, hemoglobin, gonadosomatic index and hepatosomatic index of prospective tilapia broodstock (*O. niloticus*)

No	Parameter	Treatment (Dose of Citronella Oil; mL/L)	Average ± SD
1	Time to faint (minutes)	A (0.00)	0.00 ± 0.00 [a]
		B (0.05)	8.91±0.32 [e]
		C (0.10)	7.60 ± 0.48 [d]
		D (0.15)	6.05 ± 0.40 [c]
		E (0.20)	4.50 ± 0.57 [b]
2	Recovery Time (minutes)	A (0.00)	0.00 ± 0.00 [a]
		B (0.05)	4.69 ± 0.45 [b]
		C (0.10)	7.19 ± 1.00 [c]
		D (0.15)	10.44 ± 0.87 [d]
		E (0.20)	12.89 ± 1.31 [e]
3	Erythrocytes (x10 ^{6} cells /mm³)	A (0.00)	2.69 ± 0.09 [b]
		B (0.05)	1.22 ± 0.64 [a]
		C (0.10)	1.42 ± 0.36 [a]
		D (0.15)	1.82 ± 0.33 [a]
		E (0.20)	2.12 ± 0.61 [ab]
4	Leukocyte (x10³ cells/mm³)	A (0.00)	155.60 ± 10.18 [d]
		B (0.05)	54.63 ± 38.26 [a]
		C (0.10)	90.43 ± 20.64 [ab]
		D (0.15)	118.27 ± 32.50 [bc]
		E (0.20)	148.00 ± 47.85 [cd]
5	Hemoglobin (g/dL)	A (0.00)	11.30±0.31
		B (0.05)	5.23±3.07
		C (0.10)	6.33±1.70
		D (0.15)	7.13±0.90
		E (0.20)	8.40 ± 2.95
6	Gonadosomatic Index (GSI) (%)	A (0.00)	0.13-0.75
		B (0.05)	0.06-1.54
		C (0.10)	0.11-1.79
		D (0.15)	0.10-0.61
		E (0.20)	0.04 – 0.88
7	Hepatosomatic index (HSI) (%)	A (0.00)	1.56±0.47
		B (0.05)	0.93±0.35
		C (0.10)	1.02±0.30
		D (0.15)	1.26±0.68
		E (0.20)	0.95±0.30

Number with different superscript in each parameter showed significant different ($P<0.05$)

Blood Profile

The blood profiles tested were erythrocytes, leukocytes and hemoglobin (Table 3). The mean value of erythrocytes of prospective tilapia broodstock in treatment A (control) of 2.69 x 106 cells/mm³ and treatment E (dose 0.20 mL/Llemongrass oil) of 2.12 x 106 cells/mm³ showed the highest values, whereas there is no significant different among other treatments. Value erythrocytes in this research is still in the normal range. Witeska et al.(2017) reported that the normal range of values of erythrocytes tilapia ranges between 3.0–4.2 × 106/mm3. This result is in accordance with Gbore et al. (2006), which states that the high number of erythrocytes indicate fish in a state of stress. There are some other factors that affect the value of erythrocytes. According to Destiani et al. (2019), the amount of erythrocytes is influenced by sex, age, environment, nutritional and reproductive status and can vary between different populations of the same species. Based on the results of research that has been carried out regarding the addition of lemongrass oil as an anesthetic agent for tilapia broodstock, it has a significant effect (F count > F table; 0.05) on fish leukocyte values. The average leukocyte value for tilapia broodstock is indicated in treatment A (control) 155.60 x 10 3 cells/mm³ showed a higher leukocyte value than other treatments, while treatment E (0.20 mL/Ldose of lemongrass oil) 148 x 103 cells/mm³ the leukocyte value was higher than treatment B (dose of 0.05 mL/L lemongrass oil), treatment C (0.10 mL/L

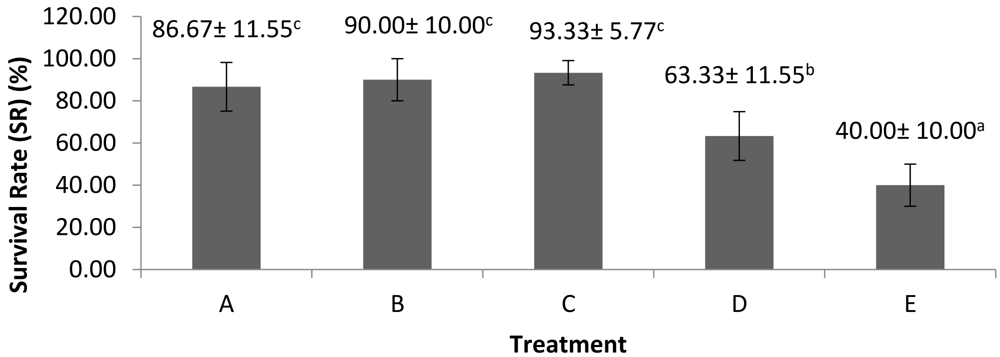

Figure 1. Survival Rate (SR) (%) of Prospective Broodstock Tilapia (*O. niloticus*) Treatment as Dose of Citronella Oil (mL/L): A (0.00); B (0,05); C (0,10); D (0,15); and E (0,20) Number with different superscript showed significant different (*P<0.05*)

lemongrass oil dose) and D treatment (0.15 mL/L lemongrass oil dose) while treatment B (0.05 mL/L lemongrass oil dose) 54.63x103 cells/mm³ showed the lowest leukocyte value. The number of leukocyte values is normal according to Kefas et al. (2015), white blood cells (WBC) of O. niloticus ranged between 108.67 x103/mL - 238.00 x103/mL. The increased leukocyte value was due to the fish being infected by foreign compounds that entered the body. In this case, it is suspected that the citronella oil given, the tilapia's body responded as a foreign object.

The highest average amount of tilapia hemoglobin was found in treatment A (control) 11.30 g/dL, while the average amount of hemoglobin in the treatment with lemongrass oil in treatment B (0.05 mL/L), treatment C (0.10 mL/L), treatment D (0.15 mL/L) and treatment E (0.20 mL/L) showed the results below normal. Azhar et al (2021) reported that normal Hb levels in tilapia ranged from 5.05-8.33 g/dL. Stress conditions in fish are thought to affect the decrease in the amount of hemoglobin. This is in line with the Paulo et al. (2009), which mentioned that fish under stress conditions can also affect Hb levels in the blood. Stress conditions can result in the amount of hemoglobin below the normal range is thought to be stressed due to the addition of lemongrass oil so that hemoglobin cannot transport oxygen evenly to all parts of the body. Furthermore, the oxygen supply in the fish's body is low and causes the fish to be stressed and weak.

Blood Glucose

In all treatment, the blood sugar of prospective tilapia broodstock before transportation were higher compare to after transportation (Figure 2). This is because the anesthetic in the form of citronella oil is able to suppress the metabolic rate of tilapia, so it can

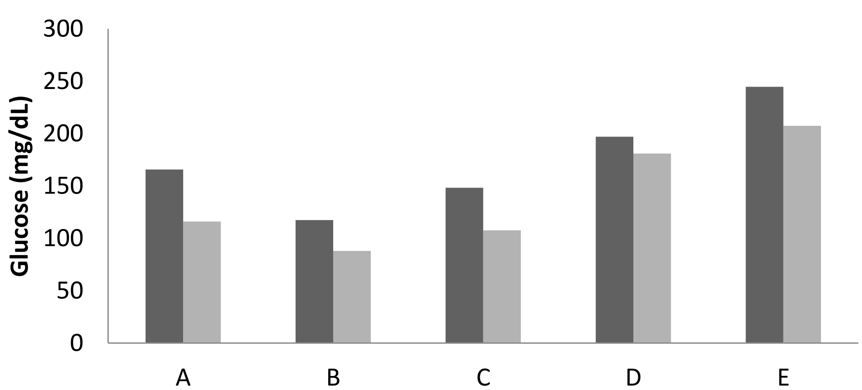

Figure 2. Comparison of Blood Glucose (mg/dL) Before (dark grey bars) and After (light grey bars) Transportation. Treatment as Dose of Citronella Oil (mL/L): A (0.00); B (0,05); C (0,10); D (0,15); and E (0,20)

reduce stress levels in fish and cause low blood glucose levels in fish

Porchas et al. (2009) mentioned that administration of anesthetics can minimize stress levels in fish so that it can suppress the increase in blood glucose levels. Furthermore, Hamid et al. (2013) reported that normal hemoglobin levels range from 33.3 – 250 mg/dL.

Gonadosomatic Index (GSI)

Gonadosomatic index was obtained by dividing the gonad weight by the total weight of the fish and multiplied by 100%. The results of the calculation of the gonadosomatic index of the prospective broodstock of tilapia before transportation had an average of 0.66%. The results of the gonadosomatic index showed results that had no significant effect between treatments. The results that had no significant effect could be caused because the fish used had different sizes and ages. According to Muchlisin et al. (2014), generaly, the gonadal development or maturity stage of fishes could be evaluated macroscopically and macroscopically. Macroscopic analysis involved eye-naked observation of gonads such as gonad weight (gonadosomatic index, GSI), gonad colour and other morphological performances of gonad.. Observation of the gonads after transportation also serves to determine the gonad maturity of the prospective tilapia broodstock and most importantly it does not interfere with the gonad maturity stages of the prospective tilapia broodstock.

Hepatosomatic index (HSI)

The liver is an organ that is very susceptible to the influence of chemicals and is the main target organ of the toxic effects of chemicals (toxicants). The hepatosomatic index value was measured before and after transportation. The results of the calculation of the hepatosomatic index of the prospective broodstock of tilapia before transportation had an average of 1.20%. The results of the hepatosomatic index showed no significant effect between treatments. The results of the calculation of the hepatosomatic index data of the prospective broodstock of tilapia before transportation have an average of 1.20%. A high HSI value can also indicate a high GSI value, so that if the HSI and GSI values in fish are high, it can be assumed that the fish have mature gonads or enter the gonad maturity IV. According to Rovara et al. (2008), the increase in the HSI value is directly proportional to the increase in the GSI value.

4. Conclusions and suggestions

Conclusions

Citronella oil did not significantly affect the blood profile (hemoglobin) but significantly affected the blood profile of erythrocytes and leukocytes of the prospective broodstock of tilapia. The administration of lemongrass oil had a significant effect on the blood glucose of the prospective broodstock of tilapia. Giving citronella oil did not significantly affect the gonadosomatic index (GSI) and hepatosomatic index (HSI)

The best anesthetic dose for transporting prospective broodstock tilapia with a size of ± 100 is in C (citronella oil 0.10 mL/L) with an average survival rate of 93.33%.

Suggestions

It is advisable to do further research on the transportation of prospective broodstock tilapia using citronella oil with a higher density and at the time of transportation when using simulations, try to maximize time in the water and use with the same fish conditions as the weight of the fish and age.

The eDNA survey revealed the biodiversity of marine eukaryotes covering five kingdoms in the marine protected area of Lombok. The alpha and beta diversity are relatively high, but no difference in diversity and community structure between the core zone, non-core zone, and non-conservation area. Likewise, there is no difference in species diversity between locations, but there are differences in community structure between locations and between media and factions in Lombok waters. The application of eDNA surveys is promising for assessing marine biodiversity and its implications for marine protected area management in Indonesia on a large scale.

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