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The Level Of Mercury Pollutan Absorption on channa strata , pangasius hypophtalmus, clarias batrachus, cyprinus carpio l, oreochromis niloticus

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Abstract

Mercury (Hg) is one of trace elements that have features liquid at room temperature in specific high electrical conductivity and gravity. Among the various heavy metals, mercury is classified as the most dangerous pollutant that has high potency to harm marine environment. The presence of mercury in the aquatic environment is due to industrial and natural activities. The effect of mercury as pollutant to marine life may be directly or indirectly, for example a reduction of water quality and disturbance of food chain. The form of mercury that is toxic is methyl mercury, which can be accumulated by aquatic biology. The process of accumulation in the body of fish occurs due to the mercury speed taking (take-up rate) by the fish faster than the process of excretion. The effect of mercury toxicity to the fish may be lethal and sub lethal, synergism and antagonism. The impact of mercury to humans' body may physiological disorders, disturbances of the nervous system growth disorders, and disorders of the kidneys.

Keywords: Mercury; Environment; Water Biology

1. Introduction

Mercury (Hg) is one of trace elements that have features as liquid at room temperature with specific gravity and high electrical conductivity. Due to these characteristics, mercury is widely used in industrial and laboratory activities. Mercury contained in the waste such as public waters altered by micro-organisms activity into component methyl mercury (CH3-Hg) that toxicant and has strong holding capacity in addition to its high solubility, especially in the body of aquatic animal. This resulted in accumulation of mercury through bioaccumulation process and bio magnification in the tissues of water animals, so that the mercury levels can reach hazardous levels to the life of aquatic animal and human health that are eating that aquatic animal. The process of mercury accumulation in the body of aquatic animals occur due to the speed of retrieval mercury (up take rate) by aquatic organisms faster than excretion process. Among the various heavy metals, mercury is classified as the most dangerous pollutant. It has high potency to harm the marine environment, because it is

produced in high amount and use in various fields.Beside that, the pollution may caused by others heavy metals such as (zinc, lead, cadmium, mercury, arsenic, nickel, vanadium and beryllium) that be a serious problem today. Effect of mercury as pollutant to marine life may be directly or indirectly, for example the reduction of water quality. The ability to accumulate mercury in the body of biota can harm themselves or other marine biota example through the food chain.

The pollution of mercury (Hg) in the soil and the water is very harmful to the environment and human health. Mercury compounds in the form of Hg (II) can be bound to the residues system of proteins or enzymes in the human body and animals, so that protein or enzyme will lost its activity. Beside Hg(II), the most dangerous of mercury compounds is organomercury preciesly metilmercury and fenilmerury. This coumpounds is highly reactive and has high mobility than Hg(O) or Hg(II). This is due to human *gastrointestin*e able to absorb aproximately 95% of metilmercury coumpounds (Rugh *et al*, 2000). This coumpounds may attack the human nervous system through blood circulation (Bizily *et al*, 2000). In the aquatic environmnet or marine occur *biomagnification* process to methilmercury through food chain, especially food chain in the water(Bizily *et al*, 2000). This *Biomagnification* process occur if methilmercurry pollutate the aquatic and marine .

Sources of mercury pollution can caused by geological and biological processes, such as the Mercury found in rocks and soil that eroded by rain and wind. Even so, it is not comparable amount when compared to the mercury pollution caused by human activities, such as burning coal, petroleum products, and the use of mercury fungiside, calisator mercury and gold mining that use mercury to extract gold particles. Effect of mercury as a pollutant to marine life may be directly or indirectly, for example through a reduction in water quality. The ability to accumulate mercury in the body can harm marine life or marine biota other relevant example through the food chain, FAO (1971).

Mercury (Hg) is one of the trace elements that have characteristics of a liquid at room temperature with specific gravity and high electrical conductivity, due to these properties, mercury is widely used in both industrial and laboratory activities. Mercury contained in waste or in public waters waste altered by the activity of micro-organisms into the component methyl mercury (CH3-Hg) that toxic and has strong holding capacity in addition to its high solubility, especially in the body of water animal. This make mercury accumulated through bioaccumulation and bio magnification process in the tissues of animals water, so that mercury levels can reach hazardous levels to aquatic life and human health, who are consuming aquatic animals. The process of mercury accumulation in the body of aquatic animals due to mercury speed (take-up rate) by aquatic organisms faster than the process eksresi Sanusi (1980). Among the various heavy metals, mercury is classified as the most dangerous pollutant, besides that the production of mercury is quite a big and its use in various fields. Pollution also caused b a rare elements (zinc, lead, kadnium, mercury, arsenic, nickel, vanadium and beryllium) is a serious problem Djojosoebagio (1978) in Widodo (1980).

According to Herawati (1980) mercury can coagulate mucus on the surface of the gills and broke gill tissue that make the fish died. Huckabee and Griffith (1974) in EIFAC (1980) state that the levels of 0.001 ppm mercury (HgC1) and selenium oxide can reduce egg bagged of *Cyprinus carpio*. In addition, at the certain methyl mercury doses can cause serious effects on biological life and additional doses can cause death. Widodo (1980) said that the

accumulation of mercury in the body of marine life is also focused on the functioning of reproduction organs, in which will affect the development of marine life, especially in its breeding.. To evaluate the effects of mercury toxicity to humans, the OECD (1974) in the sanusi (1980) define a concept called ADI (*Acceptable Daily Intake)* for mercury, the mercury intake that is allowed for humans per day, the concepts define

1. If the intake of mercury (in the form of methyl mercury) at 0.3 mg per day, so that the mercury is left in human blood at 0.2 ug. This level may cause poisoned *(clinical symptoms*). Therefore ADI recommended 0.03 mg per day.
2. If the fish containing 1 ppm of total mercury in the form of inorganic mercury, so people were forbidden to eat fish or animals exceeding 2.0 grams per week.

The Minamata tragedy which is known as Minamata disease, has encouraged the expert to do some research. Based on the results studies, found that those who were affected by Minamata disease were the people who lived around Minamata Bay. They consumed fish containing mercury (Hg) derived from plastic waste dumped in the Minamata Bay (Pervaneh, 1979). The mental Symptoms and neurological disability oddities began to appear, especially in children, about 25 years after the disease symptoms appear (found), the Japanese government stop dumping the mercury to eliminate the residue of pollutants and to rehabilitate people affected by that disease (chronic), (Lasut,2002).

In the period of the 1960s, several cases of methyl mercury toxicity outbreaks widely reported. Most cases occurred in Iraq in the fall and winter of 1971 to 1972. Almost all parts of the Iraq country, more than 6,500 people, were taken to hospital because of methyl mercury poisoning and more than 450 people died. Plague is caused by the bread consumption of household production of, because the composition is derived from wheat bread which is preserved by using fungicide containing methyl mercury. Iraqi imported wheat from Mexico that should be used as seeds. Although grain sacks have been given a warning label, but the label is written in Spanish so it was not understood by Iraq people. Moreover, the grain has been spiked with red dye, as an indicator that the grain has been given a fungicide containing Hg. Unfortunately, seed coloration easily lost when water leached, while methyl mercury cannot be lost. To test the toxicity of the seed the farmers provide animal feed and then poisoning symptoms appear to the animals. But the symptoms appear for several weeks or months, so that the epidemic was too late to prevent.

Mercury Waste from industrial pollution is often in the form of inorganic mercury, but the organisms or aquatic vegetation during the journey on the river, lake or bay, has turned into deadly methyl mercury. Mercury can undergo biotic and abiotic methylation to form methyl mercury. Organic mercury compounds, especially methyl mercury is the most concentrated in the food chain.

Fish Protein binds strongly more than 90% of methyl mercury consumed, although with a long duration in cooking, frying, boiling or burning cannot let methyl mercury go. If there is suspicion of methylmercury intoxication process, is need to know the amount of fish consumed, frequency and type of fish. The possibility of methyl mercury accumulation to the fish is greater,becasue its position high enough on the food chain. Most the cases occur to marine fish rather than freshwater fish but there is no research about this before. Freshwater fish is consumed by many people, to anticipate this problem; this research needs to be done. The reason to use freshwater as research material is due to freshwater are sensitive to toxic

materials and environments changing, easily obtainable in large quantities, easily maintained in the laboratory and appropriate for the purposes of biological assay.

B. Effect of Mercury Toxicity to Fish.

The direct pollutant effect (especially pesticides) to the fish expressed as lethal (acute) i.e the consequences that arise in less than 96 hours or sublethal (chronic), the consequences that emerge more than 96 hours (four days). The nature of the lethal and sublethal toxic can cause genetic and teratogenic effects on the biota are concerned. Effect of lethal due to disturbances in the central nervous, make the fish cannot move or breathe the consequences they die quickly. Effects of sub-lethal occur in the body's organs, damage to the liver, reducing the potential for proliferation, growth and etcetera. It is like the tragedy in Japan, where the population around the Minamata bay poisoned by methyl mercury as the results of plastic waste factory. Methyl mercury contained in fish consumed by people around the bay. Fish that die around Minamata bay has methyl mercury levels as much as 9 to 24 ppm.

Factors influential in the formation of methyl mercury is an environmental factors that determine the level of toxicity. Mercury accumulated in the animal body of water will damage or stimulate zymotic systemic, in which lead the decreasing of adaptability of that related animals to the polluted environment. In fish body, mercury accumulates the important organs such as kidney, liver and eye lens.

Toxicity of heavy metals that harm the gills and other external tissue structure, can cause death to fish due to prosesa noxemia, i.e inhibition of the circulatory and respiratory gills functions .The compounds of heavy metals that have an influence on the gills are lead, zinc, iron, copper, cadmium and mercury. Experiments were conducted on fish Carasiusauratus show that the sequence of heavy metal uptake by chemoreceptor (taste bund) of fish is mercury, copper, zinc, and tin.

The effect of mercury pollution toward ecology is in a long-term includes the community damage structure, heredity, food chain, aquatic animal behavior, physiology, and the resistance and the impact that is synergist each other's. The linear effect occurs in aquatic plants, the higher the mercury levels so greater toxic effect. The difference in the degree of toxicity of heavy metals to different species of marine life can be shown by experiments conducted by Schweiger on several types of fish (such as trout and carp) that apparently shows the different sensitivity from each type of fish.

Based on this experiment can be proven that the sensitivity difference is closely related to differences activity of the fish. Degree of toxicity also related to respiratory flow of each organism, i.e the higher the respiratory flow, also increase the toxicity of the heavy metal. Similarly, low dissolved oxygen levels for fish requires more pumping water through the gills, thereby respiratory flow increased, resulting in more toxins are absorbed into the body through the gills. In addition there are several ion of various heavy metals that is synergism or antagonistic one another, for example, Cu has such synergism against Cd and Mg. Mercury can assemble mucus on the surface of the gills and damage gill tissue that make fish dead. Levels of 0.001 ppm mercury (HgC1 2) and selenium (SE0 2) can reduction in egg carp (*Cyprinus carp*io). In addition at a certain dose methyl mercury can cause serious effects on the biological life and can cause death. The accumulation of mercury in the body of marine life is also focused on the functioning of organs for reproduction, in which will affect the development of life marine life especially in proliferation.

To evaluate the effects of mercury toxicity to humans, the OECD define a concept called ADI (Acceptable Daily Intake) for mercury, the mercury intake by humans is allowed per day. The concept is stated:

1. If the intake of mercury (in the form of methyl mercury) at 0.3 mg per day, the mercury is left in human blood at 0.2 ug. That high levels may result in toxicity (clinical symptons). Therefore recommended that ADI of 0.03 mg per day.
2. If the fish or animal containing 1 ppm of total mercury in the form of inorganic mercury, so people were forbidden to eat meat, fish or animals melampaui2.0 grams per week

C.The Mercury Absorption In Fish Body

Based on the results of the research gained the data about the absorption of heavy metal pollutants (Hg) in the body of fish carp (*Cyprinus Caprio L*), Tilapia (*Oreochromis sp*), , Fish Catfish (*Clarias batrachus*) and cork fish (*Channa striata Fowler)* covering gills and muscles, and the condition of the fish gill histology carp (*Cyprinus Caprio L*), Tilapia (*Oreochromis sp),* Patin fish, Fish catfish (*Clarias batrachus)* and cork fish (Channa striata Fowler) contaminated with heavy metals Hg are as follows:

Mechanism of Heavy Metal Pollutants or entry into the organism's body is divided into three:

1. Transport through the blood circulatory system
2. Accumulated in the target of organisme organ
3. Through the excretion system, while the physical and chemical processes such as precipitation and ion exchange. Most of heavy metal ingredient accumulated in the gills muscle, this accordance with Darmono (2001) states that metal accumulation in tissues organism body from large to small row on the gills.

Generally, Methylated mercury has toxicity that increases as the increased ability to penetrate the membrane lipids wall (Bustamante et al., 2006). For the human,Heavy Metal Pollutants entry through food chain in which bio accumulation process occurs, the concentration of methylated mercury rising and magnification. This case causing Minamata disease in Japan (JPHA, 2001). Many factors led to the methylation process, biogeochemical factors include sediment (Celo et al., 2004; Lasut & Rares, 2006). Then, MeHg accumulated by aquatic organisms such as fish (Ikingura & Akagi, 1999), shellfish(Bergeron et al., 2004), and other organism (Lasut et al., 2005). Accumulation of mercury in aquatic organisms is related to its position in the food chain (Desta et al., 2007) and its way of life (Bustamante et al., 2006) in which the predator shows a high concentration in the tissue of the victim (Bustamante et al. , 2006).

Name of Fish	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
Clarias batrachus	0.24	0.39	0.54	0.69	0.84	0.99	1.14	1.29	1.44	1.59
Channa striata Fowler	0.17	0.32	0.47	0.62	0.77	0.92	1.07	1.22	1.32	1.52
Cyprinus caprio	0.24	0.44	0.62	0.83	1.02	1.22	1.42	1.62	1.82	2.00

L										
Clarias batrachu(patin)s	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50
Oreochromis sp	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.28

Table 4.The Mercury Pollutants absorption (Hg) Into Fish Body (ppm)

Mercury in the environment through volcanic activity, weathering of rocks and the humans movement toward mercury deposited in soils, sediments, water and waste disposal (UNEP, 2002), there are three processes that occur in connection with a chemical in aquatic organisms namely: 1. Bio concentration process is a chemical process from incoming water oak in the tissue of organisms through the gills or epithelia and accumulates 2. The process of bioaccumulation i.e the famous term and includes not only the bio concentration but also the accumulation of chemicals through the food consumed and 3. Magnification process leads to a total process that occurs, including bio concentration and bioaccumulation in which the concentration of chemicals that accumulate in the tissues increases according to the level that is tropic passed (Connell and Miller 1984: Rand f Petrocelli 1985). Bio-magnification process of chemical substance in a bio transfer process, i.e bio transfer process is the transfer of a chemical biologically from a lower tropic level to a higher level in a food chain structure. (N. Ayu Mirah in Absorption and accumulation of Cr-51 radio nuclides in water by carp). The Accumulation of heavy metal toxicity in the body of a goldfish is quite high, in which can cause death in goldfish.

When visualized into a graph can be seen in the following picture:

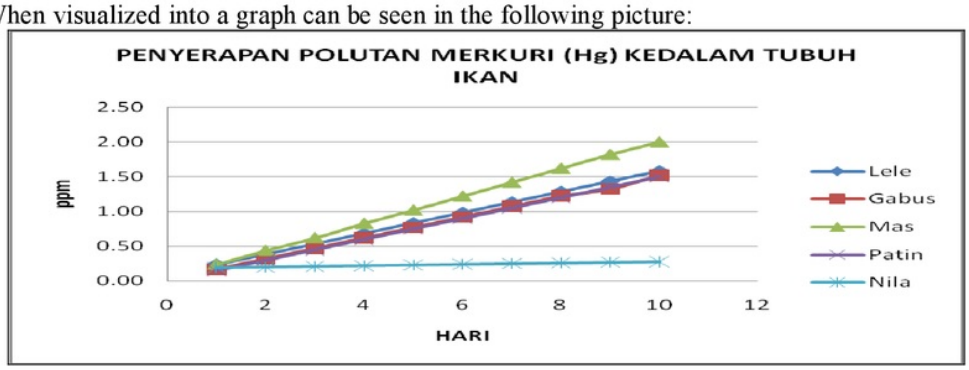


Figure 4.6. The Graph of Mercury Pollutants Absorption in Fish Fresh Water Samples

As the above figure shown that Pollutants Absorption Graph Mercury in Fish Fresh Water Samples. Figure 4.6, explains that the *Cyprinus carpio L* has a high mercury absorption, means that mortality longer than other freshwater fish samples. Whereas for the blue line designated for Tilapia (*Oreochromis sp*) has a low mercury absorption by the sense that mortality faster than other freshwater fish samples. To find out the results of each sample freshwater fish, can be explained in the following sub: Journal aquaculture Indonesia, 8 (1) = 59-65 2009 (I.Taufik, E.Supriyono, K.Nirmala in The effect of Endosulfan bioaccumulation

on the growth of carf, *Cyprinus carpio LINN*) that insecticides endosufan have high toxicity to juvenile cgold fish with LC_{50-96} .

jjam, 2.42 micron g / L.
Here are the results of a separate visualization of mercury treatment on Cyprinus Caprio L as follows

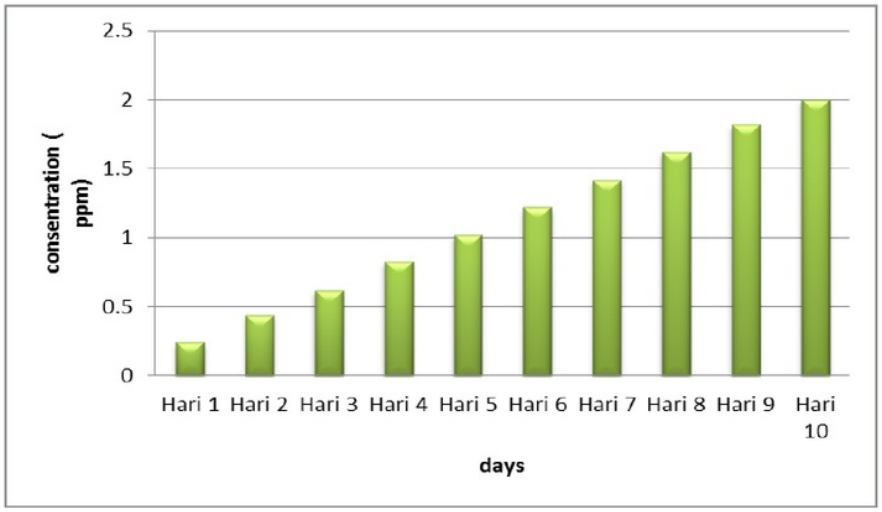


Figure4.18. Graph of Mercury Treatment on Goldfish Till 10th day

Based on Figure 4.18 seen an increasing occasionally, in which the level of change is in order. At the first treatment day 1, the position of the bar graph is 0 to 0.5. Whereas at the last day of treatment at 10th day is seen that graphs position nearly 2.

Determination of gold fish (*Cyprinus Caprio L*) to be testing fish is due to the need for uniformity in the sampling. The result showed that the type of gold fish (*Cyprinus Caprio L*) is a type of fish that were common and widely consumed by the local people. (Brinley cit, Sudamadi 1993). *Cyprinus carpio L* can be used as animal testing because it is very sensitive to environmental changes

Here are the results of visualization of mercury treatment on fish catfish (*Pangasius djambal*) as follows:

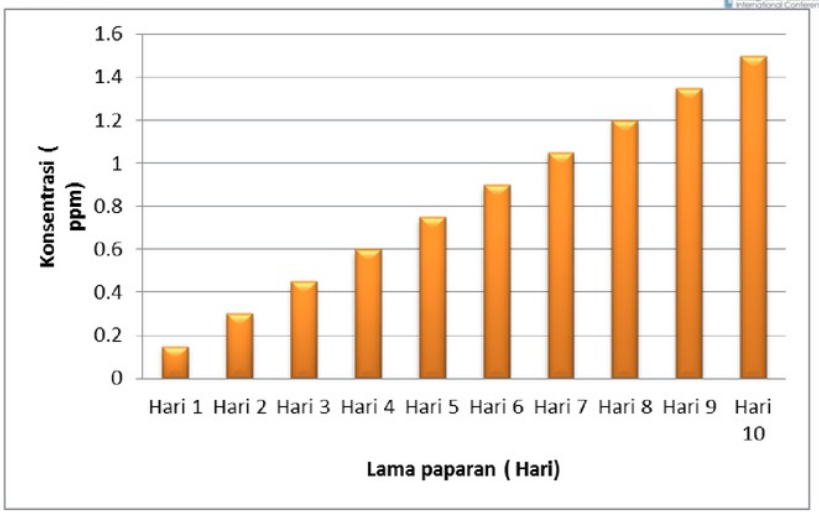
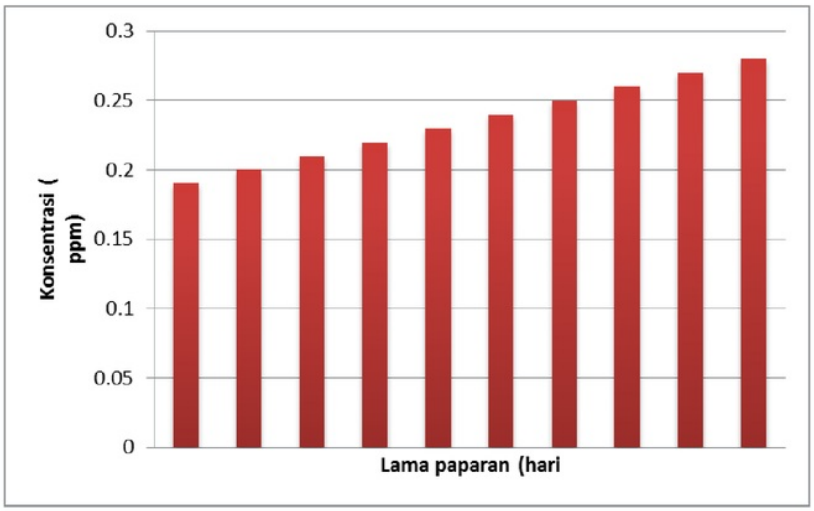


Figure 4.24 Mercury treatments in *Pangasius djambal* until day 10

Based on Figure 4.24 is seen an increase occasionally, in which the level of changing is in order. At the day 1 treatment the position of the bar graph is between 0 and 0.2. While the bar graphs at the last treatment, 10th day between 1.4 and 1.6.

Here are the results of mercury treatment to *Oreochromis niloticus* as follows:

Figure 4.13 Graph Mercury of Treatment on Tilapia Till the 10th day



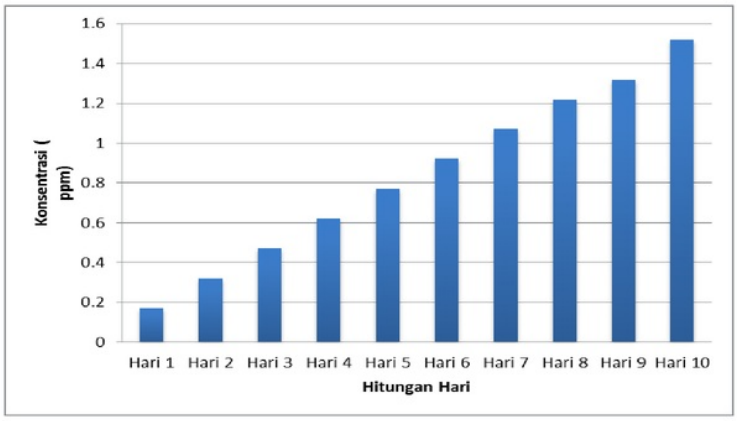
Source : Visualisation from table 4.1.

Based on Figure 4.13 seen an increase in the absorption of pollutants Hg, where the level of change that is in order. At the first treatment 1st day , the position of the bar graph is between 0:15 to 0.2.But, on the last day of treatment, namely the 10th day graph shows between 0:25

and 0.3 .From the histological observation of Tilapia's (*Oreochromis niloticus*)gill, kidney and liver obtained the following results:

The results of mercury treatment on *Channa striata Fowler* as follows:

Figure 4. Chart of Mercury Treatment on *Channa striata Fowler* until today



Sources: Visualization of Table 4.1.

Based on Figure 4.6 seen an increase occasionally, in which the level of changes is in order. .At the first treatment, day 1, the position of the bar chart is still below 0.2. While the treatment of the last day of the 10th day of bar graphs showing the range between 1.4 and 1.6.

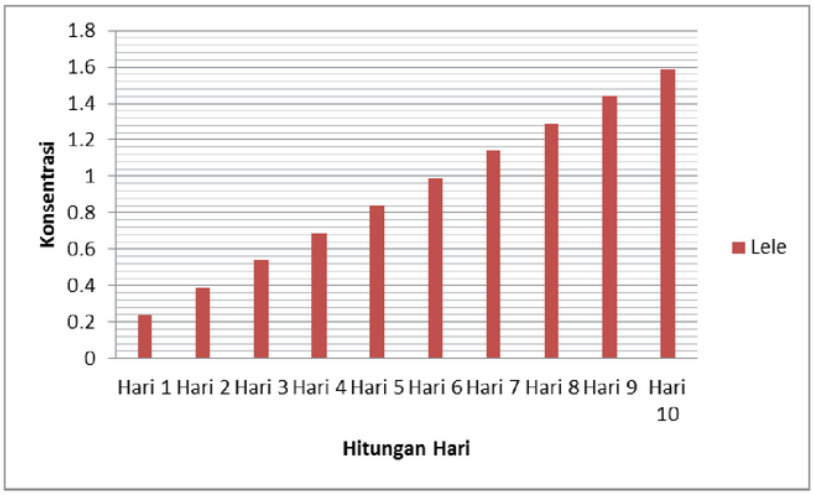
Implementation of heavy metals mechanism in living organisms, and toxicity in fish, according Darmono (2001) stated the metal into the living body tissue through a few streets, namely respiratory tract, skin, digestive, and penetration through the metal adsorbs through the respiratory tract are usually quite large, both in aquatic animals that goes through the gills and land animals that go through the dust in the air to the respiratory tract. Adsorbs through the digestive tract only a few percent but the amount of metal that goes through the digestive tract is usually quite large although the presentation absorption is relatively small.

In the animal body, metal will be absorpt associated with blood proteins are that will be distributed to all body tissues, the highest metal accumulation usually in the detoxification organs (liver) and excretion (kidney). Within these networks metal usually a associated with various types of protein such as enzymes and other proteins called metalotionein.

Tissue damage by heavy metals present in both the entry and the location of the landfill consequences of metal toxicity may include physiological disorders (impaired function of enzymes and metabolic disorders (Darmono 2001).

Here are the results of mercury treatment on catfish as follows:

Figure 4.33. Mercury treatment on in *Channa striata Fowler* to-10



Sources: Visualization of Table 4.1.

Based on Figure seen an increase in the absorption of pollutants Hg, in which the level of change is in order. At the first treatment day 1 then the position of the bar graph is still above 0.2. While the treatment of the last day of the 10th day of bar graphs showing visible between 1.4 and 1.6.

2. Conclusions and suggestions

Based on the research, it can be concluded that the absorption of pollutants Hg in *carp, catfish, cork, catfish and tilapia* from the first day until 10th increased, the higher Hg pollutants absorbed the death rate will be high, It is seen from the chart of five kinds of fish in a different concentrations.

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