Heavy Metal Analysis in Fish Muscle at Plant Retention Pond

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***Abstract*— The aim study for this project is to analyse the heavy metal uptake in different part fish of *Anabas Testudenius* by using Inductively Coupled Plasma (ICP-OES). There were several heavy metals that have been examined in this study which is Arsenic, Chromium, Copper, Iron, Zinc and Manganese. This sample of fish was weighted for every four week and their weight has been checked while leave them at the plant retention pond for two month. Then, the *Anabas Testudenius* has been divided into three parts which is head, body and lastly is tail. The finding of this data has been evaluated by using Microsoft Excel. The part that has lowest value of heavy metal is a tail part with 1.1731 ppm concentration of iron for tail of Fish 3, 1.2868 ppm concentration of zinc for tail of Fish 2 and zero reading for heavy metal of arsenic. Based on the data that has been analysing, mostly part of head has highest value for each types of heavy metal. It shows that the part of head is most dangerous part because it easily contaminated will all types of heavy metal except copper on this experiment.**

***Keywords*— Weight of fish, Heavy metal in the fish body, Inductively Coupled Plasma**

I. INTRODUCTION

Retention pond has two categories which is dead pond and wet pond and has its own characteristic. Dead pond or known is detention pond have a dead storage tank that dry and for the wet is known as dead storage tank. Retention pond has own function to reduce the impact on downstream storm water system while the volume will be held in. The advantages of retention pond are can cater all storm, pollutant from the urban areas. Next is the disadvantages of the retention pond is high maintenance to handle with it which is need proper management and monitoring.

The species fish that has been used in this research is *Anabas Testedineus* which is known as Climbing Perch. This species leave at the drainage system across such as river and lakes. *This Anabas Testudenius* can live 6 days without water but the organs must keep in the moist conditions.

The pollution of river and lakes with heavy metal may cause by rapid development of industry and agriculture. Metal in the plant and animal can be classified essential and non-essential metal which have different function. Essential metal such as iron, manganese, zinc and copper which is will help in the biological system. Non-essential metal such as cadmium (Cd), mercury (Hg), lead (Pb), and tin (Sn) will become toxic at the higher level of the concentration. Concentration of metal in the water surrounding cause the accumulation of heavy metal in the fish muscle.

Heavy metal is a metallic chemical element that has high density, toxic and poisonous at low concentration .Heavy metal can enters human body through water, soil, plants and animals. Toxic metals are not biodegradable, have a long biological half-life and have the potential to accumulate in various organs of the body can lead to unwanted side effects.

Thus, the concern about quality of food is increasing in this world is due to toxicological affect. In human diet, fish play an important component and it generally appreciated as healthier and cheapest sources of the protein. Hopefully with this study, individual that like fish too much will be aware with the heavy metal inside.

The objective of this study is to determine heavy metal of the Chromium (Cr), Arsenic (As), Manganese (Mn), Copper (Cu), Iron(Fe) and Zinc(Zn) at three parts of fish (head, body ,and tail) based on the weight of fish. Furthermore, to analyse the concentration of the Cr, As, Mn, Cu, Fe and Zn that have on the *Anabas Testudenius* fish is by using Inductively Coupled Plasma (ICP).

II. METHODOLOGY

A. Overview

Fish is collected at the waste treatment plant retention pond Universiti Teknologi Mara (UiTM) Shah Alam. The fish has been placed at the plant retention pond for two month. Every four weeks the fish has been collected and weighted the body of fish. This research has been carrying out at the Environmental Lab and Instrumentation Lab 2 of Faculty Chemical Engineering, Uitm Shah Alam. The fish has been divided into three sections which are head, body, and tail.

To complete this research the experiment must be done by using Inductively Coupled Plasma-(ICP-OES) as instrument. ICP-OES can detect many element of metal in short period. The procedure to do this experiment is by dry and ashing the sample until no molecules of hydrocarbon (HC) in the sample. After that, do the digestion with the acid and next make the dilution to check the metal in the ICP-OES. After that, do the data analysis about the research

Material that has been used to conduct the experiment was the sample of fish which is known as *Anabas Testudineus*, Nitric Acid, and Hydrochloric Acid and lastly was distilled water.

The apparatus and instrument that has been used in this study was conical flask, electronic balance, furnace, oven, hot plate, beaker, and stirrer and lastly is the Inductively Coupled Plasma (ICP-OES) as the main instrument in this research.

B. Experimental Procedures

There are four samples that have been experimented but only three samples that have been placed at the plant retention pond. Those three samples of fish have been weighted for every four weeks. These samples have birth mark at their body with different places. From the Figure 1, it shows that the birth mark for Fish 1 on the upside of the tail of the fish. Next, for the birth mark of Fish 2 is on the centre of the fish that has been shown at Figure 2. Lastly is at Figure 3 shown the birth mark for the Fish 3 which is at the centre and end of tail of fish.

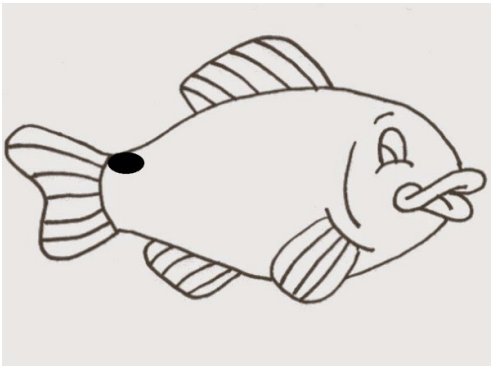

Figure 1: Birth Mark for Fish 1

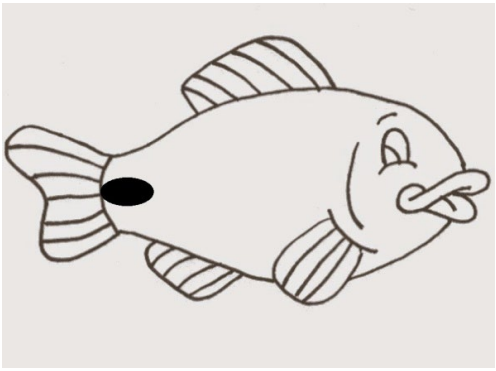

Figure 2: Birth Mark for Fish 2

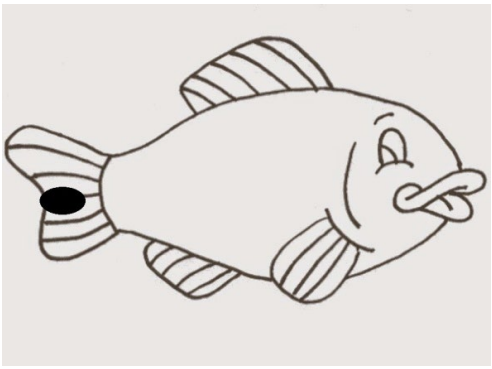

Figure 3: Birth Mark for Fish 3

The each of the sample of fish then has been separate to three parts which is head, body and tails. Then, for the purpose of drying the sample has been placed at the oven for three hours at 60 °C and then the weight of samples has been checked. The samples have been dry completely for three hours. Next, the process of ashing for one hour at 550 ° C was completely done. Then, each sample has been weighted 0.5 g and was prepared for the next step which is digestion.

In the digestion method, 30ml of HNO_3 and 10ml of HCL for each sample has been prepared. The solution that already digested was added in the beaker. The beaker that has solution was place in the hot plate to continuously evaporate and the solution has been stirred so that homogeneous solution will be obtained. After that, the solution was filtered using filter paper and has been transported to the conical flask. The distilled water was added until the conical flask full and was agitated in one minutes and the mixture then put in the vial tube and label accordingly.

Standard solution of arsenic, chromium, copper, manganese and others metal has been prepared. Stock solution for arsenic has been filled in the vials tubes and the intensity of this standard solution was analysed using ICP-OES. Then, the sample of every part of fish that has been prepared was placed in the vial tubes and then it has been analyse the heavy metal by using ICP-OES. Lastly, the data that obtained from ICP-OES need to evaluate. Heavy metal that contain in the part of the fish of *Anabas Testudineus* has been evaluated by using statistical method.

III. RESULTS AND DISCUSSION

The experiment has been done conducted as well as planned. All the data of the each experiment has been collected and analysed using suitable method and software. The parameter of doing this research was heavy metal in the three differences part of fish which was contains head, body and tail. Other than that, this experiment has been used four same types of fish but different weight of fish. The sample fish one, two and three has been leave at the retention pond for two month to check their weight. While the sample was placed at there, the fish has been weighted and the result has been confirmed that the weight of fish is affected. While the sample fish four has bought at fish stall for comparison between fish at retention pond and from the stall.

There are several heavy metal that has been choose to study in this experiment was included Chromium, Arsenic, Manganese, Copper, Iron and Zinc. The result section will discuss with all this types of heavy metal in different part of fish. On this section, the result of parameter has been analysed using a statistical method. Statistical method is a method of collecting data, summarizing, analysing and interpreting variable numerical data.

A. Comparison weight of samples

Table 1: Comparison Weight of Fish

TIME (WEEK)	**FISH SAMPLE (gram)**		
	FISH 1	FISH 2	FISH 3
WEEK 1	42.9169	56.5885	45.0843
WEEK 4	34.8949	52.5424	43.7576
WEEK 8	33.8221	41.1164	35.3174

From the Table 1 shows the comparison weight of the Fish 1, Fish 2 and Fish 3 that's has been leave at retention pond. This entire sample has been weighted each four week to check their weight. From the data above can see the weight of each sample has been decreasing for every four weeks. By look at the Fish 2, the weight of has been decreasing suddenly from 52.5424 g to 41.1164 g. From all this result it can discuss that the growth of the fish has been disturbed by the condition of the water at the retention pond.

B. Arsenic

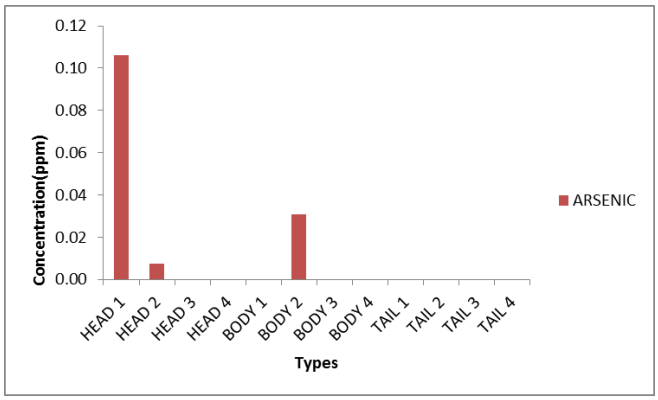

Figure 4: Concentration of Arsenic for All Samples of Fish

From the data that has been plotted shows that there are only certain part has heavy metal of arsenic on their part of body. Based on graph at Figure 4 it shows that head of Fish 1 has highest value concentration of arsenic with value 0.1061 ppm and follow by body of Fish 2 with concentration 0.0309 ppm and lastly is head of Fish 2, 0.0073 ppm for the concentration of arsenic . From Figure 4 it shows that the Fish 4 is free from heavy metal of Arsenic which is can conclude that the fish in good condition and not exposed with this heavy metal. Next, it can discuss that the fish that live at the pond has been exposed with this heavy metal. The effect to human when consume this fish was can cause skin cancer, lung cancer, bladder cancer, and kidney cancer.

C. Chromium

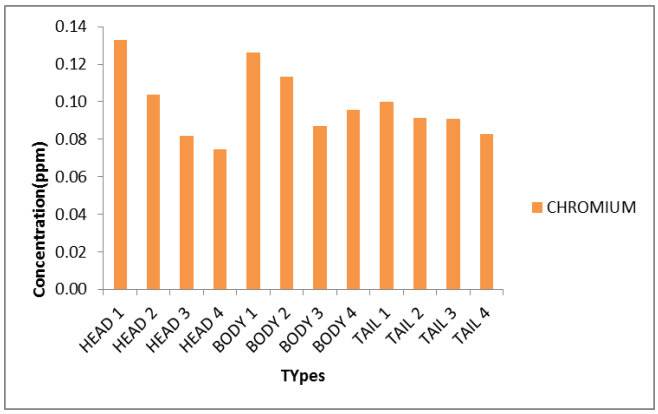

Figure 5: Concentration of Chromium for All Samples of Fish

Based on the Figure 5 it shows the comparison between four samples of fish. From the result above we can see that Fish 1 has higher level of heavy metal of chromium compare to others. For Fish 1, it shows that it has highest level of heavy metal chromium at head, body and also tail with the concentration of 0.1331 ppm, 0.1263ppm and 0.1000 ppm. Next is follows by the Fish 2 that has second highest value concentration of heavy metal chromium in their body which is 0.1038 ppm for the head, 0.1133 ppm for the body and 0.0912 ppm for the tail. Lastly, the result that show for Fish 3 and Fish 4 has a slightly result that both sample has lowest value concentration of chromium. Furthermore, the chromium has much health effect that will affect the human health which is carcinogenic effect, renal effect, hepatic effect, and more.

D. Copper

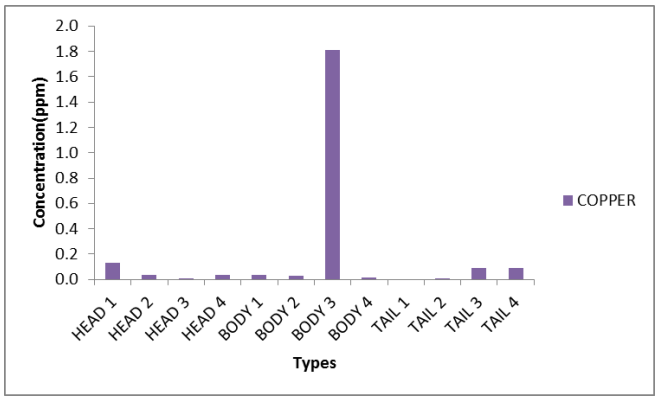

Figure 6: Concentration of Copper for All Samples of Fish

Summary of the sample fish in from this experiment has been shows that body of Fish 3 has highest value concentration heavy metal of copper with the value 1.8124 ppm compares to other sample. Based on the graph, it shows that every sample has lowest value and mostly below than 1.0 ppm concentration heavy metal of copper. There are second highest value heavy metal of copper in the sample which is in the head of Fish 1 and follow by tail of Fish 4 with concentration 0.0908 ppm and head of Fish 1 with 0.1331 ppm for the concentration. There are more copper that has end up at the environment which is the rivers that are depositing sludge on their banks that is has been contaminated with copper .There are many health impacts that will effect to human which is irritation, headaches, dizziness, liver damage and death.

E. Iron

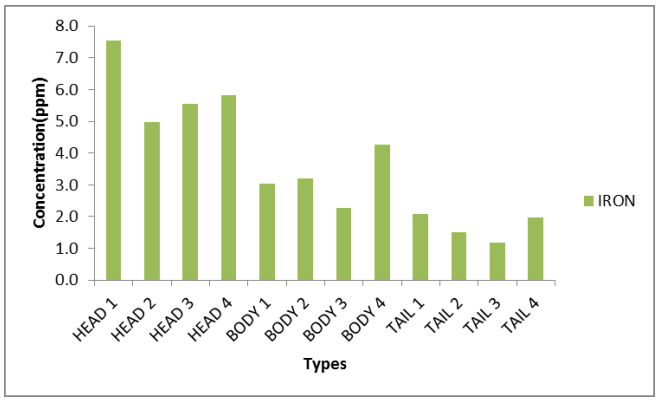

Figure 7: Concentration of Iron for All Samples of Fish

Based on the graph 7, it can observe that head of each sample has highest level concentration heavy metal of iron. From the data above, it really shows that head of Fish 1 has highest level concentration heavy metal of iron that has been contaminated in its head with value of 7.5451 ppm. For the part of body of sample fish, body of Fish 4 has highest level of concentration with 4.2726 ppm compare to others body of sample and it follows for the tail part, tail of Fish 4 has highest level of concentration with value 1.9825 ppm compare to part of tail for others samples. From the experiment, it shows that the head is a part of favourite place where the heavy metal of iron will contaminated. Other than that's, iron also can be found in our pyramid of food such as in the meat, potatoes and vegetable. Iron may contacts and remains in the tissue and iron also may cause the conjunctivitis, choroiditis and also the retinitis. It will affect the respiratory system and also will cause the lung cancer with the chronic inhalation of the excessive concentration of the iron oxides fumes or dust. Other than that, if consume high iron also might increase the risk of the heart disease and also diabetes and iron also can cause the irritation.

F. Manganese

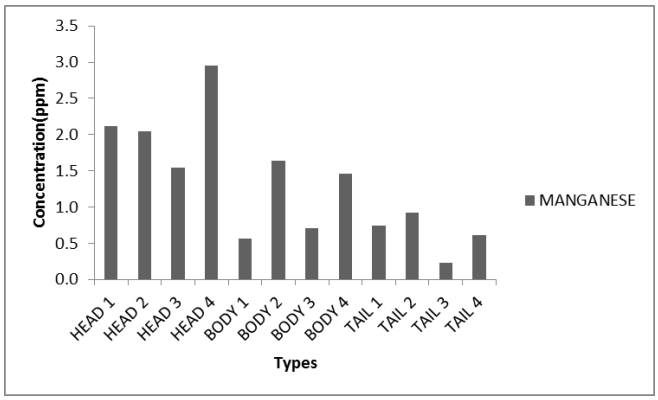

Figure 8: Concentration of Manganese for All Samples of Fish

From the figure 8 it shows that, head of Fish 1, 2 and 4 has a concentration of manganese highest than 2 ppm and the others is lowest than 2 ppm. From the experiment, it shows that the Fish 4 was the most contaminated fish of manganese compare to the other sample because it has highest concentration of manganese with value of 2.9535 ppm for head, 1.4633ppm for body and 0.6085 ppm for the tail. Furthermore, Fish 3 is a lowest contaminated with heavy metal of manganese with the value of 1.5440 ppm for head, 0.7081 ppm for body and lastly is 0.2291 ppm for the tail. There have several effects to human health due to manganese such as respiratory tracts in the brains. If the human has a nerve damaged, forgetfulness, hallucinations it may cause by manganese poisoning. Others effects by manganese is can cause Parkinson, lung embolism an also bronchitis. Then, it quite danger to man that has been exposed to manganese for a longer period time it can cause impotent. Next, if human has been exposed to the dust or fume of the manganese it will give resulted of prolonged inhalation and upper respiratory infections. There a several symptoms that human will face is has syndrome that causes by manganese such as insomnia, emotional disturbances, paralysis and weak muscles.

G.Zinc

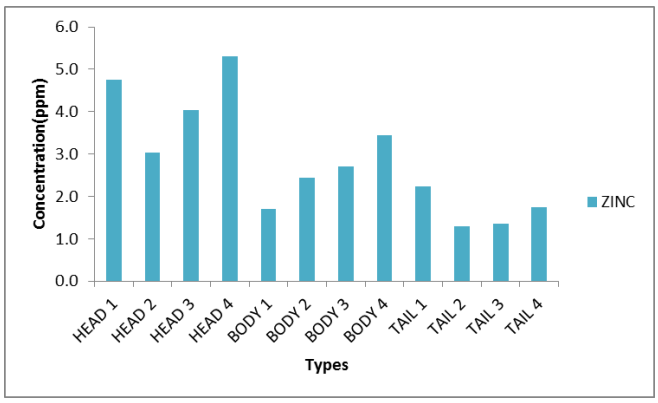

Figure 9: Concentration of Zinc for All Samples of Fish

The comparison heavy metal of zinc in this experiment shows a perfect result with part of head has highest number of concentration of zinc with the concentration of 4.7642 ppm for head Fish 1, 3.0336 ppm for head Fish 2, 4.0362 ppm for head Fish 3 and 5.5043 ppm for head Fish 4. The only sample that has highest value than 5 ppm of zinc is head of Fish 4. The others is mostly has the result lowest than 4 ppm. Tail is the part which has lowest concentration of zinc in each sample with the value 2.2265 ppm for tail Fish 1, 1.2868 ppm for tail Fish 2, 1.3607 ppm for tail Fish 3 and 1.7517 ppm for tail Fish 4. From the experiment, it shows that the favourite part the heavy metal will contaminate is the head part of fish. For human health, zinc is a trace element because when people absorbs too little of zinc they can experience a loss of appetite, decreased sense of taste and smell, skin sores and wound healing. Then, it even can cause birth defects if the mothers have absorbed large concentration of zinc. Specific short-term disease that called metal fume fever will occurs if people inhaling large amount of zinc. According to the Recommended Dietary Allowances (RDAs), the levels of zinc that recommended are 11mg/day for men and 8mg/day for women. Stomach cramps, nausea, and vomiting may occur if takes large doses of zinc (10-15 times larger than RDAs recommended). Other than that, anaemia, damage the pancreas, and decreases levels of high-density lipoprotein (HDL) cholesterol will happen if ingesting high levels of zinc for several months.

IV. Conclusion

After measuring, analyse and comparing the weight of sample of fish for every four weeks for two month it can conclude that each of the samples has a decreasing number of their weight for every four week. From the data it can analyse, the weight of fish 2 has most heavy weight than others on week four until week eight before they will be experiment. Based on the data, it shows that the every sample of fish has decreasing number for their weight this is because they has been exposed with many types of heavy metal that has been study in the plant retention pond. It can conclude that, the contaminated heavy metal will affect the growth of the fish because the weight of the fish decreased for every four weeks.

The sample of fish has been divided to three parts which is head, body and tails. Each part of the fish will analyse using Inductively Coupled Plasma (ICP) to check heavy metal in each part of the fish. Based on the result, head of Fish 1 has highest value of heavy metal arsenic, magnesium, iron and chromium compares to others. It shows that the part of head is most dangerous part because it easily can contaminate will all types of heavy metal accept copper on this experiment. The part that has lowest value of heavy metal is a tail part with 1.1731 ppm concentration of iron for tail of Fish 3, 1.2868 ppm concentration of zinc for tail of Fish 2 and zero reading for heavy metal of arsenic. Based on the data that has been analysing, mostly part of head has highest value for each types of heavy metal.

In this experiment, there are three samples (Fish 1, 2 and 3) of fish that has been placed at retention pond for two months and for the Fish 4 it was bought at the fish stall to make the comparison of concentration of heavy metal between fish that stayed at retention pond and fish that buy from the stall. There are no different between the sample Fish 1, 2, and 3 and Fish 4 because from the result, it shows that each of the samples has been contaminated with all types of heavy metal. From this experiment it can conclude that, either where fish live there will contaminate with heavy metal because our environment has been polluted with all the toxic material and will give negative effect to living thing especially human.

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UNIVERSITI TEKNOLOGI MARA

MANUSCRIPT APPROVAL FORM FOR FINAL YEAR PROJECT II (CGE691)

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Student's Name : NUR SHAFIKA AMILIA BT MOHD ARIFF Matric No. : 2013647178

Project Title : HEAVY METAL ANALYSIS IN FISH MUSCLE AT PLANT RETENTION POND

Supervisor's/ Examiner's comments:

- Re check an abstract (flow of your work)
- Methodology should be written in paragraph.
- Reference not appropriate, more Journal please.

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