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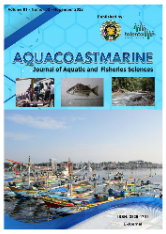

The Analysis of Lead (Pb) Contents in Tuna (*Thunnus alalunga*) Using Furnace Graph of Atomic Absorption Spectrophotometry Method

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ABSTRACT
This research aimed to determine Pb value of tuna (*Thunnus* sp.) and accordance with WHO (World Health) and, European Union as standard limits and to determine tuna Pb value in the CRM (Certified Reference Materials). The 5 Tuna fish sampling was conducted in some of Medan's traditional markets such as; Belawan, Pancing, Petisah, Padang Bulan, and Sei Kambing. The Lead of (Pb) in Tuna (*Thunnus* sp.) was determined by the Furnace graph of the AAS (*Atomic Absorption Spectrophotometry*) method. The laboratory result indicated that the highest Pb value was found the Belawan Market sample with a value of 0.070 ml/kg and the lowest was found in the sample from Petisah Market was found a value of 0.010 ml/kg. And the Pb value in Certified Reference Materials (CRM) was still in the CRM with a value of 0.404 ± 0.062 ml/kg.
Keywords: CRM Standard, Lead (Pb), AAS, Tuna (*Thunnus* sp.)

ABSTRAK
Penelitian ini bertujuan untuk menentukan nilai Pb pada tuna (*Thunnus* sp.) dan sesuai dengan WHO (Organisasi Kesehatan Dunia), Uni Eropa sebagai batas standar dan untuk menentukan nilai Pb tuna dalam CRM (Certified Reference Materials). Pengambilan sampel ikan tuna sebanyak 5 buah dilakukan di beberapa pasar tradisional Medan seperti; Belawan, Pancing, Petisah, Padang Bulan, dan Sei Kambing. Timbal (Pb) pada Tuna (*Thunnus* sp.) ditentukan dengan menggunakan grafik Furnace metode AAS (*Atomic Absorption Spectrophotometry*). Hasil laboratorium menunjukkan bahwa nilai Pb tertinggi ditemukan pada sampel Pasar Belawan dengan nilai 0,070 ml/kg dan terendah ditemukan pada sampel dari Pasar Petisah dengan nilai 0,010 ml/kg. Dan nilai Pb pada Bahan Referensi Bersertifikat (CRM) masih dalam CRM dengan nilai 0,404 ± 0,062 ml/kg.
Kata Kunci: Standar CRM, Timbal (Pb), AAS, Tuna (*Thunnus* sp.)

1. Introduction

Indonesia is one of the tuna exporting countries in the world. Based on the export destination countries in 2004, the 3 (three) countries which ranked as the top export destinations of Indonesian tuna like Japan (36.84% in volume), followed by the USA (20.45% in volume), and the European Union (12.69% in volume). The data indicated that the three countries are very affected by Indonesian tuna export (Widiastuti, 2006).

Tuna has a cigar-like body. It has two dorsal fins, front fins which are usually short and detached from the dorsal fins, and finlets at the back of the dorsal fins. The pectoral fins are located slightly upward, with small abdominal fins, and a crescent caudal fin. Tuna is a highly migratory species. Tuna migration in Indonesian waters is part of the tuna migration route in the world since Indonesia is located in the watershed border between the Indian and Pacific Oceans (Hananingtyas, 2017; Suprianto and Lelifajri, 2009).

The efforts to maintain and improve tuna quality need to be performed intensively to increase market access to export destination countries. Some Indonesian tuna export shipments have been rejected due to histamine and heavy metal levels which exceeded the quality standards limits of export destination countries as illustrated in FDA and RASFF data. This was caused by the handling of tuna which were not caught properly. Therefore, research about the handling of tuna which were not caught properly needs to be conducted so the export tuna quality will not exceed the quality standard. fish that are exposed to pollution will cause changes in the immune system, blood picture and organ/tissue structure in the fish. This study aims to analyze the impact of exposure to mercury on organ damage or abnormalities in the gills, liver and kidneys as well as changes in blood picture including red blood cells, white blood cells, hematocrit and hemoglobin in fish (Widiastuti and Putro, 2010; Nimala et al., 2012).

The nature of heavy metals which cannot be decomposed and easily absorbed by marine biota and can accumulate in the body is the pollution cause. In addition to pollution, heavy metal substance damages fish and human health. Fish that live in waters containing heavy metals will absorb heavy metals passively in line with the aeration process. Therefore, Pb levels in fish are usually found highest in the gills, followed by the digestive tract and fish flesh. This is in accordance with the physiological processes in the fish's body, namely the process of heavy metals entering together with water that diffuses, being absorbed by the gills and then being distributed throughout the body through the blood, resulting in the accumulation of heavy metals in the flesh. The accumulation that occurs in the intestine is caused by water entering directly through the mouth by osmosis or simultaneously when the fish takes food (Abolghair and Garbaj, 2015; Jagfar et al., 2014; Rusydi et al., 2021).

Lead (Pb) is proven can suppress the immune system and reduce antibody-producing cells. The immune system functions to recognize and eliminate harmful agents. When the immune system does not function properly, the body will be vulnerable to bacteria, parasites, and viruses and susceptibility to cancer. Pb metal is toxic to organisms if levels exceed the threshold limit. Metal toxicity in the digestive tract occurs through feed contaminated with water containing toxic doses of metal. The process of accumulation of Pb in tissues occurs after absorption of the metal from water or through feed contaminated with Pb and will be carried by the blood circulatory system and then distributed to the tissue system (Widyastuti, 2006; Mahalina et al., 2016).

Every metal can be toxic for all organisms such as mercury (Hg), Cadmium (Cd), Lead (Pb), Chrome (Cr), Cobalt (Co), Iron (Fe), and Nickel (Ni). When the levels exceed the safe limit, these heavy metals are dangerous since the toxicity level will damage aquatic organisms and humans who consume it directly or not. (Palar, 2008).

2. Materials and Method

2.1 Sampling

Tuna samples were collected from 5 traditional markets in Medan which are: Belawan Market, Pancing, Petisah, Padang Bulan, and Sei Kambing. Samples were collected from June to September 2018. The collected samples were preserved in an ice box and then transported to the Laboratory of Zoology, Universitas Sumatera Utara, Medan for further analysis.

2.2 Preparation and Sample Analysis

The equipment in this research were 25 ml, 100 ml dan 250 ml beakers, a blender/homogenizer, some polypropylene, a porcelain cup, 25 ml and 50 ml measuring cups, a hot plate, 50 ml and 1.000 ml volumetric flask, a micropipette, a drop pipette, 10 ml, 5 ml and 1 ml volumetric pipette, knife, spatula, glass rod, atomic absorption spectrophotometer, analytical balance with 0.0001 g accuracy, furnace, polypropylene container and smoke hood. The materials used in this research were reagents with 65% Nitric Acid (HNO_3), 37% Hydrochloric Acid (HCL), Standard Lead Solution (Pb), Distilled Water, and $NH_4H_2PO_4$, Tuna (*Thunnus sp*), comparative material of CRM (Certified Reference Material).

2.3 AAS (Atomic Absorption Spectrophotometry) Equipment Principle

AAS is principled in atomic absorption light. Atoms absorb light in certain waves based on their substance nature. With energy absorption, an atom's base energy increased to an excitation level. The success of the analysis depended on the excitation process and the right resonance line.

In AAS equipment using a Furnace Graph, the atom of a compound was released with the aid of heat energy through an electro-thermal technique with a graphite furnace.

$$\text{Pb Concentration } \mu g/g = \frac{(D-E)\times Fp \times V}{W}$$

Information:
D = sample concentration mg/l of AAS reading
E = blank sample concentration mg/l of AAS reading
Fp = dilution factor
V = final dilution volume sample (ml) must be converted into liter.
W = sample weight (g)

3. Result and Discussion

The laboratory result table indicated that the highest Pb value was found in the Belawan Market sample with a value of 0.070 ml/kg and the lowest was found in the sample from Petisah Market with a value of 0.010 ml/kg. Based on the data, it could be concluded that the Pb value in each tuna sample was relatively low in accordance with World Health Organization (WHO) with a maximum Pb limit of 0.5 while in accordance with European Union, the maximum Pb limit is 0.4 which made the tuna are still safe for consumption and exported.

In the lab test, Certified Reference Materials (CRM) was used as Pb value comparison data. The CRM is fish flour whose accuracy has been tested and approved and can be used as a heavy metal test standard. The result in the table was still in CRM standard with Pb values of 0.404 ± 0.062.

Table 1. Lead (Pb) test on tuna (*Thunnus* sp.) using furnace graph of AAS method

Original Sample	ABS	Conc. I (µg/L)	Conc. II (mg/kg)	CRM	Certificate
Belawan Market	0,0569	7,132	0,070	0,355	0,404±0,062
Pancing Market	0,0358	4,336	0,043	-	-
Petisah Market	0,0107	1,011	0,010	-	-
Padang Bulan Market	0,0129	1,304	0,013	-	-
Sei Kambing Market	0,0199	2,228	0,022	-	-

Note : ABS=Absorbance; CRM=Certificate Reference Materials

The calibration result of lead (Pb) test on Tuna (*Thunnus sp.*) using Furnace graph of ASS can be seen on Figure 1.

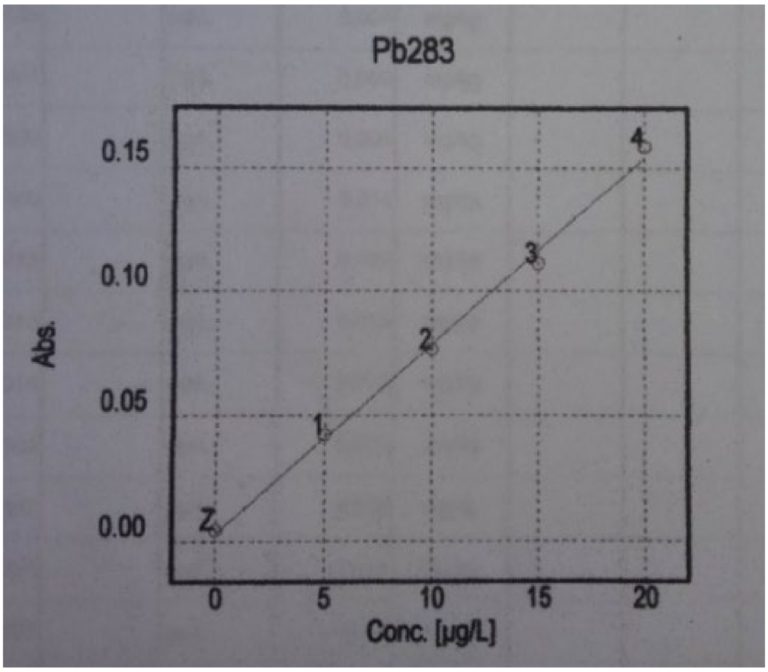

Figure 1. Lead (Pb) Calibration

R^2(adj.) = 0.992209380 Slope = 0.00755 Abs./µg/L
a = 0.0030688 b = 0.0075514

Calculation

- Lead (Pb) Conc I Belawan Market Sample

$$y = a + bx$$

$$0.0569 = 0.0030\, x\, 0.0057\, X$$

$$X = \frac{0.0569 - 0.0050}{0.0057}$$

$$= \frac{0.0519}{0.0057} = 9.105$$

- Lead (Pb) Conc II Belawan Market Sample

$$\text{Pb Conc}\left(\frac{\mu g}{g}\right) = \frac{(\text{D} - \text{E}) \times \text{Fp} \times \text{V}}{W}$$

$$= \frac{(9.105\text{ mg/l} - 0) \times 1 \text{ x } 0.05 \text{ l mg/l}}{5.0030 \text{ g}}$$

$$= \frac{7.186\text{ mg/l} \times 0.05}{5.0030\text{ g}}$$

$$= \frac{0.3593\text{ mg/l}}{5.0030\text{ g}}$$

= 0.0718 ml/kg

Heavy metals are a metal substance which has a density higher than 5 gr/cm^3. Unlike ordinary metals, heavy metals usually caused some negative effects on organisms. The nature of heavy metals which cannot be decomposed and easily absorbed by marine biota and can accumulate in the body is the pollution cause. In addition to pollution, heavy metal substance indirectly damages fish and human health. Every heavy metal can be toxic to organisms when consumed in large quantities. According to Widyastuti (2006), Lead (Pb) is proven can suppress the immune system and reduce antibody-producing cells. When the immune system does not function properly, the body will be vulnerable to bacteria, parasites, and viruses and susceptibility to cancer.

In addition to water pollution, lead which is consumed in the human body will interfere with enzyme activities, and damage nervous tissue and kidneys. Based on Abolghair's statements (2015), in the human body, Pb can interfere with the enzyme activities in hemoglobin (Hb) production, and some Pb is excreted through urine or feces since some of it is bound in protein and accumulated in kidneys, liver, nails, fat tissue, and hair. Pb can damage nerve tissue, kidney function and reduce learning ability, and cause children hyperactivity (Rusydi et al., 2021). In addition, Pb can also affect some organs such as the nervous system, kidney, reproduction system and heart, brain and cause mental disorders and retardation.

The metal substance which exceeds the limit in the body can be damaging and toxic for humans. According to Palar (2008), every metal can be toxic for all organisms such as mercury (Hg), Cadmium (Cd), Lead (Pb), Chrome (Cr), Cobalt (Co), Iron (Fe), Nickel (Ni). When the levels exceed the safe limit, these heavy metals are dangerous since the toxicity level will damage aquatic organisms and humans who consume them directly or not.

The laboratory result indicated that the highest Pb value was found in the Belawan Market sample with a value of 0.070 ml/kg and the lowest was found in the sample from Petisah Market with a value of 0.010 ml/kg. Based on the data, it could be concluded that the Pb value in each tuna sample was relatively low in accordance with World Health Organization (WHO) with a maximum Pb limit of 0.5 while in accordance with European Union, the maximum Pb limit is 0.4 which made the tuna are still safe for consumption and exported.

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4. Conclusion

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References

Abolghair, S. K. Garbaj. A. M. (2015). Determination of Cadmium Residue Levels, Lead and Mercury in Canned Tuna Meat (*Katsuwonus Pelamis* and *Thunnus Albacares*) and Fresh Little Tunny (*Euthynnus Alletteratus*) In Libya.. Open Vet J., 5 (2): 130-137

Hananigtyas, I. (2017). Pollution Study of Lead (Pb) and Cadmium (Cd) Heavy Metal Content in Tuna Fish (*Euthynnus sp.*) on the North Coast of Java., Surabaya. IOP Conf. Ser.: Earth Environ. Sci. **276** 012032. doi:10.1088/1755-1315/276/1/012032

Jagfar, Agustono, Mizar A. (2014). Detection of Lead Metal (Pb) in Tilapia Fish along the Kali Mas River. Scientific Journal of Fisheries and Marine Affairs, 6 (1): 42-48.

Mahalina, W., Tjandrakirana., T, Purnomo. (2016). Analysis of Heavy Metal (Pb) Content in Nile tilapia Fish (*Oreochromis niloticus*) Kali Tengah River, Sidoarjo. Lentera Bio., 5(1): 43-47.

Nirmala K, Yuni H, P., Fika, Y. (2012). Mercury Toxicity (Hg) and Survival Rates, Growth, Blood Figures, and Organ Damage in Tilapia (*Oreochromis Niloticus*). Indonesian Aquaculture Journal, 11 (1): 38-48

Palar, H. (2008). Heavy Metal Pollution and Toxicology, Rineka Cipta Publisher., Jakarta.

Rusydi, I., Savira, D., Putra, D.F., Dewiyanti I., Defira C.N. (2021). Analysis of Pb and Cd Heavy Metal Contents in Green Mussel (Pernaviridis L.) in Alue Naga Waters, Banda Aceh. IOP Conf. Series: Earth and Environmental Science 869 (2021) 012074. doi:10.1088/1755-1315/869/1/012074

Suprianto, Lelifajri. (2009). Analysis of Pb and Cd Heavy Metals in Fish and Shell Samples by Atomic Absorption Spectrophotometry. Journal of Chemical and Environmental Engineering, 7 (1): 5-8.

Widiastuti, I. S. Putro. (2010). Quality analysis of tuna during release. Sriwijaya University Indralaya.

Widyastuti, P. (2006). Chemical Hazards in Human Health and the Environment, Medical Book Publishers.