COMPARISON BEETWEN LEAD (PB) AND ZINC (ZN) CONTENT ON MILKFISH (*Chanos chanos,* Forsk) MUSCLE AND GILL AT AQUACULTURE PONDS OF MARUNDA, NORTH JAKARTA AND BLANAKAN, WEST JAVA, INDONESIA

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ABSTRACT

Aquaculture ponds in North coast of Jakarta at Marunda (Jakarta province) are located close to industries and housings, in contrast, ponds at Blanakan at Subang Regency (West Java province), are surrounded by agriculture areas and mangrove forest. Lead (Pb) has been recognized as hazardous metal because it can cause health problem, while Zinc (Zn) is an essential elements and needed by fish as enzymatic activator. The objective of this research was to measure the Pband Zn content in the sediment and *Chanos chanos* at aquaculture ponds of Marunda and Blanakan. Samples of sediments and *C. chanos* were collected from four (M1-M4) aquaculture ponds located at Marunda, North Jakarta and four (B1-B4) aquaculture ponds located at Blanakan, Subang Regency. Pb and Zn content in sediments, muscles and gills of *C. chanos* were analysed using Atomic Absorption Spectrometry (AAS) Shimadzu 6300. The results revealed that the ranges of metals content in sediments at Marunda ponds were 8.93 – 13.59 μg/g for Pb and 49.24 – 112.09 μg/g for Zn, while in sediments at Blanakan ponds were 10.20 – 11.8 μg/g for Pb and 44.52 – 112.09 μg/g for Zn. In addition, the ranges of Pb content in muscles and gills of *C. chanos* at Marunda and ponds were 1.45 – 4.98 μg/g and 3.35 – 5.68 μg/g, respectively, while at Blanakan ponds were 0.82 – 1.45 μg/g and 1.21 – 3.45 μg/g, respectively. Moreover, Zn content in muscles and gills at Marunda ponds were 23.30 – 41.89 μg/g and 86.89– 134.14 μg/g, while at Blanakan ponds were 31.57 – 49.10 μg/g and 67.98 – 132.86 μg/g, respectively. The results of analysis showed that there was significance difference of concentrations of Pb between Blanakan and Marunda ($p < 0.01$) and between muscle and gills ($p < 0.05$). Meanwhile for Zn concentrations there was no significance difference between Marunda and Blanakan, but there was significane difference between muscle and gill ($p < 0.05$).

Keywords: *Blanakan, Chanos chanos, Lead (Pb), Marunda, Zinc (Zn)*

1. INTRODUCTION

Heavy metals occur naturally in the environment and are found in varying levels in the ground and surface water. Anthropogenic activities such as industrial development, human settlement, agriculture can cause an increased discharge of these metals into natural aquatic ecosystems. Sometimes, aquatic organisms are exposed to unnaturally high levels of these metals that are potentially accumulated in sediments and marine organisms and subsequently transferred to man through the food chain [1]. They can damage both biodiversity and ecosystem due to toxicity and accumulation tendency in the aquatic biota and pose a risk to fish consumers, such as humans and other wildlife. Fish are relatively sensitive to changes in their surroundings environment. Fish health may therefore reflect and give a good indication of the health status of a specific aquatic ecosystem [2].

Zinc (Zn) is one of the most important trace elements in the body and participates in the biological function of several proteins and enzymes for the normal development and metabolism [3,4,5,6].Although, small quantities of zinc are required but if its level exceeds the physiological requirements, it can act as a toxicant [7]. Accumulation of zinc in various organs of fish has been described by [8,9] and [10]. Zinc (Zn) is used in various forms which eventually find its way into the river or sea. Excessive zinc enters the environment as a result of human activities such as mining, purification of zinc, lead and cadmium ores, burning of coal and burning of waste

Lead(Pb) occurs in the environment in a wide range of physical and chemical forms which greatly influence its behavior and its effect on the ecosystem. Most lead in the environment is the inorganic form as salts, oxides or hydroxides. Metallic lead does not dissolve (much) in water.Lead (Pb) may be present in hazardous concentrations in food, water, and air. Some chemicals containing lead, such as tetraethyl lead and tetramethyl lead, are used as gasoline additives [11]. Other sources include paint, urban dust, folk remedies, mining, smelting and non-ferrous metal industries. Lead poisoning is the leading environmentally induced illness in children. At greatest risk are children under the age of six because they are undergoing rapid neurological and physical development.

In water, Pb is widespread as a result from agricultural practices such as the use of pesticides which may wash off and contaminate runoff or groundwater. Besides, plowing and irrigation can accelerate leaching of Pb from soils. Toxicity studies show that poisoning effect begin to occur on fish at Pb concentrations of about 100 ppb in soft water, and 300 – 500 ppb (12-18 weeks) values on oysters [12].

Metals concentration in surface sediments of Jakarta Bay, Jakarta, and their spatial distribution have been studied. For example, concentration of Pb and Zn during 10 years period varied between 23.3-118.2 mg/kg and 0.46 – 122.0 mg/kg [13]. According to [14] concentration of Pb and Zn in Tiram Rivermouth sediments where Marunda aquaculture ponds ranged between 40.66 – 59.13 mg/kg and 136.73 – 214,22 mg/kg, respectively. Based on Canadian Standard for contaminated sediments, the ambient value for Pb is 25 mg/kg and for Zn is 60 mg/kg] (Canadian Council of Ministers of the Environment, 1991).Eventhough many research have been done on heavy metals content on ten rivermouths along Jakarta bay [14,15] no investigation has beenconducted to determine the metal contamination in fish raised in aquaculture ponds near the rivers.

According to [16] concentrations of Pb in Gresik waters, East Java, have exceeded the standard which for Pb is 0.03 mg/kg. On preliminary research, the concentration of Pb in the ponds water close to the sea, human settlement, and industrial areas were 0.049 mg/kg, 0.217 mg/kg and 0.1352 mg/kg, respectively. Concentration of Pb found in *C. chanos* ranged from 0.025- 0.052mg/kg.

Based on research by [17] levels of zinc in *C. chanos* that were grown at ponds located in Medan, North Sumatra, ranged from 5.16 – 6.45 µg/g. Meanwhile, [18] stated that zinc (Zn) content on *C. chanos* that were raised at ponds close to Er-Jen River, the most polluted riverin Taiwan, were 16:11 - 41:86 µg/g. In normal condition, the amount of metals needed by fish are very low in concentration, however in the polluted environment, the need for essential elements/metals will be excessive [19].

The objective of this research was to measure the Pb and Zn content in the sediment and *Chanos chanos* at aquaculture ponds of Marunda, North Jakarta (DKI Jakarta Province) and Blanakan, Subang Regency (West Java Province).

2. METHODS

2.1.Description of Sampling Area

Jakarta is situated on the north coast of Java between 106°03'00" Longitude and 6°10'30" Latitude. Administratively, bordered by Bekasi Regency on the East and Tangerang Regency on the West.Marunda's ponds area is located in the coastal areas of the Jakarta Bay closed to Bekasi Regency which have a lot of industries and housings. Marunda Ponds were used to be mangrove areas and converted into aquaculture ponds, mainly for milkfish (*C. chanos*). Geographically, Blanakan is situated on 6°11-'6°49' Latitude and 107°38 - 107'°40" Longitude.It is at Subang Regency, West Java, bordered by Karawang and Purwakarta Regency on the West and Indramayu Regency on the East. Due to its huge mangrove forest, it becomes one of ecotourisms destination. In this location, based on the rules from local government, in one pond, composition of mangrove and areas for pond should be 80% and 20%, respectively. Four sampling points were taken in each location. Marunda represents location of ponds without mangrove, but Blanakan represents ponds with mangrove. However, in this research, samples of mangrove trees were not analyzed for its metals content.

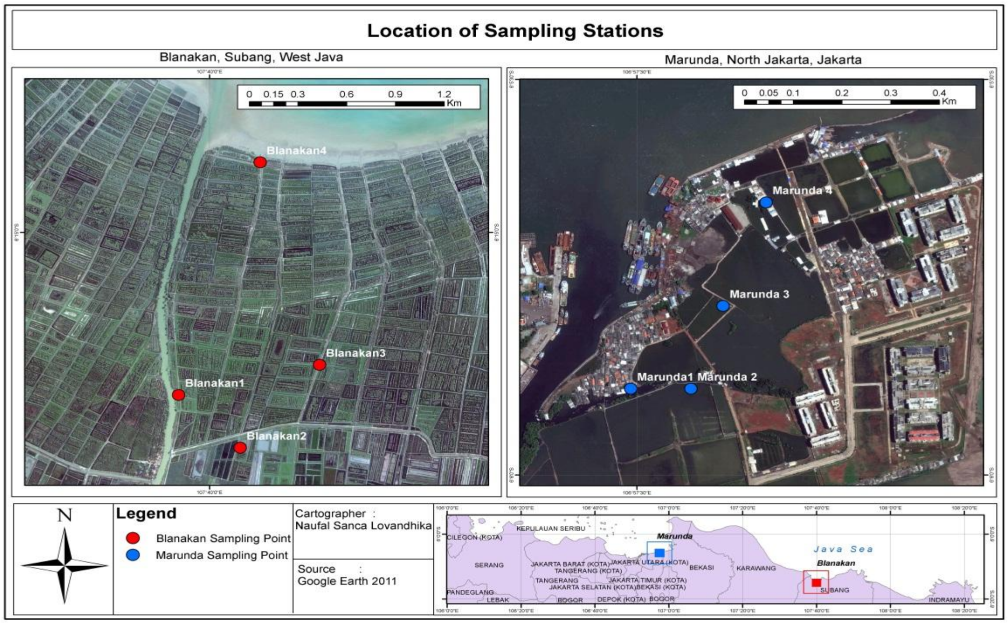

Figure 1. Sampling Location at Blanakan Ponds, Subang Regency, West Java (left) and Marunda Ponds (right), North of Jakarta, Jakarta.

2.2. Materials

Muscle and gill tissues were obtained from 30 individual of *C. chanos* taken randomly from Marunda and Blanakan ponds. Muscle tissues were sliced afterremovingthe scales from its skin. Sediment samples from ponds were collected using a 3.5 L Ekman grab sampler. The top 2–3 cm of the sediment layer was collected using a plastic spatula, and subsequently placed in the acid-washed plastic-bags and stored at -4º C during transportation to the laboratory.

2.3. Heavy Metal Analysis

Muscle and gill tissues of *C. chanos* were thoroughly washed with Milli-Q water, then extracted for further processing. Muscle and gill tissues were macerated into 1-2 cm clumps, dried at 70-80ºC, grinded and stored until chemical analysis. Lead (Pb) and Zn were analyzed by digesting the homogenized samples in a mixture of nitric: perchloric (3 : 1). The supernatant was filtered through Whatman filter paper (40 µm). Then, samples were analyzed using method according to [20].

Sediment samples were put in the 50 ml beaker glass and dried at 105 ^{o} C in the oven, then grinded using mortar. One gram of dried sediment put into plastic centrifuge tubes. Into the tubes, 5 mL of hydrogen fluoride (HF) was added. Those tubes were put in waterbath, then heated on the top at centrifuge at 200 ^{o} C. After that, aqua regia (HNO_3 : HCl = 3:1) was added and subsequently samples were filtered using Whatman filter paper(40 µm). Filtrates were stored at 25 mL volumetric flask and these solutions were diluted with aquabidest until the marked line. Samples were ready for analysis.

Determination of Pb and Zn either in sediments or muscles and gills of *C. chanos* was carried out using Atomic Absorption Spectrometry (AAS) Shimadzu 6300 at Department of Chemistry, Faculty of Mathematics and Natural Sciences, University of Indonesia. Performance of the instrument was checked by analyzing the reference standard material solutions (Merck NJ, USA); concurrently to check the precision of the instrument. compensate for matrix effects between samples and standards, blank samples were analyzed in each batch. All the samples were analyzed in triplicate. The detection limits for Pb was 0.01 mg/L while for Zn was 0.02 mg/L.

2.4. Data Analysis

Two factors analysis of variance were performedto see the difference between concentration oflead (Pb) and (Zn)and between muscle and gills. Due to the variability of these concentrations, data were transformed to logarithmic scale.

3. RESULTS AND DISCUSSIONS

Based on metals analysis, it can be seen that some of Pb content in the sediment at Marunda ranged from 8.93 – 16.33 µg/g were higher compared to ponds at Blanakan which ranged from 10.20 – 11.88 µg/g (Figure 2).

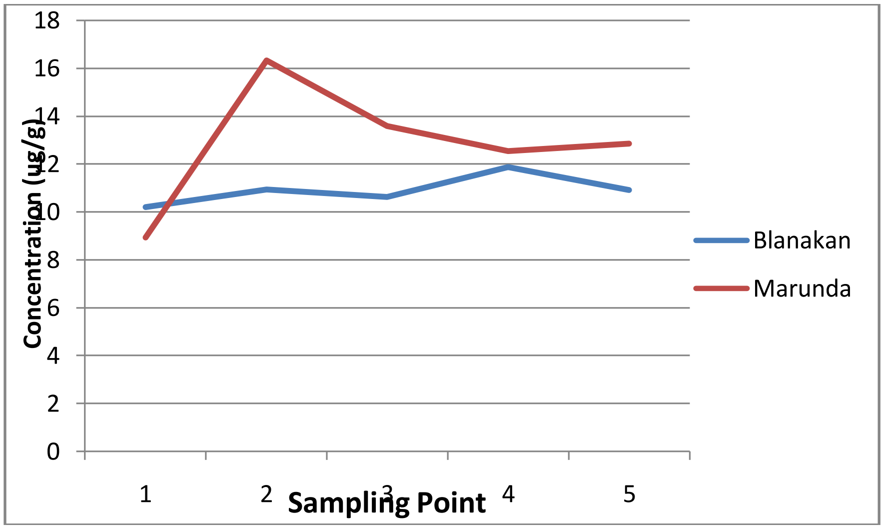

Figure 2: Comparison between Pb content in sediments of Marunda and Blanakan aquaculture ponds

For Zinc (Zn), the trend was almost the same with Lead (Pb) distribution on the ponds sediment. It was clear that, in all sites or sampling point, (Zn) content at Marunda ponds (ranged from 49.24 - 112.09 µg/g) were always higher compared to Blanakan ponds (ranged from 44.52 – 66.77 µg/g) (Figure 3).

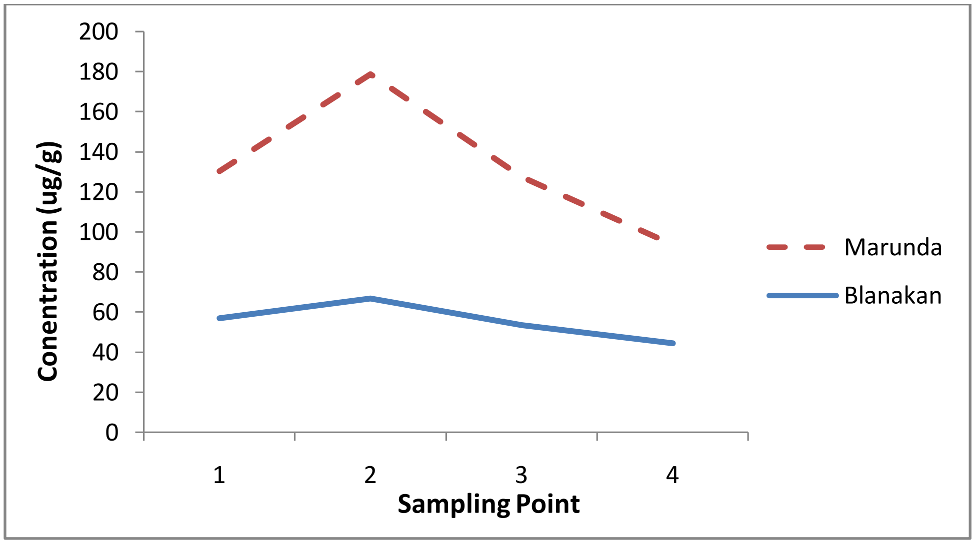

Figure 3: Comparison between Zn content in sediments of Marunda and Blanakan ponds.

In addition, the ranges of Pb content in muscles and gills of *C. chanos* at Marunda and ponds were 1.45 – 4.98 µg/g and 3.35 – 5.68 µg/g, respectively, while at Blanakan ponds were 0.82 – 1.45 µg/g and 1.21 – 3.45 µg/g, respectively (Figure 4). Moreover, Zn content in muscles and gills at Marunda ponds were 23.30 – 41.89 µg/g and 86.89 – 134.14 µg/g, while at Blanakan ponds were 31.57 – 49.10 µg/g and 67.98 – 132.86 µg/g, respectively (Figure 5).

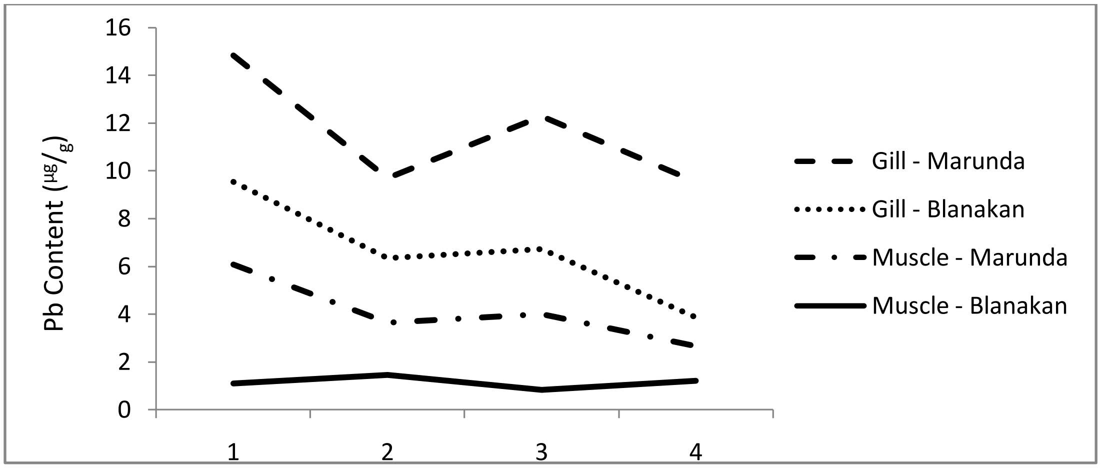

Figure 4: Lead (Pb) content in muscles and gills of *Chanos chanos* at Blanakan and Marunda ponds

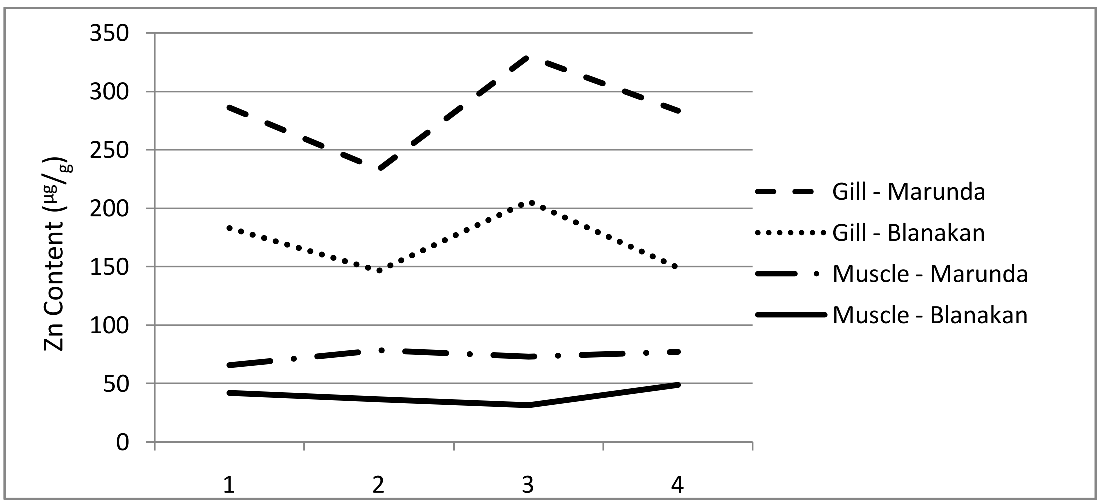

Figure 5: Zinc (Zn) content in muscles and gills of *Chanos chanos* at Blanakan and Marunda ponds

It can be seen that Marunda ponds (without any mangrove plant) always had metals content in sediments or *C. chanos* higher than in Blanakan (with mangrove). Besides acting as a pollutant trap, mangrove sediments have the capability to trap and retain the heavy metals from indirectly enters to the other ecosystems [21]. Some scientists [22, 23, 24] affirm that many mangrove forests all over the world located near to urban area. Hence, this ecosystem faces long lasting effects from industrial waste. Metal enrichment contributed from urban waste and runoff, industrial effluents, boating activities, domestic garbage dumps, agricultural runoff, mining activities and sewage treatment plant. In this research,metals like lead and zinc are importan to be studied because they accumulated in aquaticorganism (e.g. fish, shrimp, etc.) that are consumed by humans [25,26].

Also, metals content in gills of *C. chanos* always higher than in muscles. Most metal contaminant tends to not be lipid -soluble in the aquatic environment. As a result, metals will more commonly accumulate in non-lipid rich tissues in the gills of fish. However, if the metal is incorporated into a lipophilic organic compound (e.g. methyl mercury compound), the accumulation of the metal is enhanced [27].

Table 1. Lead (Pb) and Zinc (Zn) content in muscle and gill tissues of *Chanos chanos* at Marunda and Blanakan ponds

Ponds	Muscles of *Chanos chanos*				Gills of *Chanos chanos*			
	Blanakan		Marunda		Blanakan		Marunda	
	Pb	Zn	Pb	Zn	Pb	Zn	Pb	Zn
1	1.0954	42.3826	4.9836	23.3026	3.4506	117.2206	5.2991	102.9812
2	1.447	36.5035	2.1918	41.8921	2.7049	67.9757	3.3543	86.8935
3	0.8204	31.5666	3.1669	41.3288	2.7279	132.8559	5.5769	123.9803
4	1.2031	49.1016	1.4473	27.7431	1.2059	72.2682	5.6834	134.1404
Average	1.1415	39.8886	2.9474	33.5667	2.5223	97.5801	5.0050	111.9986

Heavy metals including both essential and nonessential elements have a particular significance in ecotoxicology, since they are highly persistent and all have the potential tobe toxic to living organisms [28].
Based on two-factors analysis of variance it was found that there is significance difference of concentrations of Pb between Blanakan and Marunda ($p < 0.01$) and between Muscle and Gill ($p < 0.05$; Table 2). Meanwhile for Zn concentrations there is no significance difference between Marunda and Blanakan, but there is significane difference between muscle and gill ($p < 0.05$; Table 3).

Table 2. Two ways ANOVA of Pb (logarithmic scale)

Source	df	SS	MS	F	p
Mus_Gill	1	1,17944	4,30416	9.00	0,010
Location	1	1,42133	1,42133	10,85	0.006
Errror	13	1,70339	0,13103		
Total	15	4,30416			

Table 3. Two ways ANOVA of Zn (logarithmic scale)

Source	df	SS	MS	F	p
Mus_Gill	1	0,43150	0,431502	6,43	0,025
Location	1	0,05737	0,057369	0,85	0,372
Errror	13	0,87301	0,067155		
Total	15	1,36188			

4. CONCLUSION

Most of concentrations of lead (Pb) and zinc (Zn) in sediments were still below the Canadian Standard for Contaminated sediments which for Pb is 25 mg/kg and for Zn is 60 mg/kg.. However, concentration of Pband Zn in *C. chanos* were above the ambient concentration according to Directorate General of the Medicine and Food Monitoring Centre, Number 03275/B/SK/VII/89 (which are for Pb 2 mg/kg and for Zn is 100 mg/kg. Moreover, there is significance difference of concentrations of Pb between Blanakan and Marunda ($p < 0.01$) and between muscle and gill ($p < 0.05$). For Zn concentrations, there is no significance difference between Marunda and Blanakan, but there is significane difference between muscle and gill ($p < 0.05$).

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