Original article

Potensi akumulasi timbal (Pb) melalui biomagnifikasi pada ikanpatin jambal (*pangasius djambal*) yang dipelihara di *kolong* tua pasca tambang timah Bangka Belitung

Potential accumulation of lead (Pb) through biomagnification In jambal catfish (Pangasius djambal) cultured in the old post mining pit lakes of Bangka Belitung archipelago

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Abstract

The consequences of tin mining activities is the formation large basin-shaped holes filled with water in which the local (Bangka Belitung islands) term is a Kolong or Camuy (lake). Heavy metal concentrations are still high in all the pits and endangering human health; is the image that is in today's society so that people refused to eat the fish from or doing aquaculture activities in kolong.Pb heavy metal in the jambal catfish start found in the second month, the month of December 2011 on the kidney and meat measured 0,032 mg/kg and 0,177 mg/kg, respectively. In the third month (January 2012) Pb was found in almost every organ of jambal above safe levels for consumption, ie 15,39mg/kg in liver, and 40,56 mg/kg in the flesh.Decrease in water temperature and pH also resulted in an increase of Pb accumulation in the meats of jambal catfish, which amounted to 40,56mg/kg. During the four months of cultivation, the accumulation of heavy metals Pb that occur in every organ of observation had a significant influence to the growth rate of jambal catfish. Accumulation of Pb in each jambal catfish organs in the first and second months of cultivation is almost immeasurable but still lowering the rate of growth since the first month. The jambal catfish body already polluted with the heavy metals, as evidenced by Pb measured in the meats and kidney in the second month of cultivation.

Keywords : Pb, bio-magnification, *kolong*, growth rate, jambal catfish.

Introduction

Law of the Republic of Indonesia about Fisheries No. 31 of 2004 said that, the fisheries have an important role and strategic in the development of national economy, especially in promoting the expansion of employment opportunities, income generation and improvement of living standard of the nation in general, fishermen and parties entrepreneurs in the field of fisheries with fixed preserve the environment, sustainability and availability of fish resources.

The number of excavated lakes of tin mining (Sn) (kolong/pit), in Bangka Belitung until 2012 were recorded more than 1000. The pit of PT. Timah Tbk classified as the old pit, because it has been more than 10 years, but only a small portion of reclaimed and used for freshwater fisheries activities. At least, as many as 583 pit not used optimally, and lots overgrown with various kinds of wild plants, such as rushes, thatch, gelam, palm, thatch, cypress, Sungkai and shrubs (Sujitno, 2007). The existence of pit that near by residential area were used 15.9 percent, equal for 141 pit as a reservoir and source of water, including showering and washing (Henny 2007). However, there is still 4.28 percent, or 38 pit utilized for fishing business, agriculture, source of raw water, and recreation. Left 79.82 percent was not been utilized at all. The pit number keep continues to grow until now. National Spatial Planning Coordinating Board (BKPRN, 2009), mentions that based on satellite images in 2004, found that 378 042 hectares of the 657 510 hectares of forest in the Pacific Islands has been classified as critical lands. The remaining forest vegetated areas was 17 percent of the land area of Bangka Belitung (1,642,414 hectares). Ideally,the island should have at least 30 percent well forest vegetated area.

Based on the large area of public water, so the Marine and Fisheries Department of Bangka Belitung was planning for utilize the mining pit by increasing the production of freshwater aquaculture, using floating net (KJA).

Although local government is support, the freshwater aquaculture activity in the province of Bangka Belitung was still few. The problem washeavy metals in the aquaculture pit make the villager worry.

In fact, Bangka Belitung mining pit, has a great potential for the development of freshwater fisheries and the expansion of employment opportunities. although the previous study has revealed that the heavy metal in the water was dangerous for consumed by humans (Lamidi, 1997; Brahmin et al, 2004; Henny, 2009, 2011;), especially Pb. However, if the heavy metals problem can be resolved, then the potential can be raised, which means that it will opening new jobs for the people. Recently, the PT. Timah Tbk pit areathat was not utilized reach 79.82% or 1.367.04 ha due to heavy metal contaminated.

Thus, it very important to know exactly the potential mechanism of accumulation through the food chain (biomagnification). The purpose of this study was to determine the amount of Pb accumulated in meats, liver, kidneys and digestive tract organ, as well as the effect on growth rate (GR) of jambal catfish underold pit cultivation.

Method

This research conducted under the old post of PT. TimahTbktin mining. The pit that has been chosen on this study was grasi with the coordinates of S01^{0}52.464'; E106^{0}07.005'Sungailiatdistrict of Bangka Belitung province. Under the age of over 30 years, an area of ± 2 hectares, a depth of 9-10 meters. The concentration of Pb in sediments at 16.50 mg / kg and in the water of <0,030 mg / L (undetectable).Eutrophication type moderate. The study was conductedmore than four months, October 2011 to February 2012.

Cultivation Method

The enlargement process of fish farming in floating net cages 3 × 3 × 2 m with a mesh size of 2.25 cm, depth of 2 m. Four units of floating cages were divided into one unit used for Pb test and three other units for growthtest. The weight of the initial seed stocking 7 ± 0.02 g /fish as many as 400 individuals (100 individuals / units). Artificial feeding (pellet) was 3% of weight with a three times a day. During the maintenance period,

the fish feed, health, ingredients and other such as safety nets were controlled.

Sampling Method

Measurement and sampling conducted every month from four month period maintenance.Sample was examined by Pb check and taken from randomized cage. It also sampled from three karamba unit with three replicates. On each sampling, the fish were taken 10 of fish, then measurement of the total length, body weight, and averaged.

Heavy metals measurement was conducted in the organs of fish such asliver, kidney and meats for 10 of fish.The organ that we take for each sample merged into the same organ. The separated wet organs are then mashed in a blender (for meat) and frozen for further testing Pb content in the laboratory.

Pb Analysis Method in FishOrgan

Pb contents measured in the liver, kidneys and meat. Each sample of fish organ put into a glass beaker and weighed by analytical balance. Analysis parameter was following the procedures of standard method (APHA, 2012).

After each organ into solution in a 10 ml flask, then measurement of heavy metals content of Pb using the atomic absorption spectrometry (AAS) AA 300 P artificial Techtron Varian, Australia. AAS calibratedbased on the manual instructions, measured blank metal standard solution, and sample. Standarmeasurement of metal checked periodically to ensure the constant standard value. To get the actual concentration of heavy metals used:

$$\text{K sebenarnya} = \frac{\text{KAAS x Vol. Penetapan}}{\text{Berat Kering}}$$

Composition Measurement Method of Intestinal Contents

Intestinal contents observations aimed to examine the composition of fish gut contents. Identify the number and types of plankton in the intestines of fish has done with a few steps. Firstly, take 10 of the 10 fish gut then preserved with 40%formalin. Second, measure the length of each of the intestine, and then clean the fish intestines samples by formalin. Scraped intestinal and the separation of intestinal contents then diluted into 10 cc or 1 bottle of film with aquadest. Next step is to take a single drop of intestinal contents that have been diluted with a pipette and then observed under a microscope. Observations were conducted three replications with five visual field. The final step, is to identify the type and record the number of food organisms that exist in every field of vision with algae identification book (Prescott 1970). Artificial feed crumbs and microorganisms found are recorded and calculated according to the formula on theIncidence and Frequency preponderance index (Effendie 1979).

Model Incidence and Frequency formula preponderance index used:

$$N = \frac{Vd}{Vi} \; x \; n$$

Description :

n: number of an individual species-i found in sample
N: total number of alleged individual types all i from fish to-i
Vd: volume dilution
Vi: volume drops were observed (1 drop : 0.05 ml)

1. Model rumus Indeks Preponderance :

$$Ii = \frac{Vi \text{ x } Oi}{\sum Vi \text{ x } Oi} + 100\%$$

Description :
Ii: indeks preponderance
Vi: Volume percentage of food-i
Oi: Incidence frequent of food -i

Methods of observation weight gain

Observation of the growth of red tilapia ascertained by measuring the body weight of the fish using a digital scale brand Osuka AJ 1000, the level of accuracy was 0.01. Initial weight (Wo), measured before the fish seed stocked to obtain accurate data measurement of the weight of fish every month. Final weight (Wt), measured after seed fish reared for 30 (thirty) days after the measurement of initial weight (Wo).

Fish growth, survival and feed conversion was calculated using the following equations (Effendie 1979):

1. Absolute Growth (W)

$$W = Wt - Wo$$

Information:
W: absolute weight gain (g)
Wo: Weight of test animals in the early research (g)
Wt: Weight of test animals at the end research (g)

Observation Parameter

The parameters were measured the composition of the fish digestive tracttest, the accumulated amount of heavy metals Pb in meats, liver and kidney of jambalcatfish in monthly observations to know the body weight of fish.

Data Analyze

The data presented in tabular or graphical. Connectedness of all the parameters were described.

Result

Water Quality Analyze

The water quality result of Grasi pit in Sungailiat District Bangka, Bangka Belitung province, during October-December 2011 to January-February 2012 is shown in Table 1.
The average of physical and chemical parameters of water quality measurement results shows ideal conditions for jambalcatfishcultivation.

Table 1 Results of water quality measurements of Grasi pit during October 2011-February 2012

Bulan	Parameter Kualitas Air						Keterangan
	Suhu (^{0}C)	Kec. (cm)	pH	DO (mg/l)	CO_2 (mg/l)	TOM (mg/l)	
Oktober 2011	29,4	90	6	7,2	2,10	5,77	Dry season
November 2011	29,1	90	6,5	8	1,82	4,18	Dry season
Desember 2011	25,3	60	6	8	3,06	9,06	Dry season
Januari 2012	24,1	30	5	7,8	4,09	12,91	Rain season
Februari 2012	27,1	70	6	8	3,44	7,40	Dry season
Rata-rata/bulan	**27±2,3**	**68±24,8**	**6,1±0,5**	**7,8±0,3**	**2,90±0,9**	**7,87±3,3**	
StandarBudidayauntukPatinjambal	25-30	20-30	6-8,5	≥ 3	< 5	-	SNI 2009

Description: KEC; Brightness under the water, DO; Dissolved Oxygen CO2; dissolved carbon dioxide, TOM; *Total Organik Matter*

Some parameters such as temperature, brightness andincreasing ofTOM occurred in January 2012 and did not occur in previous months. This is due in January 2012 is the rainy season.

Composition Content of Fish Gut

There are several classes of microorganisms were identified in the intestine of jambalcatfish other than artificial feed (pellets) during four months maintenance.

Using preponderance index method, the composition of the intestinal spectral range of jambalcatfishwereobtained in November 2011 to February 2012, (Figure 1 AD).

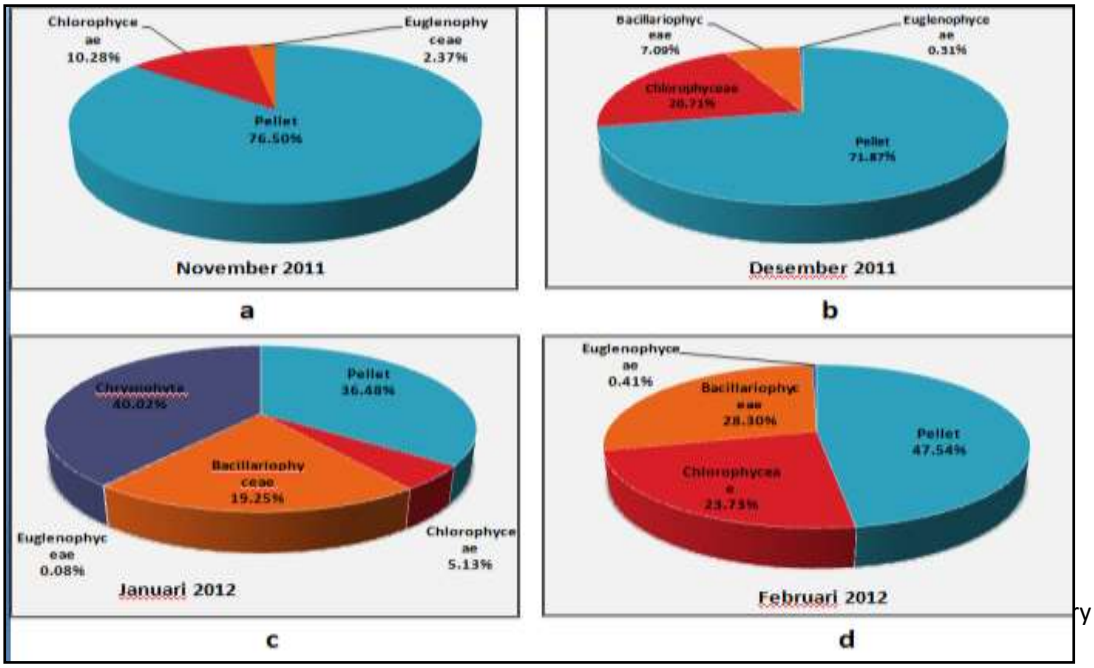

Figure2Additional fish weights during maintenance

Pb Total Accumulation

The number accumulation of heavy metals Pb measured in each organ of jambalcatfish,can be seen in Table 2. The amount of heavy metals that accumulate in the body tissues of aquatic animals that are safe for human consumption is 0.3 mg / kg (SNI, 2009). The content of Pbfound in the second month of maintenance during December 2011 in the kidneys and meat were 0.032 mg / kg and 0.177 mg / kgrespectively.During the third month (January 2012), Pbwas found in almost every organ jambalcatfish. However, only on the liver and meats thatexceeds of safe limits for consumption, were 15.39 mg / kg and 40.56 mg / kg.

Additional body weight and growth rate of fish

The results of this study showed weight gain test fish were relatively slow, but still close to normal (Figure 2).

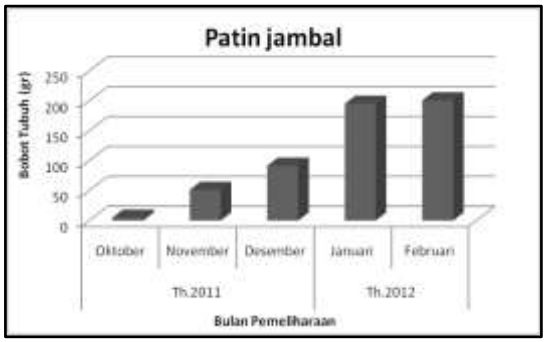

Figure 2 shows the additional of jambalcatfish body weight in the first months of maintenance until the third month (January 2012) has increased. Extra body weight almost stalled in the third month until the fourth month of maintenance (February 2012). The average weight of jambal catfishon October 2011 was 5 g ± 0.012. In February 2012 the average body weight was 201.2 g ± 17.7050.

Discussion

JambalCatfish was slow-moving fish category, so that the accumulation of heavy metals will be higher compared to faster movement fish. Maintenance with floating net system condition was very limited space, so the opportunity for the accumulation of heavy metals into the body ofjambal catfish farming will be even greater.

Possible release of heavy metals from sediment into the water will affect toaccumulating in fish. Bryan (1976a) suggested that in appropriate circumstances, some metals that bind to sediment and particles will settle back into the water followed by remobilization and diffusion upwards. This situation further is causing plankton in the water accumulatePb in the fish body.

Tabel 2. The content of Pb in the maintenance of organ catfish jambal four months under the old tin mine closure

Organ	KandunganPbPadaBulanke-					Metode/Standar
	Oktober (mg/kg)	November (mg/kg)	Desember (mg/kg)	Januari (mg/kg)	Februari (mg/kg)	
Ginjal	< 0,030	< 0,030	0,032	< 0,030	0,917	APHA ed 21 th 3111 B, 2005
Hati	< 0,030	< 0,030	< 0,030	15,39	< 0,030	APHA ed 21 th 3111 B, 2005
Daging	< 0,030	< 0,030	0,177	40,56	0,188	APHA ed 21 th 3111 B, 2005

Intake of heavy metals by water organism through three main processes, (1) water through the respiratory surface (eg gill); (2) absorption of water into the surface of the body; and (3) through by the food, or water particles or ingested through the digestive system. The process of heavy metal accumuated by autotrophic organism (phytoplankton) based on Mason (1993), is through the mechanism of ion exchange which is quickly absorbed on the surface of cells.It diffuse into the cell membrane and bound by proteins (where ion exchange) inside the cell. In fish, the entry of heavy metals into the body can also be sourced from water and food. The process of entry of heavy metals into the fish according to Houlihan (1993) through the mechanism of absorption at the body surface then bound by organic ligands and stored in protein.

Low abundance of phytoplankton related to the nutrientsconditions. Phytoplankton in the waters was being a primary producer that plays an important role in the sustainability of the food chain to the secondand third consumerlevels (crustaceans and fish). Grasi pit has a diversity index (H) of 0.8370 and dominance index (C) of 0.2281. The Grasi pit TSI value was 68 indicates moderate eutrophik status. It support our results that the accumulation in organs of jambal catfish, can occur through biomagnification. During January 2012, an increasing of the type and amount of plankton in the jambalcatfishgut, as well as increase the Pb accumulation in jambalcatfish organ. The improvement ofwater quality (February 2012), followed by the reduced value of the plankton dominance value in fish intestines. This condition is also accompanied by decreasing the amount of Pb measured in every organ of the test fish. Increasing the amount of plankton (quantity and type) gradually in fish intestines test during the month of October 2011 until December 2011, always followed by an increase in the amount of accumulated Pb in every organ of the test fish. The results of this study indicate that, accumulation of Pb in jambal catfish organs are potential during cultivation in the old pit, through the food chain (biomagnification). These findings were supported the results of previous studies, that the absorption of Pb in fish through more frequent by meals (Wilson, 1988).

Conclusion

Potential of Pb accumulation in organs of jambal catfis through the food chain (biomagnification) was very large. However, natural decreased was occur very quickly on sample fish, along with the improvement of the water quality.

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