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THE FLUSHING FOR LEAD IN FRESHWATER SNAIL FILOPALUDINA JAVANICA (VON DEM BUSCH, 1844)

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ABSTRACT
Increasing industrial activities in Lamongan District is assumed to be followed by the increase on the amount of liters in rivers and ponds. Freshwater snails *(Filopaludina javanika* v.d Busch 1844) that live in rivers and ponds are always exposed to heavy metals. Based on the result of the measurement of Pb in freshwater snails in Waung river, Glagah subdistrict, Lamongan, the highest amount of Pb reached 4.48 mg/kg. This aim of this research was to decrease the amount of Pb in freshwater snails. This research employed an experimental method using complete randomized design with 4 treatments and 3 repetitions; P1 (6-hour flushing procedure), P2 (12-hour flushing procedure), P3 (18-hour flushing procedure), and P4 (24-hour flushing procedure) with the reduction on the level of Pb in the "whole organ" of the freshwater snails. The results show that 24-hour of flushing has reduced the amount of Pb as much as 53.2%, from 2.65 ppm, leaving only 1.24 ppm. Meanwhile, the least reduction was found in the 6-hour flushing procedure at 7.2%. The results of the treatments have obtained amount of Pb under the minimum safety requirement set by *BPOM* (2009), Fisheries (*DKP*) No: Kep 17/Men/2004, SK Ditjen POM No. 03725/B/SK/VII/1989, in which it is stated that materials that contain heavy metals less than 1.5 ppm are safe to consume for duck weft and for human. Further researchers are suggested to investigate the accumulation of lead (Pb) in ducks that consume freshwater snails within certain period of time.

KEY WORDS
Flushing, freshwater snails, Pb*,* well water.

According to the data issued by (*Badan Pusat Statistik Kabupaten Lamongan,* 2007), Glagah subdistrict lies in a lowland of around 0 – 25 m in the central-north of Lamongan district which is famous for its Bonorowo lowland in Sekaran, Maduran, Laren, Karanggeneng, Kalitengah, Turi and Karang Binangun districts. In those areas, freshwater snails *(Filopaludina javanika* v.d Busch 1844) are easy to find in rivers and ponds at a huge amount of around 100 snails/ m^2 year-round. Freshwater snails can be used as ingredients for duck welt. Besides, freshwater snais are also edible for human. People in the area collect freshwater snails from the habitat manually to be sold to duck farmers *(Yuliana Firdaus, 22 August 2017).* Usually, people collect bigger snails *(Filopaludina javanika* v.d Busch 1844*)* of around 25 – 27 mm along with their shells for duck welt.

However, the result of a research conducted by Purbalisa and Mulyadi (2013), rice field areas in Glagah subdistrict contained the highest Pb of 0.67 mg/kg compared to other subdistricts; Laren (0.56 mg/kg), Karanggeneng (0.44 mg/kg) and Kedungpring (0.22 mg/kg). Whereas, the amount of Pb found in the bodies of freshwater snails in Glagah subdistrict was also the highest one at 4.47 mg/kg. From the obtained data, it can be implied that there is a certain correlation between freshwater snails which were exposed with Pb content in their habitat which had accumulated the amount of Pb in their bodies. Hutagalung (1991) mentioned that the amount of Pb found in certain organism is usually higher than the amount of Pb in its habitat due to massive accumulation. The amount of Pb in freshwater snails might contaminate the ducks that were fed with welt made from the snails.

Siregar (2013) in his research on freshwater snails of Viviparidae family found a high amount of lead in their flesh around 14.6554 mg/kg, making them dangerous to consume. Hence, it prove that organisms living in a certain habitat can be used as an indicator to measure pollution and to measure the organisms' ability to accumulate pollutants in their

bodies. Therefore, it was necessary to find out the amount of lead in the whole organ of freshwater snails in Glagah subdistrict as an anticipation of its effect on ducks and human that consume the snails.

Brite *et al.,* (2006) explained that maintaining the quality and the safety of food products can be done by reducing the amount of Pb in the snails. The amount of Pb can be reduced by conducting flushing procedure or by soaking the snails and flowing them with clean water before they are used as food for poultry and for human (*DKP,* 2008). In line with this view, Chan *et al.* (1999) said that flushing off the heavy metals in snails can be done by moving them out from the contaminated habitat to a cleaner habitat. This research provides information on the appropriateness of freshwater snails to use as food for poultry and for human consumption. This research attempted at reducing the amount of Pb in freshwater snails *(Filopaludina javanika* v.d busch 1844) through flushing procedures.

METHODS OF RESEARCH

Freshwater snails around the size of 25 – 27 mm which were usually used as duck welt *(Filopaludina javanika* v.d busch 1844) were collected from ponds and rivers which were exposed to heavy metals including Pb. The observation and the flushing procedures were conducted in the laboratory around the field. This reseach employed an experiment method using a complete randomized design with 4 treatments and 3 repetitions, including identification on the quality of the water (pH, temperature, DO) and the amount of Pb in the "whole organ" of the snails. The flushing procedure used clean freshwater that did not contain any Pb which was then filled into 12 containers. The flusing procedures used in this study were modified from the procedures performed by Nuriyani in 2016. Nuriyani (2016) showed that the soaking procedure did not give any significant effect without the changing of water.

The sample of freshwater snails used in the flushing procedure contained Pb amount beyond the safety limit set by BSN (1.5 mg/kg), DKP (1.5 mg/kg) Regulation of Food Specification NO 466/2001/EC (0.1 ppm) and Depkes (2 mg/kg). Each container was filled with water up to 20 cm for 4 different flushing periods of 6, 12, 18 and 24 hours in 3 repetitions. The flushing speed at 0.43 m/second was used regarding to the suggestions from previous studies by measuring the average water speed in the habitat. This speed was also determined from the previous study conducted by Ahmad (2012) in which the flushing of water at 0.43 m/second in 3 weeks has successfully reduced the amount of Pb in the shell of the snails from 1.19 ppm to 0.45 ppm (62.18%).

RESULTS AND DISCUSSION

The result of the first stage preliminary study done to the flesh of freshwater snail in Waung river showed the highest contamination of lead (Pb) of 4.48 mg/kg, whilst the least amount of lead (Pb) was found in Bengawan Blawi river at 0.5 mg/kg.

The sample collection in the stage 2 preliminary study was done in 4 locations which were the station 1 (Gayam Pond 1) located in the coordinate point 7^0 03'27.93" S and 112^0 27' 56.01" E, Station 2 (Gayam River) at 7^0 03'33.81" S and 112^0 27' 51.26" E, Station 3 (Gayam Pond 2) at 7^0 03'35.34" S and 112^0 27' 52.16" E, and Station 4 (Anak Kali Waung River) at 7^0 03'35.34" S and 112^0 27' 52.16" E.

The concentration of lead (Pb) in the "whole organ" of the freshwater snails showed the highest value in Station 1 at 3.432 ppm, followed by Station 3 at 2.924 ppm, Station 2 at 2.402 ppm and the lowest one was found in Station 4 at 0.07 ppm (Figure 2). Regarding to the decision letters issued by the Ministry of Marine and Fisheries No: Kep 17/Men/2004 and National Standardization Institution (2009), the maximum limit of lead content is 1.5 ppm. Thus, the freshwater snails collected from station 1, 2, and 3 had reached over the safety limit, and only the ones found in station 4 were under the limit.

In the second preliminary study, the amount of lead (Pb) in station 4 decreased from 4.48 ppm to 0.07 ppm. The decrease was resulted by the increase on the water speed in

Waung river from 0.5 m/second to 1 m/second in February until July 2017. The faster water speed has flushed the amount of Pb within the flesh of the snails. Besides, mud litters thrown into the river from rice fields were low since it was not yet the harvest time. In the harvest time, farmers throw away the litters from their field into the river, causing high mud sedimentation in the river which forces freshwater snails to accumulate more Pb in their bodies. According to Purbalisa and Mulyadi (2013) the contamination of lead (Pb) in the rice fields is assumed to come from the phosphate element as the impurities in the fertilizer. Phosphate fertilizer contains P_2O_5 as the primary element and it contains some secondary nutrients such as Ca, Mg and other micro elements including Fe, Mn, Cu, Zn and some heavy metals at various amount such as Cd (0.1-170 ppm) Cr (66-245 ppm), Pb (40 – 2000 ppm), (Setyorini,2003).

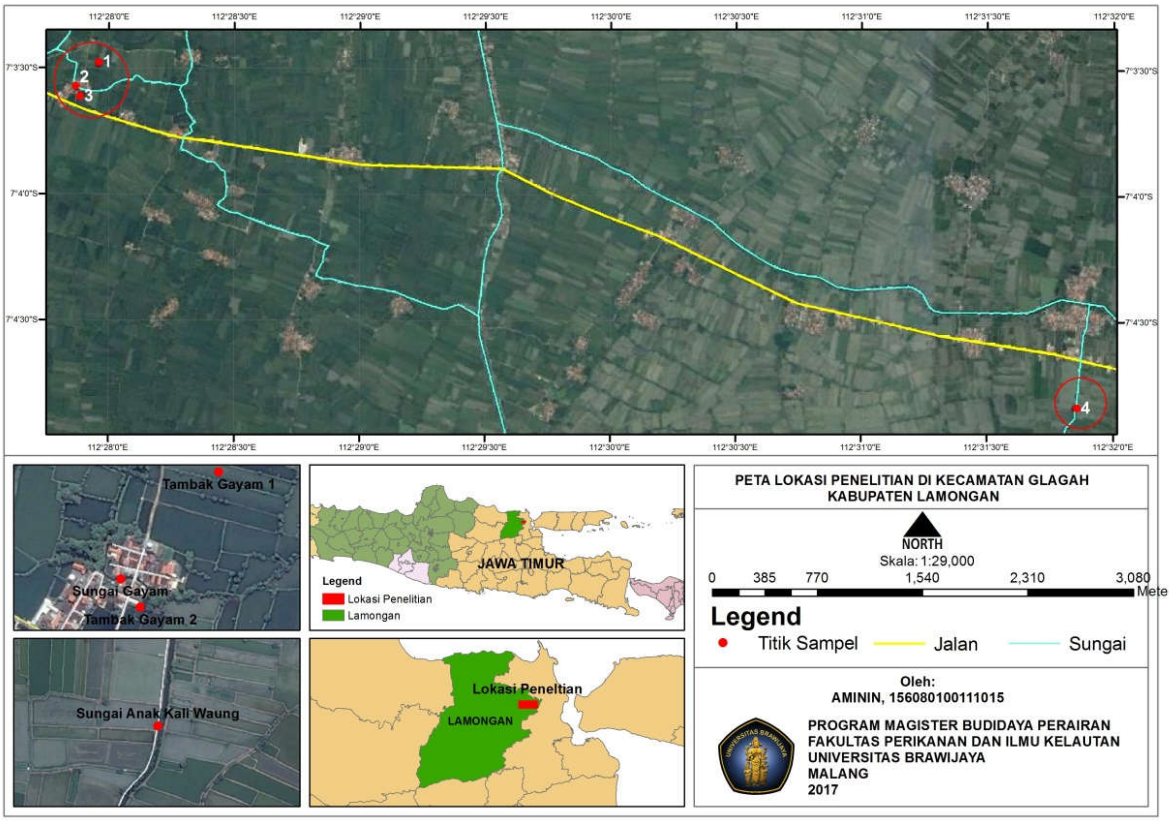

Figure 1 – The location of sample collection in the second stage preliminary study in Glagah subdistrict, Lamongan (Source: Google 2017 shapefile (SHP) Indonesian Geographical Images)

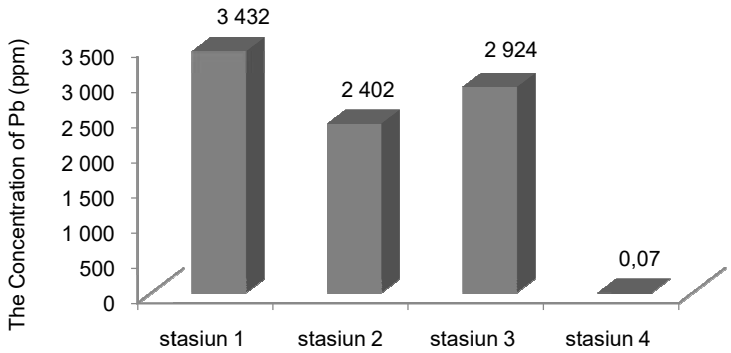

Figure 2 – Average lead (Pb) concentration in rivers and ponds in Glagah Subdistrict, Lamongan (Notes: Stasiun 1: Gayam Pond 1; Stasiun 2: Gayam River; Stasiun 3: Gayam Pond 2; Stasiun 4: Anak Kali Waung River)

Results of Flushing Procedure. Based on the result of this research, it can be concluded that the longer the flushing time, the higher the amount of ions flushed away from the flesh of the snails, which results to lower concentration of Pb in the snails. 6-hour flushing process has decreased the concentration of Pb as much as 7.2%. The 12-hour flushing process has decreased 19.6% of the Pb, leaving only 1.12 ppm. The 18-hour flushing process has decreased 38.1% of the Pb concentration, remaining only 1.64 ppm. The highest decrease of Pb was obtained from the 24-hour flushing process which has successfully decreased 53.2% of Pb concentration from 2.65 ppm to 1.24 ppm. Regarding to the maximum limit of Pb concentration determined by the BPOM (2009) at 1.5 ppm, the concentration of Pb in freshwater snails after the flushing process is under the limit and is safe for human consumption.

Suprijanto *et al*. (1997) stated that depuration procedure decreases Pb concentration within the organisms' bodies since there is no addition of heavy metals from outside. The decreased concentration of Pb s resulted form the release of metallic ions from the protein structure in the snails which are leached from their flesh as the balancer of Pb concentration in the flesh. Naturally, metallic ion exchange happens easily, especially to ions which are bounded to metalloprotein for metalloprotein chains are not stable (Wahyuni dan Widiyanti, 2004).

The result of Anova test has resulted an average concentration of Pb after the flushing procedure with a significant effect ($p<0.05$). Hence, flushing procedure can be regarded highly effective in decreasing the concentration of Pb in freshwater snails. It happened due to the changing of water all the time which washed away the heavy metals in the snails' body. This insight goes in line with Riyadi (2016) who stated that clams are able to release heavy metals from their bodies which are later flushed away by ever flowing water circulation. Zhu *et al.,* (1999) mentioned that the effort to clean clams and snails is often done in land with stable supply of flow-through water.

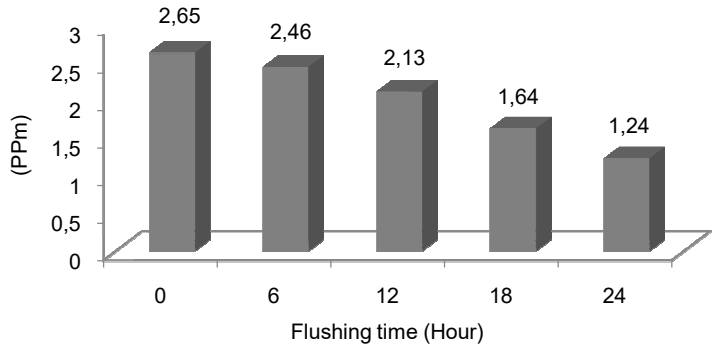

Figure 3 – The Result of AAS Test to the Whole Organ of Freshwater Snails after the Flushing Procedure

Water Quality. Physical and chemical parameters of the water were measured before and during the treatment. Water quality shows the relative condition of the water related to the necessities of creatures living in water. Moreover, the water quality also becomes the standard measurement to determine the quality of water ecosystem. Measurement was conducted on site in for each treatment including water temperature, pH and the dissolved oxygen (DO). The average score of the water quality measurement in each flushing process is presented in Table 1.

The average temperature during the flushing treatment was around 26.9 – 30.5 ^{0}C. The average temperature shows that the water in the containers was favorable for the freshwater snails to live. Sumarni (1989) stated that most Mollusca, especially snails are able to live within the temperature of around 22 – 33 ^{0}C. Meanwhile, Junting (1956) mentioned that *Bellamnya javanika* family Viviparidae are able to tolerate temperature up to 35 ^{0}C. generally, the pH found in each treatment was around 7.3 – 7.5. Hynes (1987) explained that usualy

gastropods living in fresh water are able to live in pH level around 5.0 – 9.0. Seen in Table 1, the pH of the water used in the research had been suitable with the ideal habitat of the freshwater snails. In line with Connel and Miller (1995); Novotny and Olem (1994), the increase of pH in the water is usually followed by the decrease of the solubility of the heavy metals, which makes the heavy metals to settle.

Table 1 – Average score of water quality during the flushing process

Treatment (Hour)	Parameters		
	Temperature (^{0}C)	pH	DO (ppm)
0 Hour	29.9	7.3	3
6 Hours	27.1	7.3	2.8
12 Hours	26.9	7.4	3.3
18 Hours	30.2	7.4	3.4
24 Hours	30.5	7.5	4.0

The result of the analysis on DO, the DO in each treatment tended to fluctuate. In the control treatment, the concentration of DO was found at 3 ppm, yet it decreased to 2.8 ppm after being given 6-hour flushing process. The decrease might be caused by the metabolism process of the freshwater snails *(Filopaludina javanika* v.d busch 1844) which requires high amount of oxygen. Rosita (2005) found in her research that performing depuration procedure decreases the DO of water. However, the increase in the concentration of DO in the water of immersion after the flushing process was rather caused by the aeration that works with the accordance of the gravity. In this context, the flowing water intensified the interaction between the air and the water, which gradually increased the concentration of the dissolved oxygen in the water (Wheaton, 1977).

CONCLUSION AND SUGGESTIONS

24-hour flushing procedure has been able to decrease the highest amount of Pb as much as 53.2% from 2.65 ppm to 1.24 ppm. Thus, ater the treatment, the freshwater snails are safe for poultry feed and for human consumption. The flushing treatment conducted in this research has resulted to freshwater snails which are safe to consume based on the maximum limit of heavy metal contamination at 1.5 ppm set by BPOM (2009), Fisheries (DKP) No: Kep 17/Men/2004, SK Ditjen POM No. 03725/B/SK/VII/1989.

Further research should be conducted to investigate the accumulation of Pb in ducks that consume freshwater snails that are contaminated with Pb within certain period of time.

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