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# The presence of organochlorine pesticide in Semarang Indonesia marine waters and their contamination on green mussel *Perna viridis* (bivalvia: Mytilidae, linnaeus, 1758)

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**Abstract.** This article present the existence of organochlorine contamination in marine waters of Semarang and their contamination on green mussel *Perna viridis* in Tambak Lorok coastal waters Semarang. The samples of green mussel *Perna viridis* and water sample were collected from mussel cultivated area. Five compounds organochlorine pesticide residues (OCPs) such as Heptachlor, Aldrin, Endosulfan, Endrin and pp-DDT of contaminant have been determined in the marine waters and mussel tissue. The samples were analyzed by using gas chromatography and followed by using the method of Standard Method Examination. The result of average concentration organochlorine pesticides in marine waters showed that the Heptachlor, Aldrin, Endosulfan, Endrin and pp-DDT were 20.68 µg/L, 1.88 µg/L, below detected, below detected, below detected, respectively. The high concentration of pesticide showed on Heptachlor (20.68 µg/L). On the other hand OCPs Heptachlor, Aldrin, Endosulfan, Endrin and pp-DDT in green mussel shows 140.48 µg/L, 49.04 µg/L, 28.38 µg/L, 155.13 µg/L, 116.14 µg/L. The result shows OCPs in green mussel tissues has higher concentration depend on marine waters, so that it indicates that green mussels had accumulated OCPs on their tissue.

## 1. Introduction

Green mussel which collected or cultivated from marine areas at Semarang was very common to a edible mussels. Almost green mussel which were marketing in Semarang produced from cultivated around Tambak Lorok areas. In contrary part of marine waters in Semarang has contaminated by organochlorine pesticide such as west part of Semarang coastal waters [1]. Futher more [2] informed that marine sediment near these location has been contaminated by organochlorine pesticide such as Heptachlor, Endosulfan, Endrin and pp-DDT. Although organochlorine pesticides (OCPs) such as DDT, HCH, and Aldrin are banned in developing countries over 25 years ago, they continue using it in several Asian countries [3]. Organochlorine pesticides (OCPs), due to their chemical persistence and hydrophobicity, has a tendency to accumulate up the food chain. Therefore, the occurrence of human exposure to these pollutants occurs is mainly from ingested food [4]. Marine environmental contaminants are very complicated and include polycyclic aromatic hydrocarbons (PAHs), pesticides, benzo(a) pyrene (BaP) and dichlorodiphenyl trichloroethane (DDT), which are derived from different sources and accumulation in the tropical marine ecosystems [5].

Tropical marine ecosystems contain an abundant biodiversity of organisms and complicated physical and chemical factors affect the bioeffects of various pollutants, making it difficult to evaluate the actual toxic effects of compounds [5]. To obtain basic comprehension of this intricate condition, it is essential to study the toxic responses of marine animals, such as shell fish exposed to mixtures of pollutants [6]. *P. viridis* is a suitable indicator organism for detecting pollution of the marine ecosystems, since it is filter feeding, benthic and sessile organism. It is also quite tolerant to pollutants compared to many other animals [7]; [8]. Additionally, the hepatopancreas is easily affected by many



kinds of toxicants [9]. Thus, in the current study, the hepatopancreas of *P. viridis* is selected as the target tissue to uncover the toxic mechanism of DDT, BaP and their mixtures.

Persistent organic pollutants (POPs) are carbon-based compounds that resist photochemical, biological and chemical degradation [10]. POPs are typically characterised by low water solubility and high lipid solubility, which leads to persistence and bioaccumulation. In the marine environments, POPs parts strongly solids and readily accumulate in fatty tissues of organisms. POPs can be deposited into the marine environments directly through atmospheric deposition, river inflow, discharges of municipal or industrial waste water and by leaching from contaminated sediments and dump sites [11]. The monitoring of toxic substances in the aquatic environments using green mussel *P. viridis* as a biological indicator is common, mainly due to advantages such as a wide geographical distribution, static and easy sampling, tolerance to a wide range of salinity and comparatively long life span [12] - [13]. The green mussel, *P. viridis*, are filter-feeding bivalve commonly found in Asia Pacific waters [4]. In consideration of the above, the present study measured organochlorine pesticide in marine water and their contamination in soft tissues of *P. viridis* collected in the Semarang coastal waters. In consideration of the above, the present study measured organochlorine pesticide in marine water and their contamination in soft tissues of *P. viridis* collected in the Semarang coastal waters.

## 2. Research Methods

The specimens of *P. viridis* were collected from Semarang coastal waters (Figure 1) between March and June 2017. After collection on site, samples were transported in polyethylene bags packed in ice to the laboratory for processing. The sample size and homogenization of samples was consistent with other studies conducted elsewhere using mussel [14]. The size of the mussel is known to be an important factor determining the level of pollutants bioaccumulated, only mature individuals in the size range of 8–10 cm were collected. The gender of the bivalve is not a factor affecting the organochlorine and heavy metal contents in green mussel tissues [15], and thus gender was not taken into account in the current study. In the laboratory, soft tissues were removed from shells and rinsed free of impurities before homogenization in a stainless steel blender to form a single batch sample. Homogenates were frozen and stored at  $-20^{\circ}\text{C}$  prior to freeze drying. The extraction and clean-up of the OCPs was similar to those previously described [16]. Samples were extracted in a oven for 20 min. at  $115^{\circ}\text{C}$  with a mixture of hexane/acetone. These extracts were concentrated in a rotary evaporator to about 10 mL and then subjected to a clean-up process in order to remove lipids; the extracts were then purified with sulphuric acid. Sample extracts were further evaporated to exactly 1 mL under a gentle stream of dry nitrogen gas. The extracts were then cleaned-up and separated in three fractions by chromatography using partially deactivated Florisil packed column. The first fraction, eluted with n-hexane, contained HCB, DDE, Heptachlor, Aldrin and PCBs. The second fraction eluted with n-hexane/ $\text{MeCl}_2$  mixture (70:30) which mainly contained DDTs and HCHs, while the third fraction eluted with pure  $\text{MeCl}_2$  which contained Endosulfans, Dieldrin and Endrin. All fractions were evaporated to 1 mL under a gentle stream of dry nitrogen gas. The OCPs in the extracts were analyzed using a Hewlett Packard HP6890 gas chromatograph equipped with a  $^{63}\text{Ni}$  micro Electron Capture Detector (1 - ECD) and a splitless injector, two different programme temperatures and columns (HP5 and DB5) were used. Individual organochlorine pesticides were identified either by the relative retention time using the internal standard as a reference or by analyzing the sample on two columns of different diameter polarity. Quantification of the contaminants was based on the internal standard method using the HP-GC ChemStation. Quality assurance procedures were performed by co-analyzing the reference material mussel tissue homogenate IAEA-142 together with appropriate blanks [14]. Concentrations of the analysis are expressed in dry weight (dw) basis (ng g<sup>-1</sup>). Relative standard errors of analysis concentrations based on replicate determinations of the same reference material are usually around 10 %.



**Figure 1.** The sampling areas at the Semarang Coastal waters

### 3. Result and Discussions

Tambak Lorok is the part of Semarang coastal waters is a areas of fishing ground and cultivated bivalve such as green mussel *P. viridis*. Unfortunately Semarang coastal land has been developed in many activities such as agriculture, industry and settlement. All the wastes of these activities will be discharged to the rivers such as East Banjir Kanal River, Banger, Babon and Sri Mulyo. Even the water quality can support bivalves to survive in these areas [2].

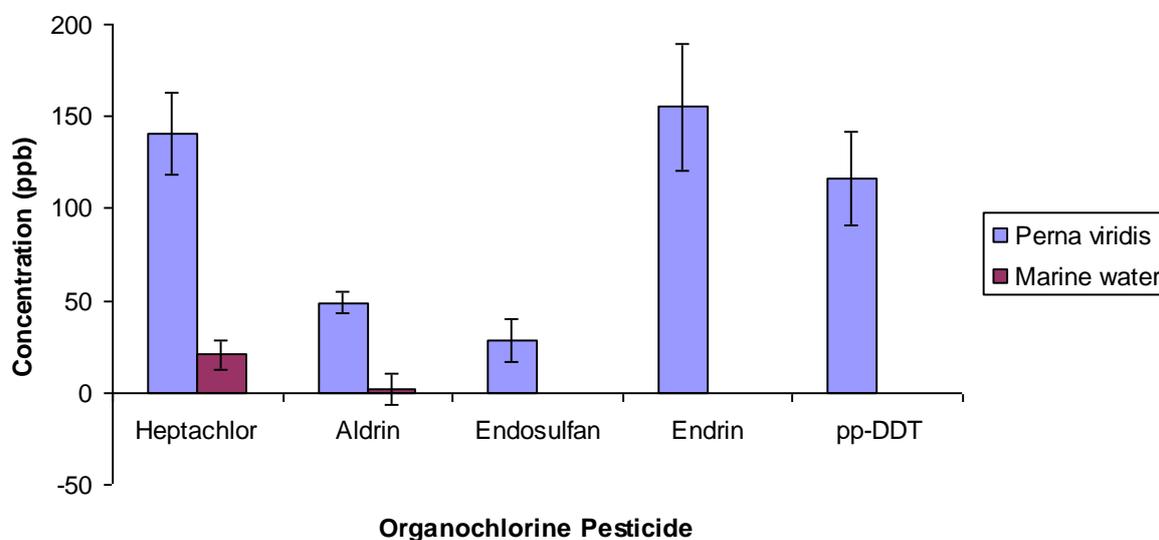
The recent research result by taking the marine waters and green mussel samples in Tambak Lorok of Semarang waters showed that the marine waters and green mussel in that area were found to contain concentrations of Heptachlor, Aldrin, Endosulfan, Endrin and pp-DDT. The average concentrations of pesticides residues in green mussel from highest to lowest were as follows: Endrin (155.13 ppb), heptachlor (140.48 ppb), pp-DDT (116.14 ppb), aldrin (49.04 ppb) and endosulfan (28.38 ppb). The average concentration of organochlorine pesticides in marine water from highest to lowest was as follows: heptachlor (20.68 ppb), aldrin (1.88 ppb) and below detection limit occurred for endosulfan, endrin and pp-DDT. The results can be seen in Table 1 and Figure 2.

**Tabel 1.** The average of organochlorine pesticides contamination in green mussel *P. viridis* and marine waters

Sample	Heptachlor	Aldrin	Endosulfan	Endrin	pp-DDT
<i>Perna viridis</i>	140.48	49.04	28.38	155.13	116.14
sd	22.3	5.6	11.7	34.1	25.4
Marine Water	20.68	1.88	bd	bd	bd
sd	8.2	4.2			

The detection of these organochlorines in the *P. viridis* and marine water samples indicates the presence of those chemical compounds in the waters of Semarang, even though organochlorine pesticides have been banned in Indonesia. The developing country like Cuba has banned these pesticides since 1990. But the distribution of Aldrin, DDT, Heptachlor, HCB and Lindane

concentrations still occurrence in *P. viridis* [16]. The result shows higher concentrations of OCPs in *P. viridis* samples than in the marine waters, demonstrating the capacity of these organisms to accumulate the organic compounds present in the waters and its potential as a accumulate organisms. The pollutant waters can be considered an important source of contamination for the marine organisms such as green mussel in Semarang waters.



**Figure 2.** The average  $\pm$  sd organochlorine pesticide in green mussel *P. viridis* and marine waters

Basically organochlorine pesticide (OCPs) has been contaminated shellfish around the world, such as India [17], Netherlands [18], Croatia [19], Turkey [20], Korea [21], Hong Kong [22], Brazil [23]. The majority informations of contamination organochlorine pesticide (OCPs) has been invesugated in the Europe county and litke beet in tropical country. So that these information of contamination of organochlorine pesticide in green mussel in Semarang water is very important information.

#### 4. Conclusion

Some of organochlorines pesticides have been contaminating green mussel *P. Viridis* and marine water in the Semarang waters. The organochlorine pesticide including heptachlor, aldrin, endosulfan, endrin and pp-DDT has been contaminated the samples of green mussel and marine waters. The concentration of OCPs in green mussel showed on endri (155.13 ppb), heptachlor (140.48 ppb), pp-DDT (116.14 ppb), aldrin (49.04 ppb) and endosulfan (28.38 ppb). The concentration of OCPs in marine showed on heptachlor (20.68ppb), aldrin (1.88 ppb) and the other is bellow detected.

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