EFFECT OF MICROPLASTIC ON GREEN MUSSEL *Perna viridis*: EXPERIMENTAL APPROACH

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ABSTRACT

Plastics become debris in the ocean that can be broken down into tiny particles of micro size (<5 mm) and scattered into columns to the bottom of the water. Its very small size makes it easily accessible to various aquatic organisms, such as plankton, crustacean, and mussel. There have been many studies use mussel as a bioindicator for microplastic pollution but no one has observed the effect of microplastic exposure to mussel mortality. The aim of study was to examine the effect of microplastic on mussel mortality. Green mussels were collected from Mandalle Waters, Pangkep Regency (Pangkajene Kepualauan) then were exposed to microplastic polyethylene originating from sheieving of scrub soap. The exposure was carried out for 7 days with microplastic concentrations of 0.05 (A), 0.5 (B), and 5 (C) g/L. Statistical test results showed the treatment B and C were not significantly different, but the two treatment were significantly different from treatment A. The percentage of green mussel mortality during the experiment increased with increasing microplastic concentrations with the percentage of mortality exceeding 80% at treatment C.

Keywords: Green mussel, microplastic concentration, mortality of green mussel

INTRODUCTION

Since plastic production in the 1950s until 2017, the amount of plastic waste has reached 348 million tons (Plastic - the Facts, 2018) and become debris in the ocean (Gwert et al., 2015; Moore, 2008). This plastic waste can break into very small micro-sized particles (<5 mm) (Dehaut et al., 2016; Depledige et al., 2013; Wagner et al., 2014; Willis et al., 2017). Microplastics spread into the column to the bottom of the water (Eriksen et al., 2014). Microplastics in the waters come from soap and washing clothes, (primary sources), and degradation of large plastics into small plastics (secondary sources) (Anbumani & Kakkar 2018; Anderson et al., 2015; Boucher & Friot, 2017). Plastic degradation in waters becomes microplastic due to the effect of UV radiation, wind, currents, waves and tides (Galloway et al., 2017; Lee et al., 2013).

This microplastic becomes dangerous because of its very small size so that was easily consumed by various aquatic organisms, such as zooplankton (Cole et al., 2013), mussel (Wegner et al., 2012), to Echinoderm (Graham & Thompson, 2009). In addition, microplastic accumulation can occur through trophic transfer from contaminated prey (Nelms et al., 2018; Wright et al., 2013) then accumulation of microplastic occurs at the highest trophic level (Fossi et al., 2012).

Mussels become a bioindicator for microplastic pollution because of their widely distributed, easy accumulated of microplastics, and are closely related to the food chain (Li et al., 2019a). Mussels are filter feeder organisms which in their feeding process can accumulate microplastic (Sussarellu et al., 2016). When microplastics in seawater meet the surface of the gills, they can be captured and trapped into mucus and then assimilated with the gill epithelium or transported into the mouth and digestive system (Bräte et al., 2018; Kollandhasamy et al., 2018). Furthermore, the particles will negatively impact the health of mussels (von Moos et al., 2012).

Some researchers have made observations to analyze the presence and effect of miroplastik on several types of mussels. Intake and accumulation of microplastics are demonstrated by various filter feeder such as *Mytilus edulis* (Browne et al., 2008; Van Cauwenberghe et al., 2015; Kollandhasamy et al., 2018; von Moos et al., 2012; Porter et al., 2018; Qu et al., 2018; Ward & Kach, 2009; Wegner et al., 2012), *Mytilus galloprovincialis* (Bonello et al., 2018; Li et al., 2015; Renzi et al., 2018; Vandermeersch et al., 2015), *Modiolus modiolus* (Catarino et al., 2018), *Perna perna* (Santana et al., 2016), and *Perna viridis* (Khoironi et al., 2018).

Some researchers also observed microplastic accumulation in mussels exposed to various types, sizes, shapes, and concentrations. Mussels are able to accumulate microplastics with different amounts of accumulation in each tissue (Van
In addition to absorption, microplastic accumulation also occurs through attachment to the foot of mussels. Kolandhasamy et al. (2018) found a high number of microplastics in the foot of *M. edulis* about 42 - 59% of the total microplastics in all other tissues. Microplastics can also be accumulated by mussels through the process of fusion with byssus (Li et al., 2019b).

Based on the above information, there was lack of study to observed the effect of microplastic exposure to the mortality of green mussels *Perna viridis*. Therefore this paper will discuss the results of research on the effects of microplastic on the mortality of green mussels.

**MATERIALS AND METHODS**

**Microplastic (MP)**

The microplastic used was a type of polyethylene derived from the shieving of scrub soap. The scrub was dissolved in water, then filtered using filter size 0.075, 0.125, and 0.180 mm arranged in sequence with the lowest size at the bottom. The results were transferred into a petri dish to be heated in an oven at 90°C for 48 hours (Figure 1).

**Sample Collection**

Green mussels with size of 5.1 – 6.0 cm were collected from Mandalle Waters, Pangkep Regency (Pangkajene Kepualauan) by using hand. Length of mussel shell was measured using a digital caliper. The mussels were acclimatized for 14 days (Rist et al., 2016) in the aquarium before being used in the experiment. During the acclimatization period, green mussels were given algae (*Spirulina* sp) 1.2 g/L.

**Statistical Analysis**

Parametric anova was used to analyze the differences in microplastic accumulation and the percentage of mortality in each range of microplastic concentrations.

**RESULTS AND DISCUSSION**

**Results**

Statistical results showed that there were significant differences in the amount of microplastic accumulation between treatment A and B, likewise between treatment A and C. However there was no significant difference in the amount of microplastic accumulation between treatment B and C (Figure 2). The percentage of green mussel mortality during the experiment increased with increasing microplastic concentrations. In the control treatment, percentage of mortality was 5.53%, then the percentage of mortality increased at treatment A by 30.57%, treatment B by 50%, while the
percentage of mortality exceeded 80% at treatment C (Figure 3).

![Number of microplastic particles in the body of green mussels at each treatment.](image1)

Picture 2. Number of microplastic particles in the body of green mussels at each treatment.

Increased microplastic concentrations were accompanied by an increase in the percentage of green mussel mortality (Figure 3). Galloway and Lewis (2016) revealed that the consumption of microplastic caused disruption in organs of organisms to death. Microplastic could accumulate in the organ (Kolandhasamy et al. 2018) and caused damage to tissues from the organ (Avio et al. 2015; von Moos et al. 2012), such as gills and hepatopancreas. Both organs have an important role in the process of taking, absorbing, and digesting food (Au 2004). Therefore, if the gills and hepatopancreas were damaged and unable to carry out their roles as they should, then the function of other organs will be disrupted to cause death.

![Percentage of mortality of green mussels at each treatment.](image2)

Picture 3. Percentage of mortality of green mussels at each treatment.

CONCLUSION

Mussel which has been exposed by varying concentration over 7 days causes mortality up to 80% at the highest microplastic concentration treatment. This mortality due to the damage of mussel organs, consequently it could not be function properly.

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