

ORIGINAL PAPER

Comparing microplastic contamination in bivalves (*Siliqua radiata*) collected from Hat Laem Son, Satun Province, and Hat Pakmeng, Trang Province

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Abstract. Microplastic contamination in marine biota is an important and interesting issue at both national and international levels. It becomes one of the major causes of marine pollution that continuously impacts marine ecosystems, particularly carrying toxic substances that accumulate in marine organisms through food webs. The study on microplastic contamination in the sunset clam, *Siliqua radiata*, the economically important bivalve found along the Andaman coast of Thailand, is highly required in order to comprehend the plastic impacts in marine ecosystems. This study compared the microplastic contamination in *S. radiata* collected from Hat Laem Son, Satun Province, and Hat Pak Meng, Trang Province. The samples were digested with 30% hydrogen peroxide solution before separating microplastics by floating in saturated sodium chloride solution, then filtering with a paper filter. Our analysis revealed that the mean densities of microplastics found in the sunset clam collected from Satun and Trang Provinces were about 6 and 8 particles/individual, respectively. Microplastics were mostly found between the size range of 1,001 - 2,000 μm . and were colorless fibers. This study highlights the microplastics contamination in *S. radiata* in the Andaman Sea, reflecting the needs for continued monitoring on microplastics accumulation in coastal environments.

Keywords: microplastic, contamination, *Siliqua radiata*, Andaman Sea

1. Introduction

The production of plastics has increased steadily since 1950, and approximately 335 million tons of plastics were produced in 2016 (Plastics Europe, 2017). Jambeck et al. (2015) has estimated that 275 million tons of plastic waste were generated in coastal countries in 2010,

of which 2-5% were mismanaged, ultimately reaching the ocean as marine debris. Due to its high persistence in the environment, marine plastic debris has had adverse impacts on marine wildlife and ecosystems, fisheries, and navigation safety and has caused economic losses to coastal countries. Once plastic debris enters the ocean, it is gradually broken into smaller pieces through various environmental weathering processes, including UV exposure, biodegradation, and physical stress (Browne et al., 2007; Andrady, 2011).

Plastic particles with the longest dimension smaller than 5 mm are commonly called microplastics (Kershaw, 2015). Due to their small size, microplastics are available to a wide range of marine species, from planktonic invertebrates to large marine mammals (Kershaw, 2015). The Convention on Biological Diversity (CBD) reported that more than 800 species of the marine organism were affected by marine debris, mostly through entanglement and ingestion, and over 80% of these effects were associated with plastics. As a result, microplastics are widely detected in bivalves, polychaetes, crustaceans, fish, and sea birds (Murray and Cowie, 2011; Van Cauwenberghe and Janssen, 2014; Li et al., 2016; Lusher et al., 2016; Zhao et al., 2016; Jang et al., 2018). Microplastics may have physical and chemical effects on these organisms (Wright et al., 2013;

Rochman et al., 2013), and may move through food webs (Ivar do Sul and Costa, 2014).

Among marine species, bivalves have been widely used as indicator species for monitoring environmental contaminants such as heavy metals and persistent organic pollutants due to their broad distribution, sessile nature (or immobility), easy accessibility, high tolerance to a wide range of environmental contaminants, and low metabolism rate (Zhou et al., 2008). Bivalves are filter feeders that filter a large volume of seawater while feeding and, thus, can ingest and accumulate the microplastics present in the water column. In addition, bivalves are popular as seafood and, therefore, can be a direct route of human exposure to microplastics, as they are consumed whole without gut removal. For these reasons, it is worthwhile to assess the contamination status and characteristics of microplastics in bivalves, to understand their potential risks to marine ecosystems and human health (Li et al., 2018).

Therefore, this study aimed to evaluate the microplastic accumulation in the sunset clam, *Siliqua radiata*, from Hat Laem Son, Satun Province, and Hat Pak Meng, Trang Province.

2. Materials and Methods

2.1 Study sites and sample collection

The study sites are located in Hat Laem Son, Satun Province (6° 58'30"N, 99° 47'20"E) and Hat Pak Meng, Trang Province (7° 29'41.9"N, 99° 19'37.4"E) as shown in figure 1. Fortnightly the samples of *Siliqua radiata* were collected when low tide on both areas during January to February in the year 2017. The samples were preserved in a 10% buffered formalin solution then transported to the marine biodiversity research group laboratory for further analysis. The 30 individuals of sunset clam from each study site were selected to measure the shell length and then proceed the microplastics extraction.

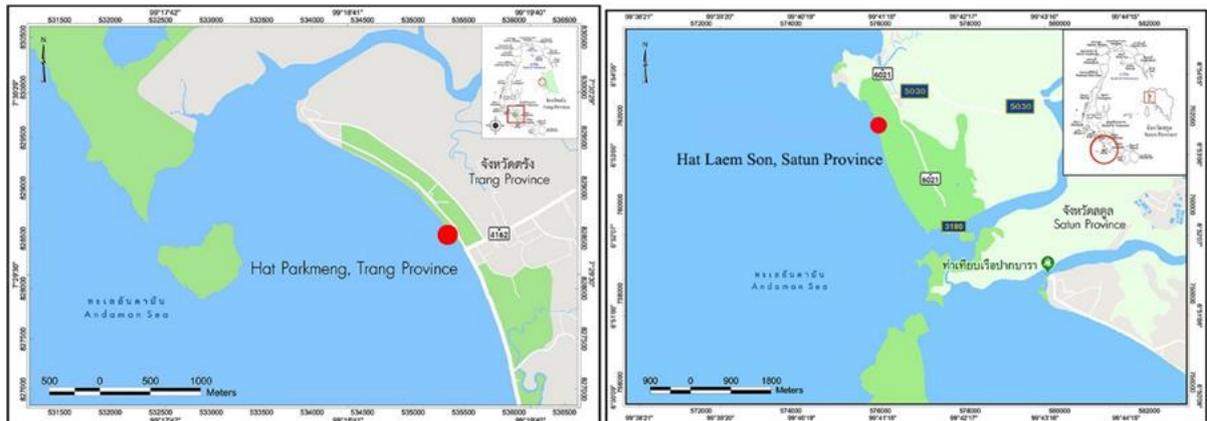


Figure 1. Location of study sites



Figure 2. Sunset clams (*Siliqua radiata*)

2.2 Microplastics extraction

The sampled sunset clams were dissected and cleaned with distilled water. The sunset clam samples were digested in a 30% hydrogenperoxide (H₂O₂) solution, and then heated to 60 °C for 48 h, to remove soft tissues, followed by filtration of the solution through 25 mm pore paper filter with 12.5 cm in diameter (Whatman PLC 122 the United Kingdom) using a vacuum system, the details were described by Li et al., 2015. The microplastics were separated from the digested samples by flotation in saturated sodium chloride solution (250 g/L). The methods were described in Mathalon and Hill (2014). The samples were rinsed in distilled water to remove salts, and then microplastics were detected by visual identification using a stereomicroscope. The polymer types and plastic particles were identified by using Fourier transform infrared spectroscopy (FTIR).

2.3 Statistical analysis

The abundance of microplastics was expressed mean with standard deviation. R program (package “vegan”, version 3.5.0) was used to perform the difference of abundance of microplastics, microplastics length in sunset clam and the shell width and length by using Welch’s t-test.

3. Results

The microplastics accumulation in the sunset clam at Hat Pak Meng was significantly higher than Hat Laem Son ($p= 0.01$) (Figure 3). The highest proportion of microplastics in the sunset clam ranged between 501-1000 μm at Hat Laem Son, whereas the highest on at Hat Pak Meng ranged from 1001 to 2000 μm (Figure 4).

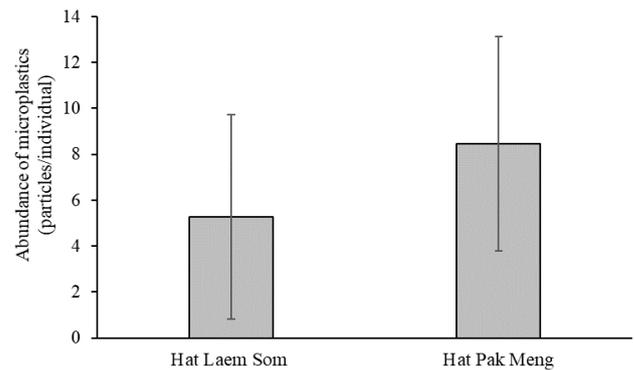


Figure 3. Abundance of microplastics in the sunset clam at study sites

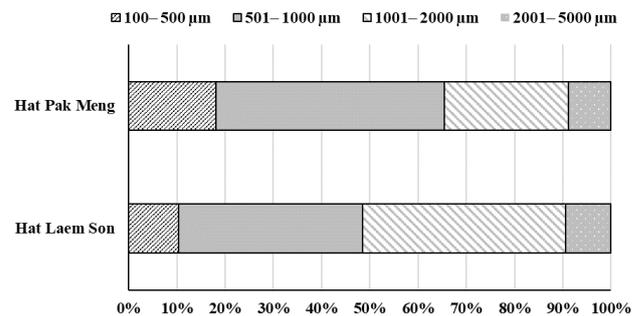


Figure 4. Proportion of microplastics sizes in the sunset clam at study sites

Table 1. Comparison of sunset clam morphology and microplastics found.

Details	Study sites	
	Hat Pak Meng	Hat Laem Son
Shell		
Width (cm)	2.30±0.23	2.63±0.41
Length (cm)	6.28±0.61	7.12±0.92
Average length of microplastics (μm)	1245.26±357.64	1445.79±394.69
Types (%)		
Fibers	100	100
Colours (%)		
Black	9.41	3.43
Blue	3.92	23.04
Colourless	85.49	72.55
Red	1.18	0.98

The width and length of the sunset clam shell at Hat Laem Son was significantly bigger than that Hat Pak Meng ($p=0.00$), but the average length of microplastics found in the sunset clam from both study sites did was significantly difference ($p=0.06$). The most microplastics found in the sunset clam was colourless fibers for both study sites (Table 1). The polymer types of microplastics in sunset clams were identified to be Polypropylene (PP) and Polyethylene (PE) (Figures 5 and 6).

4. Discussion

The microplastics ingestion in bivalves has been widely reported before, such as in the marine bivalves from the biggest fishery market of Shanghai (Li et al., 2015), *Perna perna* collected from Brazilian coastal region (Santana et al., 2016), bivalves from the French Atlantic coast (Phuong et al., 2018) as well as

bivalves from the Persian Gulf (Naji et al., 2017). The abundance of microplastics in *Donax scortum* collected from Hat Pak Meng, Trang Province in the Andaman Sea was detected in 60% of the clam samples with an average of 4.7 ± 1.20 items per individual (Jungrak et al., 2018). Our results revealed that the microplastics ingestion in the sunset clam *S. radiata* is higher than in those regions, and similar to many reports that indicate the frequency sizes of microplastics in bivalves to generally be below 2000 μm (De Witte et al., 2014; Karlsson et al., 2017; Phuong et al., 2018; Jungrak et al., 2018; Renzi et al., 2018). Previous studies estimate that in European countries with high shellfish consumption, up to 11,000 microplastic particles are ingested by consumers per year, whereas in countries with low shellfish consumption, an average of 1800 microplastics were ingested per year (Van Cauwenberghe and Janssen, 2014).

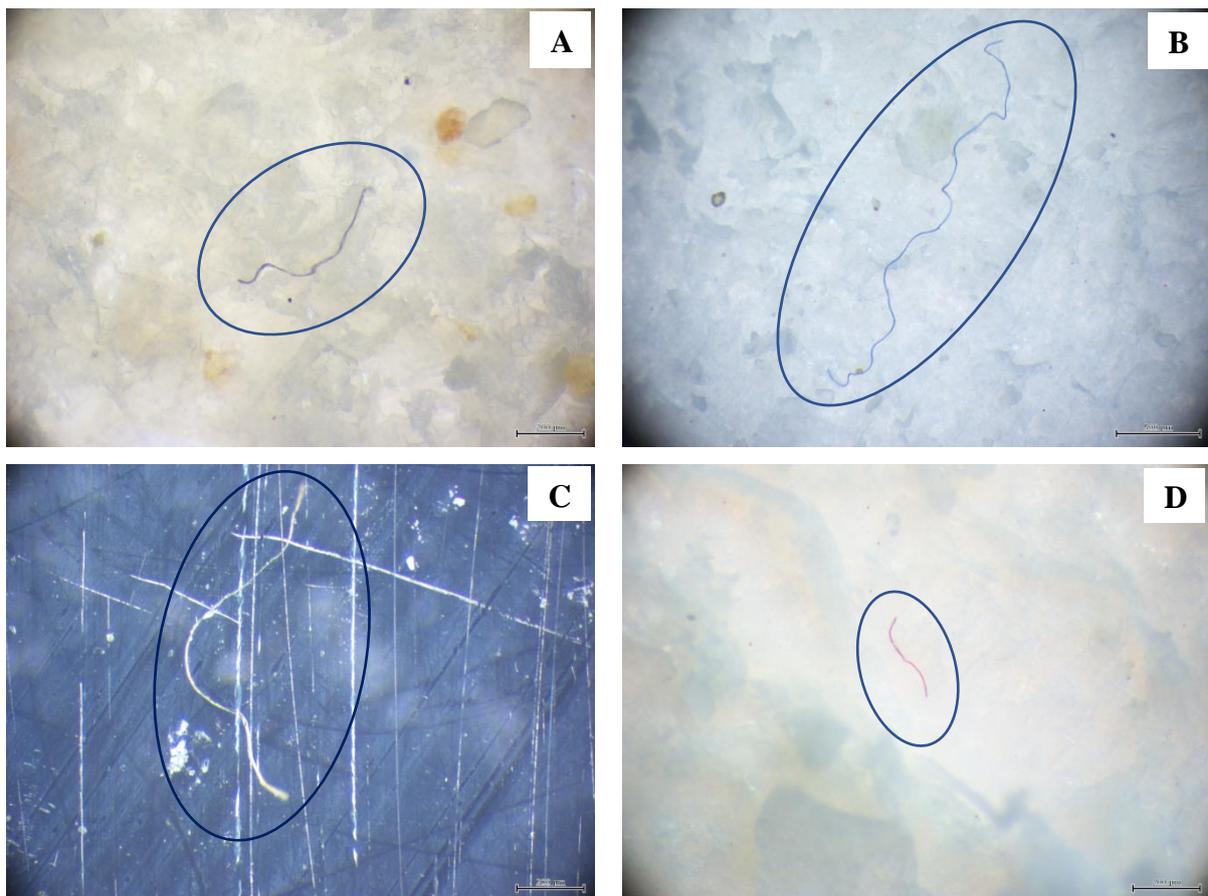


Figure 5 Examples of microplastics found in sunset clam. A= black polypropylene (PP); B= blue polypropylene (PP); C= colourless polyethylene (PE) and D= red polyethylene (PE).

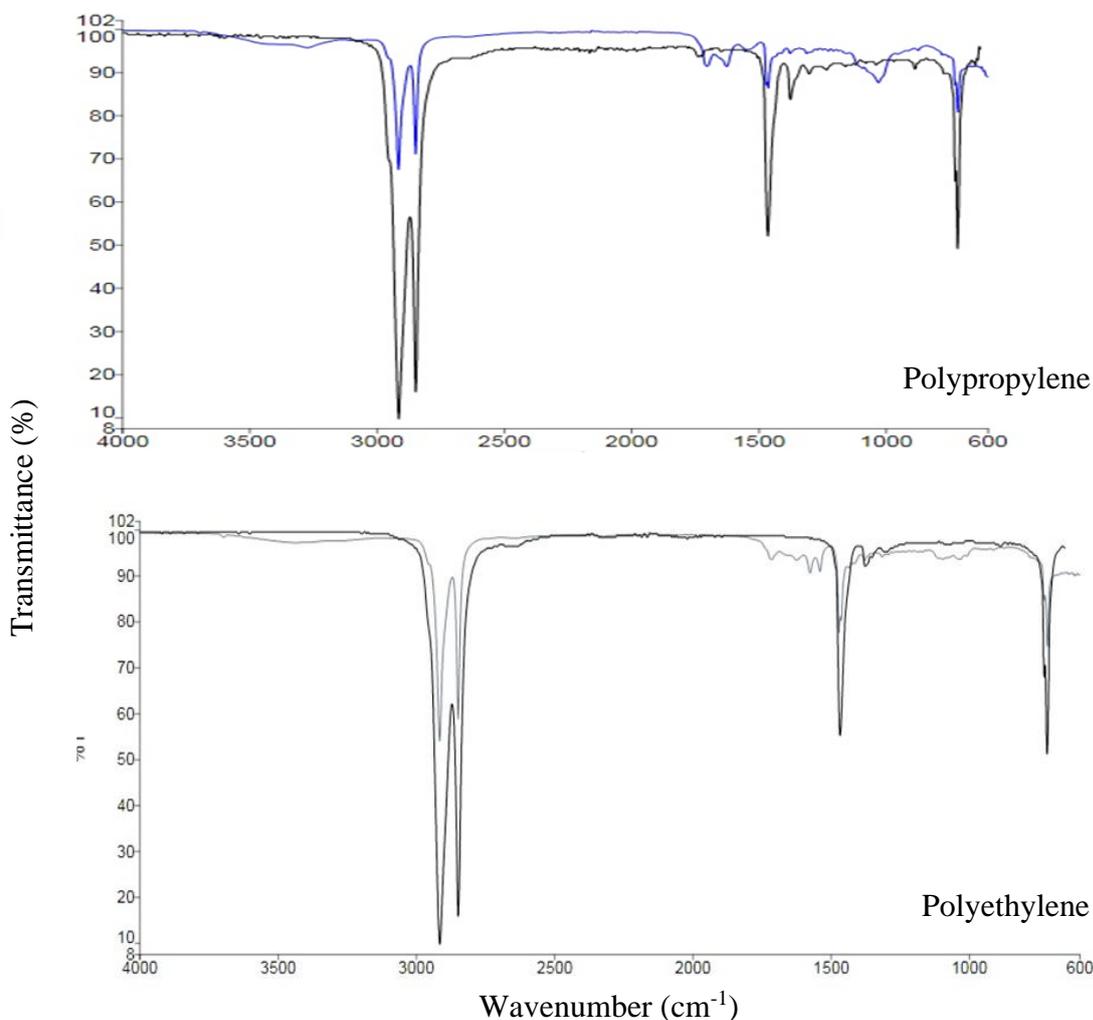


Figure 6 FTIR spectra of the selected microplastic particles

Thailand has high shellfish consumption, indicating the microplastics ingested by Thai consumers might be high. Our results emphasize the importance of microplastics contamination and the proper strategies are urgently needed to mitigate the accumulation of microplastics in coastal and marine ecosystems in the Andaman Sea. Further intensive studies of microplastics accumulation in shellfish are require.

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