Microplastic study on (*litopenaeus vannamei*) cultivation enterprises on the east coast of aceh

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Abstract. Microplastics are small plastics measuring <5mm which, if they enter the water, can contaminate aquatic biota such as shrimp. The research aims to identify the number, shape and color of microplastics in shrimp bodies in vanname shrimp cultivation businesses on the East Coast of Aceh. Shrimp samples were taken from 3 stations, namely Pidie, Pidie Jaya and Bireuen. The samples were measured for weight and length, then prepared using H_2O_2 and H_2SO_4 in a ratio of 3:1 20 mL then incubated, heated, then filtered and identified using a Zeiss microscope with 40x magnification. The results obtained from shrimp body samples contained 2 types of microplastics, namely fiber and film. The most dominant microplastics at the three stations were 13 particles in the Pidie location, 9 particles in the Pidie Jaya location and 5 microplastic particles in the Bireuen location. The presence of microplastics that have entered the body of biota in the vannamei shrimp cultivation business is an early warning. So it is necessary to develop research on other consumption biota to determine the presence of microplastics and their impact if consumed by the public.

1 Introduction

Plastic is a material that is widely used for various human needs because it is easy to shape/mould, is durable and has low production costs [1,2]. However, as the production costs and practicality of plastic materials become increasingly cheap, their use becomes increasingly uncontrolled and often enters the environment uncontrollably [3]. The presence of plastic waste in the environment, as a result of exposure to UV rays, increased temperatures, and mechanical abrasion, can cause the plastic waste to break down into small plastic pieces known as microplastics [4].

The presence of microplastics in the aquaculture environment can come from various sources, both internal sources resulting from the aquaculture activity itself and external sources from outside the aquaculture activity. Internal sources of microplastics in aquaculture activities cannot be separated from the use of plastic equipment in all aquaculture activities from seeding to the harvest process. Externally, microplastics also have a significant influence on the presence and distribution of microplastics in the aquaculture environment. Using water from various external sources (rivers, lakes, sea, groundwater) can potentially provide MP pollutant input to the aquaculture environment. Some of these plastic equipment, for example, are used in maintenance containers, nets, fishing gear, water pipes and wiring [5]. The use of tools with plastic material allows plastic fragments to be released and enter the fish rearing media as microplastics.

Data on the presence of microplastics in aquaculture in Indonesian waters, especially in the coastal areas of the east coast of Aceh, is still very minimal, while [6] stated that the level of plastic pollution in Indonesia was very high. Apart from that, research regarding microplastic contamination in aquaculture on the east coast of Aceh is also not yet available. because most research focuses on marine areas, without paying attention to research for aquaculture [7]. Meanwhile, the presence of microplastics in aquaculture has an impact on reducing water quality and threatens aquaculture safety, because aquaculture is a source of income from cultivation in coastal areas on the east coast. It is hoped that the research will be able to confirm microplastic contamination in vaname shrimp on the east coast of Aceh. It is feared that this will have a negative impact on the condition of biota that consume microplastics that accumulate in sediment in waters so that it can cause both physical and chemical damage to internal organs and disrupt the digestive tract system [8].

2 Methods

This study will be held in July - August 2023. Sampling is done at the Vanname Shrimp Cultivation Business at the East Coast of Aceh. This research was carried out in June - August 2023. Samples were taken at a vannamei shrimp cultivation business on the east coast of Aceh. Then the sample identification continued at the Fish Nutrition and Histology Laboratory, Faculty of Marine Affairs and Fisheries, Syiah Kuala University, Darussalam, Banda Aceh, Aceh.

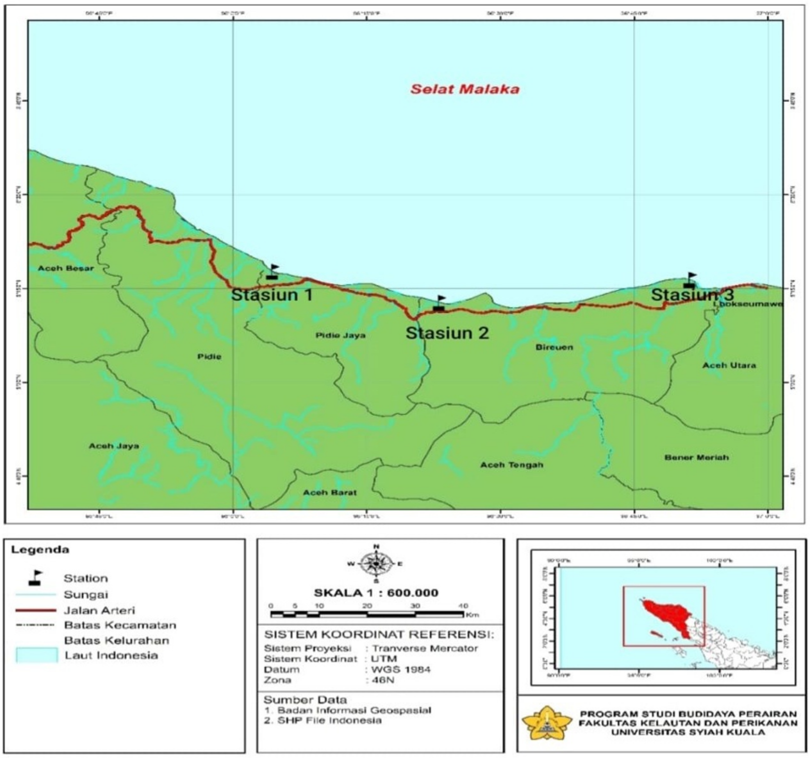


Fig. 1. Research location map

- Station 1 kembang tanjong
- Station 2 panteraja
- Station 3 samalanga

2.1 Sampling technique

This research was carried out in several stages including determining the location by observation, taking samples using random sampling. The work procedure is carried out in 3 stages, namely, 1. Taking samples of vannamei shrimp; 2. Preparation and storage of shrimp samples; 3. Identify microplastic samples from vannamei shrimp samples

2.2 Sampling

Sampling was carried out using a random sampling method, where samples of biota caught at cultivation businesses were taken randomly at 3 points in one location on the east coast of Aceh. Samples were taken from catches in different cultivation businesses, 5 individuals each randomly from each of several vannamei shrimp cultivation sites.

2.3 Sample Preparation

The shrimp sample preparation method used in this research is the method used in [9]. Sample preparation is carried out starting from measuring and recording the weight and length of the shrimp sample using a ruler and scale. Shrimp samples are placed in sample bottles that have been labeled with the name of each sample. The samples that have been taken are then stored in a cool box, then a microplastic analysis test is carried out at the Fish Nutrition and Histology Laboratory, Faculty of Marine Affairs and Fisheries, Syiah Kuala University. Shrimp samples were weighed using a digital scale with an accuracy of 1 gram for further analysis.

2.4 Separation of samples and microplastics

This separation of samples and microplastics refers to research by [10]. Shrimp sample preparation is carried out by starting from measuring the length and weight of the shrimp sample. Separated from the exoskeleton, legs and head of the shrimp. The shrimp meat is then crushed using a mortar and pestle. The finely ground samples were then added with a solution of 30% H_2SO_2 and 30% H_2O_2 as much as 2 times the weight of the shrimp sample. Shrimp samples were incubated for 24 hours. After that, heat the sample jar using a water bath over low heat at around 40-60 ºC for 1 hour. After the shrimp sample is crushed, then filter the sample using Whatman filter paper. The sample is then identified using a Zeiss microscope.

2.5 Microplastic Identification

The microplastic samples were ready and placed in a petri dish. Then the type of microplastic in the sample was identified using a Zeiss microscope. Identification of myroplastics using a Zeiss microscope connected to a computer so it is easier to see the sample and with 40x magnification. Microplastic samples are identified based on shape. Based on shape, microplastics are divided into 3 groups, namely fiber, fragments and films. Microplastic samples that have been collected from shrimp meat are cleaned using distilled water, dried and stored in aluminum foil to prevent contamination

3 Result

3.1 Microplastic abundance

The results of the research showed that the highest number of microplastic particles was found in shrimp at the Pidie location, namely 13 particles/g shrimp weight and the least was found in shrimp at the Bireuen location, namely 5 particles/gram shrimp weight. Meanwhile, more fiber type microplastics were found in shrimp, namely 20 particles from all locations , while the least film type microplastics were found in shrimp, namely 3 particles from all these locations.

Table 1. Number of Microplastics in Shrimp Samples

Location name	Shrimp sample (tail)	Total average weight of shrimp samples (grams)	Number of microplastics (particle)			Total particles	Microplastic abundance (particles/gram)
			Fiber	Film	fragment		
Pidie	5	8,11	10	2	1	13	1.6
Pidie Jaya	5	9.6	6	0	3	9	0.9
Bireuen	5	7	4	1	0	5	0.7

3.2 Presence and Forms of Microplastics

The presence and form of microplastics found in Vaname shrimp from the 3 locations consisted of 3 types, namely fiber, fragment and film. The most microplastic particles were found in the samples located in Pidie, namely 13 particles, for the particles located in Pidie Jaya, 9 particles were found and the fewest particles were found in the Bireuen location, namely 5. This is because in the Pidie, Pidie Jaya and Bireuen locations, microplastics were found in the body. shrimp because the area is located close to residential areas, fishing activities and remaining pond activities. As stated by Yizheng Li *et al,* . [9] that aquaculture activities are the main cause of the high abundance of microplastics in ponds, for example shrimp fishing and degradation of aquaculture equipment so that pond residues and community activities can cause the entry of microplastic particles through the air or water, as according to [10] that there is a relationship between human activities, tourism and fishermen's activities on the distribution of microplastics in the air and in the waters.

The dominant forms found in the three locations were fiber with a total of 20 particles, film with a total of 4 particles and fragments with a total of 3 particles. In accordance with research by Yizheng Li *et al,* [9], The results of research on the identification of microplastics in cultivation ponds show that fiber is the most dominant microplastic , followed by fragments and film . Similarly, research by [11], identification of microplastics in shrimp samples at all four stations shows that the type of microplastic is the most abundant. found is fiber. Fiber type microplastics come from plastics which are often contaminated with waste, fishing equipment and pond equipment [12].

The most dominant type of microplastic fiber was found in these three locations. The cultivation ponds of these three locations supply water from the sea, because the disposal of household waste into river estuaries which is released into the sea can cause the spread of microplastics [13]. Therefore, many fiber-type microplastics were found in the bodies of vannamei shrimp in this study.

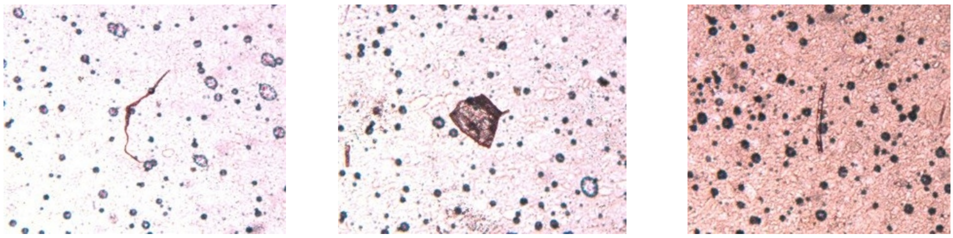
Fragment type microplastics are thought to come from materials such as plastic bottles, paralon pipes and other tools made from plastic produced from aquaculture activities, as well as small-sized waste that can easily move from place to place resulting from the activities of local residents through the air [14]. Fragment type microplastics also come from the fragmentation of large plastics caused by exposure to UV light which causes them to degrade [15]. Fragments have different densities that can make them float, float and sink in waters. Therefore, this type of microplastic can contaminate aquatic biota, both those that move freely and also those that live at the bottom of the water [16].

Very few film-form microplastics were found in these three locations. Film-formed microplastics come from thin plastic fragments and the presence of microplastics in the body of vannamei shrimp is caused by several factors. One of the factors is the presence of waste left over from pond activities, pond equipment used in pond activities and feed storage areas. The film forms in the form of sheets that are thinner than fragments, originating from the fragmentation of plastic bags and other packaging [17].

Based on the results of this research, the most microplastics were found from three research locations, namely Pidie. This is caused by the cultivation system using a semi-intensive system, according [9] Microplastics are found at a higher rate in soil pond sediments compared to the water surface. According to research[18], the high level of microplastics in sediment samples obtained from land ponds is caused by two factors. The first factor is influenced by high anthropogenic activity and the second is within the pond itself. It is impossible for microplastics to enter sediment into earthen ponds and over time the number of microplastics will continue to increase and tend to accumulate at the bottom of the substrate. The cultivation environmental activities at the Pidie location are not well maintained, because there is burning of rubbish near the pond, which allows microplastic pollution through the air. This is in accordance with the statement [13] that microplastics can also enter the aquaculture environment through air contamination. Due to their very small size, microplastics can easily be carried by the wind and float in the air. Meanwhile, relatively few microplastics were found at the Pidie Jaya and Bireun cultivation locations, because the cultivation locations were quite well maintained. The Pidie Jaya and Bireun cultivation locations use an intensive system using HDPE tarpaulin which has many advantages, namely high impermeability, flexibility, strength, anti-tearing and resistance to high temperatures [19]. Therefore, using HDPE tarpaulin is very appropriate to reduce the presence of microplastics. In intensive system ponds in the Pidie Jaya and Bireuen locations, the presence of microplastics is due to the aquaculture activities themselves and plastic equipment such as the use of ropes, cables and pipes. The large number of microplastics in aquaculture ponds is due to the weak hydrodynamics of the pond environment and poor water exchange quality. In the end, the water exchange in this cultivation comes from seawater exchange [9].

This shows that there is a relationship between the microplastic content in shrimp. Microplastics can absorb toxins produced from chemicals in waters and the surrounding environment and can be transferred into the food chain indirectly [4]. This can have a negative impact on the food chain sequentially. Shrimp that consume microplastics for a long period of time will experience death and stunt growth because the plastic particles cannot be digested in the shrimp's body [20]. Due to the size, chemical composition and physical properties of microplastics, this can affect shrimp and water quality and can have an impact on cultivation activities. Another thing that can affect human health is the accumulation of microplastics in ponds consumed by shrimp at that location and will enter the human body if humans consume contaminated biota [21].

Identification of microplastics in vannamei shrimp with the type of microplastic obtained using a Zeiss microscope with 100x magnification and producing images like the following



a b c

Fig. 2. Microplastic photo sample and kind (a) fiber (b) fragment (c) film

This classification is obtained from matching research results with the characteristics of each microplastic. Several research sources from [17-14] show that the form of microplastic fiber can be recognized by its shape which tends to be elongated and resembles a thread . Microplastic film form It has the form of thin sheets of plastic , this type is also in the form of plastic fragments which are not like sheets and fibers . Fiber and film can be sourced from various types of plastic, most of which are the result of use from domestic activities. The shape of microplastics in general can also be influenced by how long the microplastics are in the water and how long the fragmentation process takes.

3.3 Microplastic Color

The research results showed that there were 4 types of microplastic colors in vannamei shrimp , namely red , black, yellow and clear . The overall color of microplastics is most often found in colors black namely with a total of 18 particles at all sampling locations , while the lowest overall microplastic color was found in the clear color, namely 1 particle at all sampling locations.

Table 2. Number of microplastic colors

Location	Number of colors of microplastics (Particles)				Amount (Particles/gram)
	Red	Black	Clear	Yellow	
Pidie	3	8	1	1	13
Pidie Jaya	2	6	0	1	9
Bireuen	1	4	0	0	5
Total	6	18	1	2	27

The most dominant colors of microplastics in this study found in the three locations were black and red, black and red which came from shrimp fishing equipment such as nets and tools left over from pond activities such as the use of shrimp fishing nets, ropes and cables as per Yizhenli's research. [9], Most microplastics are identified as PP, and there are two main sources, namely fishing equipment such as fishing nets and woven feed bags which can be directly broken down and entered the pond with the feed. Activity waste from pools and clothing threads from pool activities can also enter microplastics into the water. Black and red colors are also artificial colors from anthropogenic results [22] and also colors that have been degraded by sunlight (UV). Fiber type microplastics are dominated by black and red. The color of microplastics, which are yellow and clear, is the least dominant in the three locations. The yellow color also comes from *polystyrene* or food packaging or *Styfoam boxes* , which indicates the length of time they stay on the surface of the sea, land and water, as well as the level of weathering. The yellow color indicates it has been in the water longer and has been oxidized. The color of film type microplastics is dominated by clear and fragment type microplastics are dominated by yellow. The clear color found in these microplastics is thought to have come from plastic bags and the yellow microplastics came from broken styrofoam boxes that were not managed properly and also indicates the length of time the microplastics have been degraded by UV light over a long period of time. [23]

The color of microplastics is used as an indicator for identifying the source, type of contamination, level of degradation and time period. According to [24], microplastic color can be used to identify the source and type of contamination in shrimp. This happens because the color of microplastics can increase the chance of contamination of aquatic biota because their characteristics resemble the natural prey of shrimp [25], the color of microplastic particles is a contamination sector because they can attract shrimp to prey on them due to the color similarity to their natural prey.

The results obtained from shrimp body samples contained 3 types of microplastics, namely fiber and film. The most dominant microplastics at the three stations were 13 particles in the Pidie location, 9 particles in the Pidie Jaya location and 5 microplastic particles in the Bireuen location. The presence of microplastics that have entered the body of biota in the vannamei shrimp cultivation business is an early warning [11]. So it is necessary to develop research on other consumption biota to determine the presence of microplastics and their impact if consumed by the public.

D.Conclusion

The abundance of microplastics from the three locations was 27 microplastic particles and the highest microplastics were found at the Pidie location. The presence of microplastics in vannamei shrimp proves that shrimp can be a means for microplastics to enter the human body through the food chain. The forms of microplastics found in the three research locations were Fiber, Fragment and Film, the highest type of fragment found in the three locations.

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