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Isolation and Analysis of Microplastics in Feather Clams (*Anadara antiquata*) at Tanjung Luar Fish Landing Base, East Lombok Regency

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Abstract: Microplastics are small particles <5 mm produced from plastic waste. The plastic waste thrown in the sea, As a result, microplastics have increased and are widespread almost throughout the sea surface, including Tanjung Luar Fish Landing and East Lombok Regency. Microplastics are very dangerous for human health due to microplastic contamination in feather clams, which are often consumed by the local community. Microplastics in the shellfish body can accumulate from the food chain and enter the digestive system. This study aims to determine the presence and characteristics of microplastics in feather clams (*Anadara antiquata*) at Tanjung Luar Fish Landing, East Lombok Regency. The research method used was descriptive quantitative. Samples of feather clams obtained from Tanjung Luar Fish Landing were separated from their shells. The clam meat was added with 10% KOH to destroy organic matter. The sample was incubated in a water bath until it was homogeneous. The sample was filtered using a 250 µm sieve. The filter results were dried with a dryer at 40˚C. Samples were identified with a microscope. The results showed microplastic contamination in feather clams from Tanjung Luar Fish Landing. Microplastic particles found were 59 particles with fibre types, as many as 47 particles, films 9 particles, and fragments 3 particles; there were 4 types of colours: black, clear, red and green. The dominant microplastics found were of the fibre type. Feather clams contaminated with microplastics harm human health, including metabolic disorders.

Keywords: Feather Clams (*Anadara antiquata*); Microplastics; Tanjung Luar Fish Landing.

Introduction

The problem experienced by all countries today is waste, especially in Indonesia, which is increasing yearly, which increases the potential danger of plastic waste to the environment. Plastic waste is a serious threat to the sustainability of marine ecosystems. This plastic waste has contaminated more than 690 large and smaller marine species, such as debris observed in the marine food chain's digestive tract of organisms of various trophic levels [1]. Plastic waste entering the water degrades into small particles of microplastics [2]. Microplastic particles 5 mm in size can seriously impact on the aquatic environment and marine biota, such as fish, shrimp, and shellfish, such as feather clams (*Anadara antiquata*) [3].

Microplastics generally come from plastic waste produced daily because plastic materials are lightweight, strong, durable, and cheap, causing the number of plastic users to continue to increase. Plastic waste can disrupt the environment because of its non-biodegradable nature, making it the largest contributor to waste that can damage the environment [4]. Tidal currents will carry plastic waste dumped into coastal areas and will settle on important coastal ecosystems such as mangroves, seagrasses and coral reefs [5]. Based on the source, microplastics are classified into two types, namely primary and secondary microplastics. Primary microplastics are plastic products produced with a small size of about 5 mm derived from cleaning and beauty products, resin powder and laundry soap that enter the sea in small sizes (microscopic). In contrast, secondary microplastics result from fragmentation that has changed in size to become smaller, such as discarded plastic bags or fishing nets [6]. As for the shape, microplastics are divided into fragments, films, fibres, foam, and granules. The characteristics of microplastics are different in colour, including blue, black, transparent, green, red, white, and yellow [7].

Microplastic particles in the body of biota can damage the digestive tract, inhibit enzyme production, affect reproduction and cause exposure to plastic additives with greater toxicity [8]. Marine animals that ingest microplastics include benthic and pelagic organisms. One of the benthic organisms that are susceptible to contamination by pollutants is the feather clam because it has a way of eating that is a filter feeder, this means the process of filtering any food in water or sediment so that various types of contaminants in the aquatic environment can enter the body of the clam, including microplastics [9]. When an ecosystem is polluted, the organisms that live in it will also be affected. This pollution also compromises food safety, as microplastics can enter the bodies of aquatic organisms and then be consumed by humans, potentially posing serious health risks [10].

The clam's habitat is at the bottom of the water, where it buries itself under the mud. The more microplastic contamination in the marine environment, both in waters and sediments, the more microplastics accumulate in the shellfish body. Mussels can survive even though their bodies contain toxic contaminants from their polluted habitat. Mussels are a source of seafood with high nutritional value and protein but are vulnerable to microplastic contamination [11]. Several studies prove that shellfish have been contaminated with microplastics in several locations in Indonesia, such as blood clams (*Anadara granosa*) in the

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waters of Cape Oyster, Ambon Bay, Kendari Bay waters, mussels (*Pilsbryoconcha exilis*) in Perancak River, Jembrana and many others [12]. Microplastic particles ranging in size, shape, and polymer type in various water areas can cause negative impacts on biota [13]. According to other literature, based on research, microplastic content in feather clams (Anadara antiquated) with a total sample of 15 feather clams totalling 512,53 particles/kg on the coast of Garassikang Jeneponto Regency. From the results of observations, feather clams are positively contaminated with microplastics due to the large amount of plastic waste originating from domestic waste and seaweed fishermen's ropes. If consumed by humans, Shellfish containing microplastics have a potential risk that is not good for human health [14]. Other researchers stated that the body of manila clams contains microplastics because clams are filter-feeder organisms which eat whatever is around them, including water and sediment [15].

Tanjung Luar Fish Landing Base is one of the largest fisheries centres in Tanjung Luar, East Lombok Regency. Many types of marine biota, such as shrimp and shellfish, are traded at Tanjung Luar fish landing. Feather clams are one of the clams that are commonly found and are in demand by the public. They have a high economic value because they can be used as culinary seafood. Therefore, this research is important because it is highly relevant to identifying the characteristics and analysing the types of microplastics. This study aims to determine the abundance and characteristics of microplastics in feather clam meat (*Anadara antiquata*) at Tanjung Luar Fish Landing Base, East Lombok Regency.

Research Methods

Sampling of feather clams was conducted at Tanjung Luar Fish Landing Site, East Lombok Regency (Figure 1). Tanjung Luar is one of the villages in the Keruak sub-district of East Lombok, which is located in the coastal area with most of the surrounding communities as fishermen and traders. This location was chosen because Tanjung Luar fish landing is one of the largest fisheries centres in Lombok. Fish and many other types of biota, such as shellfish, will be distributed to other small markets.

The samples that have been obtained will then be analyzed at the Immunology Laboratory, Faculty of Mathematics and Natural Sciences, Mataram University.

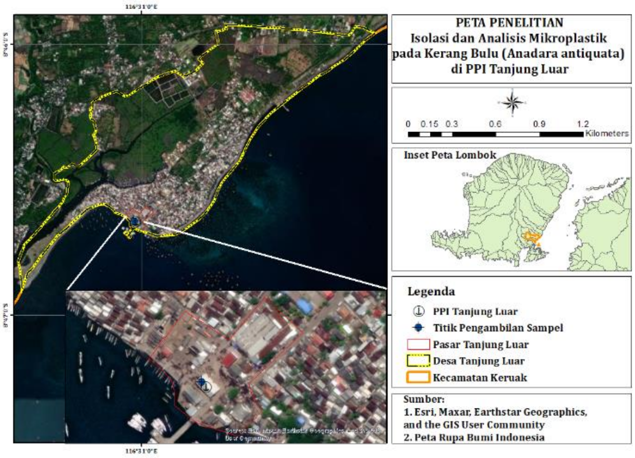

Figure 1. Map of sampling location at Tanjung Luar Fish Landing Bse, East Lombok.

Tools and Materials

The tools used in this research are a cool box, petri dish, dryer, 500 mL beaker, stereo microscope, analytical balance, ruler, tweezers, pallet knife, 250 µm multilevel sieve, water bath, notebook and camera. While the materials used are 10% KOH, equates, aluminium foil and feather clams (Anadara antiquated).

A sampling of Feather Clams

Feather clam samples obtained at Tanjung Luar Fish Landing Base from fisherman's catch were wrapped in aluminium foil to avoid contamination, stored in a cool box with ice blocks, and taken to the Immunology Laboratory of the Faculty of Mathematics and Natural Sciences, Mataram University for further analysis.

Preparation and Isolation of Biota Sample

The feather clam samples taken were given prior preparation by sterilizing all equipment with distilled water and cleaning the feather clam samples from impurity organisms. The feather clam samples used were 100 varying shell sizes [16]. After that, the feather clam samples were weighed whole (shell and body) using analytical scales. The meat was separated from the shell using a scalpel and weighed, the meat sample obtained was washed with aquades until clean and put into a sample bottle for analysis.

The feather clam meat sample weighed 250 grams, and then 250 mL of 10% KOH was in a ratio (1:1) in a glass beaker [17]. KOH solution destroys organic matter in the sample, making it easier to observe its microplastics. The sample was incubated using a water bath at 70°C, 150 rpm, until homogeneous. Next, the sample is filtered using a 250 µm graded sieve, and then the filter results are dried with a dryer at 40 ° C for approximately 2 hours; the dried samples are collected in a petri dish to be observed under a Stereo microscope.

Microplastic samples were analyzed using a stereo microscope. Microplastics found in mussel bodies are classified based on shape and colour. The process of visually identifying microplastics based on their shape. The abundance of microplastics can be calculated visually by observation under a microscope, and the data can be processed using Microsoft Excel.

Results and Discussion

The Presence of Microplastics in Feather Clams (*Anadara antiquata*)

Feather clam (*Anadara antiquata*) is one of the marine organisms of non-fish biological resources, including the Arcidae family and the Bivalve class. The habitat of feather clams in coastal waters with muddy substrate characteristics [18]. Feather clams are one of the benthic animals fulfilling nutritional needs by filtering the water media. Feather clams have siphons with two lines to drain and remove water [19].

Microplastics are one of the global problems that can threaten food safety because they are found in various types of biota, such as fish, shrimp and shellfish, including in various Indonesian waters [20]. Microplastic contamination was found Based on research conducted on samples of feather clam meat (Anadara antiquata) obtained at Tanjung Luar Fish Landing, East Lombok Regency. The presence of microplastics in feather clams may be closely related to the quality of the environment and sediments that are the habitat of the clams. Feather clams are filter feeders that automatically swallow anything that filters into their digestive tract, including microplastics; various pollutants can accumulate in clams' bodies if microplastics contaminate their habitat. Mussels are also used as aquatic bioindicators [21]. The microplastics found in feather clams were 59 particles.

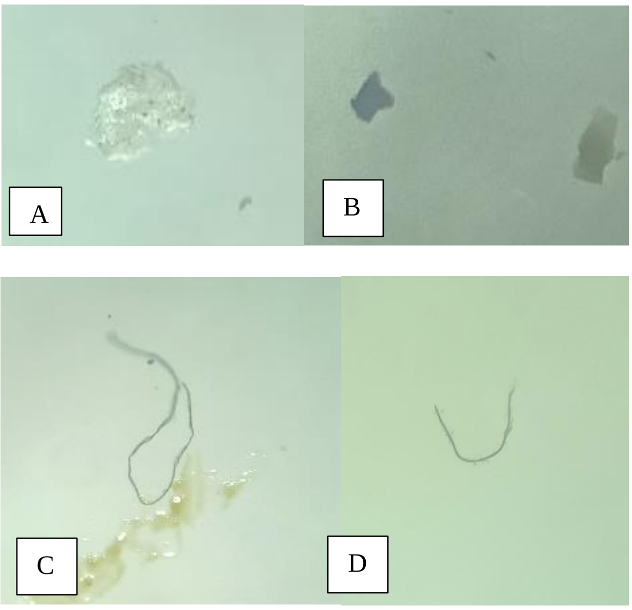

Figure 2. Microplastics found in feather clams (*Anadara antiquata*) (A) Film (B) Fragment (C) and (D) Fiber

Table 1. Microplastic Abundance in Feather Clams (*Anadara antiquata*).

Form	Colour			
	Black	Clear	Red	Green
Fibre	45	1	1	0
Film	0	9	0	0
Fragments	0	1	0	2

The table above shows the number of microplastic particles found. Various sources cause the high presence of microplastics in feather clams. Based on Tanjung Luar Fish Landing observations, plastic waste mostly comes from domestic and fishermen's rope waste [14]. Fishermen dominate the economic activities of the community around Tanjung Luar Fish Landing. The people who litter the rubbish along the coastline are one of the sources that trigger the formation of microplastics. The distribution of microplastics in the waters is influenced by currents, winds, tides and seasons [22]. Plastic waste that enters the marine ecosystem can be degraded and undergo changes in composition due to sunlight, ultraviolet radiation, oxidation, and biofilm growth so the degradation process can cause changes in size to become smaller, called microplastics and changes in colour density [23]. Based on reference the research of microplastics with higher densities will settle to the bottom of the waters, and it has been found that the number of microplastics found on the deep seabed is four times the number observed on the surface. This is the cause of the possibility of bottom-dwelling biota, such as shellfish, being contaminated with microplastics [15]. Microplastics are made from various types of polymers, including PE (polyethene), PP (polypropylene), PS (polystyrene), PVC (polyvinyl chloride), and PET (polyethylene terephthalate) [24]. PET is often found and is usually used in plastic bottles, beverage bottles, mineral water, juice, sports drinks, and soft drinks [25]. Studies conducted on marine biota and waters show that polymer types of PP (polypropylene) and PE (polyethene) are found in the digestive tract. However, some aquatic biotas are also found in other body parts, such as gills and skin [7].

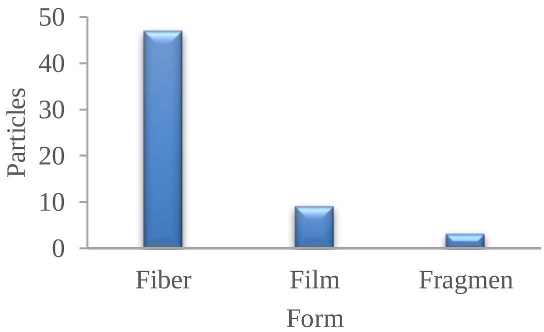

Figure 3. Abundance Diagram of Microplastic Forms in Feather Clams (*Anadara antiquata*)

The characteristics observed in this study are the shape of microplastics. Based on the diagram above (Figure 2), the results of microplastic identification based on shape found three forms of microplastics: fibre, film, and fragments. The most dominating form is fibre, with as many as 47 particles; fibre has a thin, long and fibrous shape (Figure 2). Fibre usually comes from synthetic fibres derived from household waste, namely clothes washing [14]. The cause of the presence of this type of fiber also comes from fishing ropes and nets used by local people to catch fish because one of the jobs of the community is fishing. In accordance with the sampling location, it is very close to the population and the harbour where fishing boats often stop, so it is likely that fishermen's waste is thrown into the sea [26]. The results of this study are in accordance with the results of other, who found fibre as the highest form of microplastics found in shellfish, presumably because the research location is close to rivers and settlements, where many community activities occur [5]. Ramli et al. (2021) also stated that fibre is the most dominating particle in bivalves, most likely originating from fishing ropes and fishing boat nets that are no longer used so that they break down into plastic particles of very small size [2]. The least microplastics found in this study are fragment-shaped microplastics with as many as 3 particles. Fragment-type microplastics in the sea come from fragmented microplastics; many polyethene polymer fragments are found, which are the main ingredients that make up plastic bottles and bags [27]. Furthermore, 9 film-shaped microplastic particles come from thin plastic bags and disposable waste [28]. Therefore, feather clams and other biota are easily contaminated with microplastics because so many local people use raffia or ropes for fishing activities, plastic bottles and plastic bags that are disposed directly to the shoreline and dragged into the ocean [27].

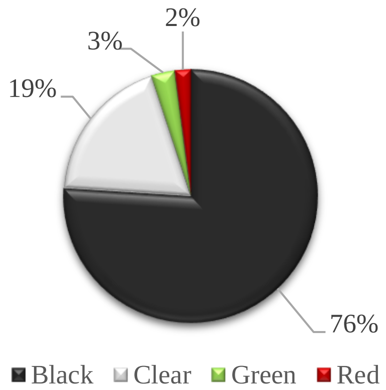

Figure 4. Percentage of Microplastic Color Abundance in Feather Clams (*Anadara antiquata*)

Based on the results of microplastic observations, feather clam samples come in various colours. The colours are black, clear, red, and green (Figure 4). The black colour was found the most, namely 47 particles with a percentage value of 76%, then obtained clear 9 particles with a percentage of 19%, red colour 1 particle with a percentage of 2% and green colour 2 particles with a percentage of 3%. The colour diversity in each microplastic particle is thought to come from its source. During the degradation process by ultraviolet light, the colour of microplastics can also change. Still, solid microplastics indicate that they have not undergone significant colour changes [29]. The dominant clear colour in film-form microplastics may indicate that it has undergone long-term photodegradation by ultraviolet light [30]. The clear colour of microplastics is thought to come from the original colour of food or beverage packaging. The black colour is dominant in fibre, the most common colour found and can indicate that many contaminants have been absorbed in microplastics and other organic particles [31]. The black colour of the fibre is thought to be a type of PET; according to other references, PET production in the world in 2013 was around 56 million tons. PET in the textile world is often called polyester. Many activities, especially in the Tanjung Luar Fish Landing area, are still found, such as washing clothes by the sea or washing waste disposed of at sea so that the degradation of fabrics derived from polyester is mixed in the waters until eaten by marine biota such as in feather clams (*Anadara antiquata*) [25]. As for red and green, colours found are likely to come from the original colours that have not undergone significant colour degradation as in Kapo et al.'s study, blue, red, and green colours come from clothes and washing water [32]. The colour of microplastics can provide information about marine debris or the condition of microplastics [33].

From the research results, it is evident that microplastic contamination accumulates in the body of the shellfish, endangering the community as consumers. Shellfish contaminated with microplastics can have physical effects because they contain toxic, so they can damage the digestive tract, reduce the growth rate of biota, inhibit enzyme production, and affect reproduction [34].

Microplastics harm human health because can be contaminated through the food chain and impact disease [24]. Microplastics potentially cause metabolic disorders, neurotoxicity, and increased risk of cancer as well as reproductive disorders, liver function disorders, kidney function disorders and anaemia [35]. Other references showed in their research that microplastics are everywhere in the marine environment and are increasingly contaminating species in the marine environment, with the transfer of microplastics through the food chain (trophic transfer) inevitable that humans exposed to microplastics at a certain level. The excretory system of the human body removes microplastics, possibly removing 90% of ingested micro and nanoplastics through faeces [37].

The presence of microplastics in waters is indeed dangerous for human survival. Microplastics contain many harmful compounds, such as Polychlorinated biphenyls (PCBs), metals, and Polybrominated Diphenyl Ethers (PBDEs), which can be harmful if accumulated in the human body. Other researchers conducted a trial of eight volunteers; microplastics were detected in faeces with an average concentration of 20 microplastic particles per 10 grams of faeces [38]. Therefore, it is necessary to conduct further research on microplastics to obtain more in-depth information. However, the presence of microplastics can be reduced in various ways, such as socialization related to handling plastic waste, beach clean-up actions and efforts to reduce the use of disposable plastics to reduce microplastic pollution in the waters.

Conclusion

The abundance of microplastics in feather clams (*Anadara antiquated)* in the research area, Tanjung Luar Fish Landing, was found 59 particles/individuals, addition to the characteristics of the microplastic forms found were distinguished based on particle shape, including fibre 47 particles, film 9 particles and fragments 3 particles. In addition, the colour of microplastics was found in four kinds of colours: black 76%, clear 19%, green 3% and red 2%.

Author's Contribution

Nurul Waroatul Aulia: Designed the research framework, conducted the research, analyzed the data, and prepared the results and discussion. Eka Sunarwidhi Prasedya: contributed to drafting the research procedures, data analysis and discussion. Dining Aidil Candri: Contributed to data analysis, discussion and authorship.

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