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Microplastic Content in Blood Cockles (*Anadara granosa*) from the Coastal Waters of Tanah Merah Meranti Islands, Riau

Kandungan Mikroplastik pada Kerang Darah (*Anadara granosa*) dari Perairan Pantai Tanah Merah Kepulauan Meranti, Riau

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ABSTRACT

This research was conducted in December 2023 to determine the type and content of microplastics in blood cockles (*Anadara granosa*) by taking samples from the coastal waters of Tanah Merah Beach, Meranti Islands. The sampling location was based on the purposive sampling method divided into residential areas, fishing ports, and mangrove areas. Blood cockle samples from the three locations were selected for only large sizes (2.5-3.7cm). The water quality parameters at the sampling location were measured for temperature, salinity, and pH, indicating that the coastal waters of Tanah Merah Beach are still natural habitats for blood cockles. Three types of microplastics were found in blood cockles, namely fiber, film, and fragments, with an average abundance of 56.33 particles/ind ($p>0.05$). Further research is needed regarding size differences and relationships with environmental parameters.

Keywords: Microplastics, Pollution, Blood cockles, *Anadara granosa*, Riau

ABSTRAK

Penelitian ini dilaksanakan pada bulan Desember 2023 dengan tujuan untuk mengetahui jenis dan kandungan mikroplastik pada kerang darah (*Anadara granosa*) dengan mengambil sampel kerang dari perairan Pantai Tanah Merah, Kepulauan Meranti. Lokasi pengambilan sampel dilakukan dengan metode *purposive sampling* yang dibagi menjadi tiga lokasi yaitu pemukiman penduduk, pelabuhan nelayan, dan sekitar kawasan mangrove. Sampel kerang darah dari ketiga lokasi dipilih dengan ukuran yang besar (2,5-3,7cm). Parameter kualitas air di lokasi penelitian yang diukur berupa suhu, salinitas, dan pH, menunjukkan bahwa perairan Pantai Tanah Merah masih alami sebagai habitat kerang darah. Ditemukan tiga jenis mikroplastik yang terdapat pada kerang darah yaitu fiber, film, dan fragmen dengan nilai rata-rata yaitu 56,33 partikel/ind ($p>0,05$). Perlu dilakukan penelitian lebih lanjut mengenai perbedaan ukuran dan hubungan dengan parameter lingkungan.

Kata Kunci: Mikroplastik, Pencemaran, Kerang darah, *Anadara granosa*, Riau

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INTRODUCTION

Tanah Merah Village is one of the coastal areas in Riau Province, located in Rangsang Pesisir District, Meranti Islands Regency. Local communities carry out many activities, such as fishing, loading and unloading ships, farming, and plantations around the coast, as well as household activities, which produce a large amount of waste, especially plastic waste. According to Alpiansyah et al. (2021), plastic waste undergoes mechanical degradation and turns into microplastic granules.

Microplastics are found in water, sediment, and marine biota. Biota at low trophic levels can directly accumulate microplastics, while biota at high levels accumulate microplastics directly and through the food chain (Lolodo & Nugraha 2019). Based on the source, microplastics are grouped into primary and secondary microplastics. Primary microplastics are the result of plastic production in microform. Meanwhile, secondary microplastics are fragments or fragmentation results of large, macro-sized plastics. According to Rachmat et al. (2019), the microplastics most often found are films, fibers, and fragments. The presence of microplastics in waters has the potential to be ingested by marine biota such as fish (Amin et al., 2020), sea cucumbers (Amin et al., 2021), shrimp (Saborowski et al., 2022), gastropods (Yana et al., 2021), and bivalves, namely blood cockles (Listiani et al., 2021).

Blood cockles (*Anadara granosa*) are filter feeder biota because they can filter organic particles and phytoplankton suspended in water (Wahdani et al., 2020). Therefore, blood cockles can potentially be contaminated by microplastics based on where they live and how they eat. The more microplastics there are in the aquatic environment, the more microplastics have the potential to accumulate in the bodies of shellfish. Blood cockles are one of the sources of livelihood for fishermen in the coastal waters of Tanah Merah Village because they have economic value and high nutritional content, so many people consume these shellfish. If blood clams consumed by humans contain high amounts of microplastics, it is likely to have a bad impact on the health of humans who consume these shellfish (Wright et al., 2013).

Based on this description, it is essential to research microplastics' presence in waters, especially for aquatic biota consumed by humans. Research on the microplastic content in blood cockles has been widely conducted. However, there is no information or data regarding the microplastic content found in blood cockles, especially in the waters of Tanah Merah Beach, Meranti Islands Regency. Therefore, this research was conducted to obtain information regarding the microplastic content in giant blood clams in Tanah Merah Beach, Meranti Islands, Riau Province.

MATERIALS AND METHOD

Time and place of research

This research was carried out in December 2023 in the coastal waters of Tanah Merah, West Rangsang District, Meranti Islands Regency, Riau Province (Figure 1).

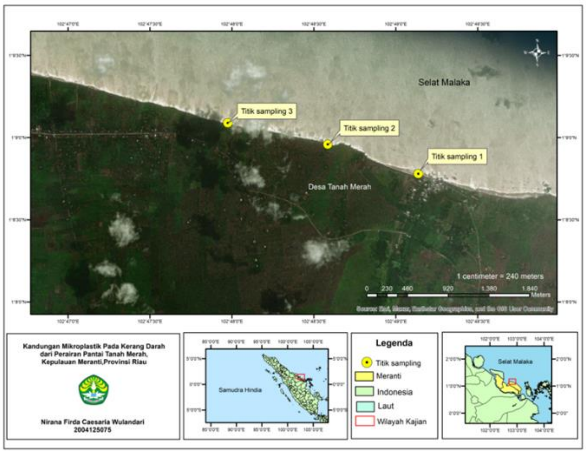

Figure 1. Research location

Determining the location of the sampling

Determining the sampling location uses the purposive sampling method by observing the environment around the location of the observation of the research object. The sampling location was divided into three sampling points, namely residential areas (sampling point 1), fishing ports (sampling point 2), and mangrove areas (sampling point 3).

Sampling and preparation of blood cockle

Blood cockles were sampled at low tide with large sizes (2.5-3.7cm) at each sampling point. Blood cockle samples were taken, and six individuals were obtained with relatively the same size, so the total number of blood cockle samples from the three stations was 18 individuals. The blood cockle samples taken are put in a plastic bag labeled, then put into an ice box and given ice cubes for further analysis at the Marine Chemistry Laboratory, Department of Marine Science, Faculty of Fisheries and Marine Science, Universitas Riau.

Analysis of blood cockle samples

Analysis of microplastics in bivalves refers to Rochman et al. (2015). There are three stages: sample preparation, dissolving the sample with 10% KOH solution, and visual observation using a microscope. The first step to analyzing the sample is to clean the blood clams using running water. After that, samples of blood clams were collected to measure their morphological characteristics, such as the shell's length, width, and height, using calipers and weighing the total weight of the clams using analytical scales. Then, a surgical process is carried out to separate the clamshell from the soft tissue of the blood clam. Blood cockle soft tissue was weighed using an analytical balance.

The next stage is that the soft tissue is put into a glass beaker, and an alkaline solvent in the form of 10% KOH is added in a proportion three times the weight of the soft tissue. Then, the samples were left for 2 weeks at room temperature (20-25ºC). The KOH10% solution functions to destroy organic material in the sample, making it easier to observe microplastics. The dissolved sample is then filtered using a vacuum pump on Whatman filter paper. Then, the filter paper was observed visually using an Olympus CX23 microscope.

Data analysis

The data obtained during the research was tabulated into tables, depicted in graphs, and then analyzed statistically using the One-Way Analysis of Variance (ANOVA) test. Analysis of microplastic content based on sampling points with ANOVA.

RESULT AND DISCUSSION

Conditions of the research area

Tanah Merah Village is one of the villages in Rangsang Pesisir District, Meranti Islands Regency. Geographically, it is located at coordinates 1°09’01.99” N - 102°47’28.96” E. Tanah Merah coastal waters have an area of 48 km^2, with a population of 1,891 people, the majority of whom make their living as fishermen. To the north, Tanah Merah Village borders directly on the Melaka Strait, to the east is Sonde Village, to the south is Kayu Ara Village, and to the west is Kedabu Rapat Village. Sampling point 1 (1°09’11.61” N - 102°47’34.67” E) is the residential area of Tanah Merah Village residents. There are several houses on the beach, and the activities of the residents are great.

Sampling point 2 (1°09'12.83" N - 102°47'31.42" E) is a fishing port where fishing communities can carry out activities, trade, and collect mussels and blood clams. Apart from that, there are many ships anchored at the port and a bridge used as a tourist spot by local residents to enjoy the sunset in the afternoon. Sampling point 3 (1°09'13.59” N - 102°47'26.60 E) is a mangrove rehabilitation area because the waters of Tanah Merah Beach directly border the Malacca Strait, so that the abrasion that occurs is very high.

Oceanographic parameters

Judging from the parameters measured, it can be categorized as still natural, with the salinity of Tanah Merah Beach waters ranging between 29-30‰, temperature 28-29°C, and pH 7. According to the Decree of the Minister of the Environment Number 51 of 2004, it is stated that the optimum temperature for aquatic biota is between 28-30°C, with a salinity of 30‰ and a pH of 7 (KLH., 2004). The results of measuring water quality parameters show that the water quality at Tanah Merah Beach is still natural and suitable as a habitat for blood cockles.

Types and content of microplastics in blood mussels based on observation station

Based on the results of observations, there are three types of microplastics found, namely fiber, film, and fragments, while research conducted by Isjayanti et al. (2021) in the waters of Kendari Bay and Nugroho et al. (2023) in Rawa Pening, Central Java found four types of microplastics in blood cockles, namely fiber, film, fragments, and pellets. The differences in the microplastics found are thought to be due to the different types of microscopes and methods used. Apart from that, maybe because there are no industrial plastic processing factories around the Tanah Merah waters, this is supported by the opinion of Sari et al. (2021), who stated that pellet-type microplastics are primary microplastics which are raw materials for making plastic products and are produced directly by factories.

a. fiber b. film c. fragment

Figure 2. A type of microplastic found in blood cockles (*A. granosa*)

The dominant type of fiber microplastic was found at sampling points 1 and 3, while the least kind of microplastic found was filmed at each station. The high level of microplastic fiber is influenced by anthropogenic activities such as household and fishermen's activities. Research conducted by Tuhumury & Ritonga (2020) in the waters of Tanjung Tiram, Ambon Bay, also found that fiber-type microplastics were most commonly found in the bodies of shellfish.

Table 1. Types and content of microplastics in blood cockles (*A. granosa*)

Location sampling	Microplastic Content (partikel/ind)			Amount (Particle/ind)
	Fiber	Film	Fragment	
1	16.17 ±6.18	14.17 ±3.19	16.83 ±7.73	47.17 ±13.73
2	18.50 ±9.29	16.00 ±5.10	20.83 ±3.37	55.33 ±7.42
3	29.33 ±9.77	16.67 ±6.15	20.50 ±10.39	66.50 ±6.37
Average	21.33±9.98	15.61±4.79	19.39±7.49	56.33 ±12.25

Kawung et al. (2022) stated that the most common type of microplastic fiber is found in waters because it comes from washing clothes, fishing lines, fishing nets, and waste originating from communities in coastal areas. At the same time, Sekarwardhani et al. (2022) stated that several factors, such as the source of entry, movement of water masses, and physical and chemical characteristics, influence the type of microplastic that dominates an aquatic environment.

At sampling point 1, it was found that fiber-type microplastics were dominant compared to the other two types of microplastics, namely films and fragments. Film-type microplastics can come from the fragmentation of plastic bags, food packaging, drinks, and detergent wrappers. Isjayanti et al. (2021) explained that the source of film-type microplastics comes from using plastic daily, which is then thrown away on the coast, causing increased plastic waste in the waters. According to Arifin et al. (2023), the presence of film-type microplastics and fragments found in shellfish indicates that microplastic pollution comes from household waste or waste deliberately thrown into rivers and ends up in the sea.

At sampling point 2, a fishing port, it was found that fiber-type microplastics were the most dominant, followed by fragment and film types. Fragment-type microplastics have irregular shapes, are sturdy and thick, and are formed from degradation or large plastic fragments such as drinking bottles, mica folders, the remains of discarded jars, fast food packaging, and paralon pipes (Dalimunthe et al., 2021). Fragment-type microplastics have a greater density than fiber and film, so they tend to sink in the sea and are easily found on the seabed (Arifin et al., 2023). The high level of microplastic fragments after fiber at this station is due to the activities of fishermen who anchor their boats on the beach, the use of plastic as fishing gear, several shipwrecks have been damaged, there are mussel harvesting activities, and the large number of local people who come to enjoy the sunset around the bridge. The large number of activities at this location causes the microplastic content in shellfish at sampling point 2 to be higher than at sampling point 1.

The highest total microplastic content was found at sampling point 3 in the mangrove rehabilitation area. Plastic remains, such as polybags, were left behind when mangroves were planted. Apart from that, the mangrove rehabilitation area is also a place where fishermen's boats pass, so a lot of plastic waste gets stuck in the roots of the mangrove trees. This follows research conducted by Hiwari et al. (2019) Listiani et al. (2021), who stated that the large amount of plastic waste stuck in mangroves resulted in higher microplastic content in the area than in other stations.

Mangroves are ecosystems that always receive water exchange due to tidal influences, which can potentially carry microplastics from the surrounding environment and become trapped in the ecosystem due to the mangrove root system (Ayuningtyas et al., 2019; Naji et al., 2019). The physicochemical conditions in mangrove waters are a suitable habitat for shellfish and can potentially increase the accumulation of microplastics in the shellfish's bodies. Ayuningtyas et al. (2019) revealed that the nature of microplastics is easy to move and move due to currents or wind, causing microplastic contamination to not only be found in zones that have high human activity, making it possible for microplastic pollution to be found in zones far from human activity.

The microplastic content found in blood cockles in Tanah Merah coastal waters (56.33 particles/ind) is higher than research conducted by Sari et al. (2021) on local sea shells in the waters of Bengkalis Island in the same waters directly bordering the Malacca Strait with an average of 13.199 particles/g. Meanwhile, higher results were found in green mussels (*Perna viridis*) carried out by Prameswari & Muhammad (2022) with an average value of 98.83 particles/ind at Mangunharjo Beach, Semarang. If we look at the characteristics of the sampling locations, which are the same as those carried out by Listiani et al. (2021) stated that the average microplastic content found in blood cockles in Kwanyar waters, Bangkalan Madura Regency was less, namely in residential areas the number was 23-25 particles/ind, at river estuaries the number was 20.2-22.9 particles/ind, and an average of 23.9-26.8 particles/ind in the mangrove area.

This difference is likely due to differences in the number of shellfish samples used. Apart from that, water conditions during sampling can also have an influence. Listiani et al. (2021) took shellfish samples during the dry season, so the river flow carrying plastic waste toward the sea was insignificant. The average value of microplastic content in the waters of Tanah Merah Beach is lower compared to research by Tuhumury & Ritonga (2020) in the waters of Tanjung Tiram, Ambon Bay (61-360 particles) and Isjayanti et al. (2021) in Lapulu waters (445.8 particles/ind).

The high content of microplastics in blood cockles in waters is partly caused by a lack of awareness among people who still use plastic and then throw plastic waste on land, rivers, or seas where the plastic will be carried by wind or water towards the sea, resulting in increasing amount of plastic waste in waters (Isjayanti et al., 2021). The different characteristics of the research locations could cause the differences in microplastic content at each research location. Tanah Merah waters are coastal waters that directly border the Malacca Strait and are influenced by the activities of fishermen. According to Amin et al. (2020), coastal areas are influenced by anthropogenic activities such as residential areas, beach tourism, and shipping or sea transportation, which can ultimately become a source of microplastics.

Apart from differences in the characteristics of the shellfish sampling locations, the types of shellfish used as research samples, substrates, and water quality can also influence the microplastic content that accumulates in the shellfish's body. Blood cockles live around intertidal areas with muddy sand substrate conditions, such as in mangroves and seagrass beds, which have much organic content and filter feeder properties. Feeder filters are organisms that take in all types of food around them or through suspended solids such as water and sediment. Therefore, various water pollutants, such as microplastic particles, can enter the shellfish's body. Cauwenberghe et al. (2013) explained that the presence of microplastics is often found in waters and sediments, but the abundance of microplastics is greater in sediments because microplastics that settle in sediments is caused by microplastic transport, which moves more slowly compared to waters.

Apart from that, even though the samples were taken in different places, they were still in relatively the same water area, so the microplastic content was not significantly different between observation locations. The results of this research are in line with Amin & Nedi (2020), who stated that the number of microplastics between stations on the West Coast of Karimun Island is not significantly different ($p > 0.219$), this is because the environmental conditions and anthropogenic activities are almost the same at each station. In addition, Listiani et al. (2021) stated that although, in general, locations around mangrove areas had higher amounts of microplastics in shellfish, there was no difference in the amount of microplastics in shellfish between research locations ($p > 0.05$).

CONCLUSION

The types of microplastics found in blood cockles in the waters of Tanah Merah Beach are fibers, films, and fragments with an average value of 56.33 particles/ind. The dominant fiber type of microplastic was found at the three sampling points, while the film type was the least found. The microplastic content in blood cockles between sampling points in Tanah Merah coastal waters was not significantly different, with a p-value> 0.05.

REFERENCES

[KLH] Kementrian Lingkungan Hidup Republik Indonesia., 2004. Baku mutu air laut untuk biota laut. Keputusan Menteri Negara Lingkungan Hidup No. 51 Tahun 2004 tentang Baku Mutu Air Laut KLH, Jakarta.

Alpiansyah, B., Amin, B., Galib, M., 2021. Identification of microplastic type and abundance in East Coast of Karimun Besar Island, Riau Islands. *Journal of Coastal and Ocean Sciences*, 2(2): 104-110.

Amin, B., Febriani, I.S., Nurrachmi, I., Fauzi, M., 2020. Microplastics in gastrointestinal tract of some commercial fishes from Bengkalis Waters, Riau Province, Indonesia. *Journal of Physics: Conference Series*, 1655(1): 1-7.

Amin, B., Ghalib, M., Setiawan, F., 2020. Preliminary investigation on the type and distribution of microplastics in the west coast of Karimun Besar Island. IOP Conference Series: Earth and Environmental Science, 430(1): 012011.

Amin, B., Nedi, S., 2020. Distribution of microplastics in sea water on the west coast of Karimun Island, Kepulauan Riau Province. *Berkala Perikanan Terubuk*, 48(3): 1–8.

Amin, B., Rukim, M., Nurrachmi, I., 2021. Presence of microplastics in Sea Cucumber *Paracaudina sp* from Karimun Island, Kepulauan Riau, Indonesia. *IOP Conference Series: Earth and Environmental Science*, 934(1): 1-7.

Arifin, M.S., Suprijanto, J., Ridlo, A., 2023. Keberadaan mikroplastik pada kerang darah (*Anadara granosa*) dari TPI Tambak Lorok Semarang. *Journal of Marine Research*, 12(3): 447-454.

Ayuningtyas, W.A., Yona, D., Julinda, S.H., Iranawati, F., 2019. Kelimpahan mikroplastik pada Perairan di Banyu Urip, Gresik, Jawa Timur. *Journal of Fisheries and Marine Research*, 3(1): 41–45.

Cauwenberghe, Van, L., Vanreusel, A., Mees, J., Janssen, C.R., 2013. Microplastic pollution in deep-sea sediments. *Environmental Pollution*, 182(1): 495–499.

Dalimunthe, A.M., Amin, B., Nasution, S., 2021. Microplastic in the digestive tract of kurau (*Polydactylus octonemus*) in the coastal waters of Karimun Besar Island, Riau Islands Province. *Journal of Coastal and Ocean Sciences*, 2(2): 80–86.

Hiwari, H.N.P., Purba, Y.N., Ihsan., Yuliadi, L.P.S., Mulyani, P.G., 2019. Condition of microplastic garbage in sea surface water at around Kupang and Rote, East Nusa Tenggara Province. *Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia,5*(2): 165-171.

Isjayanti, W., Sara., Emiyarti, L., 2021. Kandungan mikroplastik pada kerang darah (*Anadara granosa*) di Perairan Teluk Kendari. *Sapa Laut*, 6(3): 255-260.

Kawung, N.R., Adnyana, I.W.S., Hendrawan, I.G., 2022. Analisis kelimpahan mikroplastik pada bivalvia di Perairan Tuminting dan Malalayang Kota Manado. *ECOTROPHIC: Journal of Environmental Science*, 16(2): 220.

Listiani, N.W., Insafitri., Nugraha, W.A., 2021. Microplastic in different size of cockle (*Anadara granosa*) at Kwanyar Waters, Bangkalan District, Madura. *Jurnal Sumberdaya Akuatik Indopasifik*, 5(2): 169–180.

Lolodo, D., Nugraha, W.A., 2019. Mikroplastik pada bulu babi dari rataan terumbu Pulau Gili Labak Sumenep. *Jurnal Kelautan*, 12(2): 112-122.

Naji, A.M., Nuri, P., Amiri Niyogi, S., 2019. Small microplastic particles (S-MPPs) in sediments of mangrove ecosystem on the northern coast of the Persian Gulf. *Marine Pollution Bulletin*, 146: 305–311.

Nugroho, R.Y., Rozirwan., Fauziyah., 2023. Karakteristik mikroplastik pada saluran pencernaan kerang (*Anadara granosa*) menggunakan metode ekstraksi basa. *SIMBIOSA*, 12(1): 1-11.

Prameswari, A.P., Muhammad, F., 2022. Kandungan mikroplastik pada ikan belanak (*Mugil cephalus*) dan kerang hijau (*Perna viridis*) di Pantai Mangunharjo Semarang dan Pantai Sayung, Demak. *Bioma*, 24(1): 36-42.

Rachmat, S.L., Purba, N.P., Agung, M.U., Yuliadi, L.P., 2019. Karakteristik sampah mikroplastik di Muara Sungai DKI Jakarta. *Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan*, 8(1): 9-17.

Rochman, C.M., Tahir, A., Williams, S.L., Baxa, D.V., Lam, R., Miller, J.T., Teh, F., Werorilangi, S., Teh, S.J., 2015. Anthropogenic debris in seafood: plastic debris and fibers from textiles in fish and bivalves sold for human consumption. *Scientific Reports,* 5(1): 1–10.

Saborowski, R., Korez, S., Riesbeck, S., Weidung, M., Bickmeyer, U., Gutow, L., 2022. Shrimp and microplastics: a case study with the Atlantic ditch shrimp palaemon variants. *Ecotoxicology and Environmental Safety*.

Sari, N., Amin, B., Yoswaty, D., 2021. Analysis of microplastic content in lokan (*Geloina erosa*) in North Beach Waters of Bengkalis Island, Riau Province. *Asian Journal of Aquatic Sciences*, 4(1): 13-20.

Sekarwardhani, R., Subagiyo, S., Ridlo, A., 2022. Kelimpahan mikroplastik pada berbagai ukuran kerang hijau (*Perna viridis*) dan kerang darah (*Anadara granosa*) yang didaratkan di TPI Bungo, Demak dan TPI Kedungmalang, Jepara, Jawa Tengah. *Journal of Marine Research*, 11(4): 676–684.

Tuhumury, N., Ritonga, A., 2020. Identifikasi keberadaan dan jenis mikroplastik pada kerang darah (*Anadara granosa*) di Perairan Tanjung Tiram, Teluk Ambon. *Triton: Jurnal Manajemen Sumberdaya Perairan*, 16(1):1–7.

Wahdani, A., Yaqin, K., Rukminasari, N.S N., Inaku, D.F., Fachruddin, L., 2020. Konsentrasi mikroplastik pada kerang manila (*Venerupis philippinarum*) di Perairan Maccani Baji, Kecamatan Labakkang, Kabupaten Pangkajen Kepulauan Sulawesi Selatan. *Maspari: Marine Science Research*, 12(2): 1–14.

Wright, S.L., Thompson, R.C., Galloway, T.S., 2013. The physical impact of microplastics on marine organisms. *Environmental Pollution*, 178(1): 483-492.

Yana, T.D., Amin, B., Siregar, Y.I., 2021. Identification of the types and abundance of microplastics in *Telescopium telescopium* in the Coastal Waters of Karimun Island, Riau Islands Province. *Journal of Coastal and Ocean Sciences*, 2(2): 93–97