Detection of microplastic in sediments at beach tourism area of Muaro Lasak, Padang City, West Sumatra, Indonesia

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Abstract. Microplastic pollution is currently a threat to marine ecosystems and has become the focus of research by environmentalists around the world. This problem also occurs in Indonesia, especially in Muaro Lasak, Padang City Beach, West Sumatra, Indonesia. The high activity along the coast in Muara Lasak is expected to mediate the wide distribution of microplastics into aquatic sediments. The purpose of this study was to determine the shape, color, abundance and type of polymer in sediment samples which were carried out by sampling at 3 stations representing Muaro Lasak Beach, Padang, Indonesia. Microplastics from sediment were separated by the following steps: drying of sediment samples, density separation of sediment samples, destruction of organic matter and filtering with the help of vacuum and visual sorting. The results showed that most of the identified sediment samples contained microplastics with the types of fiber, film, and fragments at stations S1, S2 and S3, respectively, the average value of microplastic abundance was 6.033, 4,116 and 3,083 particles/kg of dry sediment. Based on the results of Fourier-transform infrared spectroscopy (FTIR) characterization polyethylene (PE), polypropylene (PP) and polyamide (PA) were found and then a comparison is carried out with a standard (Ni'mah et al 2010) to ensure that the FTIR spectrum obtained from the sample is high-density polyethylene (HDPE) polymer or not. The spectrum detected was HDPE.
Key Words: ecosystems, FTIR, pollution, polymer.

Introduction. The problem of plastic waste has penetrated into marine coastal waters including Muaro Lasak Beach. This beach is a tourist spot for people who come both from within the country and abroad. Muara Lasak plastic waste is estimated to come from the mouth of the river that carries it to the coast. Based on data from the State Ministry of Environment and Forestry, plastic waste in Indonesia in 2021 has reached 21.88 million tons (State Ministry of Environment and Forestry 2021), and plastic waste that is in the aquatic environment for a long time will be degraded into microplastics (Browne et al 2011).

Microplastics (MP) are plastics that have a particle size of less than 5 mm (Crawford & Quinn 2017; Barnes et al 2009; Hidalgo-Ruz et al 2012). Based on the source, MP is grouped into two types, namely primary MP and secondary MP (Andrady 2011). Primary MP is the product of plastic production made in micro form, such as microbeads in skin care products (Andrady 2011; Browne et al 2011; Wang et al 2016). Secondary MP is a fragment, part, or result of the fragmentation of larger plastic particles (Zettler et al 2013) that comes from washing clothes from synthetic textile materials, generally in the form of fibers (Browne et al 2011). The number of microplastics will continue to increase due to the process of decomposition of macroplastic waste that occurs continuously in water areas. The distribution of microplastics in water areas is not fully known, because there is still a lack of knowledge about the pressure and currents that cause the movement of microplastics (Victoria 2016).

Although microplastics are a very heterogeneous group of contaminants of various sizes and shapes, they are made of various materials, and their properties, such as density, size, surface morphology, color, change over time due to weathering, as well as interact with other pollutants and biota (Kalcíkova et al 2020; Rozman et al 2021). The presence of certain additives (e.g. fluorescent dyes) in manufacturing can affect the final result due to leaching (e.g. incorrect particle translocation) (Schür et al 2019). In addition, many microplastics that enter the environment float on the surface of the water, because they are made of polymers with lower density than water, e.g. PE (Chubarenko et al 2018). On the water surface, interactions with aquatic organisms are minimal. However, over time, microplastics become laden with organic and inorganic materials and are covered by a biofilm (i.e. communities of aquatic microorganisms that adhere to the surface) and consequently begin to sink and interact with aquatic organisms. These microplastics have very different properties compared to native (pure) microplastics (Ateia et al 2020; Rummel et al 2017).

Microplastics are more dangerous than larger plastics because of their microscopic size and low trophic level organisms can eat them, their color is similar to natural foods, their abundance is high, and their density is low (Guzzetti et al 2018; Wright et al 2013). In addition to the physical properties of microplastics that are easily ingested, additional dangers of microplastics such as polybrominated diphenyl ether (PBDE), phthalates, nonylphenol (NP), bisphenol A (BPA), and antioxidants can increase toxicity to organisms (Hermabessiere et al 2017). These additives can be absorbed and accumulated by microplastics from polluted aquatic environments (Guzzetti et al 2018). Several materials such as heavy metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and dichlorodiphenyltrichloroethane (DDT) were found to bind to microplastics (Purwiyanto et al 2020; Van Cauwenberghe et al 2015).

In some waters, MP is more commonly found in sediments than in surface waters because these microplastics are trapped in eddies, eventually settling in sediments, not flowing offshore (Claessens et al 2011). In this study, we only focused on detecting microplastics in sediments. The abundance of microplastics in Jakarta Bay sediments (166.9 particles/kg) (Takarina et al 2022) was 6 times greater than microplastics in intact bay sediments (28.1 ± 10.28 particles/kg) (Cordova et al 2021) and comparable to microplastics from Banten Bay (267 ± 98 particles/kg) (Falahudin et al 2020) which are also surrounded by residential and industrial activities. Fadel (2021) study at Air Manis Beach showed that the abundance of microplastics in sediment samples was 16,861-86,684 particles/kg. Triadi (2021) in the Batang Arau River showed an abundance of microplastics from 26.57 to 168.86 particles/kg in sediments of various shapes, namely fibers, fragments, and films. Wijaya and Trihadiningrum (2019) in Kali Surabaya showed that there were differences in the abundance of microplastics at different depths. Differences in the abundance of microplastics are strongly influenced by the level of pollution, sampling locations, and water hydrodynamics in each study area (Suteja et al 2021). Sianturi et al (2021) and Amin et al (2020), stated that current velocity affects the distribution of microplastics in waters. According to Wright et al (2013), differences in the abundance of microplastics are influenced by types of human activities in coastal areas, environmental factors, and population density. The increase in the human population can also increase the microplastic particles in the aquatic environment.

To our knowledge, no researchers have investigated the content of microplastics in sediments at Muaro Lasak Beach, and in the long term, the presence of microplastics will have a negative impact if not treated properly. Therefore, it is necessary to detect the content of microplastics in the sediment so that it becomes a reference for stakeholders in carrying out coastal management. This study aims to determine the shape, color, abundance, and characteristics of microplastics found in sediment samples.

Material and Method

Description of study sites. Geographically, the city of Padang is located on the west coast of the island of Sumatra ($00^0$44'00''S - 01'08''35''S and $10^0$05'05''E - $10^0$34'09''E) with an area of approx. 720 km², which have a length of 84 km of beaches and 19 small islands and is the capital city of West Sumatra Province. The waters of Padang City, which are part of the Indian Ocean, have mixed tidal type characteristics which are dominated by double type, where in this area there are 2 high tides and 2 low tides in a day. This type is influenced by water depth conditions or local coastal geomorphology.

The city of Padang has many tourist attractions and beautiful beaches, visited by many tourists, but the beaches have not been managed well, like the beach of Muaro Lasak. One of the famous spots is Taman Muaro Lasak Beach. The location of this beach is still in the Purus Beach area, Rimbo Kaluang Village, West Padang District, Padang City, West Sumatra. In addition to enjoying the view of the beach with rocks breaking waves neatly arranged, the public was also seen visiting the Merpati Peace Monument which was inaugurated by President Jokowi on April 12, 2016. People who came to Muaro Lasak Beach always took the time to take pictures at the monument with the symbol of a dove. The atmosphere towards dusk is getting more exciting with the paragliding activities which happen almost every day.

Determination of the location of the samplings was done using the random triangular grid sampling method, namely the selection of locations randomly. Sediment sampling was taken at 3 stations, namely the left end, the middle and the right end with a distance of 50 m each. The coastal watershed of Muaro Lasak Padang has a total area of about 694.96 km^2 or equivalent to 1.65% of the area of West Sumatra Province. Based on the results of field observations, sediment sampling was carried out at 3 stations, namely Kampung Berok (Station 1, S1), Parak Kelapa (Station 2, S2) and Tugu Euro (Station 3, S3) (Table 1; Figure 1).

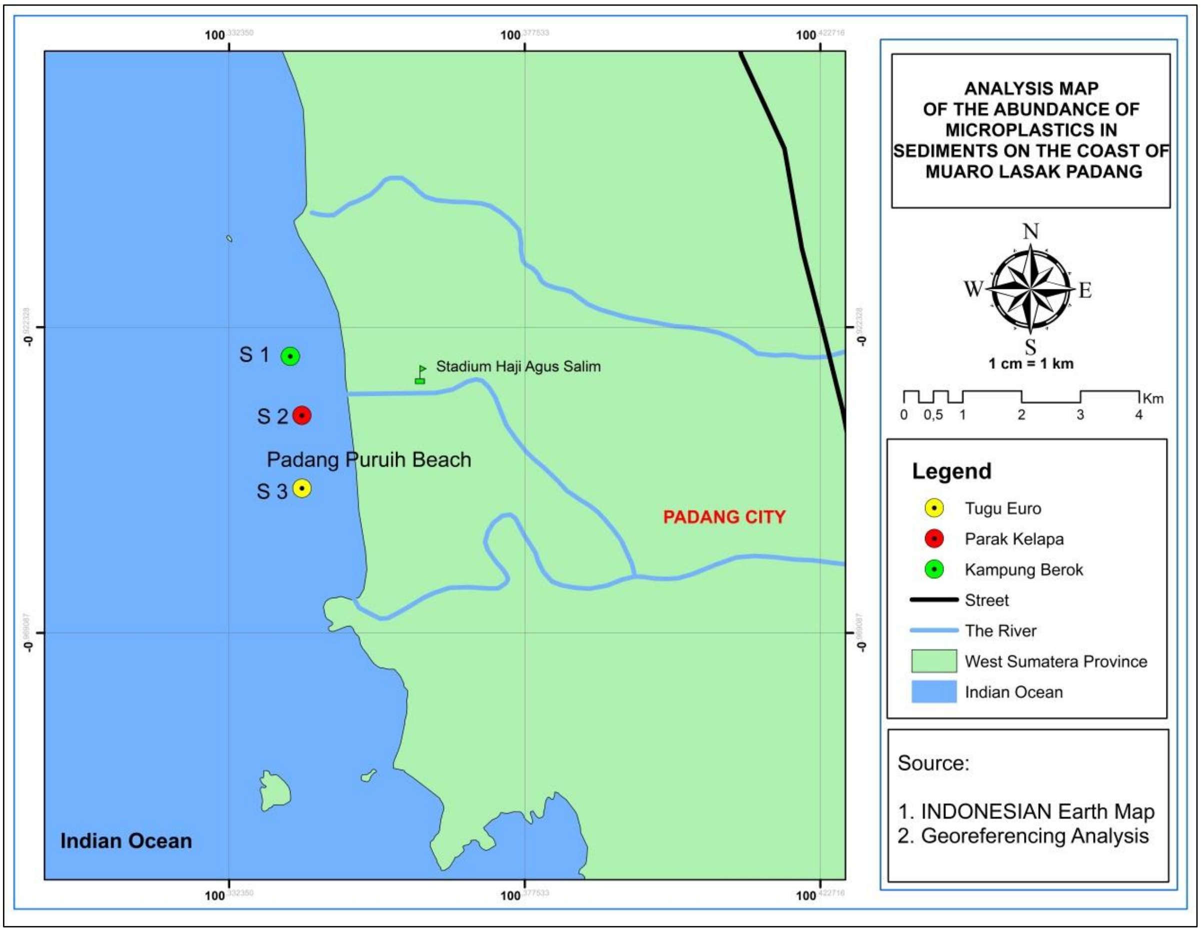

Figure 1. Map representing sampling stations (Indonesia Geospatial Portal 2022).

Table 1

Sampling stations and their descriptions

Study area	*Coordinate*	*Description*
Kampung Berok Station 1 (S1)	0°55'36,785"S 100°20'29,361"E	S1 is 100 m from the beach and has a depth of 6 m. The characteristics of the sediment are slightly sandy, and the texture is very fine. Macroplastic waste is abundant.
Parak Kelapa Station 2 (S2)	0°56'08.9″S 100°20'36.5″E	S2 is 100 m from the beach area which has a depth of 6 m. Sediment characteristics are slightly sandy due to strong currents from the shore, this area is slightly sandy. Macroplastic waste is abundant.
Tugu Euro Station 3 (S3)	0°56'06.4″S 100°20'36.6″E	S3 is 50 m from the Euro Monument, and is ± 100 m from the beach front area which has a depth of 6 m. The characteristics of the sediment have a very sandy texture, so that sediment is difficult to obtain. Macroplastic waste is abundant.

Sediment sampling and storage. The sediment sampling was carried out on May 24, 2022 starting at 11.00 Western Indonesian Time, on sunny weather. Sediment samples were taken at the time of the highest tide because in that zone there was an abundance of microplastics. Sampling started from taking a sample of 300 g to analyze the abundance of microplastics. Sampling was carried out at 3 stations located ± 100 m from the beach using an Ekman Grab (3.5 L volume and weighing 4.5 kg), then the sediment sample was put into a glass bottle and tightly closed with aluminum foil and put into a coolbox.

The samples that have been taken are stored in a coolbox, with ice cubes, or in a refrigerator at a temperature of approximately 4°C, then the microplastic analysis test is carried out under an optical microscope in the laboratory.

Microplastic sediment sample preparation. Microplastics from sediments were separated by the following steps: drying of sediment samples, density separation of sediment samples, destruction of organic matter, vacuum filtration and visual sorting (Nor & Obbard 2014; Sianturi et al 2021; Claessens et al 2011; Hidalgo-Ruz et al 2012; Jiang et al 2022; Masura et al 2015; Martin et al 2022).

Sediment sample drying. The preparation of sediment samples was carried out by drying. 20 g of sediment samples were taken and placed on a stainless steel tray to be dried, then dried using an oven at 50°C for 24 hours, then the dried samples were mashed using a mortar, which aims to smooth the sample.

Sediment sample density separation. The density separation process was carried out by mixing 300 mL of 5M NaCl solution into 20 g of sediment, then stirred using a magnetic stirrer for 2 minutes. After stirring, the sediment samples were allowed to stand for 24 hours, then filtered and the supernatant was taken using a 125 μm sieve.

Destruction of organic matter. In the process of destroying organic matter, to the sample is added a volume of 20 ml of 30% H_2O_2 solution, then the sample is homogenized with a stirrer. If the sample is still cloudy, then 20 mL of 30% H_2O_2 solution is added until the sample is clear, then the sample is filtered.

Microplastic sediment sample screening. The clear sample was then filtered using Whatman No. 42 filter paper with the help of a vacuum pump, then the results from the filter were placed in a Petri dish, then the filter paper was air-dried, then identification was done using an optical microscope.

Identification of microplastics by optical microscope. Identification of microplastics with an optical microscope with a magnification of 40x was done with the help of a camera branded Moticam 3+, connected to a laptop, where images were processed by the Motic Images software.

Identification of microplastic types. The compound results were characterized using Fourier-transform infrared (FTIR) spectroscopy at a wave number of 4000-600 cm^{-1}, using the ATR (Attenuated Total Reflectance) method, with the use of PerkinElmer Frontier C90704 spectroscopy machine. The ATR method is also an FTIR technique that can be used to measure samples in solid and liquid forms and requires only a small number of samples. The advantages of this ATR method are that the sample preparation is not too complicated, thus the spectrum variation is wider and without the use of potassium bromide (KBr).

Quality assurance analysis. In order to obtain valid data, it is necessary to prevent contamination from external plastic factors during the process of sampling, preparation, research, and analysis with the tools to be used. The use of plastic-based tools is avoided as much as possible, and before use, tools are rinsed with double distilled water for 3 times. Glass and stainless steel utensils were cleaned, rinsed with distilled water, covered with aluminum foil, and dried in an oven at 50ºC for 5 hours before use. Before conducting the study, the workbench was cleaned with 70% alcohol and double distilled water and the study was carried out in a closed room (Brander et al 2020; Prata et al 2019; Hidalgo-Ruz et al 2012).

To ensure that the sample was not previously contaminated, a blank solution which was treated the same as the sample was used. In addition to blanks, new filter paper is also provided to be placed around the workbench which aims to determine contamination from the surrounding air. Each blank and control is provided at least two pieces (Hung et al 2020; Van Cauwenberghe et al 2015).

The entire solution used was filtered using Whatman 541 filter paper with the help of a vacuum. Researchers also used nitrile gloves and a 100% cotton long-sleeved lab coat as one of the contamination prevention measures.

Results and Discussion

Identification of microplastic forms. Microplastics are categorized into several types based on their shapes, such as fiber, fragment, film, foam, pellet, and others (Zhang et al 2017). The results of research in all study areas indicate the presence of particle suspended microplastic (PSM). The particles in the sediment samples were thought to be microplastic particles that had different shapes and colors (Figure 2).

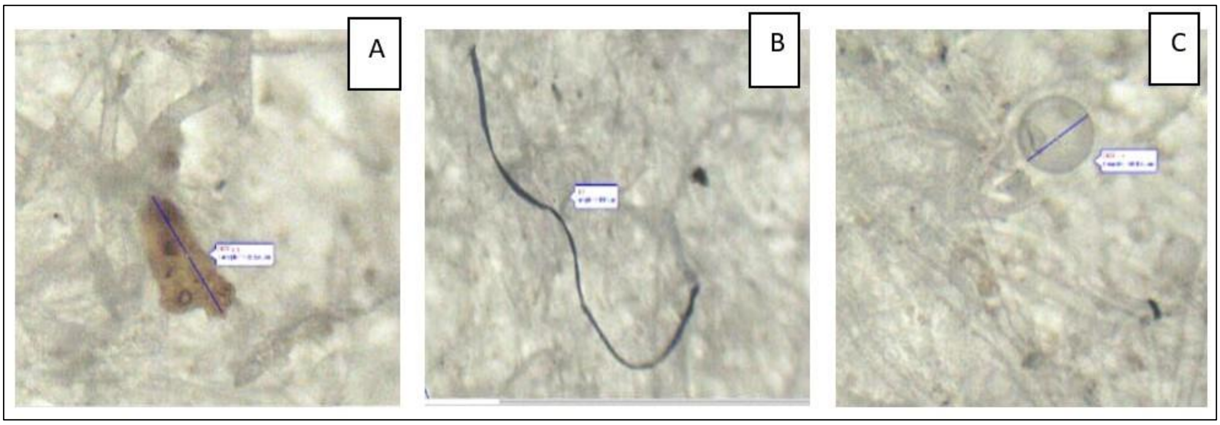

Figure 2. A. microplastic fragments; B. microplastic fiber; C. microplastic film.

Research shows that the origin and route of entry of microplastics determine the shape of these microplastics (Pan et al 2019). Microplastic fragments are the result of fragmentation of macro waste (Andrady 2011) that comes from pieces of drink and food bottles, pieces of jars, gallons and hard plastic as well as small pieces of paralon pipes from community activities around the Muara Lasak (Septian et al 2018). Microplastic fragments have a low density so they can float on the surface of the water (Hidalgo-Ruz et al 2012). Microplastic pollution from anthropogenic sources such as household waste accounts for the largest microplastic in the form of fragments (Ayuningtyas et al 2019; Browne et al 2011). In this study, the shape of microplastic fragments was dominant for all study areas, respectively, at S1, S2 and S3, 329 fragment particles were found with an abundance of 16,450 particles/kg dry sediment weight; 110 with an abundance of 5,500 particles/kg dry sediment weight, and 97 with an abundance of 4,850 particles/kg dry sediment. The mean abundance value was 8,933 particles/kg dry sediment weight (Figure 3). Irregularly shaped microplastics have a complex deposition mechanism compared to spherical microplastics (Horton & Dixon 2018).

The microplastic film ranked second for all stations, where S1, S2, and S3 each had 22 microplastic particles with an abundance of 1,100 particles/kg dry sediment weight; 126 particles with an abundance of 6,300 particles/kg dry sediment weight, and 79 particles with an abundance of 3,950 particles/kg dry sediment weight. The average value of the abundance of microplastics in the form of films was 3,733 particles/kg of dry sediment weight (Figure 3). The shape of the film has is flexible and thin (Ebere et al 2019). Film-type microplastics are thought to originate from plastic bags and other food packaging which tend to be transparent and have been degraded (Claessens et al 2011), have a low density which floats in irregular shapes, and tend to be attracted inward. Clemente et al 2018, stated that the film type microplastic comes from the fragmentation of plastic bags or plastic packaging which is the main plastic waste that is dumped into the waters of the Muara Lasak coastal area.

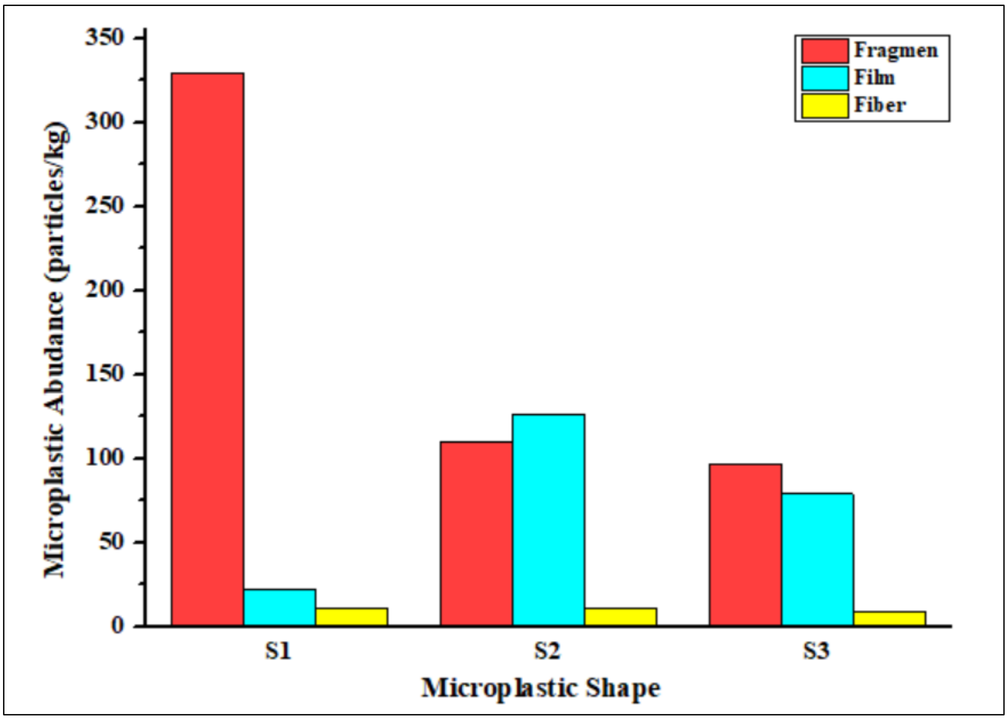

Figure 3. Microplastic abundance (particles/kg) in different shapes.

Microplastics that rank third are microplastics in the form of fiber, which at S1, S2, and S3 respectively have 11 particles with an abundance of 550 particles/kg dry sediment weight; 11 particles with an abundance of 550 particles/kg dry sediment weight, and 9 particles with an abundance of 450 particles/kg dry sediment weight. The average value of fiber abundance obtained was 516 particles/kg dry sediment weight (Figure 3). Fiber-type microplastics are secondary plastic polymers that have the characteristic of being elongated like fibers or like fishing nets, in general, fiber-type microplastics are easy to find. This is because its use as a basic material in the manufacture of clothing, clothing fibers, fishing nets, as well as in the manufacture of household appliances (Lie et al 2018, Ng & Obbard 2006) and can also come from laundry waste (Hiwari et al 2019).

The forms of microplastics found in all locations were dominated by secondary forms of microplastics formed due to degradation of ultraviolet light and physical abrasion that caused micro-sized plastics to become smaller, even nano-sized plastics. Secondary microplastics such as films and fragments come from weathering plastic packaging or plastic bags (Fahrenfeld et al 2019).

Identification of microplastic color. Several types of microplastic colors can appear due to the influence of environmental and climatic conditions, seen from the influence of garbage and waste in the environment not only consisting of one color. Continuous exposure to sunlight or ultraviolet light can affect the discoloration of microplastic particles. The color in the microplastic is the original color of the plastic before the plastic undergoes a fragmentation process so that the color changes (Sulistyo et al 2020).

The color data found in all sediment samples at all sampling stations are black, transparent, yellow, blue, green and red. The photodegradation index of the color of microplastics can be used as a determinant of how long the microplastics are in the water, because the longer the plastics are adrift in the water, the color of the plastics will experience color degradation (Sugandi et al 2021). The most dominant color found was black with as many as 316 microplastic particles with an abundance of 5,267 particles/kg dry sediment (Figure 4). Black microplastics can indicate the amount of contaminants absorbed in microplastics and other organic particles (Anderson et al 2015), having the ability to absorb pollutants which is relatively high and can affect the texture of microplastics (Abdulloh 2020).

The second color is a transparent color with 302 microplastic particles with an abundance of 5,033 particles/kg dry sediment. Transparent colored microplastic is the initial identification of the type of polymer polypropylene (PP). PP polymer is one of the polymers that are often found in water. The transparent color is an indication of the time that microplastics that have been in the water and are photodegraded by UV light (Harpah et al 2020; Hiwari et al 2019).

Furthermore, the red color was found with 62 particles with an abundance of 1,033 particles/kg dry sediment, and yellow 38 particles with an abundance of 633 particles/kg dry sediment (Figure 4). Both showed that the plastic color was very dense and had not undergone significant color degradation (Van Cauwenberghe et al 2015). Microplastics that have a concentrated color are the initial identification of polyethylene (PE) polymers. PE is the starting material for making plastic bags and containers (Anderson et al 2015). The dry season allows more exposure to ultraviolet light than the rainy season, which causes blue and red to be the dominant colors found, while black can indicate that many contaminants and other organic particles are absorbed in the microplastic. Black microplastics have relatively high pollutant absorption capabilities and can affect the texture of microplastics (Hiwari et al 2019).

The least microplastic color found was green with 1 particle with an abundance of 16 particles/kg dry sediment and blue with 2 particles with an abundance of 33 particles/kg dry sediment. The color of the microplastics is thought to come from the original colors (blue, green) from clothes threads and the rest from washing water. Red and blue colors are also artificial colors from anthropogenic results (Dekiff 2014).

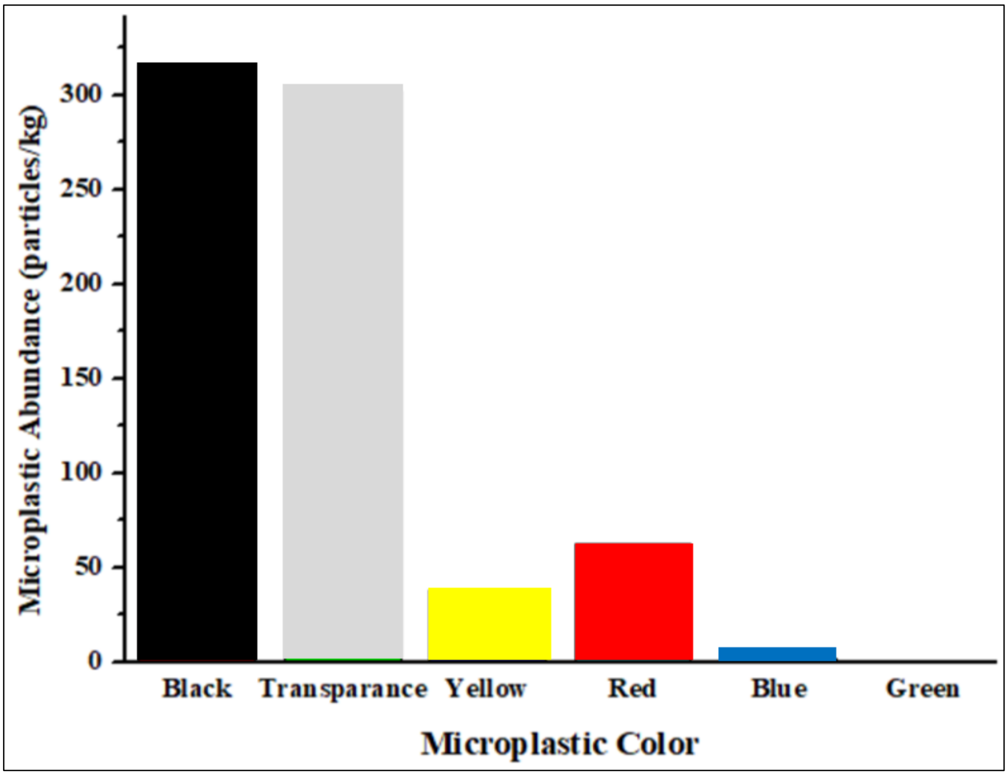

Figure 4. Microplastic abundance (particles/kg) at different colors.

Identification of microplastic abundance. The study area S1 was contaminated with 362 microplastic particles with an abundance of 18,100 particles/kg dry sediment, S2 was contaminated with 243 particles with an abundance of 12,350 particles/kg dry sediment, and S3 was contaminated with 185 particles with an abundance of 9,250 particles/kg dry sediment (Figure 5). This difference is caused by several factors. First, microplastic waste in Kampung Berok (S1), Parak Kelapa (S2), and Tugu Euro (S3) comes from tourist activities, traders who sell food and garbage carried by the rivers. S1 is the closest location to food traders and the river mouths, followed by S2 and S3 so the highest abundance of microplastic particles is at S1, S2, and S3 respectively. Second, the different textures of different study areas, and the more muddy sediments, the greater the abundance of particles in microplastics, because if microplastic particles have settled in muddy sediments, they are less likely to drift away than from sandy sediments. This can be observed at each station, S1 having a muddy sediment texture, a large amount of sediment, and the highest abundance of microplastics, S2 having a muddy and slightly sandy texture, a low amount of sediment, and a less high abundance of microplastics, and S3 having a slightly muddy and sandy condition, the amount of sediment being low and the abundance of microplastics is low. Third, at S1 there are strong and neatly arranged breakwaters so that the current and hydrodynamics of the water are calmer and the deposition of microplastic waste is faster than at S2 and S3.

Figure 5 presents the abundance of microplastics from the three sampling points (S1, S2, and S3) in Muaro Lasak Beach.

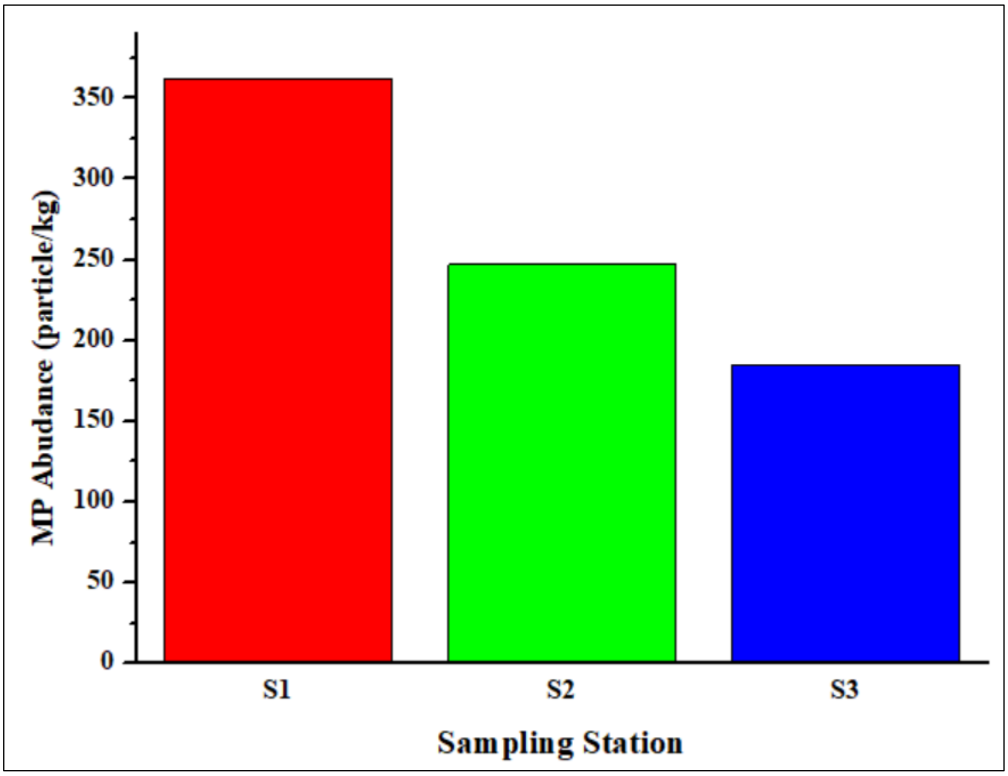

Figure 5. Microplastic abundance (particles/kg) at the sampling stations.

Identification of microplastics by FTIR. The identification of microplastics with a size of less than <1mm is quite difficult to distinguish between microplastic and non-microplastic particles because their appearance and characteristics are almost the same. To ensure that the particles found are microplastic, it can be done based on color, but to be more accurate, characterization can be carried out using FTIR (Fourier-transform infrared) spectrophotometry, by knowing molecular vibrations that can be used to predict the structure of chemical compounds (A'yun 2019). The spectrum obtained from the results of the FTIR spectrophotometric characterization can be seen in Figures 6, 7, and 8 (Nandiyanto et al 2019).

Figures 6, 7, and 8, show that at the wave number 3333.43 - 3320.31 cm^{-1} there is an NH stretch bond in the amine compound which has a wave number range of 3360-3310 cm^{-1}, while at the wave number 2898.50 - 2892 0.05 cm^{-1} the presence of C-H stretch bonds in alkane compounds that have a range of 2900 - 2880 cm^{-1}, at wave numbers 1637.45 - 1633.65 cm^{-1} the presence of C=O stretch bonds is in carbonyl compounds with a wave number range of 1637 -1670 cm^{-1}, then at wave numbers 1031.62 - 1034.63 cm^{-1} the presence of CN stretch bonds is in amide compounds with a wave number range of 1090-1020 cm^{-1} (Jung et al 2018). Furthermore, the peak value of the wave number can be identified and found in 3 types of microplastic polymers, namely polyethylene (PE), polypropylene (PP), and polyamide (PA). The estimation of the types of polyethylene and polypropylene polymers in the sample was indicated by the presence of peak wave numbers in the range of 2900-2880 cm^{-1} which interpreted the presence of CH stretch bonds. The CH bond is used as an estimate because the main constituent of PE and PP is CH. PE-type microplastics can come from plastic bags, detergent wrappers, and shampoo bottles. PP-type microplastics can come from bottle caps, straws, and toys made of plastic. Estimation of the type of polyamide polymer is characterized by the presence of the N-H functional group which is the main constituent of polyamide. The structural constituents of polyamide are N-H, C=O, and C-N. Polyamide is commonly referred to as nylon, if it is resistant to high temperatures, and is considered a high-performance plastic or thermoplastic. Applications for the use of PA plastic usually come from the fishing gear used by local fishermen or from cloth fibers that drift into the sea.

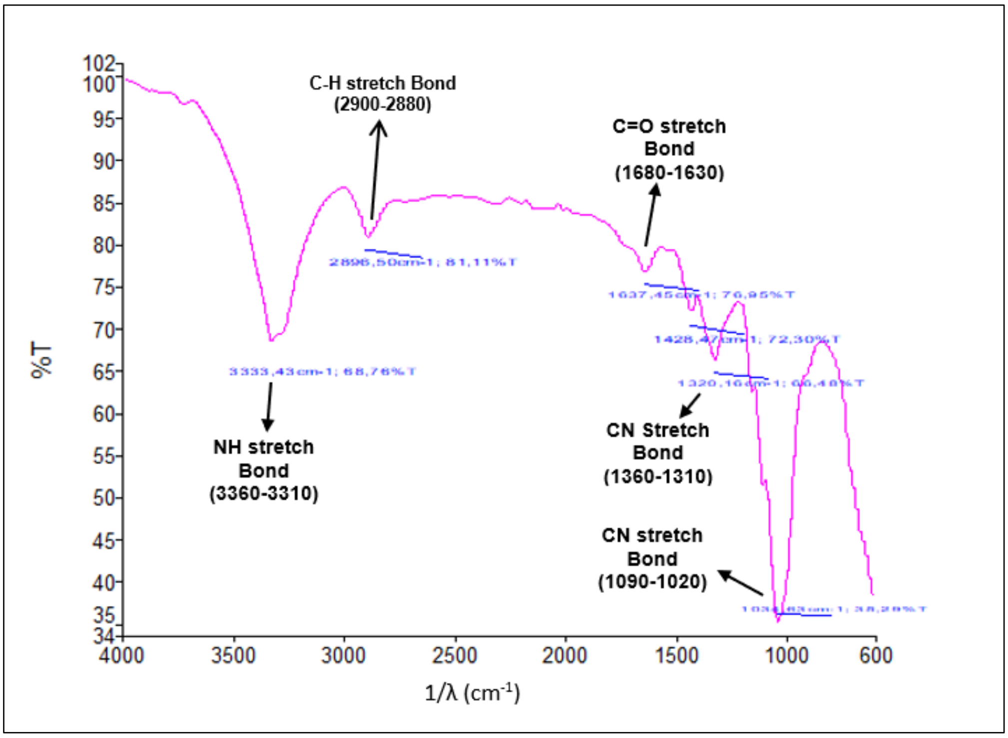

Figure 6. FTIR spectrum in S1 sample.

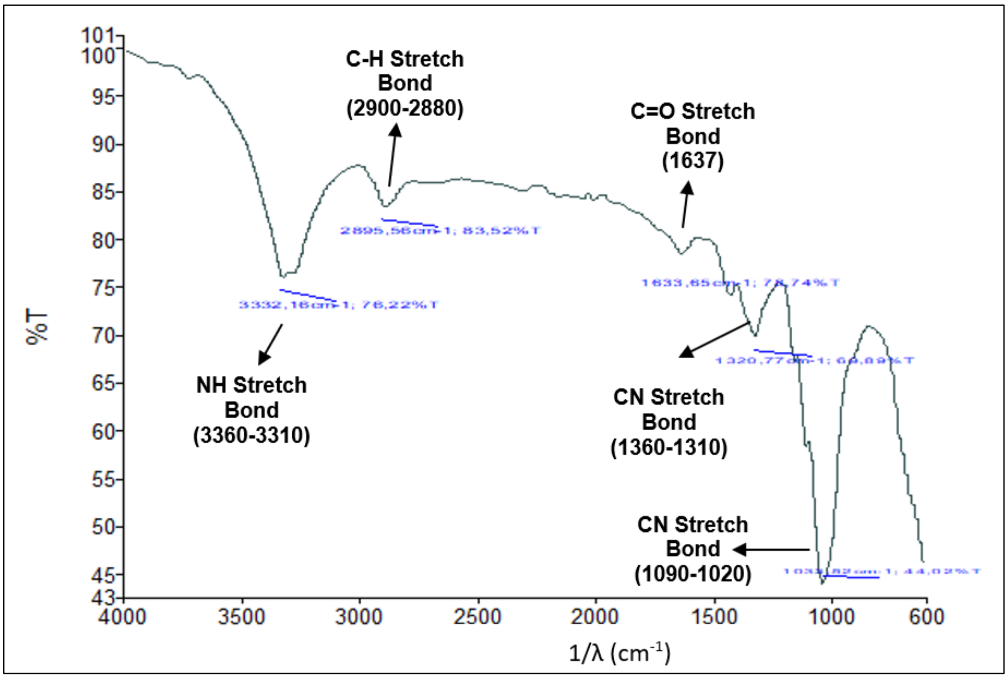

Figure 7. FTIR spectrum in S2 sample.

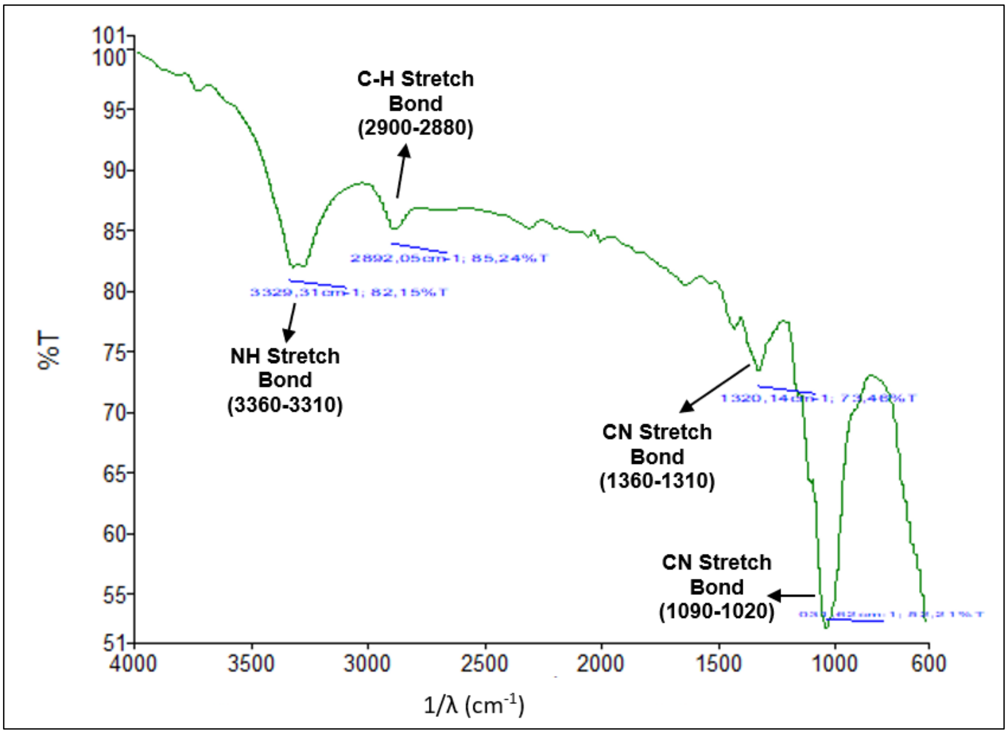

Figure 8. FTIR spectrum in S3 sample.

If a spectrum comparison is made by looking at the similarity of the spectrum, the spectrum obtained belongs to the HDPE group, following the comparison of the spectrum similarity obtained (Ni'mah et al 2010).

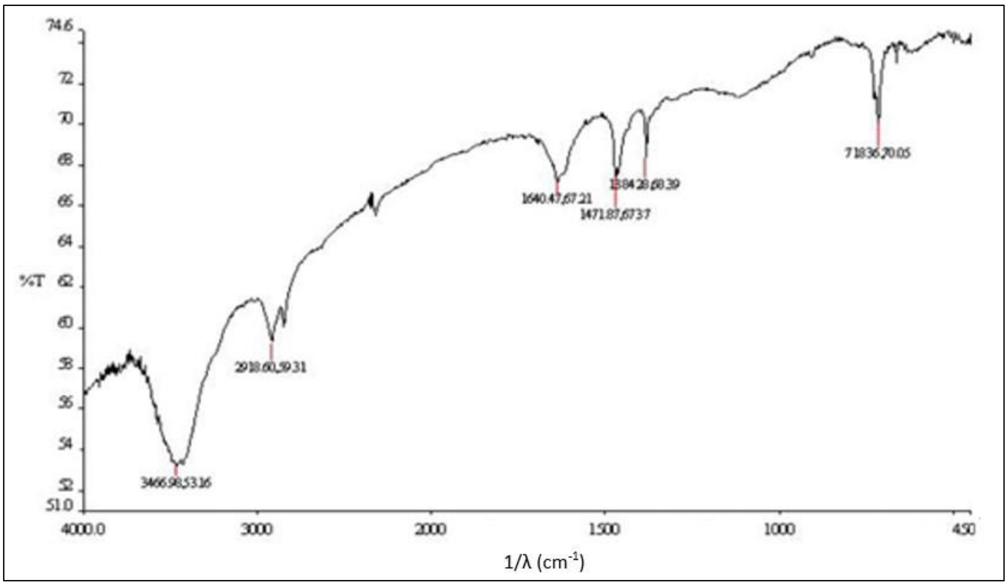

Figure 9. Comparison of the spectrum in this study with the standard (Ni'mah et al 2010).

Figure 9 presents the spectrum where it is shown that the detected polymer is HDPE (high density polyethylene) polymer. Next, the IR spectrum of the samples were compared with the standard spectrum (Ni'mah et al 2010), and it was found that the polymer was HDPE. Usually HDPE comes from packaging bottles, wrapping bags, other medicine bottles, and HDPE is classified as one of the strongest plastics.

Conclusions. Based on the results of the study on the abundance of microplastics in the Muaro Lasak Beach area of Padang, it can be concluded that the identification results of microplastics in sediment samples have three forms, namely fragments, films, and fibers, with a total number of microplastic particles in sediments of 794 with a total abundance of 13,233 particles/kg of dry sediment. The composition of microplastic particles in the form of fragments amounted to 556 particles, while in the form of fiber there were 32 microplastic particles and 228 microplastic particles in the film form. A large number of fragments comes from the breakdown of larger plastics. The composition of microplastics is based on color, the most dominant color being black, which amounted to 316 microplastic particles, caused by a large number of contaminants and other organic particles absorbed in the microplastics. The most dominant microplastic constituent polymers found using FTIR in sediment samples were polyethylene (PE), polypropylene (PP), and polyamide (PA). The IR spectrum of the sediment sample is then compared with the standard (Ni'mah et al 2010), obtained by high density polyethylene (HDPE) polymer. PE and PP are usually used in plastic bags, bottle caps, straws, and toys made of plastic, while PA is usually used in textiles, carpets, etc., then HDPE is usually used in packaging bottles, wrapping bags, and others. Community activities in the Muaro Lasak Padang Beach area, namely tourism and trade activities affect the amount of microplastic content in sediment samples at Muaro Lasak Padang Beach.

Conflict of interest. The authors declare that there is no conflict of interest.

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