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Analysis of Microplastic Content in the Digestive Tract of Clupeichthys goniognathus

Analisis Kandungan Mikroplastik pada Saluran Pencernaan Ikan Bunga Air (Clupeichthys goniognathus, Bleeker 1855)

Radiatun Israk[1*], Budijono[1], Eko Prianto[1]
[1]Department of Aquatic Resources Management, Faculty of Fisheries and Marine, Universitas Riau, Pekanbaru 28293 Indonesia
**email: radiatun.israk1557@student.unri.ac.id*

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Abstract

This research aims to determine the type and abundance of microplastics in the digestive tract of *Clupeichthys goniognathus* in the Koto Panjang Reservoir. This research was carried out from December 2023 – February 2024 in West Koto Tuo Village. Sampling was carried out by purposive sampling from the catch by fishermen. Sample analysis and microplastic identification were conducted at the Waste Processing Laboratory, Faculty of Fisheries and Marine, Universitas Riau. The research results show that the microplastics identified in the digestive tract of *C. goniognathus* are fiber, film, and fragment types. The most common type found was film-type microplastics with an abundance of 35% or 119 particles.

Keywords: Microplastic, Fiber, Film, Fragmen, Abundance

Abstrak

Tujuan penelitian ini adalah untuk mengetahui tipe dan kelimpahan mikroplastik pada saluran pencernaan ikan bunga air *Clupeichthys goniognathus* di Waduk Koto Panjang. Penelitian ini dilaksanakan pada Desember 2023 – Februari 2024 di Desa Koto Tuo Barat. Pengambilan sampel dilakukan secara *purposive sampling* dari hasil tangkapan oleh nelayan. Analisis sampel dan identifikasi mikroplastik dilakukan di Laboratorium Pengolahan Limbah Fakultas Perikanan dan Kelautan Universitas Riau. Berdasarkan hasil penelitian menunjukkan bahwa mikroplastik yang teridentifikasi dalam saluran pencernaan ikan bunga air *C. goniognathus* adalah tipe fiber, film dan fragmen. Tipe yang paling banyak ditemukan adalah mikroplastik tipe film dengan kelimpahan sebesar 35% atau 119 partikel.

Kata kunci: Mikroplastik, Fiber, Film, Fragmen, Kelimpahan

1. Introduction

Koto Panjang Hydropower Plant (PLTA) Reservoir is the result of the damming of several rivers, namely Kampar Kanan River, Batang Mahat, Gulamo, Tapung Air Tiris, Kapau, Tiwi, Takus, Osang, Arau Kecil, Arau Besar, and Cunding in West Sumatra Province, with an inundation area of approximately 12,400 ha. Koto Panjang Reservoir is a power plant and flood control (Hasibuan et al., 2017). Koto Panjang Reservoir is also used as a place for floating nte cage cultivation and fishing activities by fishermen.

Several fish species caught in the waters of Koto Panjang Reservoir and Kanan Kampar River have economic value, including the water flower fish (*Clupeichthys goniognathus*, Bleeker 1855). *C. goniognathus* is also widely distributed in the upper Mekong River in the Ngon Tha region of Laos (Taki, 1975). In Koto Panjang Reservoir, research on the analysis of microplastics in fish stomachs has been carried out; three types of microplastics were found in the stomach of kapiek fish Puntius schawanafeldii, namely fiber, film, and fragment types (Margaretha & Fauzi, 2022). Microplastics come from various chemicals found in seawater, rivers, and the surrounding environment and can be transported directly or indirectly through the food chain broken down in the body of fish (Hollman, 2019). According to Cole et al. (2017), microplastics have a negative impact on aquatic life, especially fish. Due to their small size, microplastics can be found in fish's respiratory and digestive tracts in river water and seawater. Several studies have shown that the types of microplastics found in pelagic and demersal fish are fibers (Rummel et al., 2016).

Microplastics consumed by biota can cause damage to the digestive tract, inhibit growth rates, interfere with the production process, and be exposed to harmful substances from toxic plastics (Wright et al., 2013). Microplastics in body tissues will affect metabolism, significantly disrupting the digestive system (Rochman et al., 2015). Microplastic contamination can enter the food chain consumed by marine animals such as fish, bivalves, and eventually humans who consume them (Abdli et al., 2017).

The community widely consumes water flower fish. If water flower fish contain microplastics, it can impact the health of people who consume them. According to Hirai et al. (2011), the human body containing microplastics can affect intestinal swelling and reduce the immune system. Given the high public interest in consuming water flower fish and the absence of research on the microplastic content in water flower fish, it is necessary to research the analysis of microplastic content in the digestive tract of water flower fish in Koto Panjang Reservoir.

2. Material and Method

2.1. Time and Place

This research was conducted from December 2023 - February 2024 in Koto Tuo Barat Village, Kampar Regency, Riau Province. Microplastic analysis was performed at the Waste Management Laboratory of the Faculty of Fisheries and Marine Sciences, Universitas Riau.

2.2. Methods

The method used in this research is a survey method located in West Koto Tuo Village. The object of study is the digestive tract of water flower fish caught by fishermen using net bagan fishing gear. The data collected are primary and secondary data, where primary data is obtained from direct survey activities to take samples and observations of environmental conditions and observation data from samples that have been analyzed in the laboratory.

2.3. Procedures

2.3.1. Sampling Location Determination

The sampling location in this study was divided into three stations, carried out using a purposive sampling method based on the catch area of water flower fish carried out by fishermen. Determination of stations in this study is divided into three stations, namely as follows: Station I: The location of station 1 in the survey is located around the waters of the Koto Panjang reservoir, precisely near the Kampar River with coordinates 0˚20′29.61″N 100˚39`44.45″E. At this location, fishermen engage in fishing activities.

Station II: The location of station 2 in the study is located around the waters of the Koto Panjang reservoir, precisely near the Langgai River with coordinates 0˚20′18.63″N 100˚42`20.58″E. At this location, fishermen engage in fishing activities. Station III: Station 3 is located around the waters of the Koto Panjang reservoir, precisely near the mouth of the Sepat Keruh River with coordinates 0˚23′21.63″N 100˚42′20.58″E. At this location, fishermen engage in fishing activities.

2.3.2. Fish Length and Weight Measurement

The fish were placed on paper towels so that their weight would not differ much from the original, and then the total length and weight of the fish were measured. The total length of the fish was measured from the tip of the mouth to the tip of the fish using a ruler with an accuracy of 1 mm. Fish weight was weighed using a digital scale with an accuracy of 0.01 g.

2.3.3. Fish Sample Analysis and Microplastic Identification

The fish were dissected, and the digestive tract was taken and put into a centrifuge tube. The water flower fish digestive tract samples were then treated with 10% KOH solution and incubated for 14 days. The identification of microplastics in the digestive tract samples of water flower fish using an Olympus CX 21 binocular microscope at 4×/0.10 magnification with the sweep method. Microplastic samples found were documented and identified to determine the type of microplastics. Calculation of the percentage of microplastic abundance used the following formula:

$$\text{Percentage (\%)}=\frac{\text{Number of microplastics}}{\text{Fish count}}\times 100\%$$

Furthermore, the calculation of microplastic abundance based on fish length was carried out using the formula:

$$K = 1 + 3{,}3 \text{ Log N}$$

Description:

K = many classes
N = many data

Determination of class intervals using the following formula: $C = \frac{x_n - x_1}{k}$

Description:

C = class interval
X_n = largest data value
X = smallest data value
K = many classes.

2.4. Data Analysis

Data obtained from research is in the form of primary and secondary data. Primary data includes microplastic-type data on fish samples and water quality data tabulated in tables and figures and then analyzed descriptively.

3. Result and Discussion

3.1. Length and weight of Water Flower Fish

The water flower fish *C. goniognathus* observed in the study had a size ranging from 2.6-4.3 cm with a weight of 0.25-0.69 g. The fish used in the study belonged to the small fish category, as shown in Figure 1.

Figure 1. Waterflower fish (*C.goniognathus*)

The abundance of microplastics found based on the size class of fish sampled at each station can be seen in Figure 2.

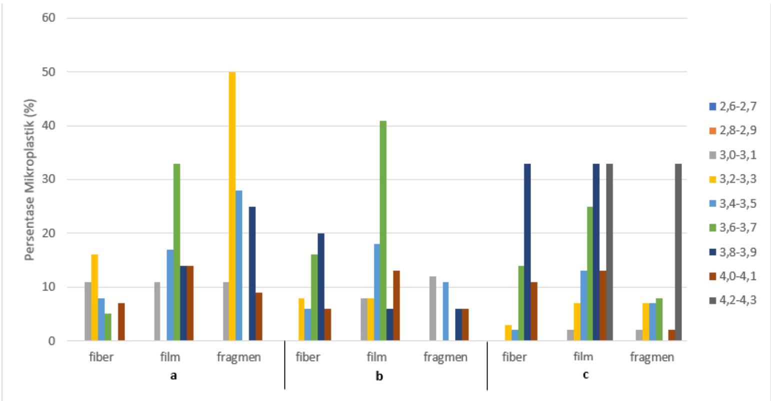


Figure 2. Microplastics Found Based on Size Class of Fish Samples (a) station 1, (b) station 2, (c) station 3

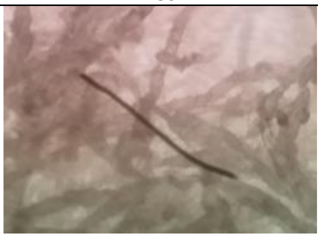
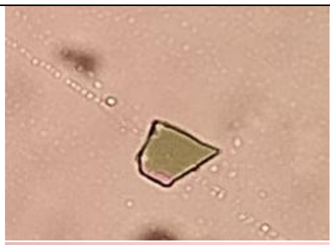
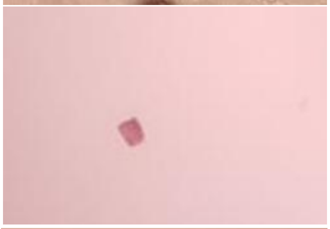
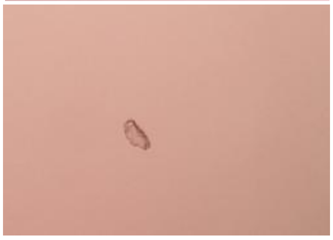
Based on Figure 2, it is known that the size class of water flower fish was obtained in nine classes. The highest abundance of microplastics based on the size class of water flower fish was found in the size of 3-4 cm, while in the size < 3 cm, microplastics were found in the fish. The highest abundance of microplastics based on the size class of sampled fish was found in the size range of 3.2-3.3 cm at station I. Microplastics were found in fish in the size range of 3.2-4.3 cm compared to fish in the size range of 2.6-3.1 cm. It can be concluded that people can consume water flower fish with a size of less than 3 cm because the research obtained more microplastics found in fish measuring around 3-4 cm.

3.2. Types of Microplastics in the Gastrointestinal Tract of Water Flower Fish

Microplastics found in the digestive tract of water flower fish, which fishermen catch in Koto Tuo Barat Village, have three types of microplastics: fiber, film, and fragment types. Fiber, film, and fragment-type microplastics were found in the digestive tract of water flower fish at each sampling station.

Film-type microplastics found in the study are generally transparent and usually derived from polyethylene terephthalate (PET) type plastics. Fragment-type microplastics that are thick and black in color are thought to come from hard plastic. Hard plastic can come from various sources, but the most common types of plastic associated with fragments are polyethylene terephthalate (PET) and high-density polyethylene (HDPE). Fiber-type microplastics found in the study were generally black in color and usually derived from nylon (polyamide) plastics. The types of microplastics found in the digestive tract of water flower fish Clupeichthys goniognathus can be seen in Table 1.

Table 1. Types of microplastics found

Fiber	Film	Fragment
		
		
		

Based on Table 1, there are three types of microplastics at stations I, II, and III, namely fiber, film, and fragment-type microplastics found in the digestive tract of water flower fish. Fiber-type microplastics are elongated and thin, like a net/fishing line (Wicaksono, 2018). Film-type microplastics are irregular shapes derived from thin plastic fragments, transparent color, and low density (Ayuningtyas et al., 2019). Fragment-type microplastics come from pieces with a shape that tends to be irregular with sharp edges (Dai et al., 2018). Film and fragment-type microplastics in the study were sourced from plastic waste such as plastic bags or containers. Fiber-type microplastics can be sourced from fishing activities by fishermen/communities using nets/ rods that allow fiber degradation in fishing gear.

3.3. Abundance of Microplastics in the Gastrointestinal Tract of Water Flower Fish

The abundance of microplastics in the digestive tract of water flower fish is most commonly found at station I. Fish containing microplastics at station I ranged from 47-57% of the total 30 fish at each sampling time. Fish containing microplastics at station II ranged from 43-53% of the total 30 fish at each sampling time. Fish containing microplastics at station III ranged from 37-43% of fish containing microplastics from 30 fish each time. Microplastics found in the digestive tract of water flower fish at each research station can be seen in (Table 2).

The community catches water flower fish for sale and consumption. When processing water flower fish, the fish stomach is not disposed of; for fish exposed to microplastics, this will undoubtedly have a negative impact on humans who consume it. Microplastics come from large plastic waste that has gone through a degradation process. The amount of plastic in the waters is influenced by settlement activities around the waters and those around the Koto Panjang Reservoir Waters. At the research site, there is a lot of plastic food packaging and other packaging types, so this can cause microplastics in the Koto Panjang Reservoir Waters.

The abundance of microplastics at each research station is not significantly different, which is thought to be due to the same source of plastic pollution. Human activities around the research area, such as fishing, can also affect the abundance of microplastics, causing the abundance at the three stations to be much different. In addition, environmental factors such as current speed also affect the distribution of microplastics. Film-type microplastics have the highest abundance. The high abundance of film-type microplastics found is due to the large amount of plastic waste, such as plastic food packaging and other bag-type packaging, in the waters originating from the activities of the surrounding community. According to Ningrum et al. (2022), film-shaped microplastics have flexible and thin physical characteristics that are thought to come from pieces of degraded disposable plastic bags.

Table 2. Microplastics found in fish body samples at each station

Station 1			
Mont	Total Fish (fish)	Number of fish containing microplastics (fish)	Percentage (%)
December	30	17	57
January	30	17	57
February	30	14	47
Station 2			
Mont	Total Fish (fish)	Number of fish containing microplastics (fish)	Percentage (%)
December	30	16	53
January	30	15	50
February	30	13	43
Station 3			
Mont	Total Fish (fish)	Number of fish containing microplastics (fish)	Percentage (%)
December	30	13	43
January	30	12	40
February	30	11	37

Fragment-type microplastics come from pieces of plastic products with strong synthesized polymers that have a denser density, such as paralon pipes, bottle caps, buckets, bottle waste, jars, mica plastic, and so on (Ayuningtyas, 2019), which can sink and are slightly difficult to break into small pieces (Septian et al., 2018). The least common microplastic found in the digestive tract of water-fower fish is fiber-type microplastics. According to Dewi et al. (2015), fiber-type microplastics are found in ropes or fibers; fibers are thought to come from fishing activities, such as fishing boat waste and fishing gear, such as fishing rods/nets.

3.4. Water Quality

Water quality parameters measured in Koto Panjang Reservoir waters include temperature, current speed, pH, brightness, depth, and dissolved oxygen. The results of water quality parameters measured during the study can be seen in Table 2.

Table 2. Water quality parameters

Parameter	Average measurement results
Temperature (˚C)	30,5
Current Velocity (m/s)	0,12
pH	6
Brightness	1,52
Depth (m)	5,6
Dissolved Oxygen (mg/L)	6,5

The average temperature of the Koto Panjang Reservoir waters during the study was 30.5˚C; the surrounding air temperature influences the high and low water temperature. The more sunlight intensity that hits the water body, the higher the water temperature will be. According to Effendi et al. (2015), the ideal temperature for fish growth ranges from 25-32˚C. The current velocity obtained during the study averaged 0.12 m/s and was categorized as slow. A current speed of 0.1 - 0.25 m/s can be classified as a slow current (Kuasa in Sumiarsih, 2023). Current speed is one of the main factors in the spread of microplastic particles in the waters. The average measurement result of the brightness of the waters in Koto Panjang Reservoir is 1.52m. Brightness is a measure of the transparency of a body of water that can be penetrated by sunlight and observed visually using a Secchi disc (Sayekti et al., 2015). The average depth measurement of Koto Panjang Reservoir waters is 5.6 m. Water depth is the vertical distance from the water surface to the bottom of the reservoir. The depth of the water in the reservoir varies depending on the condition of the water and the topography of the reservoir bottom. The average pH of the reservoir waters during the research was 6; on the pH value scale, the water conditions are considered reasonable and optimal for the productivity of aquatic organisms, especially freshwater fish farming (Kulla et al., 2020). The dissolved oxygen obtained in the study was 6.5 mg/L, suitable for aquaculture.

4. Conclusions

Based on the results of the study, it can be concluded that the identification that has been carried out during the research on the digestive samples of water flower fish in the waters of Koto Panjang Reservoir, Koto Tuo Barat Village 3 (three) types of microplastics (fiber, film, and fragments in water flower fish from 3 (three) stations set and there is no significant difference in both the type and abundance of microplastics between sampling stations.

5. References

Abdli, S., Toumi, H., Lahbib, Y., & Menif, N.T. (2017). The First Evaluation of Microplastics in Sediments from the Complex Lagoon-Channel of Bizerte (Northern Tunisia). *Water Air Soil Pollut*, 228:262.

Ayuningtyas, W.C., Yona, D., Julinda, S.H., & Iranawati, F. (2019). Kelimpahan Mikroplastik pada Perairan di Banyuurip, Gresik, Jawa Timur. *Journal of Fisheries and Marine Research*, 3(1): 41-45.

Cole, M., Lindeque, P., Fileman, E., Halsband, C., Goodhead, R.M., Moger, J., & Galloway, T. (2013). Microplastic Ingestion by Zooplankton. *Environmental Science and Technology*, 47: 6646– 6655.

Dai, Z., Zhang, H., Zhou, Q., Tian, Y., Chen, T., Tu, C., Fu, C., & Luo, Y. (2018). Occurrence of Microplastics in the Water Column and Sediment in an Inland Sea Affected by Intensive Anthropogenic Activities. *Environmental Pollution*, 242:1557-1565.

Dewi, I. S., Budiarsa, A. A., & Ritonga, I. R. (2015). Distribusi mikroplastik pada sedimen di Muara Badak, Kabupaten Kutai Kartanegara. *Depik*, 4(3):121-131.

Effendi, H., Utomo, B. A., Darmawangsa, G. M., & Karo-Karo, R. E. (2015). Fitoremediasi limbah budidaya ikan lele (*Clarias sp*.) dengan kangkung (Ipomoea aquatica) dan pakcoy (*Brassica rapa chinensis*) dalam sistem resirkulasi. *Ecolab*, *9*(2), 80-92.

Hasibuan, I.F., Hariyadi, S., & Adiwilaga, E. M. (2017). Water Quality State and Trophic of PLTA Koto Panjang Reservoir, Riau Province. *Jurnal Ilmu Pertanian Indonesia, 22*(3): 147–155.

Hirai, H., Takada, H., Ogata, Y., Yamashita, R., Mizukawa, K., Saha, M., Kwan, C., Moore, C., Gray, H., Laursen, D., Zettler, E. R., Farrington, J.W., Reddy, C.M., Peacock, E.E., & Ward, M.W. (2011). Organic Micropollutants in Marine Plastics Debris from the Open Ocean and Remote and Urban Beaches. *Marine Pollution Bulletin, 62*(8): 1683-1692.

Hollman, P.C.H., Bouwmeester, H., & Peters, R.J.B. (2013). *Microplastics in the Aquatic Food Chain: Sources, Measurement, Occurrence, and Potential Health Risks*. RIKILT Wageningen UR, Wageningen.

Kulla, O.L.S., Yuliana, E., & Supriyono, E. (2020). Analisis Kualitas Udara dan Kualitas Lingkungan untuk Budidaya Ikan di Danau Laimadat, Nusa Tenggara Timur. *PELAGICUS : Jurnal IPTEK Terapan Perikanan dan Kelautan1* (3): 135-144.

Margaretha, S.L., & Fauzi, M. (2022). Identifikasi Mikroplastik pada Ikan Kapiek (*Puntius schawanafeldii*) di Waduk PLTA Koto Panjang Kabupaten Kampar Provinsi Riau. *Juni, 27*(2): 235–240.

Ningrum, I.P., Sa'adah, N., & Mahmiah, M. (2022). Jenis dan Kelimpahan Mikroplastik pada Sedimen di Gili Ketapang, Probolinggo. *Journal of Marine Research*, 11(4): 785-793.

Rochman, C.M., Tahir, A., Williams, S.L., Baxa, D.V, Lam, R., Miller, K.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. *Nature Publishing Group*, 5: 1-10.

Rummel, C.D., Loder, M.G.J., Fricke, N.F., Lang, T., Griebeler, E.M., Janke, M., & Gerdts, G. (2016). Plastic Ingestion by Pelagic and Demersal Fish from the North Sea and Baltic Sea. *Marine Pollution Bulletin*, 102(1): 134-141.

Sayekti, R.W., Yuliani, E., Bisri, M., Juwono, P.T., Prasetyorini, L., Sonia, F., & Putri, A.P. (2015). Studi Evaluasi Kualitas dan Status Trofik Air Waduk Selorejo akibat Erupsi Gunung Kelud untuk Budidaya Perikanan. *Jurnal Teknik Pengairan, 6*(1): 133-145.

Septian, F.M., Purba, N.P., Agung, M.U., Yuliadi, I.P., Akuan, I.F., & Mulyani, P.G. (2018) Sebaran Spasial Mikroplastik di Sedimen Pantai Pangandaran, Jawa Barat. *Jurnal Geomaritim Indonesia*, 1(1): 1-8.

Sumiarsih, E. (2023). Microplastic Content in Water using the Bongo Net Sweeping Method in Koto Panjang Reservoir, Kampar. *Berkala Perikanan Terubuk, 51*(3).

Taki, Y. (1975). Systematics and Distribution of Indochinese-Thai Clupeid Fishes in the Subfamily Pellanulinae. *Japanese Journal of Ichthyology*, 2 (2).

Wicaksono, K.B. (2018). *Mikroplastik pada Teripang Holothuria leucospilota (Brandt, 1835), Air, dan Sedimen di Pulau Rambut, Kepulauan Seribu, DKI Jakarta*. Department of Biology, Faculty of Mathematics and Natural Sciences. University of Indonesia. Depok. p 53.

Wright, S.L., Thompson, R.C., & Galloway, T.S. (2013). The Physical Impact of Microplastics on Marine Organisms: A Review. *Env. Poll.*, 178: 483-492