



Microscopic Evidence of Suspected Microplastic Ingestion in Guppies (*Poecilia reticulata*) from a Polluted Urban Drain on a University Campus: A Preliminary Study

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Abstract

Microplastic contamination is an increasing concern in freshwater ecosystems, particularly in urban drainage systems receiving domestic inputs and surface runoff. This study investigated the occurrence and morphological characteristics of suspected microplastics in the gut contents of guppies (*Poecilia reticulata*) collected in December 2025 from a polluted freshwater drain near Universiti Putra Malaysia, Selangor, Malaysia. Ten individual guppies were examined using light microscopy following direct gut dissection and homogenization, without chemical digestion or density separation. Microscopic examination revealed morphologically diverse suspected microplastic particles, with fibre-type particles representing the most frequently observed form. In addition to isolated fibres, film-like particles, irregular fragments, and aggregated fibrous material associated with organic detritus and gut residues were observed. The particles varied considerably in size, ranging from approximately 162 to 690 µm, demonstrating the ingestion of both relatively small and comparatively large particles. The occurrence of suspected microplastics intermixed with organic detritus suggests that these particles may be ingested incidentally together with natural food materials. Considerable variation in particle size and morphology further indicates heterogeneity in the suspected microplastic particles ingested by guppies inhabiting the polluted freshwater drain. As polymer composition was not chemically confirmed, the observed particles are conservatively classified as suspected microplastics based on their morphological characteristics, including the absence of visible cellular structures and their relatively uniform, synthetic-like appearance. Overall, the findings demonstrate the occurrence and morphological diversity of suspected microplastics in guppy gut contents and support the potential use of small freshwater fish as sentinels of microplastic contamination in polluted urban drainage systems.

Keywords: Microplastics; Freshwater Fish; *Poecilia reticulata*; Gut Content Analysis; Urban Drainage Pollution

Introduction

Plastic pollution has become a pervasive environmental issue, extending beyond marine ecosystems into rivers, lakes, and urban drainage networks. Of particular concern are microplastics, commonly defined as plastic particles smaller than 5 mm, which originate either from the fragmentation of larger plastic debris or from primary sources such as synthetic fibres and industrial materials [1]. Freshwater systems act both as sinks and conduits for microplastics, transporting them from terrestrial sources toward downstream aquatic environments. Urban drains, in particular, receive continuous inputs from domestic wastewater, road runoff, and surface erosion, making them important yet understudied hotspots of microplastic contamination [2, 3].

Fish are widely used as bioindicators of aquatic pollution because of their ecological relevance, trophic positioning, and direct interaction with contaminated sediments and water columns. Numerous studies have reported the ingestion of microplastics by freshwater and marine fish,

raising concerns about ecological impacts and potential transfer through food webs [4, 5]. Ingestion may occur passively during feeding on plankton, detritus, or benthic material, particularly in omnivorous or detritivorous species. Once ingested, microplastics may interact physically or chemically with gut tissues or act as vectors for associated contaminants and microorganisms [6, 7].

The guppy fish (*Poecilia reticulata*) is a small-bodied, non-selective freshwater species commonly found in urban drains and modified habitats. Its widespread distribution, tolerance to polluted environments, and opportunistic feeding behaviour make it a suitable sentinel organism for assessing microplastic exposure in urban freshwater systems. Despite increasing attention to microplastics in large rivers and lakes, comparatively fewer studies have focused on small drainage systems and resident fish species, particularly in tropical urban settings [8, 9].

This study aims to provide microscopic evidence of suspected microplastic ingestion in *P. reticulata* collected from a polluted urban drain near Universiti Putra Malaysia. By documenting particle morphology, size range, and association with gut contents using light microscopy, this work contributes baseline information on microplastic exposure in a neglected freshwater context. Although chemical polymer identification was beyond the scope of this study, visual characterization remains a valuable first step in understanding the extent and nature of microplastic contamination and in guiding future, more detailed investigations.

Materials and Methods

Guppy fish (*P. reticulata*) were collected in November 2025, from a polluted drain located near the Ecology Laboratory, Department of Biology, Universiti Putra Malaysia (UPM). Immediately after collection, fish were transferred into clean containers filled with site water and transported to the laboratory to reduce handling stress prior to processing.

Ten individual guppies (5 males with body length: 1.8-2.2 cm; 5 females with body length 3.0-3.7cm) were selected for analysis. Each fish was measured for total length (cm) using a ruler before dissection. Basic morphometric data were recorded for each specimen to allow comparison of gut content observations across individuals.

Dissection was conducted using standard laboratory dissection tools under clean working conditions. The abdominal cavity was opened using a dissecting knife. The stomach was carefully excised with forceps, and the gut was identified and further opened using a scalpel. The entire gut contents were transferred into a clean Petri dish using forceps.

Gut contents were rinsed with approximately 5 mL of distilled water to disperse food materials and any suspected microplastic particles. The suspension was gently stirred to homogenize the mixture. A small drop of the homogenized suspension was then placed on a clean glass microscope slide using a dropper and covered with a clean coverslip. No filtration, sieving, chemical digestion, or density separation was applied during preparation.

Microscopic examination was performed using a camera light microscope (Olympus CX33 HD Digital Microscope equipped with an Accu-Scope Excelis digital camera, Olympus Corporation, Japan) at magnifications of 100× to 400×. Observations focused on documenting natural gut contents including diatoms, algae, zooplankton, detritus, and other biological materials.

Suspected microplastic particles were recorded and classified visually based on observable features such as colour, shape, and morphology (for example fibres, fragments, and films). Particles were considered potential microplastics when they lacked obvious cellular structures and appeared uniform with a synthetic like texture or form under light microscopy.

Because no separation or confirmatory polymer identification was performed, particles reported as microplastics should be interpreted as “suspected microplastics” based on visual criteria from light microscopy.

Results

Figure 1 summarizes the types, morphology, and approximate sizes of suspected microplastic particles observed in the gut contents of *P. reticulata*. Microscopic observations revealed a heterogeneous mixture of particle forms, with fibres being the most frequently encountered category, followed by fragments and aggregated materials.

Table 1 compiles the microscopic observations of suspected microplastic particles in *P. reticulata*'s gut contents by panel position, dominant visual feature, suspected particle category, colour and appearance, and approximate size inferred from the scale bars. Overall, the table shows that fibres were the most consistently recorded particle type across the presented panels, while fragments and film or sheet-like particles occurred less frequently but were clearly present.

Upper section (top row)

The upper row in Figure 1 shows three morphologically distinct

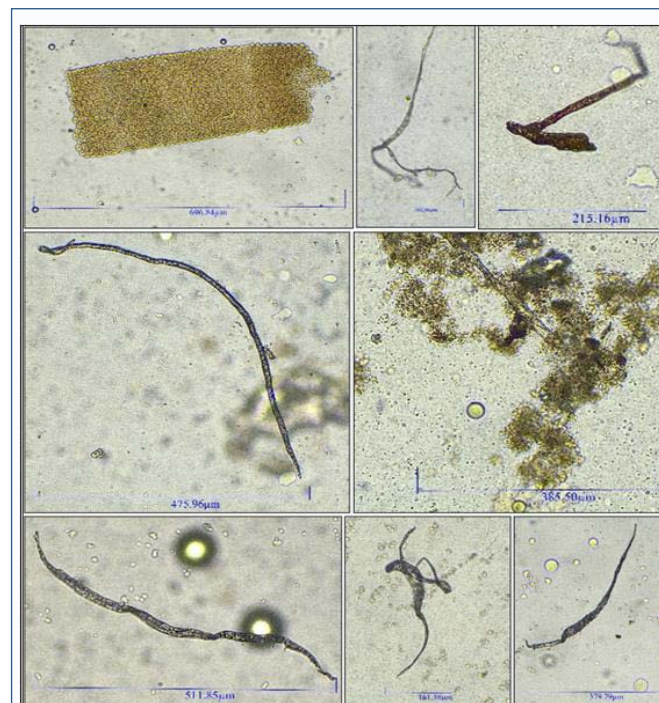


Figure 1: Representative light-microscope images and summary of microscopic observations of suspected microplastic particles detected in the gut contents of guppy fish (*Poecilia reticulata*), showing panel position (top left, top middle and top right; middle left, middle right; bottom left, bottom middle and bottom right), dominant visual features, suspected particle type, colour and appearance, and approximate particle size as indicated by the scale bars in each image.

Table 1: Summary of microscopic observations of suspected microplastic particles in the gut contents of guppy fish (*Poecilia reticulata*), showing panel position, dominant observation, particle type, colour and appearance, and approximate size based on scale bars.

Panel position (as presented)	Dominant observation	Suspected particle type	Colour and appearance	Approx. size from scale bar
Top left	Large rectangular sheet like particle	Film or sheet fragment	Yellowish to brown, compact and uniform, no cellular structure	~690 μm
Top middle	Long, thin curved strand	Fibre	Dark, uniform thickness	~362 μm
Top right	Short irregular rigid piece	Fragment	Dark brown to black, rigid looking	~215 μm
Middle left	Single elongated strand	Fibre	Dark, smooth outline	~476 μm
Middle right	Dense organic mass with embedded fine strands	Fibre with detritus aggregate	Brownish organic clumps, fibres interwoven	~386 μm field spread
Bottom left	Twisted thicker strand	Fibre	Dark, weathered look	~512 μm
Bottom middle	Intertwined cluster of fibres	Fibre bundle	Dark strands tangled together	~162 μm (cluster feature)
Bottom right	Isolated slender strand	Fibre	Dark, uniform thickness	~380 μm

suspected microplastic particles that differ in size, shape, and structural appearance. In the top left panel, a large rectangular, sheet-like structure measuring approximately 690 μm was observed, representing the largest size class reported in Table 1. The particle exhibited a dense and relatively uniform appearance without visible cellular organization, consistent with a film-like or compacted synthetic fragment rather than biological tissue. The top middle panel shows a long, thin fibre measuring approximately 362 μm , characterized by slight curvature, smooth edges, and relatively uniform thickness. These features distinguish it from typical algal filaments and support its identification as a suspected synthetic microfibre. In the top right panel, a smaller irregular fragment measuring approximately 215 μm was recorded. Its darker coloration, rigid appearance, and uneven morphology are consistent with a fragmented plastic particle rather than organic debris. Collectively, the upper row therefore represents three contrasting morphological forms, namely a film or sheet-like particle, an elongated fibre, and an irregular fragment.

Middle section

The middle section in Figure 1 shows two contrasting forms of suspected microplastic occurrence, comprising an isolated fibre and fibrous material associated with aggregated debris. In the middle-left panel, a single elongated fibre measuring approximately 476 μm was observed. The particle was thin and slightly curved, with a relatively uniform, thread-like morphology and no visible internal structure, features consistent with a suspected synthetic microfibre. In contrast, the middle right panel contained clusters of dark, irregularly shaped material with an overall spread of approximately 386 μm . Fine fibrous particles appeared embedded within or associated with the aggregated material, which also contained organic detritus and gut residues. This close association suggests that suspected microplastic fibres may occur intermixed with natural gut contents rather than exclusively as isolated particles.

Lower section (bottom row)

The lower row in Figure 1 is predominantly characterized by fibre-type suspected microplastics that vary in length, thickness, and degree of aggregation. In the bottom left panel, a relatively thick, twisted fibre measuring approximately 512 μm was documented. Its irregular surface and curved morphology suggest possible physical weathering or degradation of synthetic material. The bottom middle panel shows a compact cluster of intertwined fibres, with the prominent fibrous feature measuring approximately 162 μm . This clustered configuration may indicate aggregation of shorter microfibres within the gut contents. In the bottom right panel, an isolated slender fibre measuring approximately 380 μm was

identified. Its relatively consistent width, elongated morphology, and absence of visible cellular structures support its classification as a suspected microplastic fibre. Overall, the lower row demonstrates the predominance and morphological variability of fibre-type particles, ranging from thicker and twisted fibres to compact aggregates and isolated slender forms.

Across all examined positions, fibre-type particles dominated the observations, indicating that fibres were the most frequently observed form of suspected microplastics in the guppy gut contents. The observed particles varied considerably in size, ranging from approximately 162 μm to 690 μm , demonstrating the presence of both relatively small and comparatively large particles within the gut contents. In addition to isolated fibres, film-like particles, irregular fragments, and aggregated fibrous material associated with organic detritus were also observed. The variation in particle size and morphology recorded in Table 1 therefore demonstrates considerable heterogeneity in the suspected microplastic particles ingested by guppies collected from polluted freshwater drains.

Taken together, Table 1 indicates that suspected microplastics in guppy gut contents were primarily fibre-shaped, spanning a size range from roughly 162 μm to 690 μm , with occasional fragments and at least one film or sheet-like particle. The repeated description of uniform, non-cellular, synthetic-like appearance across fibre and film categories supports their classification as suspected microplastics based on light microscopy.

Discussion

Dominance of fibre-type microplastics in guppy gut contents

Across all four tables, elongated fibres consistently represented the most frequently observed suspected microplastic form in the gut contents of *P. reticulata*. Fibres occurred as isolated strands, tangled bundles, and embedded within organic matrices, with lengths ranging from 162 to 690 μm . This dominance is consistent with global freshwater and marine studies, which report fibres as the prevailing microplastic type ingested by fish due to their high environmental availability and buoyancy characteristics [1, 4]. Synthetic fibres are commonly derived from textile laundering, degraded fishing gear, and domestic wastewater effluents, all of which are relevant sources in urban drain systems. The consistent fibre morphology observed here, including uniform thickness, lack of cellular structure, and smooth or weathered surfaces, supports their classification as suspected synthetic materials rather than biological filaments.

Size variability and implications for ingestion pathways

The wide size spectrum of suspected microplastics observed, spanning approximately 162 to 690 μm , suggests multiple ingestion pathways. Smaller fibres and fragments are likely ingested incidentally during feeding on detritus, algae, and suspended particles, while larger fibres and film-like fragments may be consumed alongside macro-detritus or adhered food items. Previous studies have demonstrated that small-bodied fish such as guppies are capable of ingesting relatively large microplastic particles relative to their body size, particularly in confined or polluted habitats where plastics accumulate [5, 6]. The presence of both fine and coarse particles indicates continuous exposure rather than a single episodic event, reflecting chronic contamination in the drain environment.

Association of microplastics with organic matter and gut aggregates

Table 1 was the close association of suspected microplastics with organic debris, including compact gut residues, detritus, and particulate aggregates. Fibres were frequently embedded within dense biological material rather than appearing as free particles. This finding aligns with evidence that microplastics readily adsorb organic matter and biofilms in aquatic environments, increasing their likelihood of ingestion by detritivorous and omnivorous species [7, 9]. Within the digestive tract, physical mixing and peristaltic movement may further promote aggregation. Such interactions complicate visual identification and highlight the methodological challenge of distinguishing synthetic particles from natural materials when chemical confirmation techniques are not applied.

Ecological relevance and methodological considerations

The repeated detection of suspected microplastics in guppy gut contents underscores the role of small freshwater fish as effective sentinels of microplastic contamination in urban aquatic systems. Guppies are non-selective feeders and occupy lower trophic levels, making them particularly susceptible to passive ingestion of microplastics present in sediments and suspended matter [8]. However, it is important to acknowledge that the present observations are based solely on light microscopy without polymer confirmation. Visual identification may overestimate microplastic presence due to overlap with natural fibres or fragments. Nevertheless, similar microscopy-based approaches are widely used in baseline studies and remain valuable for initial screening and ecological assessments [10]. Future work incorporating chemical characterization, such as FTIR or Raman spectroscopy, would strengthen source attribution and risk evaluation.

This study provides clear observational evidence that *P. reticulata* inhabiting a polluted urban drain are consistently exposed to and ingest suspected microplastics. Across all examined samples, fibre-shaped particles dominated the gut contents, with additional occurrences of fragments and film-like materials. The wide size range of particles observed, from very fine fibres to relatively large sheets and strands, indicates continuous and non-selective ingestion linked to everyday feeding activities. The frequent association of these particles with organic debris and compact gut material suggests that microplastics are incorporated into the digestive system together with natural food items rather than being actively selected, reflecting the pervasive presence of plastic debris in the surrounding freshwater environment.

Although the present findings are based on light microscopic observations and therefore represent suspected rather than chemically

confirmed microplastics, the consistent morphological patterns observed across multiple individuals highlight the value of small freshwater fish as practical sentinels of microplastic contamination in urban aquatic systems. These results contribute baseline information on microplastic exposure in guppies and underline the ecological relevance of drains and small water bodies as important yet often overlooked pathways for plastic pollution. Future studies integrating polymer identification and controlled exposure assessments will be essential to refine source attribution, evaluate potential biological effects, and better understand the implications of chronic microplastic ingestion for freshwater ecosystems.

Conclusions

This study demonstrates that *P. reticulata* inhabiting a polluted urban drain consistently ingest suspected microplastic particles, as evidenced by repeated microscopic observations across multiple gut samples. Fibre-shaped particles were the dominant form detected, with additional occurrences of fragments and sheet-like materials, indicating diverse sources and degradation states of plastic debris in the freshwater environment. The wide range of particle sizes observed, from fine fibres to relatively large films, suggests continuous exposure and non-selective ingestion during normal feeding activities. The frequent association of suspected microplastics with organic detritus and compact gut material further indicates that ingestion occurs passively alongside natural food items rather than through active selection.

Although the identification of microplastics in this study was based solely on visual criteria under light microscopy, the consistent absence of cellular structures and the uniform, synthetic-like appearance of the observed particles supports their classification as suspected microplastics. These findings highlight the ecological relevance of small freshwater fish as practical sentinels for monitoring microplastic contamination in urban drainage systems, which remain understudied despite their importance as pathways for plastic pollution. Future investigations incorporating chemical polymer identification and quantitative assessments are needed to confirm particle composition, evaluate potential biological effects, and improve understanding of the implications of chronic microplastic exposure in freshwater ecosystems.

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References

1. Cole M, Lindeque P, Halsband C, Galloway TS. Microplastics as contaminants in the marine environment: A review. *Marine Pollut Bull.* 2011; 62(12): 2588-2597.
2. Wagner M, Scherer C, Alvarez-Muñoz D, Brennholt N, Bourrain X, Buchinger S, et al. Microplastics in freshwater ecosystems: What we know and what we need to know. *Environ Sci Eur.* 2014; 26: 12.
3. Horton AA, Walton A, Spurgeon DJ, Lahive E, Svendsen C. Microplastics in freshwater and terrestrial environments: Evaluating the current understanding to identify the knowledge gaps and future research priorities. *Sci Total Environ.* 2017; 586: 127-141.
4. Rochman CM, Tahir A, Williams SL, Baxa DV, Lam R, Miller JT, et al. Anthropogenic debris in seafood: Plastic debris and fibers from textiles in fish and bivalves sold for human consumption. *Sci Rep.* 2015; 5: 14340.
5. Jabeen K, Su L, Li J, Yang D, Tong C, Mu J, et al. Microplastics and

- mesoplastics in fish from coastal and fresh waters of China. *Environ Pollut.* 2017; 221: 141-149.
6. Wright SL, Thompson RC, Galloway TS. The physical impacts of microplastics on marine organisms: A review. *Environ Pollut.* 2013; 178: 483-492.
 7. Zettler ER, Mincer TJ, Amaral-Zettler LA. Life in the "Plastisphere": Microbial communities on plastic marine debris. *Environ Sci Technol.* 2013; 47(13): 7137-7146.
 8. Auta HS, Emenike CU, Fauziah SH. Distribution and importance of microplastics in the marine environment: A review of the sources, fate, effects, and potential solutions. *Environ Int.* 2017; 102: 165-176.
 9. Wang J, Peng J, Tan Z, Gao Y, Zhan Z, Chen Q, et al. Microplastics in the aquatic environment: A review of distribution, ecological effects, and analysis methods. *Chemosphere.* 2026; 274: 129631.
 10. Hidalgo-Ruz V, Gutow L, Thompson RC, Thiel M. Microplastics in the marine environment: A review of the methods used for identification and quantification. *Environ Sci Technol.* 2012; 46(6): 3060-3075.