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Research Article

Occurrence of Microplastics in the Tissues of Nile Tilapia (*Orechromis niloticus*) from Zobe Dam, Katsina State, Nigeria

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ABSTRACT

A study of the detection of microplastics on *Oreochromis niloticus* in Zobe Reservoir, Katsina State, Nigeria was carried out. Three fish sampling sites were used; the upstream (Tsawatsawa), midstream (Makera), and downstream (Garhi) were selected based on variation of anthropogenic activities. A total number of one hundred and forty-four (144) fish samples with a total weight (MTW) and total length (MTL) varied between 134.1 ±1.50 to 154.2± 3.41g and 17.5 ± 0.10– 22.1± 0.54 cm respectively, were collected and analysed for the presence of microplastics using standard protocols. Fourier Transform Infrared Spectrophotometer (FTIR) was used for the chemical characterization of microplastic composition examined in the fish species. The examination of microplastic occurrence in different sampled fish gills, liver, and kidney revealed the presence of Polystyrene, Polypropylene, Polyethylene terephthalate, Nylon, Polyester, and Polyvinyl chloride. Fish from all sampling sites revealed varying histopathological alterations ranging from lifting of epithelium thickening, distortion of the primary lamellae, and degeneration of secondary lamellae, blood congestion, and massive lamellae degeneration in the gill tissues. Liver tissues had hepatocyte hypertrophy, sinusoidal dilatation and cytoplasmic vacuolation, presence of lipid granules, cellular infiltration, cytoplasmic vacuolation, and haemorrhage. The kidney tissues were presented with Bowman's capsules hyperplasia, tubular elongation, renal tubular epithelium shrinkage, hyperplasia, and cytoplasmic vacuolization of renal cells. The severity of the damage varies from site to site indicating that the water body is experiencing pollution at varying locations. Our findings provide important insights into the prevalence and distribution of microplastics in this particular environment.

Keywords: Histopathology, Microplastics, Nile Tilapia, Tissues

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INTRODUCTION

Plastics are synthetic compounds manufactured from organic polymers which are routinely used due to low cost, endurance, and easy handling (Wang *et al.*, 2020). Microplastics are minute plastics (<5 mm long) that come in a variety of shapes, sizes, and chemical compositions (Zhang *et al*., 2020). They are produced when large plastic particles such as tires, nets and plastic containers are broken down into smaller plastics over time under different environmental conditions. Some microplastics are produced in small size and are directly released into the environment and are found in products like cosmetics, textiles toothpastes and face washes (World Economic Forum, 2016). The presence of plastic debris in all oceans has made plastic pollution a global environmental problem with negative impacts on aquatic biota, biodiversity in addition to human health (Wright *et al.*, 2013). However, the threats posed by plastics to the aquatic ecosystem were initially disregarded for a long period (McCormick *et al*., 2014).

Microplastics have been discovered in all freshwater chambers, including biota (Wright *et al.*, 2013). It has been reported by Enyoh *et al.* (2019) that microplastics are found in the air we breathe, in the food we consume and in the soil where our crops are grown (Corradini *et al.*, 2019). They were also found at the peak of Everest (Napper *et al.*, 2020) and at the depths of the deep ocean (Zhang *et al.*, 2020). There was also research conducted by Schwabl *et al*. (2019) which reported that microplastics were discovered in human stool. In addition, for the first time, microplastics particles were found in the human placenta (Shen *et al.*, 2022). Most freshwater microplastics are found in the water surface, where they pose a risk to freshwater organisms that consume plankton and may accidentally ingest microplastic particles while feeding. As these creatures tend to be at the first level of the freshwater food chain, microplastics can bio-accumulate up the food chain to pose further risks to other wildlife and human consumers. Nile tilapia (*Oreochromis niloticus*) is one of the most farmed fish globally, with a significant contribution to improving local livelihoods, especially in developing countries, increased household incomes, improved food security, and higher nutritional value through increased protein consumption (Yue *et al.*, 2016).

Zobe Dam is currently threatened by human activities such as electronic waste deposition, intense irrigation, domestic input, and deposition through laundry services around the reservoir. These activities would facilitate alteration in the water physicochemical parameters and the survival of the aquatic biota. Microplastics in aquatic ecosystems are a major concern globally and are regarded among the major pollutants due to their toxicity and threat to biota as they cause environmental contamination and alter natural ecological balance (Ighalo and Adeniyi, 2020).

Ingestion of microplastics by aquatic organisms can cause several harmful health impacts, such as mechanical injury, low growth rate, increased immune responses, blocked enzyme production, decreased fecundity, oxidative stress, histological disorder, and even morbidity (Sussarellu *et al.*, 2017). In addition, microplastics could concentrate a considerable amount of waterborne toxic pollutants, which may cause toxicological hazards to aquatic life once these contaminated microplastics are consumed (Liu *et al.*, 2017). This study may assist in filling the data gaps regarding microplastics pollution in the Zobe freshwater ecosystem and guidance for future monitoring of microplastics pollution in the Dam. Therefore study on microplastics in Zobe Dam will provide information that will serve as a baseline for effective management and optimum utilization of its aquatic resources. The work is aimed at detecting Microplastics on the Nile Tilapia of Zobe Dam, Katsina State, Nigeria.

MATERIALS AND METHODS

Study Area

Zobe Dam is located in Dutsin-ma Local Government Area of Katsina State. It is an earth-fill structure with a height of 19 meters and a total length of 2,750 meters. The Dam has a storage capacity of 179 million cubic feet and an irrigation potential of 8,000 hectares. The main purpose of the Dam is irrigation and water supply to the surrounding communities. Two different seasons exist annually in the area (wet and dry seasons) characterized by a long summer and brief winter, with an average yearly temperature of 31 °C. Communities near the Dam primarily rely on the water body for their source of income by over-exploiting its abundant natural resources. Their main occupations are fishing and farming crops which are grown in this region and the area is estimated to have about 5000 hectares of active agricultural land.

Site A: This Site is the Upstream (Tsawa-Tsawa) located between latitudes 12°22′3571" N and 7°32′6291" E. Waste water flows directly to this point from nearby farms. Irrigation activities take place during dry season and vegetation is subjected to chemicals input from agrochemical inputs at this site.

Site B: This site is the midstream of the reservoir (Makera) 12°21′0561″ N and 7°30′112′′E where there are fewer human activities apart from fishing.

Site C: This is downstream (Garhi) 12°22′4921″ N and 7°27′9071′′ E where human activities such as recreation, laundry services, and irrigation among other anthropogenic activities are carried out at this site.

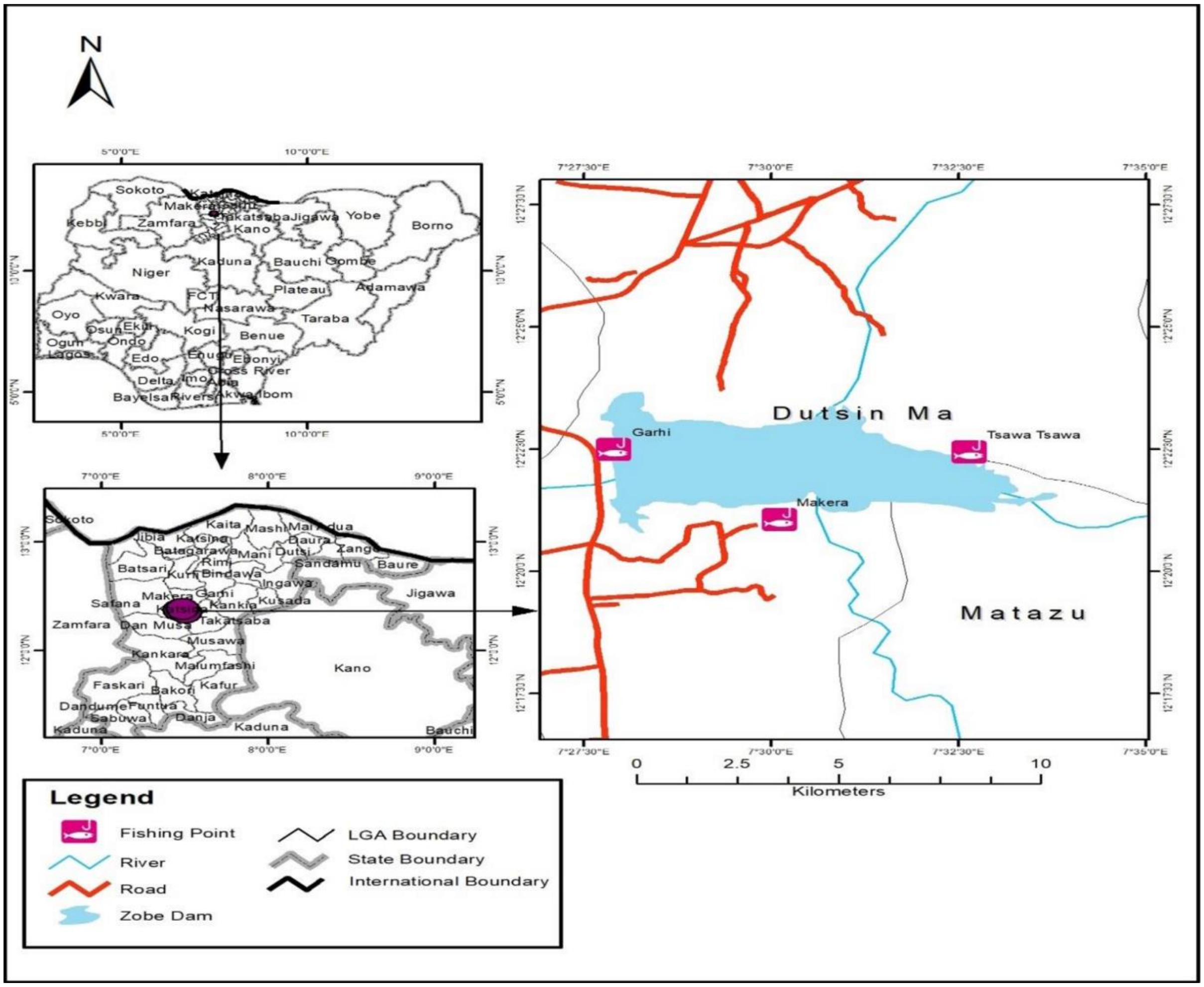

Figure 1: Nigeria Showing Zobe Dam Indicating the Sampling Sites (Source: Cartography unit, Department of Geography, Federal University Dutsin-Ma, Katsina (2021)

Fish Samples Collection and Analysis

The fish samples were harvested between 6:00 am to 7:00 am monthly from June-November, 2022. Three fish sampling sites were chosen for this study and designated as upstream (A), midstream (B) and downstream (C) on the watercourse of the reservoir while the control fish were procured and maintainedin an aquarium at Fisheries unit, Federal Dutsin-Ma, University, Nigeria. The choice of the stations was based on the variation of anthropogenic activities within the sampling areas as described by Nafiu *et al*. (2017).

A total of 144 samples of *Oreochromis niloticus* were harvested with the assistance of artisanal fishermen using cast nest fishing gear from the three sampling sites (fifteen fish per site) for a period of six months (July-December, 2022) cutting across dry and wet seasons. Twenty (36) sets of uniformly equal sizes of *Oreochromis niloticus* were kept in the aquarium as control. They were weighted to the nearest 0.1g using a weighing balance (M-Metlar Model). The Total Lengths were taken on a measuring board from the tip of the mouth to the distal tip of the longest caudal-fin ray with the aid of a calibrated meter rule to the nearest 0.1 cm. The fish samples were put on an ice block before individually excising their gills and visceral parts including kidney and liver for microplastics investigation and histopathology analysis.

Microplastic Extraction

Visceral weights of the sampled fish were determined before dissection at Fisheries Laboratory, Department of Fisheries and Aquaculture, Federal University Dutsin-Ma. Immediately after dissection, gastrointestinal contents from the esophagus to the vent, dorsal part and anus were transferred into a 500 mL beaker and 200 mL of H_2O_2 (30% v/v) was added and shaken vigorously. Assessment of microplastics content was carried out using gravimetric methods for each fish as described by Atamanalp *et al*. (2021). Liver and Kidney tissues were removed and incubated at 60 °C for 24 hrs; while gill tissues were incubated at 40 °C for 72 hrs to digest the organic matter. To extract all types of microplastics, density separation techniques was carried out by the addition of 300 mL of saturated sodium chloride solution (1.2 g mL^{-1} NaCl) and kept for 8 hrs at room temperature as described by Jabeen *et al*. (2017). After incubation, a Polyester (PETE) membrane filter (10 µm, 25 mm diameter) membrane filters were used to suspend the contents in an air-dried at room temperature for 4-5 hrs.

Microplastics Identification and Characterization

MPs were identified based on their morphological features such as the types (fiber, film, fragment, and beads), and the number of MP particles per fish was counted using the protocol of Sun *et al*. (2019) and Aytan *et al*. (2020). Chemical characterization (molecular bonds, chemical compounds and functional groups) of the identified MP particles was carried out using infrared radiation using Fourier Transform Infrared Spectrophotometer (The Cary 630 FTIR spectrometer Model) in the range 650-4000 cm^{-1} at Umaru Musa Yar'adua University, Central Laboratory, Katsina using the procedure adopted by Mukund *et al.* (2014), Nadal *et al*. (2016) and Primpke *et al*. (2018). ATR-FTIR Analysis All samples of MPs were measured with a Cary 630 FTIR spectrometer. The FTIR measurements with the Cary 630 were conducted in Attenuated Total Reflectance mode (ATR) in a wave number range of 4000-650 cm^{-1} with spectral resolution of 8 cm^{-1} and 32 background scans. Particle spectra were compared with reference spectra for the most common polymer type using handbook of spectroscopy by Gaughtz and Vo-Dinh (2003) to identify the functional group

Histopathological Analysis of Fish Tissues

The biopsies of *O. niloticus* tissues (gills, kidney and liver) were conducted at Histopathology Laboratory, Aminu Kano Teaching Hospital, Kano, Nigeria using the method described by Auwioro (2010). Fish tissues were fixed with 10% buffered formalin for 24 hours, dehydrated with an ascending grade of alcohol, cleared with xylene and embedded with molten paraffin wax. Microtome sections (5 µm) of the tissues were stained with Haematoxylin and Eosin stains, examined under a microscope (LEICA DM 750 model) and photomicrographed with an HD camera (LEICA ICE 50 model).

Data Analysis

All data were statistically analyzed using SPSS 2016. One-way analysis of variance (ANOVA) was used to determine the variation between microplastic types in different sample sites. Student's T-test ($p<0.05$) level of significance was used to analyse the difference between the months sampled.

RESULTS

The FTIR spectroscopy spectrum of MPs was obtained from the different sample sites to identify the functional groups from both male and female *O. niloticus* (Fig 2 to 7). The wave number indicates the type of microplastics obtained from the visceral organs of male and female fish from each site. Figure 2 shows the MP indicated by the noticeable presence of 21127 cm-1, 2925 cm-1, and 2854 cm-1 absorbing groups. Figures 3 to 7 show the examples of polymer types found which is indicated by the clear presence of 998.9 cm-1, 2922.2 cm-1, 1625.1 cm-1, 1002,7 cm-1, and 1625.1 cm-1 absorbing groups, respectively.

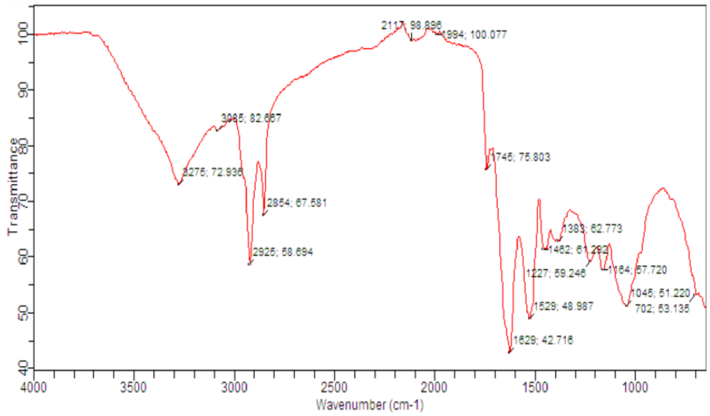

Figure 2: Site A male *O. niloticus* indicating the types of microplastics obtained

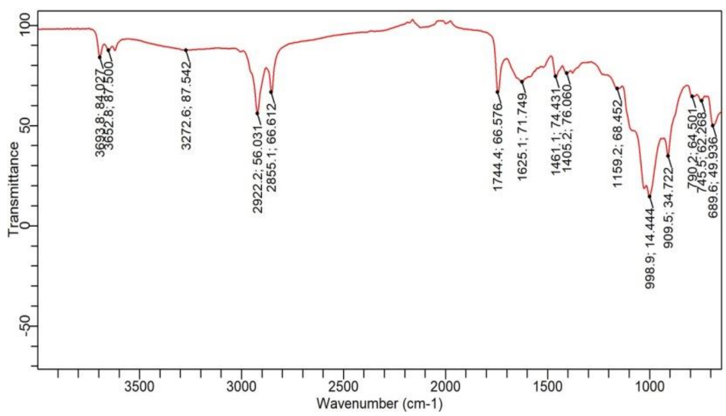

Figure 3: Site B male *O. niloticus* indicating the types of microplastics obtained

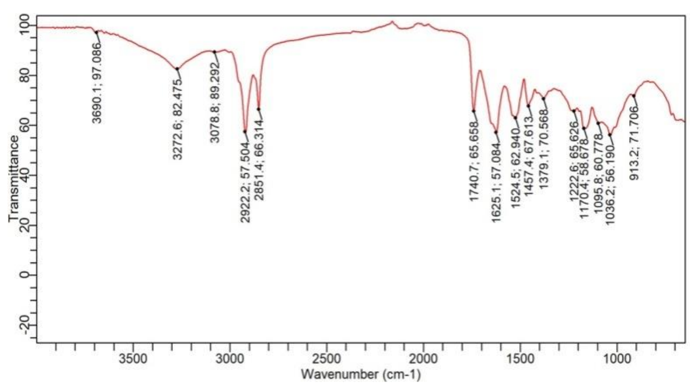

Figure 4: Site C male *O. niloticus* indicating the types of microplastics obtained

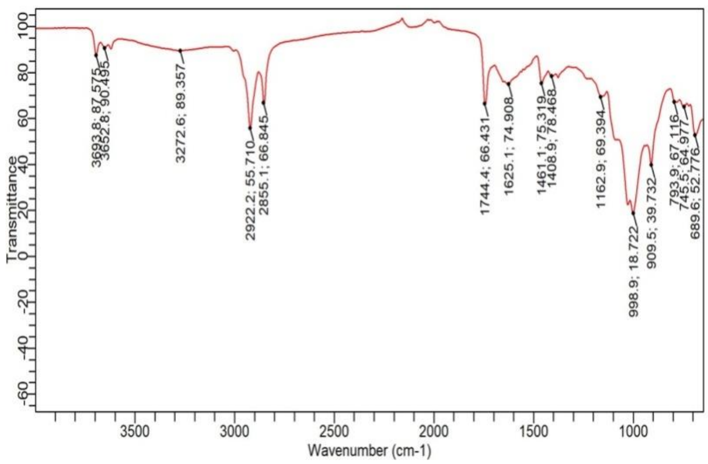

Figure 5: Site A Female *O. niloticus* indicating the types of microplastics obtained

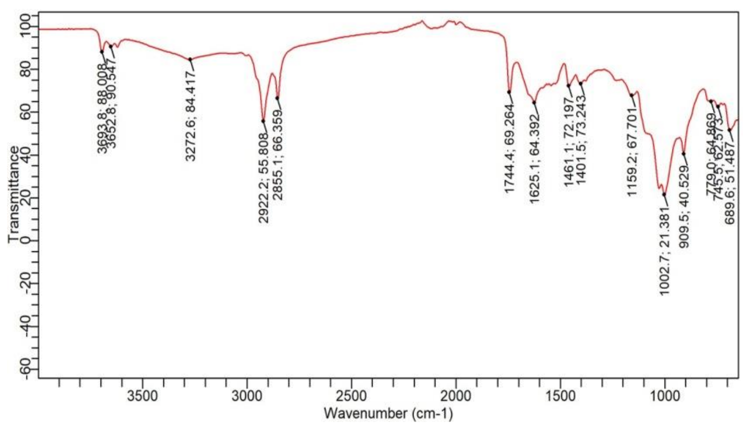

Figure 6: Site B female *O. niloticus* indicating the types of microplastics obtained

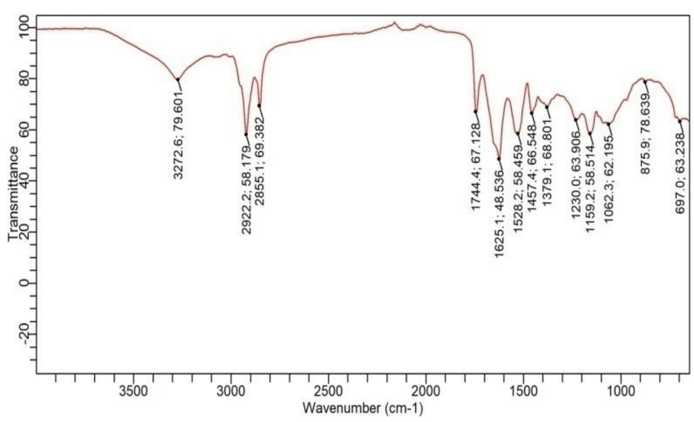

Figure 7: Site C female *O. niloticus* indicating the types of microplastics obtained

The Various MPs Obtained in *Oreochromis niloticus*

Table 1 and 2 shows the various MPs obtained from the study and their sources. The MPs present are Polystyrene (PS), Polypropylene (PP), Polyethylene Terephthalate (PET), Polyvinyl Chloride (PVC), Polyethylene (PE), Polypropylene (PP) and Polyamide (PA). Nylon (N) Polymer (P). The most abundant MP that cut across the months sampled were PS and PET, it was also observed that N was the least MP obtained from both male and female *O. niloticus* sampled.

Table 1: Microplastics Types Obtained from Males *Oreochromis niloticus*

Months	MPs Types	Source
July	PVC, PP, PS, PET,N	Electric cables, bottle caps, floats, bottles,
August	PS, N ,PP, PE,PET	Plastic containers, fishing net, ropes ,bottles caps
September	PVC, PS, PE, PET	Cables, floats, plastic bags
October	PVC,PE, PS,PET,P	Cables, rope,coolboxes, plasticbootles,fishing nets
November	PE, PS, PP,P	Plastic containers, cups, rope, fishing nets
December	PVC,PS ,PE,PET,PA	Cables, utensils, storage containers, textiles.

Polystyrene (PS), Polypropylene (PP), Polyethylene terephthalate (PET), Polyvinyl chloride (PVC), Polyethylene (PE), Polypropylene (PP), Polyamide (PA), Nylon (N), Polyester (P)

Table 2: Microplastics Types Obtained from Females *Oreochromis niloticus*

Months	MPs Types	Sources
July	PVC, PP, PS, PET, N	Electric cables, bottle caps, floats, bottles, textiles
August	PS, N, PP, PE	Plastic containers, fishing net, ropes, bottles caps
September	PVC, PS, PE	Cables, floats, plastic bags
October	PVC, PE, PS, PET, P	Cables,rope,coolboxes,plasticbootles,fishing nets
November	PE, PS, PP, P	Plastic containers, cups, rope, fishing nets
December	PVC, PS, PE, PET, PA	Cables, utensils, storage containers, textiles.

Polystyrene (PS), Polypropylene (PP), Polyethylene terephthalate (PET), Polyvinyl chloride (PVC), Polyethylene (PE), Polypropylene (PP), Polyamide (PA), Nylon (N), Polyester (P)

Histopathological Analysis of Fish Tissues

Histological investigation of gills

Histological investigation of the gills indicates normal gill architecture of the lamellae in the control group without any discernable pathological change (Plate Ia). The occurrence of fusion of secondary lamellae and disruption of the filament arrangement was observed in fish from site A (Plate Ib). Conversely, fish collected at Site B revealed epithelial lifting, swollen and shortened lamellae (Plate Ic). Hyperplasia of the gill filament, epithelial lifting and swollen lamellae were recorded in fish sampled from site C (Plate Id).

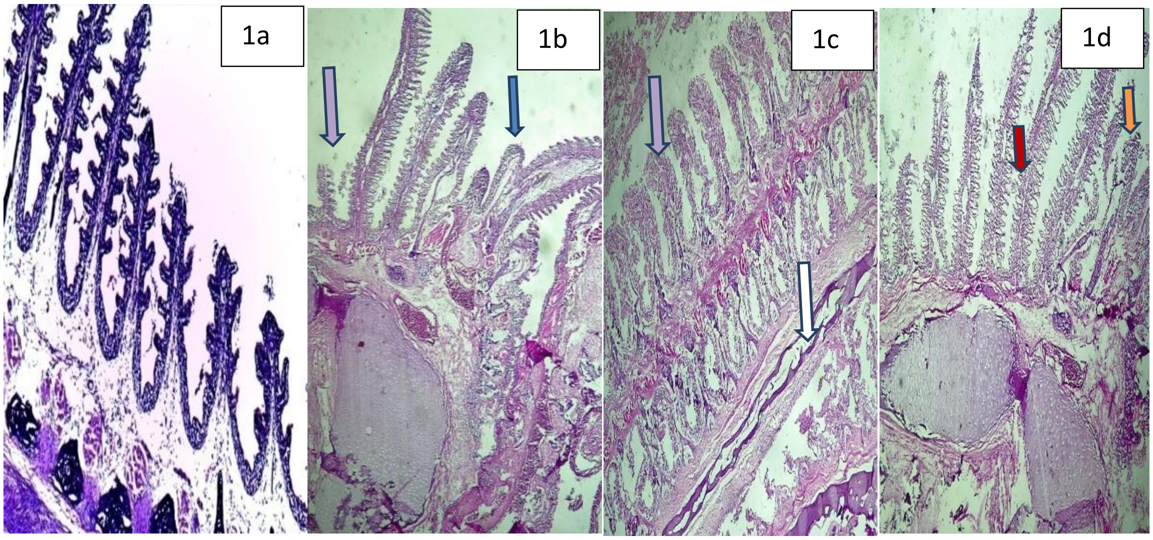

Plate I. Shows the gill tissue of ***Oreochromis niloticus*** sampled from Zobe Dam

Figure Ia: Photomicrograph of normal gill tissue structure of showing compact lamellar gill epithelium, gill arches, parallel primary and secondary lamellae arrangement of *O. niloticus* (control) (H&E mag × 400)

Plate Ib: Photomicrograph of gills tissues indicating fusion of secondary lamellae (Blue arrow) and disruption of the filament arrangement (yellow arrow) (H & E mag × 100)

Plate Ic: Photomicrograph of the gill tissues indicating epithelial lifting (white arrow), swollen and shortened lamellae (yellow arrow) (H & E mag × 100)

Plate 1d: Photomicrograph of the gill tissues indicating hyperplasia of the gill filament (red arrow), epithelial lifting and swollen lamellae (green arrow) (H & E mag × 100

Histological investigations of liver tissues

Liver tissues revealed normal architecture with normal hepatocyte morphology, vacuolation and hepatic cord arrangement in the control samples without any discernible alterations (Plate IIa). Liver tissue indicating areas of hepatocyte hypertrophy, sinusoidal dilatation and cytoplasmic vacuolation were observed in fish collected from site A (Plate IIb). Blood congestion in hepatic parenchyma and hepatocyte infiltration were recorded from fish at site B (Plate IIc). Epithelial degeneration, distorted central vein and necrosis were observed in fish sampled from site C (Plate IId).

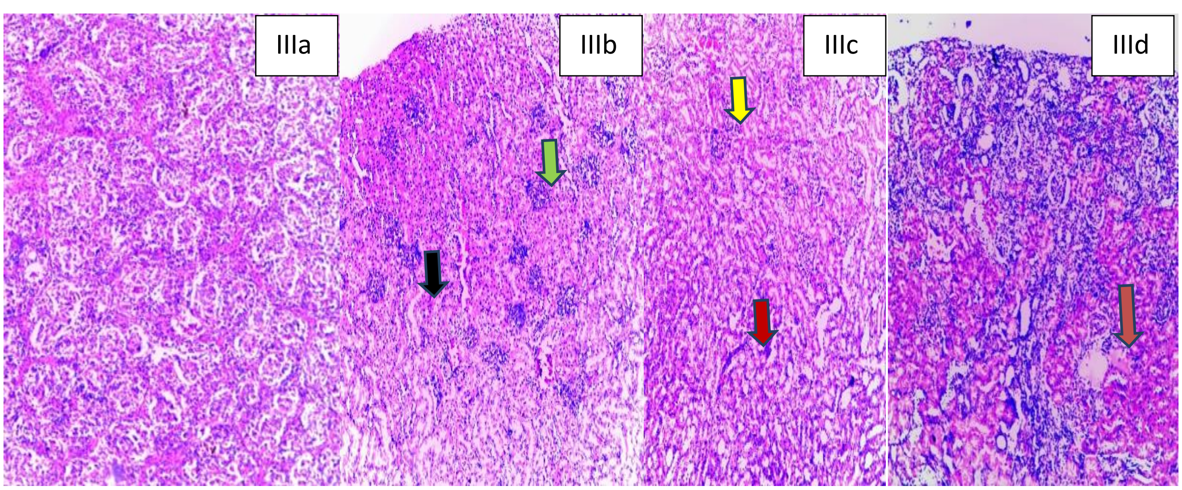

Plate II. shows the liver tissue of ***Oreochromis niloticus*** sampled from Zobe Dam

Plate IIa: Liver tissue indicating normal architecture with normal hepatocyte morphology, vacuolation and hepatic cord arrangement in the control samples without any discernible alterations (control) H&E mag × 400)

Plate IIb: Photomicrograph of *O. niloticus*liver tissue from site A indicating areas of hepatocytes hypertrophy (black arrow), sinusoidal dilatation (yellow arrow) and cytoplasmic vacuolation (blue arrow) (H&E mag × 400)

Plate IIc: Photomicrograph of *O. niloticus* liver tissue from site B, revealed Blood congestion in hepatic parenchyma (black arrow), hepatocyte infiltration (green arrow) (H&E mag × 400)

Plate IId: Site C liver tissues indicating epithelial degeneration (green arrow), distorted central vein (blue arrow) and necrosis (black arrow) (H&E, mag × 400)

Histological investigations of kidney tissues

Kidney tissues revealed normal architecture with normal hepatocyte morphology, vacuolation and hepatic cord arrangement in the control samples without any discernible alterations (Plate IIIa). Plate IIIb shows Bowman's capsule hyperplasia and tubular elongation (site A). Plate IIIc shows renal tubular epithelium shrinkage and hyperplasia (site B). Plate IIId shows cytoplasmic vacuolarization of renal cells (Site C).

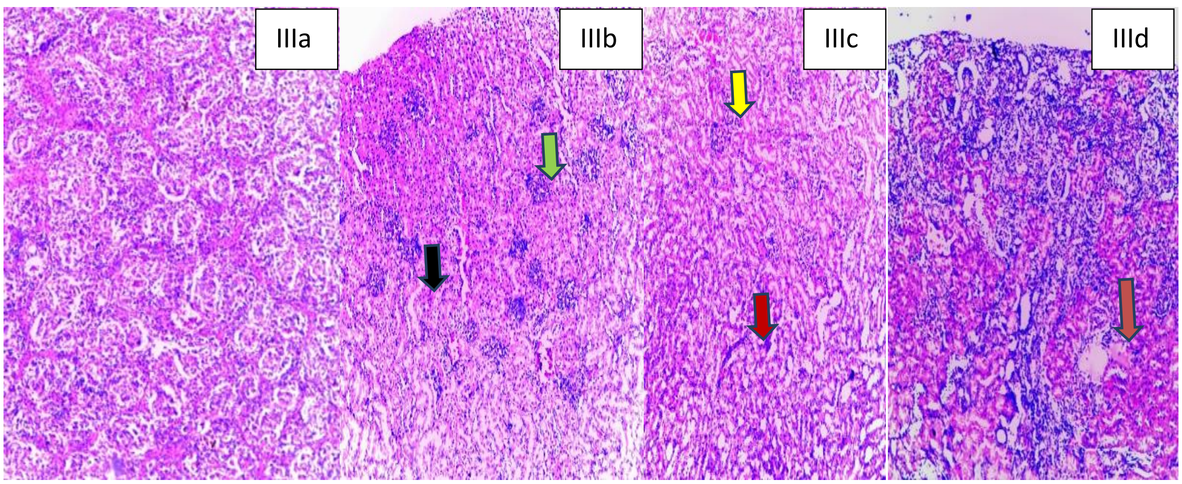

Plate III. shows the kidney tissue of ***Oreochromis niloticus*** sampled from Zobe Dam

Plate IIIa: Photomicrograph of control kidney tissue sample of *O. niloticus* indicating many nephrons, harboring renal corpuscles with glomerulus and renal tubules (H&E mag × 400)

Plate IIIb: Photomicrograph of kidney tissues indicating bowman's capsules hyperplasia (green arrow) and tubular elongation (black arrow) (H&E mag × 400)

Plate IIIc: Photomicrograph of kidney tissues indicating renal tubular epithelium shrinkage (red arrow) and hyperplasia (yellow arrow) (H&E mag × 400)

Plate IIId: Photomicrograph of kidney tissues revealed cytoplasmic vacuolization of renal cells (orange arrow) (H&E mag × 400)

DISCUSSION

Several studies have shown that MPs are ingested by fish (Lusher *et al.*, 2016; Xiong *et al.*, 2018; Hancchi *et al.*, 2019). The result of this study revealed that MPs were present in the fish sampled in Zobe Dam. The differences between the sampling sites were visible, Makera (Midstream) shows the highest number of MPs, probably due to high anthropogenic activities, it may also be due to the intense fishing activities that are carried out in the area, where ropes and fishing nets are used. Higher MP concentration levels could also be due to the density of the polymers. Ecological variables such as feeding mode, habitat, and trophic level are the critical factors that determine and influence of MPs uptake in the fish population from Zobe Dam, tilapia are active swimmers and will readily swim to all parts of the water body to feed. Also, their ability to explore a wider ecological habitat for different feed sources and their surface feeding mode may allow them to ingest more MPs in the water column (Karlsson *et al.*, 2017; Leslie *et al.*, 2017). Aina *et al.* (2020) in the municipal water supply of Southern western Nigeria recorded diverse types of MP in fish as observed in this study. The presence of a small bronchial apparatus in the filter feeders may also enhance their ability to filter and take up smaller MPs from the water column with high efficiency (Collard *et al.*, 2017).

Polyethylene terephthalate, Polystyrene and Polypropylene were the most common polymers found, this may be due to runoff from agrochemical fertilizers, beverage bottles and also from detergents that are used for washing, cosmetics and fibers from clothing and could also be due to floats on the surface water. Oluwatosin *et al.* (2020) in Lagos Lagoon, Nigeria reported Polypropylene and Polyethylene as the most common polymer. Polyethylene terephthalate and Polystyrene were the most dominant polymer type in this study; their main source is to be from the surrounding domestic sewage and land origin (Wang *et al.*, 2019). Similar results were reported by Wang *et al.* (2020) in the surface water of the Manas River basin, in China.

Different Microplastics were found in the July rainy season, especially Nylon than in the dry season, this could be due to stormwater runoff: heavy rainfall can wash microplastics from urban and industrial areas into waterways, carrying them into the Dam. Heavy rainfall can cause soil erosion which leads to the transport of microplastics from land to the Dam. Agricultural runoff: Microplastics from plastic mulch, fertilizers, and other sources can be washed directly into water bodies due to rainfall. In dry seasons, water flow is reduced, and as such microplastics may settle or become trapped in sediment. The result of the abundance of MPs in this study was in tandem with the findings of Kang *et al.* (2015) in Nakdong River, South Korea, and also collaborated with the findings of Fok and Cheung (2015) in Hong Kong. On the contrary, no seasonal variation was observed in Hong Kong (Tsang *et al.*, 2020). Generally, the pollution of microplastics varies geographically with locations.

Histopathological alterations due to exposure to stressors are useful tools to determine the effect of toxicity of xenobiotics in aquatic biota such as fish (Raibeemol and Chitra, 2016). Previous findings have established the histopathological assessment as a reliable biomarker of stress in fish species. Many lesions examined in the gills and liver tissues revealed varying tissue damage that correlates with contact with pollutants such as agrochemicals and domestic effluents as reported by Fu and Wang (2019). These pollutants may be bioaccumulate and biomagnify in a food chain leading to secondary toxicity to aquatic biota such as fish (Abbas *et al.*, 2022). The gill tissues are mainly concerned with respiration among other homeostatic processes such as hormones metabolism and osmo-regulation. The observed hyperplasia and gill epithelial lifting in the tissues of the gills examined could be due to waterborne compounds released from microplastic particles, which might interfere with the gills' function as observed by Bour *et al.* (2018). The blood congestion, mucus secretion, swollen and shortage of secondary lamellar suggest that the gill tissues are exposed to unidentified responses to the toxic irritants which may impair the fish's well-being and possibly productivity (Batel *et al.*, 2016; Wu *et al.*, 2020). Among the obvious adverse impacts as a result of microplastic ingestion in aquatic biota is the disruption of the gill chamber which could influence the process of respiration and osmo-regulation among other functions (Ziccardi *et al.*, 2016; Tosetto *et al.*, 2017). Epithelial thickening and fusion observed in this study could serve as a defense mechanism by the gill filaments and these lead to an increase in the proximity between the immediate environment and tissues as reported by Qiu *et al*. (2015) and Bessa *et al.* (2018). An Increase in mucus secretion in the gills chamber has been reported as a sign of gill necrosis (Raibeemol and Chitra, 2016). The liver of the examined fish revealed cytoplasmic vacuolation, sinusoidal dilatation and hypertrophy which are symptoms of fatty degeneration of the hepatocytes (Baalkhuyur *et al.*, 2018; Wu *et al.*, 2020). Sinusoidal dilatation recorded might be due to the excessive energy required by the fish to get rid of the microplastic toxicants from its body as reported by Aina *et al.* (2020) from southwestern Nigeria. Fish species possess metallothionein (a sequestering agent), however, the epithelial degeneration and melanomacrophages aggregate observed in the liver tissue reaches a threshold in which liver function is impeded, leading to progressive distortion of the liver cells arrangement. MPs have been associated with fish oxidative stress, tissue damage as well as alterations in immune-related gene expression (Usman *et al.*, 2021). After being exposed to MPs, fish suffer from neurotoxicity, growth retardation and behavioral abnormalities. Necrosis and hepatocyte infiltrations in the liver tissues could be attributed to the inability of liver cells to regenerate new cells as reported by Bharti and Rasool (2021). Epithelial degeneration could be attributed to an imbalance between the synthesis rate and the discharge rate of materials in the hepatocytes (Free *et al.*, 2014). Fu and Wang (2019) depicted that microplastics, like other toxicants, induce free radicals generation which damages important macromolecule constituents in the cells, hence, the distortion of hepatocyte functions in the fishes examined is a reflection of the toxic effect of the pollutants. It was also observed that the histological alterations in the liver result in metabolic problems; this is evident as recorded in the fatty granules congestion (Costa *et al.*, 2013; Bessa *et al.*, 2018). The histopathological changes examined in the present findings might have been the results of many biochemical anomalies which could be attributed to the necrosis of hepatocytes and cytoplasmic vacuolation as a result of exposure to the microplastic toxicants. Therefore, the histopathological alterations examined in the present finding indicate that the fish were responding to the effect of the microplastic contaminants which have been also reported to play a vital role as an agent for the entrance to heavy metals in aquatic biota (Ferreira *et al.*, 2020). Fish from all the sampling sites revealed histopathological alterations in the kidney tissues in comparison with the control. The alterations ranged from hyperplasia in the bowman's capsules and tubular elongation, renal tubular epithelium shrinkage, cytoplasmic vacuolization of renal cells, tubular necrosis and granuloma formation and shrunken glomerulus and hematopoietic tissue damage. The kidney, being the one of the organ responsible for osmo-regulation and detoxification is trying to get rid of the xenobiotics eventually leading to the changes of the kidney tissue architecture. Similar observations were reported by Samuel *et al.* (2015) and Ahmed *et al.* (2022) who reported that metals that accumulate in the kidneys of *O. niloticus* damaged the filtering mechanisms and affected its ultra-structure. The severity of the tissue damage was more pronounced in kidney tissues from site A (which harbors most of the domestic and agrochemicals input) which might be adversely impacted by human activities of the surrounding communities as a result of direct waste discharge.

A comparison of data on microplastics from different regions can be challenging due to differences in sampling methods used, size ranges investigated and reporting units that are employed (Harrison *et al.*, 2012). There is also a need to adopt universal criteria for sampling and reporting MPs occurrence data to facilitate comparison.

CONCLUSION

Microplastic occurrence in Zobe Dam, Dutsinma, Katsina State was investigated for the first time. The present finding revealed that *O. niloticus* in Zobe Reservoir consumed varying components of microplastics. Polyethylene terephthalate, Polystyrene and Polypropylene were the most abundant MPs detected among others. The alteration in the architecture of the gill, liver and kidney tissues may be a result of microplastics as observed in the study, or probably other anthropogenic activities which also take place in the dam. MPs accumulate the severity of tissue damage varies from site to site indicating that the water body is experiencing pollution at varying degrees.

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