

Microplastic Contamination in Edible Tissues of Broiler and Free -Range Chickens (*Gallus gallus domesticus*) from Nigeria: Polymer and Morphological Characterisation Using ATR-FTIR and SEM with Comparison of KOH and Fenton Digestion Protocols

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ABSTRACT

Microplastic (MP) occurrence in poultry tissues is an emerging area of research, particularly in sub-Saharan Africa where data on MPs in terrestrial animals remain limited. This study identified and characterized MPs in the liver, heart, and breast muscle of broiler and local chickens (*Gallus gallus domesticus*) in Chikun LGA, Kaduna State, Nigeria and compared KOH and Fenton digestion methods. A total of 30 samples (liver, heart and muscle) were obtained from ten chickens comprising five intensively farmed broilers and five free-range local chickens. The samples were processed using two independent digestion protocols: Alkaline (10% w/v KOH) and Fenton oxidative ($\text{H}_2\text{O}_2/\text{Fe}^{2+}$). Isolated particles were characterized by Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy and Scanning Electron Microscopy (SEM). Five polymer types were identified: polyethylene (PE) 63.2%, polystyrene (PS) and polyethylene terephthalate (PET) 47.4%, polypropylene (PP) 15.8% and polyvinyl chloride (PVC) 10.5% among 19 MP- positive samples. Broiler tissues showed a higher MP occurrence pattern and greater polymer diversity while the liver showed the highest occurrence pattern of MP detection among the tissues analysed. Fenton digestion resulted in greater PET detection among the subsamples analysed and appeared more effective for the digestion of lipid-rich tissues. SEM analysis of 19 MP-positive filter samples revealed four morphological categories: fragments (47.4%), fibers (21.1%), foam (21.1%), and spheres (10.5%). This study provides preliminary evidence of MP occurrence and polymer diversity in the analysed chicken tissues from the study area. Further studies using larger sample sizes and recovery validation are needed to quantitatively evaluate digestion performance and MP occurrence in poultry tissues.

Received: 25 July 2026

Accepted: 25 Aug. 2026

Published: 15 Sept. 2026

Keywords:

Microplastics, Emerging Contaminant, Fenton Oxidation, KOH Digestion, Food Safety, Poultry Tissues

INTRODUCTION

Plastics are important materials in everyday life due to their unique properties such as affordability, multipurpose nature, and durability (Wu et al., 2021), these properties make plastics convenient for human activities and applications. However, their large-scale production, indiscriminate disposal and prolonged degradation pose serious threat to the environment (Dhahirjkar et al., 2022). Over time, larger plastic debris can degrade into smaller particles known as microplastics (MPs), which have infiltrated various components of the environment, including terrestrial ecosystems and animals such as poultry birds (Susanti et al., 2020; Bilal et al., 2023). Microplastics are plastic particles measuring less than 5 mm in size (Thompson et al., 2004; Rodriguez-Seijo & Pereira, 2017). They are generally insoluble in aqueous media, resistant to biodegradation, and capable of persisting and accumulating in soil, water, and air (Bergman et al., 2015). Nigeria, Africa's most populous country, ranks ninth globally in plastic pollution, generating an estimated 2.5 million tonnes of plastic waste annually, of which less than 12% is recycled (Babayemi et al., 2018; Dumbil et al., 2020).

Chicken (*Gallus gallus domesticus*) is one of the most widely consumed meats globally (FAO, 2020) and is highly valued for its nutritional benefits such as its high protein content, essential amino acids, rich source of vitamins and minerals

(Kughur et al., 2019). Chickens may be exposed to MPs contamination independent of the production system, whether intensive or extensive. Contaminated water, feed and soil have been identified as potential pathways through which chickens can ingest MPs (Huerta et al., 2017). Most studies investigating MPs contamination in poultry have focused on the gastrointestinal tracts particularly the intestine, crop and gizzard. However, this study focuses on MPs contamination in internal organs and edible tissues, specifically the liver, heart and breast muscle, which are commonly consumed by humans. Although some studies have reported the accumulation of MPs in chicken tissues (Chen, et al., 2023; Sharma & Vidyarthi 2024). These reports are based on laboratory induced exposure experiments, while data on accumulation resulting from natural environmental exposure remains limited. Direct ingestion and subsequent transfer through the food chain have been identified as important pathways for MPs accumulation in organisms including humans (Yu et al., 2025). For example, Bilal et al., (2023) reported 1,227 MPs in the crop and gizzard of broilers chickens from Pakistan with polyvinyl chloride (PVC) accounting for 51.2%, low-density polyethylene (LDPE) 30.7%, polystyrene (PS) 13.6%, and polypropylene (PP) 4.5% as identified using FTIR, and KOH digestion method for MP isolation, fragment shaped MPs was the most abundant morphology in the crop and gizzard, similarly, Leon

et al., (2022) focused primarily on the morphological characterization of MPs, identifying film, pellet and fragment shaped particles in the gizzard and intestine of domestic chickens. However, chemical characterization of the particles was not performed, and MPs were isolated using KOH digestion method. Similarly, Wu et al., (2021) detected polyethylene (PE) and polypropylene (PP) in poultry manure and feed using FTIR microscopy, while Maganti & Akkina (2023) characterized PET, PP, and PVC in animal feed using FTIR and field emission scanning electron microscopy (FESEM). Despite this growing body of evidence, data on MPs occurrence in edible internal organs such as the liver, heart, and breast muscle, following natural environmental exposure remains scarce (Sharma & Vidyarthi 2024). Laboratory-based exposure studies have demonstrated that PS-MPs can impair the liver-gut axis (Yin et al., 2023), affect meat quality (Chen et al., 2023), and induce gut microbial dysbiosis (Li et al., 2023; Zou et al., 2023). Furthermore, MPs have been detected in human blood (Lesile et al., 2022), lungs (Jenner et al 2022), placenta (Ragusa et al., 2021), and breast milk (Ragusa et al., 2022). Yalwaji et al., (2022) identified limited data on MPs contamination in Nigerian terrestrial animals, highlighting the need for country-specific investigations. Furthermore, there is also a methodological gap concerning the comparative performance of alkaline (KOH) and Fenton reagent (oxidation) digestion methods for microplastics extraction from biological tissues.

Alkaline KOH digestion is widely used for tissue digestion because it effectively removes organic matrices while generally preserving the integrity of many polymer types (Bilal et al., 2023; Thiele et al., 2019). Fenton oxidation ($\text{H}_2\text{O}_2/\text{Fe}^{2+}$) provides an alternative digestion approach and may be particularly suitable for lipid-rich biological tissues (Benevides & Geovanna 2024; Yu et al., 2025). However, the comparative performance of these two digestion methods for the extraction of MPs from edible poultry tissues has not been

adequately evaluated. Therefore, this study aims to identify and characterize MPs in liver, heart and breast muscle of chickens and also evaluate their occurrence in edible tissues, while comparing the effectiveness of two digestion protocol. The findings are expected to contribute to baseline data on microplastic occurrence in edible chicken tissues in the study area.

MATERIALS AND METHODS

Materials

All chemicals and reagents used during this research were used without further purification. Potassium hydroxide (KOH $\geq 90\%$ purity), hydrogen peroxide (H_2O_2 30% v/v), Tetraoxosulphate (VI) acid (H_2SO_4 98% purity), sodium chloride (NaCl), ethanol (99.9%), iron (II) tetraoxosulphate (VI) heptahydrate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$). Chemicals and reagent were all purchased from Haddis scientific, Zaria, Nigeria.

Study Area and Sample Collection

The study was conducted in Chikun Local Government Area, Kaduna State, Nigeria (lat. $9^\circ 56'N$ – $10^\circ 53'N$; long. $6^\circ 48'E$ – $7^\circ 48'E$; area $\approx 4,690 \text{ km}^2$) (Adewuyi & Olofin 2018). A total of 30 tissue samples (liver, heart and breast muscle) were obtained from ten chickens. The samples comprised five broilers (*G. g. domesticus*, improved breed, 6–8 weeks old), of which two were obtained from Farm A and three from Farm B in Ungwar Boro community and five local free-range chickens (4–6 months old) of which three were obtained from Maraban Rido Market, and two from Sabo Market. The chickens were euthanized and the liver, heart, and breast muscle tissues were collected using stainless instruments rinsed with ethanol. Each tissue sample was individually wrapped in pre-cleaned aluminum foil, placed in labelled glass beakers, transported on ice, and stored at -20°C until analysis (Bilal et al., 2023; Masura et al., 2015).

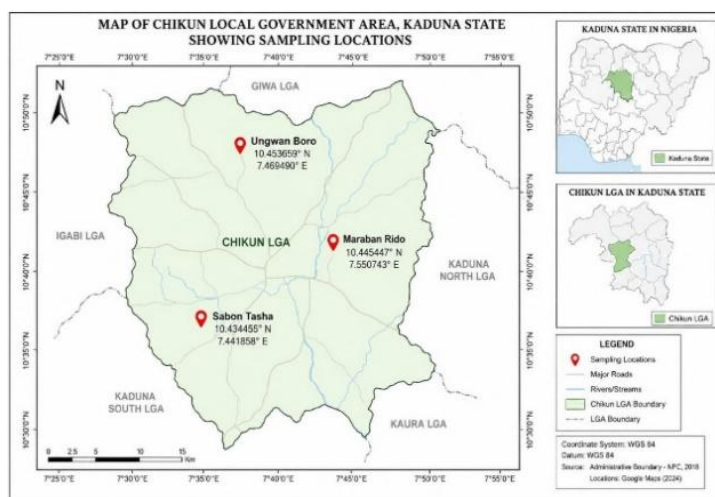


Figure 1: Map of Chikun LGA in Kaduna State Showing Locations Where Samples were Collected

Tissue Digestion

Two digestion methods were applied to the 30 samples: 15 samples comprising liver, heart and muscle tissues from two broilers and three local chickens were processed using KOH digestion, while the remaining 15 samples comprising three broilers and two local chickens were processed using Fenton digestion. The samples were randomly assigned to the two digestion methods.

Alkaline Digestion

Each tissue sample was weighed and transferred into a 250 mL conical flask. The samples were reacted with 10% (w/v) KOH at a sample to solution ratio of 1:5 and incubated in a water bath at 50°C for 8–10 days until complete tissue dissolution. For lipid-rich liver samples, ethanol was added at a ratio of 1:4 (v/v) to redissolve the saponified gel and improve MP recovery (Dawson et al., 2020).

Fenton Digestion

Each weighed tissue sample was treated with 30 mL of 0.05 M $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ (acidified with 3 mL conc. H_2SO_4) and 30 mL 30% (v/v) H_2O_2 . The mixture was allowed to react for 5 min at room temperature and subsequently transferred to water bath maintained at 50°C . After 1 hour, an additional 30 mL of H_2O_2 was added, and digestion was continued until complete tissue dissolution, which was achieved after 10–12 days (Yu et al., 2025; Benevides & Geovanna 2024; Masura et al., 2015). The relatively prolonged digestion period observed in this study was primarily due to the modification of the digestion procedure, the temperature and water bath were selected to minimize the potential alteration of polymer integrity, samples were covered with aluminum foil all through the digestion process to minimize contamination. Density separation was performed using saturated NaCl (1.2 g/mL, 1:3 v/v, shaker 150 rpm $\times$ 30 min, 24 h settle); the floating supernatant was filtered under vacuum through 0.45 μm and 2.5 μm Whatman® filter papers. For samples processed using Fenton digestion, an 11 μm pre-filter was used to prevent clogging of the filter paper. The filter papers were kept in a desiccator until further analysis.

Microplastic Identification and Characterization

Microplastic identification and characterization were primarily qualitative, based on polymer identification using ATR-FTIR spectroscopy and morphological examination using Scanning Electron Microscopy (SEM). Particles retained on the filter papers were analysed using an Agilent Cary 630 ATR-FTIR spectrometer equipped with a diamond/ZnSe ATR accessory; $650\text{--}4000\text{ cm}^{-1}$; 4 cm^{-1} resolution; 16 scans per measurements; ATR crystal was cleaned with isopropanol between measurements to minimized cross contamination. Polymer identification was done using the instrument's IR library and published reference spectra for microplastic. (Joint Research Centre 2022;

Veerasingam et al., 2021; Tikey & Upadhyay 2021). Surface morphology was examined using a Thermo Scientific Axia ChemiSEM, (2023 model, USA) operated at 3.00 kV and $2,000\times$ magnification under high vacuum conditions. The SEM images were acquired with (HFW = 104 μm , scale bar = 20 μm). SEM analysis was performed on 19 of the 30 samples. The SEM images were interpreted alongside images obtained from two procedural blanks to assess potential laboratory contamination. To minimize contamination during sample processing, all solutions and distilled water were prefiltered through 0.45 μm Whatman® filter papers, laboratory benches were wiped with ethanol, samples were covered with aluminum foil during processing and analysis procedures. Two procedural blanks (digestion without tissue) and four blank filter papers were included as contamination controls. No polymer was identified in procedural blanks following ATR-FTIR analysis. Consequently, no blank correction was applied to the results during data interpretation.

Data Analysis

The data obtained during this study were subjected to Microsoft Excel to obtain percentages and charts.

RESULTS AND DISCUSSION

Polymer Identification

Chemical composition of the isolated particles was identified using ATR-FTIR spectroscopy with all spectral interpretation background corrected against procedural blank for each digestion method. Polymer identification was based on diagnostic peaks confirmed by comparison with equipment's spectral library and published reference spectra in MPs literatures. Five polymer types were identified polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET) and Polyvinyl chloride (PVC). The polymers detected from the FTIR spectra are summarized in Table 1.

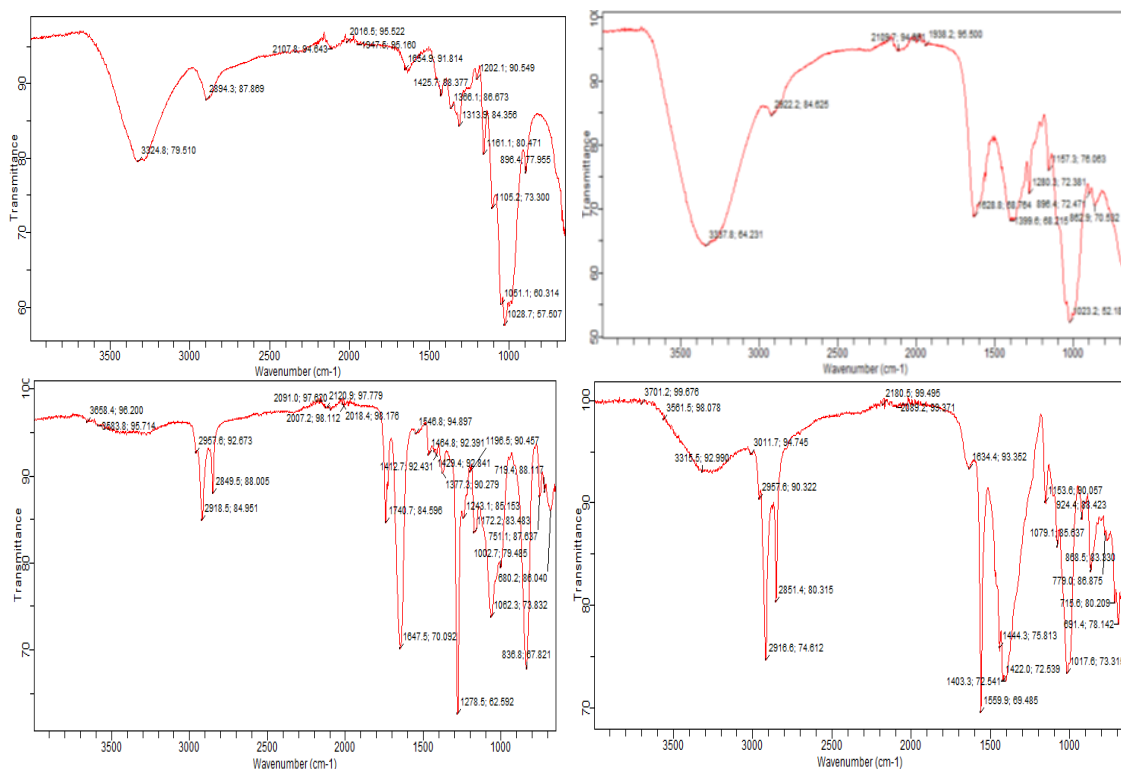


Figure 2: Shows ATR-FTIR Spectra of Procedural Blanks (Fenton and KOH) and Some Selected Samples

The various polymers types identified in the isolated samples are summarized in Table 1. ATR-FTIR showed characteristic absorption peaks of five polymers: polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polystyrene (PS) and polyvinyl chloride (PVC).

Table 1: Summary of Various Polymers Types Identified in the Isolated Samples

Polymer type	Absorbance peak (cm ⁻¹)	Functional group	Spectral Range
PE	2916/ 2853	C-H stretching Alkane	2840-3000
	1464	C-H bending Alkane	1465-1500
	719	C-H bending Alkane	665-730
PP	2918	C-H stretching Alkane	2840-3000
	2957	C-H stretching (CH ₃) Alkane	2840-3000
	1377	C-H bending (CH ₃)	1375-1450
PET	1740	C=O stretching Ester	1720-1750
	1243	C-O-C stretching Ester	1220-1310
	1028	C-O-C bending Ester	1100-1210
PS	3011	C-H stretching Aromatic ring	3000-3100
	1628	C=C stretching Aromatic benzene ring	1620-1650
	697	C-H bending Aromatic	665-730
PVC	2899	C-H stretching Alkane	2840-3000
	1105/1161	C-Cl/C-C stretching	
	657	C-Cl bending	550-850

Table 2: Polymer Distribution Identified in the Various Tissues

Digestion	Farm/Market	Breed/Tissue	Polymers Identified
Fenton Digestion	A ₂	Broiler	PET/PE/PS
		Liver	PET/PE
		Heart	PET/PE
		Muscle	
	B ₂	Liver	PE/PP
		Heart	PET/PE
		Muscle	PS
	B ₃	Liver	PET/PE/PS
		Muscle	PET/PE/PS
	Market	Local	
	Maraban Rido(LM ₂)	Heart	PET
	Sabo LS ₃	Liver	PVC/PET
		Heart	PET
Alkaline Digestion	A ₁	Broiler	
		Liver	PE
		Heart	PE/PS
	B1	Liver	PS/PVC
	Market	Liver	PS/PE
	Sabo LS ₁	Heart	PP
	Sabo LS ₂	Liver	PS/PE
		Heart	PP
	Maraban Rido LM ₁	Liver	PS/PE

MPs were detected in 19 of the 30 samples analyzed. In terms of frequency of detection among the MPs positive samples, polyethylene (PE) 63. 2% (12/19) was the most observed polymer detected, followed by polystyrene (PS) and polyethylene terephthalate (PET) each detected in 47.4% (9/19) of the samples. Polypropylene (PP) 15.7% (3/19) and polyvinyl chloride (PVC) 10.5% (2/19) of the positive samples occurring as the least. Different studies have reported varying polymer types in birds. The findings of this study align with common polymers identified in different studies, although their relative frequencies differ across studies. Bilal et al (2023) reported similar polymers but at different occurrence PVC (57.2%), PE (30.7%), PS (13.6%) and PP (4.5%) in crop and gizzards of farmed chickens. Shifa & Mostafa (2026) also identified PET, PE, and PP in the liver, breast muscle and gizzard of poultry birds and feeds. Similarly, Bessa et al (2019) identified polyethylene, polypropylene, polyacrylonitrile and polyacrylate as polymers present in penguins from Antarctic region.

Tokunaga et al (2023) reported PP and PE in the lungs of rock doves while ethylene-vinyl acetate (EVA) was detected in barn swallows. Tatli et al (2025) reported 50% ethylene vinyl acetate (EVA), 20% polyamide (PA), 15% PE and halogen-free flame retardant as the polymers (15%) among the polymer types identified in various bird species in Turkey. The variation in polymer types identified in different studies could be attributed to the difference in plastic materials present in the birds' feeding medium (Rodriguez- Seijo & Pereira 2017). The occurrence of PE and PP in environmental matrices may be due to their widespread use in packaging materials such as plastic bags and containers, while PET may be attributed to plastic bottles, PVC is widely used in plastic pipes, hoses and PS is used in single use packaging materials such as cups, plates and insulating materials. Overall, the findings provide preliminary evidence of MPs like polymer within the terrestrial food chains and highlight the potential for environmental MPs to enter edible poultry tissues.

SEM Morphology Characterization

Scanning Electron Microscope (SEM) was used to characterize the morphology and surface changes of MPs after digestion. All sample images (panels c–f) are interpreted

relative to procedural blanks (panels a–b). Features absent in both blanks and displaying distinct morphological characteristics are classified as MPs.

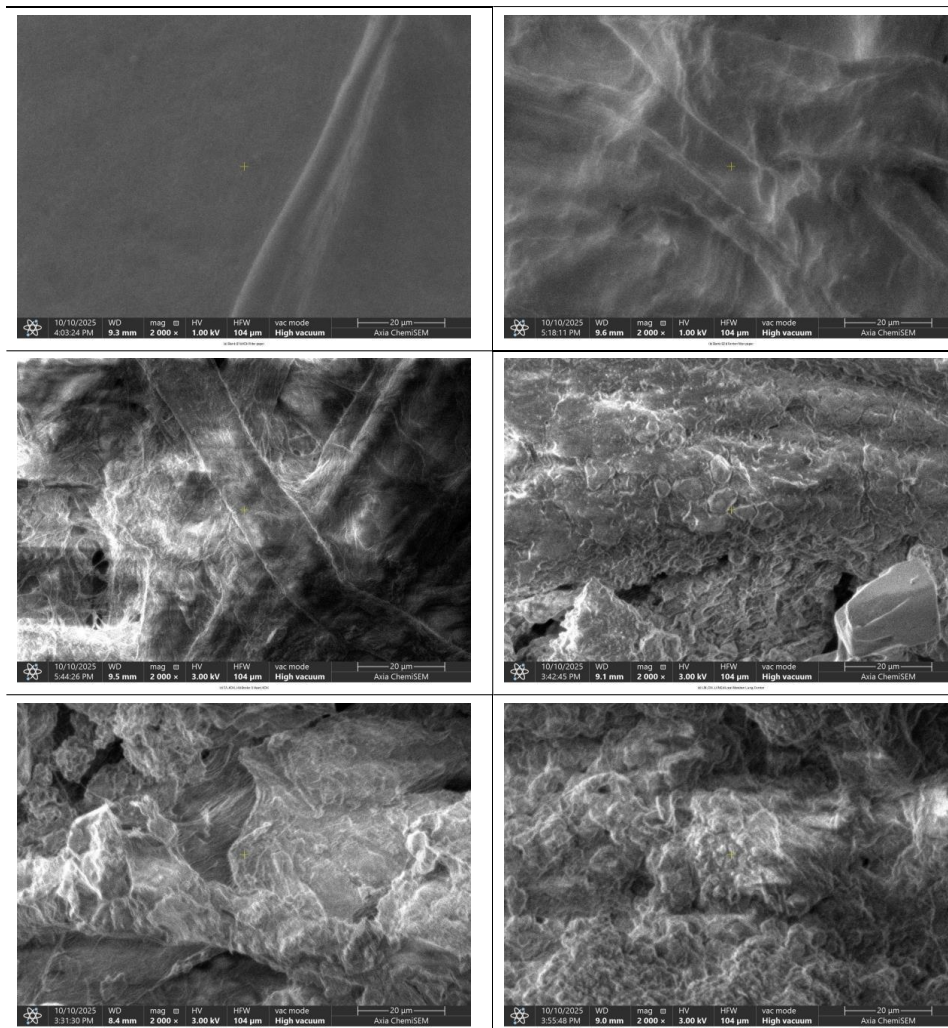


Figure 3: Scanning Electron Microscopy (SEM) Images of Procedural Blanks and Selected MP-Positive Filter Samples

(a) Micrograph of procedural Blank B1 KOH (BLANK_B1_2000X), (b) Micrograph of procedural Blank B2 Fenton (BLANK_B2_2000X), (c) FA_KOH_H — Broiler

Farm A Heart, KOH. (d) LM_KOH_H — Local Maraban Heart, KOH. (f) FB_OXI_H — Broiler Farm B Heart, Fenton.

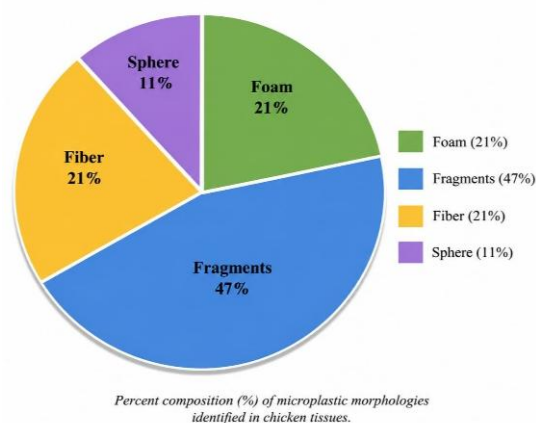


Figure 4: Morphology Distribution of Microplastics

Four MP morphological categories were identified (fragment, fibre, foam and sphere) across 19 SEM images, referenced against procedural blanks. The morphology of MPs found in animal tissues are primarily determined by their environmental source and degree of degradation they undergone in the environment.

Fragment 47.4% (9/19): were the dominant morphology observed across tissues of the broiler breed, characterized by angular, rough cracks, irregular shapes, and prominent surface cavities (Cowger et al., 2020; Soliz et al., 2024). Fibre 21.1% (4/19): appeared as elongated structure and large irregular surfaces (Cowger et al., 2020; Soliz et al., 2024) was observed more in the liver and heart of the local breed which may be attributed to synthetic textile or clothing sources. Their relatively low-density may facilitate aerial transport and dispersal in terrestrial environments (Bhattacharjee et al., 2024) facilitating systematic vascular transport and occurrence in other internal tissues (Dong et al., 2024). Foam 21.1% (4/19): characterized by rough and porous surfaces (Soliz et al., 2024). Foam MP shaped particles were observed in the heart and liver of both breeds. Their occurrence may be associated with exposure to single use packaging and insulating materials indicating polystyrene (Turner, 2020). Sphere 10.5% (2/19) appeared as bead-like particles. Their morphology may indicate a possible primary source of MPs, such as industrial resin pellets (Rani, 2024). Spherical MP-like particles were observed in the heart and liver of the local breed (LLsKOH and HLsOX), which may have originated from industrial resin pellets or other spherical plastic materials present in the environment. Such materials have been reported as potential sources of plastic pollution in Nigerian aquatic and terrestrial environments (Babayemi et al., 2018). The findings of this study align with previous studies which have reported shaped based differences in MP occurrence between farmed and free ranging birds. Bilal et al (2023) identified fragment as the most abundant morphology, followed by fibres, sheets and foam in the crop and gizzard of farmed chickens. Zhao et al (2016) reported fibres (87.3 %) and fragments (22.7%) in terrestrial birds in China. Similarly, Weitzel et al (2021) documented fibres (98%) and fragments (2%) in the gastrointestinal tract of seaside sparrows (*Ammodramus maritimus*) along the Mississippi Gulf Coast. Deonizak et al. (2022) also reported fibres (84%) as the dominant morphology in the gastrointestinal tract of predatory birds. Although Tokunaga et al., (2023) observed fragments as the dominant morphology in wild birds from Japan. Most studies have identified fibres and fragments as the two primary MP morphologies in avian species (Carrasco et al., 2025). The relatively high proportion of fragment shaped MP observed in this study may indicate secondary

MPs generated through weathering and fragmentation of large plastic materials within breeding environments.

Digestion Method Comparison

This study did not perform recovery validation using spiked microplastics. Therefore, the efficiency of digestion and extraction procedure could not be quantitatively assessed. Visual inspection of filters presented in Figure 5 revealed alkaline digestion with 10% KOH produced clearer filters suggesting more complete removal of organic matter. Digestion efficiency is generally assessed based on the absence of residual debris and organic matter (Fiore et al., 2024). However, Fenton oxidation appeared to be more effective in breaking down tissues with high lipid content than alkaline digestion. The use of KOH can result in saponification which may complicate the digestion process as also observed by (Yu et al., 2025). The relatively prolonged digestion period observed in this study was primarily due to modification of the digestion procedure. This was done to deliberately facilitate gradual digestion of the biological tissues while minimizing the potential degradation of the polymer particles due temperature. Although, higher temperatures may accelerate the breakdown of organic tissues, excessive heat may potentially affect the characteristics of the polymer types present (Karami et al., 2017). Importantly, Fenton digestion resulted in greater detection of polyethylene terephthalate (PET) across the examined tissues, whereas PET detection was limited under alkaline conditions as observed in Table 2. This finding aligns with previous studies (Huang et al., 2026; Lui et al., 2025) which reported that Fenton reagent does not alter the chemical structure of PET. In contrast, alkaline conditions may affect PET polymer through hydrolysis of its ester linkages, producing water-soluble monomers such as terephthalic acid and ethylene glycol, thereby hindering the recovery of PET polymer intact. The findings of this study indicate that alkaline digestion using 10% KOH was effective for the removal of organic matter, as evidenced by the absence of residual material on filters, consistent with the findings of Fiore et al (2024). However, Fenton oxidation appeared to be a more suitable alternative for fatty biological tissues in this study, providing effective tissue digestion while allowing greater detection of PET polymers. These findings are qualitative and are based on small sample size without recovery validation. Further studies involving larger sample sizes are needed to evaluate digestion efficiency and to determine the suitability of different digestion methods based on tissue composition and target polymer type in microplastic research.

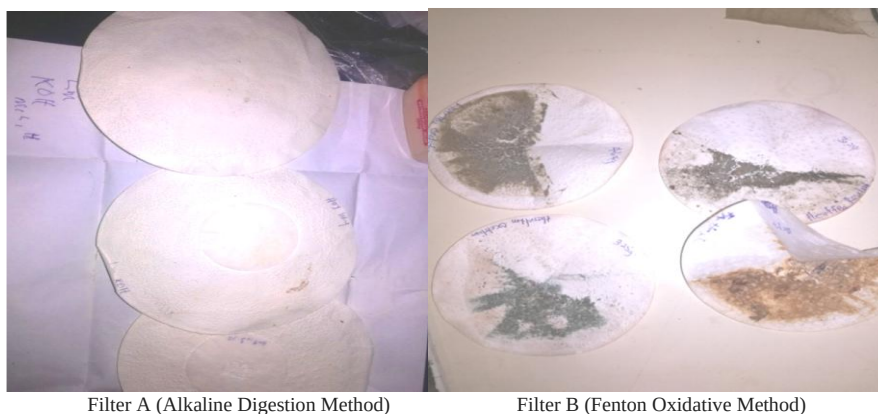


Figure 5: Filter Papers for the Different Digestion Protocols

Microplastic Occurrence Across Tissues and Breed Comparison

This study was limited to the identification and characterization of MPs. Therefore, quantitative assessment of MP contamination was not conducted. The findings of this study are discussed in terms of microplastic occurrence, detection frequency and polymer diversity. MPs like particles were detected in 19 of the 30 samples analyzed. As shown in Figure 6, The liver exhibited the highest occurrence of MPs-like particles, with 90% (9/10) of the samples testing positive, followed by the heart at 70% (7/10) while the muscle showed the least occurrence at 30% (3/10). Liver: the liver exhibited the highest frequency of MP-occurrence and polymer diversity among the tissues examined. This finding is consistent with earlier studies. Collard et al (2017) reported a high occurrence of MPs in the liver of anchovies (*Engraulis encrasicolus*). Similarly, Haave et al (2021) observed that 3 out of the 9 animals (birds and fishes) examined, the liver showed the highest level of MP detection while MPs were not detected in the muscle tissues. Shifa and Mostafa (2026) also reported the liver as the major site of MPs detection after the gizzard. The relatively high occurrence of MP-like particles and polymer diversity observed in the liver maybe related to the liver role as a primary detoxification and filter organ, responsible for processing contaminants from the blood, thereby explaining the observed polymer diversity (Bhattacharjee et al., 2024; Dong et al., 2024). However, the

present study did not quantify MPs. Therefore, these observations are detection frequency and polymer diversity rather concentration. Heart: MPs were also detected in the heart, indicating that MPs-like particles may occur in tissues associated with the circulatory system. This observation aligns with experimental studies reporting that MPs can interact with circulating cells and may subsequently be detected in organs and tissues including the heart (Dong et al., 2024; Zhang et al., 2022). However, evidence of MP occurrence in the heart under natural environmental conditions remain limited. Therefore, the detection of MPs in the heart in this present study provides an observation that requires further investigation. Muscle: The breast muscle exhibited the lowest occurrence of MPs, with all positive samples originating from the broiler breed. the low detection frequency of MPs in the muscle tissue may be attributed to the liver's role in detoxification and excretion (Chen et al., 2023) which may explain the detection of MPs in chicken waste reported in previous studies (Wu et al., 2021). In addition, factors such as body size and weight of the birds may influence MPs occurrence and distribution within tissues (Tatli et al., 2025; Valencia-Castaneda et al., 2024). However, the present findings are based on MP detection frequency and the relationship between these factors and the actual concentration of MPs within tissues requires further qualitative assessment.

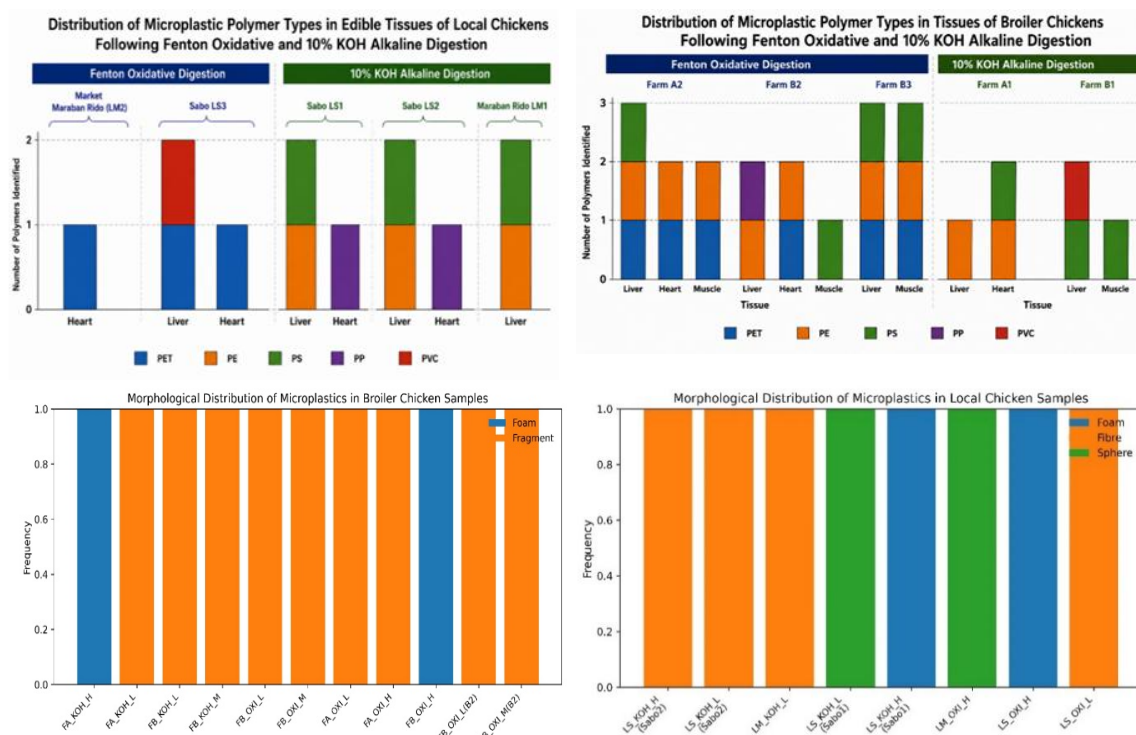


Figure 6: Polymers Identified and Morphological Difference Identified Across Tissues of Both Breeds

Breed Comparison of Microplastic Occurrence and Polymer Diversity

Due to the qualitative nature of this study, MP occurrence is discussed based on detection frequency rather than particle concentration. As shown in Figure 6, the broiler breed (11/15) exhibited a higher occurrence of MPs across the examined tissues than the local breed (8/15). This disparity may be attributed to the difference in body size and weight which may influence MP retention and distribution within biological tissues (Tatli et al., 2025; Valencia-Castaneda et al., 2024).

Although feed contamination was not assessed in this study, previous studies have reported that exposure to contaminated feed and water represents an important pathway for MP exposure in farmed chickens (Wu et al., 2021; Shifa & Mostafa 2026). As shown in Figure 6, the broiler breed also showed greater polymer diversity with polyethylene terephthalate (PET) and polyethylene (PE) being the most frequently identified polymers. This pattern may be attributed to widespread use of plastic packaging materials for poultry feed and plastic-based poultry equipment used in intensive

breeding. However, polystyrene (PS) and polyvinyl chloride (PVC) were detected in liver samples of LFaKOH, MFb3KOH, and LFbKOH, suggesting possible exposure to diverse plastic sources within the feed production process (Maganti & Akkina 2023). However, since feed and environmental sources were not directly assessed, the specific sources of these polymers cannot be confirmed. In contrast, the local breed showed a lower frequency of microplastic occurrence across examined tissues (8/15), despite their free-ranging feeding behavior. This observation may be related to differences in body size and weight between the two breeds. The local chickens examined in this study were 4-6 months old but were generally smaller in size than the broilers, which attain a larger body size and weight within few weeks of breeding. However, local chickens are predominantly reared in rural areas (Duniya et al., 2015) where plastic pollution is generally lower than urban environments. However, differences in rearing environments alone cannot be established as the cause of the observed pattern. PE and PS were the most frequently identified polymers in the local breed, which may indicate exposure to plastic packaging materials commonly found in feeding and surrounding environments. Morphological analysis displayed in Figure 6, revealed fragments (9/11) dominated the broiler breed while fibre (4/8) were more common in local breeds. This finding aligns with previous studies (Alvarez et al., 2018; Jeong et al., 2023; Bhattacharjee et al., 2024) which documented higher occurrence of fibre-shaped MPs in free ranging birds, potentially due to their feeding behaviours and increasing exposure to environmental fibres. The relatively low density of some plastic fibres may facilitate their transport through atmospheric and terrestrial pathways, thereby enhancing bioavailability to free ranging birds (Carrasco et al., 2025). In contrast, the predominance of fragments in farmed chickens has been reported in previous studies (Wu et al., 2021; Bilal et al., 2023), and may be associated with exposure to plastic materials used in commercial feed packaging and poultry equipment. Such materials may introduce fragment shaped plastic particles to intensive feeding environments (Wang et al., 2022). However, these proposed sources remain tentative because the present study did not assess feed, water and other environmental matrices.

CONCLUSION

This study provides preliminary evidence of environmentally-acquired microplastic-like polymer occurrence in the edible liver, heart, and breast muscles tissues of sampled broiler and free range local chickens from Chikun Local Government Area, Kaduna State, Nigeria. Using dual digestion protocol, ATR-FTIR polymer identification and SEM morphological analysis. Five polymer types polyethylene (PE), polyethylene terephthalate (PET), polystyrene (PS), polypropylene (PP) and polyvinyl chloride (PVC) were identified. PE and PET were more frequently detected in broilers, while PE and PS were more common in local chickens indicating differences in the types of polymer detected between the two rearing systems. The liver showed the highest microplastic occurrence pattern, followed by the heart and breast muscle suggesting that MP-like particles may occur beyond the gastrointestinal tracts in the sampled birds. Fenton oxidative digestion resulted in greater PET detection and appeared to be more effective for the recovery of PET polymers and dissolving lipid-rich tissues than alkaline digestion under the conditions used in this study. SEM morphological analysis revealed that fragments (47%) were the predominant morphology followed by fibres (21%), foam (21%) and spheres (11%). The detection of PET and PS in edible tissues

highlights the need for further research to better understand their occurrence, sources and potential relevance to dietary exposure and health effect. However, this study was exploratory and qualitative in nature, together with the relatively small sample size and lack of quantitative analysis, limits the generalizability of the findings beyond the sampled birds and study area. Future studies should include larger sample sizes, quantitative assessment of particle abundance and direct assessment of potential sources of microplastic occurrence in poultry tissues could be considered.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the laboratory technologist of Department of Chemistry, Ahmadu Bello University, Zaria for ATR-FTIR instrumentation and Department of Mechanical Engineering, University of Nigeria, Nsukka for SEM analysis for their analytical support.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

INFORMED CONSENT

All authors read and approved the final manuscript.

ETHICAL APPROVAL

Not applicable

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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