Turkish Journal of Bioscience and Collections,
TJBC 2025, 9 (2): 65–75

https://doi.org/10.26650/tjbc.1745221

Submitted 23.07.2025
Revision Requested 29.07.2025
Last Revision Received 15.08.2025
Accepted 16.08.2025
Published Online 29.08.2025

Turkish Journal of Bioscience and Collections

Research Article

Open Access

Health Risks and Environmental Threats of the Food Prepared on Plastic Cutting Boards

Oya Özuluğ [1], İrem Şarlak [2], Fahrettin Sarcan [3], Özgün Deniz Yürekli [2], Nilgün Kaya [4] & Doğan Çetin [2]

[1] İstanbul University, Faculty of Science, Department of Biology, İstanbul, Türkiye
[2] İstanbul University, Institute of Graduate Studies in Sciences, Department of Biology, İstanbul, Türkiye
[3] İstanbul University, Faculty of Science, Department of Physics, İstanbul, Türkiye
[4] Çanakkale Onsekiz Mart University, Faculty of Science, Department of Biology, Çanakkale, Türkiye

Abstract

Objective: This study investigated the number and size of microplastics (MPs) found in foods prepared by chopping on commercially available and widely used plastic cutting boards. It was revealed that when plastic cutting boards are used for chopping, they introduce MPs into foods in quantities that pose a health risk and contribute to the rapid increase in MPs in environmental pollution.

Material and Methods: The kitchen chopping process was simulated as the cutting of the meat with 100 knife strokes on white (low-density polyethylene) and pink plastic (a mixture of several plastics) cutting boards. Chopped food was dissolved in 10% potassium hydroxide (KOH) solution. The samples were filtered using a vacuum filtration system with 1.6 µm pore size glass fiber filters and left in Nile red for 10 min. Incorporating a 470 nm LED light, images were taken using a camera at ISO 100 with an orange filter. For the automatic quantification and characterization of the shape and size of the fluorescent MPs, ImageJ software (the Microplastics Visual Analysis Tool MP-VAT 2.0) was used.

Results: A total of 7413 MP pieces of fiber, fragment, and particle types, along with their respective diameters, were identified as a result of the experiments. This means that for every stroke of the knife made on the plastic cutting board, 12 pieces of MP are released into the food. When these pieces were classified by size, it was determined that pieces in the “50-110 µm” size range, considered potentially hazardous to health, constituted 44.3% of the total MPs. The total area of the 7413 MPs particles obtained from the experiment was calculated to be 225359 µm^2.

Conclusion: Our study has shown that foods prepared on plastic cutting boards contain microplastics in sizes that pose a risk to human health. Furthermore, cutting on plastic cutting boards increases the amount of MPS particles, which never decompose in nature, thus endangering the environment. The best way to protect both human health and the environment is to identify the source of the problem and take action to stop the use of plastic cutting boards.

Keywords Human health · Microplastics · Sanitation · Clean water

Citation: Özuluğ, O., Şarlak, İ., Sarcan, F., Yürekli, Ö. D., Kaya, N. & Çetin, D. (2025). Health Risks and Environmental Threats of the Food Prepared on Plastic Cutting Boards. *Turkish Journal of Bioscience and Collections*, *9*(2), 65-75. https://doi.org/10.26650/tjbc.1745221

Corresponding author: İrem Şarlak iremsarlak@gmail.com

Introduction

The primary reason for plastics being present in many areas of our lives is their wide range of applications and their high resistance to deterioration. Despite their high resistance, when exposed to factors such as UV radiation from sunlight, physical abrasion, the oxidative effect of the atmosphere, and the hydrolytic property of seawater, they can become brittle and break down into smaller pieces, dispersing into the environment when they reach the end of their lifespan or are turned into waste (Moore, 2008; Rainieri & Barranco, 2019; Tirkey & Upadhyay, 2021). It is also known that although plastics break down into various sizes of small particles or monomers due to external factors, none of the commonly used synthetic polymers can be biologically degraded, and as a result, they accumulate in the natural environment rather than decompose (Barnes *et al.*, 2009; Geyer *et al.*, 2017). Plastic particles ranging from 1 µm to 5 mm in size are considered to be microplastics (MPs). Detecting and identifying these MPs, which are found in nature and even in food, can be quite challenging. To overcome these challenges and identify MPs, many methods have been developed (Besley *et al.*, 2017; Lopes *et al.*, 2022; Lusher *et al.*, 2017; Scopetani *et al.*, 2020). Increasing research has shown that MPs can be found in various areas such as oceans, lakes, rivers, fish, aquatic and terrestrial invertebrates, and soil (Çullu *et al.* 2021; Ivleva *et al.*, 2017; Pongon & Owen 2020; Xie *et al.*, 2023; Zheng *et al.*, 2023). It is stated that in Europe, a 30% recycling target is aimed at plastic packaging (Plastics Europe, 2023). The existence of efforts and plans for the control and management of large-sized plastics through recycling methods is promising. However, it is difficult to hold the same hope for MPs that are already found in soil, oceans, rivers, all habitats, and even in human feces (Arthur *et al.*, 2009: Andrady, 2017: Yadav *et al.*, 2022). Old and used MPs that accumulate in nature can absorb organic pollutants and heavy metals. This situation increases the harm to living organisms (Dong *et al.*, 2020; Gao *et al.*, 2019; Koelmans *et al.*, 2013; Liu *et al.*, 2019; Wagner *et al.*, 2018; Zhou *et al.*, 2018).

The presence of MPs, especially in human feces, is evidence of the ingestion of MPs for various reasons. In a study evaluating approximately 15% of the calorie intake of Americans, the annual consumption of MPs by an average person is estimated to range from 39,000 to 52,000 particles, depending on age and gender (Cox *et al.*, 2019). When inhalation is included in these estimates, the number of particles intakes rises to around 74,000 and 121,000 (Cox *et al.*, 2019). What could be the sources of MPs that we do not want in our bodies but ingest through various means? The presence of so many MPs in feces indicates that we not only obtain MPs from the air but also from our food. If there is a possibility of MPs being present in every food, from ready-made meals to the food we prepare in the kitchen, finding out how MPs are incorporated into our food and which processes introduce plastic into our food would be the first step in solving the problem.

MPs were found in food products such as meat, chicken, and fish that were cut using plastic cutting boards commonly used in food retail businesses (De-la-Torre, 2019: Habib *et al.*, 2021; 2022). In some studies, it has been demonstrated that chopping on plastic cutting boards results in the contamination of food with plastic using a plastic cutting board in a laboratory setting. Mixing of the MPs with the food was achieved, and unlike previous studies, we quantified the numbers, sizes, types, and areas covered by the MPs introduced into the food during the chopping process. The objectives of this study were: *i*) to determine the number and characteristics of MPs that mix with the food when the chopping process is performed using a plastic cutting board and to identify the percentage of fragments that pose a health risk; *ii*) to calculate the numbers, types, and sizes of MPs introduced into the food, drawing attention not only to their potential threats to human health but also to the dimensions of environmental pollution. This study was conducted to determine the effects of the MPs produced using cutting boards on human health according to their size and to reveal their harm to environmental health due to their numerical abundance and increased surface area.

Material and Methods

Samples

In homes, restaurants, and supermarket butcher sections, food is mostly cut on a plastic cutting board. This experiment was conducted to observe the MPs loaded onto the food during the chopping process on plastic cutting boards in terms of their number, shape, size, and area during the food preparation stage. Two different types of plastic cutting boards sold in supermarkets were used in the experiment. The white plastic cutting board (Low Density Polyethylene =LDPE), size: 285×190×9 mm), one of the two different plastic cutting boards, is a product commonly used in households, as well as in businesses such as butcher shops, supermarkets, delicatessens, and restaurants. The pink (a mixture of PVC, PP, PE, PET, PS, CPE plastics) plastic cutting board (size: 345×245×2 mm), on the other hand, is a product sold for use in household kitchens, owing to its thin build.

During the experiment, codes WB-1, WB-2, and WB-3 were used for the white cutting board, and codes PB-1, PB-2, and PB-3 were used for the pink cutting board. A knife with a wooden handle was used for the chopping process. The bench where the study was conducted was cleaned with cotton cloths suitable for MP research before the experiment. Nitrile gloves and cotton aprons were worn during chopping. All materials used in the experiment were provided in metal and glass. During the experiment preparation phase, all items to be used, such as 250 cc beakers, Petri dishes, forceps, measuring spoons, glass pipettes, distilled water bottles, and paint bottles, were washed with pre-filtered pure water and alcohol, wrapped in aluminum foil, and made ready for the experiment. A control group was prepared to determine if any contamination was present. An ethanol added petri dish was left in the laboratory open during each cutting procedure to identify potential environmental contamination. After the cutting process was completed, filtration and Nile Red staining were also applied to the ethanol in the petri dish. After examining the control group, only two MP (one fragment, one particle) were detected in the control petri dish.

Extraction of the MP

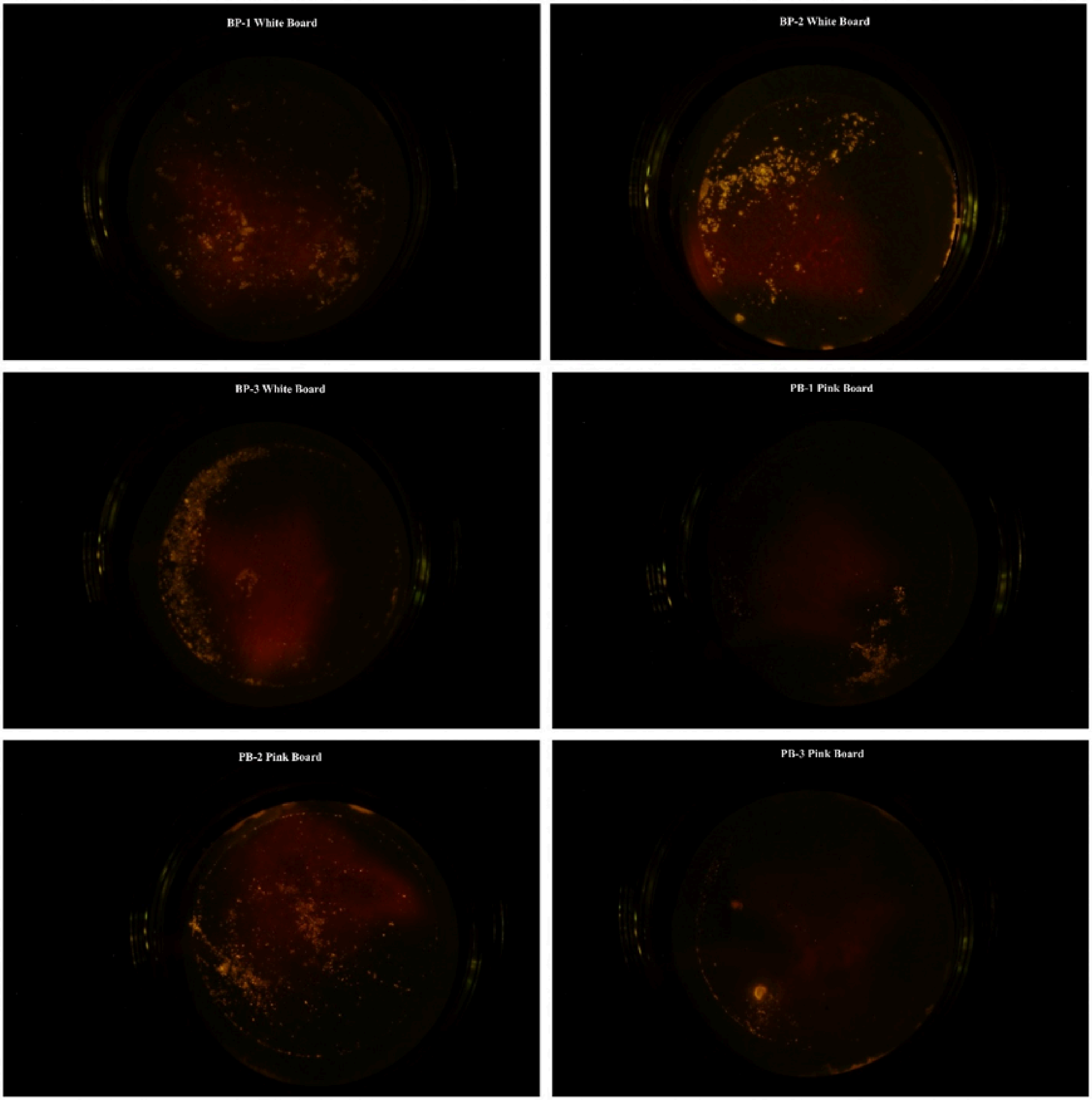
While selecting the foods to be used in the experiment, efforts were made to identify a food that would completely dissolve without leaving any organic residue. Through preliminary trials, it was observed that a small amount of lamb muscle yielded the best results; hence, lamb meat was chosen for the experiment. Considering the conventional process of food preparation, the cutting of the meat was simulated with 100 knife strokes. In the experiment coded as WB-1: 2.18 grams of meat were cut, in WB-2: 1.84 grams, and in WB-3: 1.58 grams; in PB-1: 1.80 grams, in PB-2: 2.38 grams, and in PB-3: 1.87 grams. The chopped meats were each placed in separate beakers, filled with a pre-prepared and filtered 10% potassium hydroxide (KOH) solution, sealed with aluminum foil, and left in an oven at 50°C for 24 h until completely dissolved (Prata *et al.*, 2021). The samples were filtered using a vacuum filtration system with GF-A (1.6 µm pore size glass fiber, 47 diameter) filters. After the filtration process, they were washed with hot water, soaked in 10 ml of acetone for 5 min, and then a sufficient amount of Nile red prepared in ethanol (0.1 mg/ml) was added to cover 1 cc of filter paper. The samples, left in Nile red for 10 min, were washed again with 10 ml of acetone and placed in a Petri dish, covered with another Petri dish, and left to dry in a dark environment (Meyers *et al.*, 2022). After the filtration stage of all the samples, the equipment used was cleaned with hot water, soap, and filtered pure water before proceeding to the next filtration process. Upon completion of the filtration and staining processes for all experiments, a total of six Petri dishes experimental results were obtained. To observe the glares on the dried filter papers, a wooden box painted black on the inside was designed, incorporating a 470 nm LED light, and images were taken using a Pentax K-7 camera at ISO 100 with an orange filter (Prata *et al.*, 2019). Next, the images (Figure 1) were used in the program ImageJ. For the automatic quantification and characterization of the shape and size of the fluorescent MPs, the Microplastics Visual Analysis Tool MP-VAT 2.0 macro was used. Furthermore, using circularity (varying from 0 for elongated shapes to 1 for perfect circles), categories such as fiber (0.0–0.3), fragments (0.3–0.6), and particles (0.6–1.0) were roughly defined. The program also given the largest and smallest dimensions of the particle, presented as Feret (Prata *et al.*, 2019; 2020). In the images, pieces that were larger with unusual glare were checked for plasticity with a hot soldering iron, and only one sample (Figure 1: PB-3) was found to consist of fat. Only the *x* and *y* axes were found in image-j and were removed from the size calculations. Data file created by the ImageJ- program Tool MP-VAT 2.0 macro Analysis, Excel was used to evaluate the analysis results on some parameters such as Feret, min Ferret and Area.

Raman Spectroscopy

The types of plastic cutting boards were determined using Raman spectroscopy. A custom-built micro-Raman system was used to excite the samples with a 532-nm CW laser (Novanta Photonics gem 532) and collect the signal from the samples, via a 100X NIR objective (NA=0.7). The excitation laser beam is focused to a spot of ~0.8 µm in diameter on the sample placed on an XYZ piezo stage. The

Figure 1

Filters in which the fluorescent reflection of the MPs obtained because of the experiment is visible.



same objective collects emissions. The 1800 g/mm grating provided a spectral resolution of ≈0.6 cm^{-1}.

Results

Raman spectroscopy results

Raman spectroscopy is a useful tool to provide both chemical and structural information about the materials, as well as the identification of substances through their characteristic Raman 'fingerprint' (Sarcan *et al.*, 2014; 2023). The plastic types of the white and pink cutting boards were analyzed using Raman spectroscopy. The Raman spectra of the boards are given in Figure 2.

Compared to that of the white cutting board, strong fluorescence on the spectrum of the pink board was observed under the characteristic vibrations because of the

Figure 2

Raman spectra of the white and pink board, plastic types: PVC (polyvinyl chloride), PP (polypropylene), PE (polyethylene), PET (polyethylene terephthalate), PS (polystyrene), CPE (chlorinated polyethylene) LDPE (low density polyethylene).

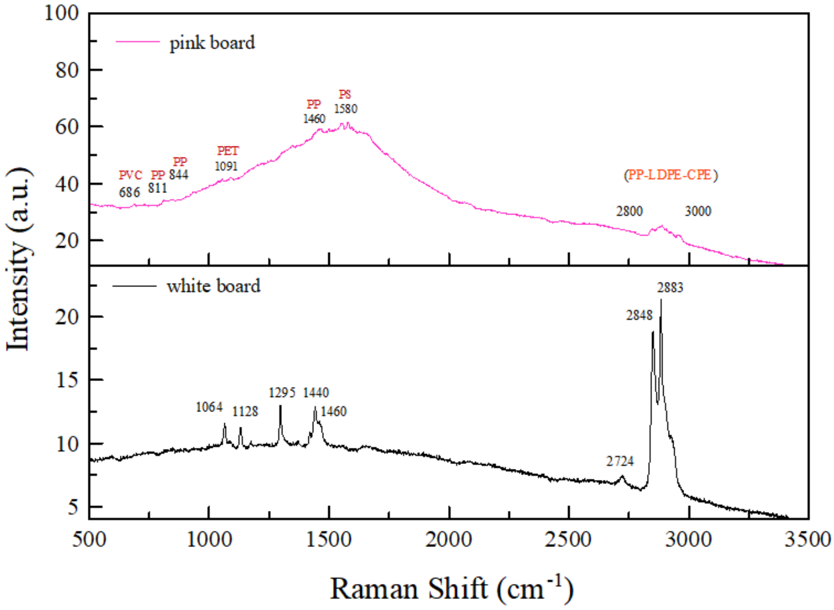


Table 1

Observed and valid Raman shifts for the pink board and comparison with the possible microplastics from the literature.

This study (cm^{-1})	From literature (cm^{-1})	Assignment	Microplastic	Reference
686	690	stretching vibration mode of C–Cl	PVC	Ludwig *et al.*, 2018
811	808-811	rocking vibration mode of CH_2 group	PP	Yang *et al.*, 2012
844	841-845	rocking vibration mode of CH_2 group	PP	Yang *et al.*, 2012
1091	1096	a ring vibration mode	PET	Tong *et al.*, 2016
1460	1458	CH_3 asymmetric bending vibration mode	PP	Andreassen, 1999
1580	1583	skeletal stretch mode	PS	Vieira *et al.*, 2023
2800-3000	2800-3000	multi-mode vibrations band	PP-LDPE-CPE	Feng *et al.*, 2023

presence of the additional paint in the pink board. The observed characteristic vibration modes are marked and given in Table 1 and Table 2 for the pink and white cutting boards, respectively. The possible related materials were identified by comparing them with those of the possible MP literature given in Tables 1 and 2. It revealed that the white cutting board was made of low-density polyethylene (LDPE), while the pink cutting board was found to be a mixture of several plastics (Figure 1). The variation in the types of plastics used for chopping food implies diversity in the types of plastics entering the human body.

Plastic cutting board experiment results

Experiments were conducted to reveal the amount and size of the MP mixed into the food cut on a plastic cutting board. The MPs obtained from the meat cut on the plastic surface were counted in the Image-J computer program. Their distributions were determined based on the fiber, fragment, and particle types, along with their respective diameters and areas. As a result of the experiment, it was found that there is an average probability of ± 1235.5 MPs (Min-Max: 175–2193) being mixed into the food sample cut with 100 knife strokes on the plastic surface. The numerical distribution and detailed values of the MP counts based on fiber, fragment, and particle types from the conducted experiments are shown in Table 3.

According to the results obtained, in all repetitions of the experiments, the numbers of fibers (range: 5-160 pieces) were lower compared to fragments (range: 19-439) and particles (range: 151-1594), and the numbers of particles were higher compared to other types (Figure 3). Because of the cutting of food on the plastic surface, it has been determined that the food is most contaminated with particle-type MPs.

Table 2

Observed and valid Raman shifts for the white board and comparison with the possible microplastics from the literature.

This study (cm^{-1})	From literature (cm^{-1})	Assignment	Microplastic	Reference
1062	1062	C-C asymmetric stretching vibration mode	LDPE	Nava *et al.*, 2021
1128	1129	C-C symmetric stretching	LDPE	Nava *et al.*, 2021
1295	1295	twisting and wagging vibration mode of the CH2	LDPE	Nava *et al.*, 2021
1440	1440	twisting and wagging vibration mode of the CH2	LDPE	Feng *et al.*, 2023
1460	1460	bending vibration modes of the CH2 bonds	LDPE	Feng *et al.*, 2023
2847	2846	CH2 symmetric stretching vibration mode	LDPE	Feng *et al.*, 2023
2880	2881	CH2 asymmetric stretching vibration mode	LDPE	Feng *et al.*, 2023

Table 3

Fiber, fragment, and particles white cutting board (WB.1-3) and pink cutting board (PB.1-3) obtained from the photographs taken from the test plates using the software.

	WB-1					PB-1				
		Max Feret (µm)		Area (µm²)			Max Feret (µm)		Area (µm²)	
	n	Range	Mean ±SD	Range	Mean ±SD	n	Range	Mean ±SD	Range	Mean ±SD
Fibers	160	133-2115	465±404	4 -1684	105±242	19	175-3102	1024±1017	5-2230	425±621
Fragments	439	68-1250	185±130	1-710	16±49	74	69-1210	214±215	1-437	29±76
Particles	1594	53-2330	143±136	1- 2273	16±74	357	54-753	159±126	1-308	18±36
Total	2193			47967		450			16673	
		WB-2					PB-2			
	n	Max Feret (µm)		Area (µm²)		n	Max Feret (µm)		Area (µm²)	
		Range	Mean ±SD	Range	Mean ±SD		Range	Mean ±SD	Range	Mean ±SD
Fibers	38	147-3878	824±950	4-3839	318±792	107	127-5231	575±764	3-3095	154±436
Fragments	181	69-2554	326±383	1-710	16±49	346	72-1378	238±227	2-649	35±90
Particles	732	55-2659	199±240	1-2425	42±169	1370	56-1374	156±147	1-815	20±53
Total	951			59690		1823			56617	
		WB-3					PB-3			
	n	Max Feret (µm)		Area (µm²)		n	Max Feret (µm)		Area (µm²)	
		Range	Mean±SD	Range	Mean±SD		Range	Mean ±SD	Range	Mean ±SD
Fibers	124	303-4371	611±0,448	43-2321	160±249	5	533-3529	1436±1207	82-2,560	700±1062
Fragments	355	131-0,608	233±68	9-42	18±9	19	140-2779	622±606	5-1681	168±387
Particles	1342	55-280	97±37	1-9	3±2	151	88-1043	278±201	3-0491	49±78
Total	1821			30373		175			14039	

The number of MP pieces as well as the sizes of these MPs that may be mixed with the food are important. Among the obtained size values, "Feret" values were considered as the limiting dimension that restricts entry into tissues. Accordingly, when categorized according to the largest diameter, no MP pieces were encountered in the 1-50 µm range in the samples. The found MPs pieces were observed to be larger than 50 µm. In the range of 50-110 µm, a maximum of 922 pieces (in WB-1) were counted (Table 4).

Figure 3

Fiber, fragment, and particle numbers of MPs, obtained in the experiment.

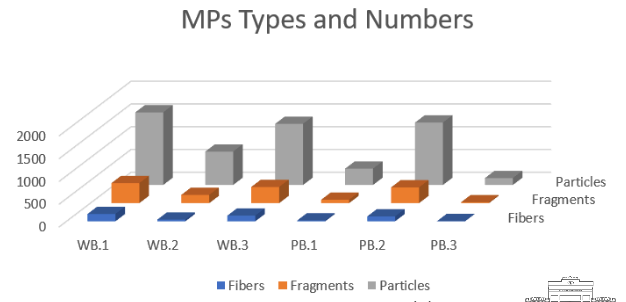


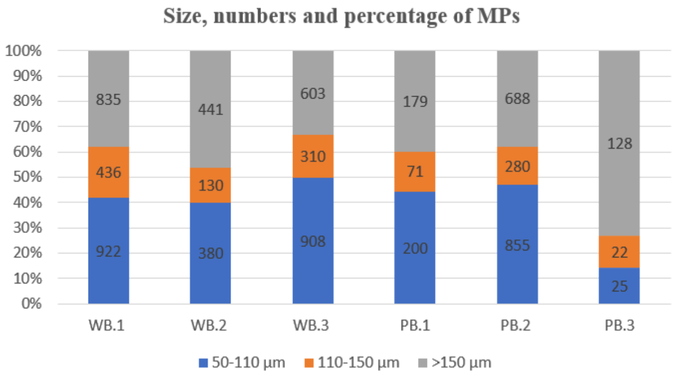
Table 4

Number of MP pieces obtained in the experiment according to their sizes and percentage.

Size (μm)	WB.1	WB.2	WB.3	PB.1	PB.2	PB.3	Total	Total %
50-110	922	380	908	200	855	25	3290	44.3
110-150	436	130	310	71	280	22	1249	16.8
>150	835	441	603	179	688	128	2874	38.7
Total	2193	951	1821	450	1823	175	7413	100

Figure 4

Percentage distribution of MPs according to the piece size.



This number exceeds 40% of the total 2193 MP pieces obtained only in WB-1. However, proportionally evaluated, it is observed that approximately 50% of the total MP pieces count in WB-3 falls within the 50-110 μm range. In the 110-150 μm range, Min: 22 and Max: 436 MP pieces were counted. For > 150 μm, there are at least 128 and at most 835 pieces (Figure 4).

The area information of the obtained MPs was also considered in the results of our experiment. Results of six repeated experiments, we identified 7413 pieces of MPs. This number is the number of MP fragments resulting from 600 knife blows. According to this, 12 pieces were revealed for each knife stroke. We observe that the total area of these pieces, 225359 μm², does not proportionally increase with the increase in the number of pieces. In WB-1, we see that an area of 47967 μm² is divided into 2193 pieces, while in WB-2, a larger area (59690 μm²) is divided into fewer pieces (951) (Table 3).

Discussion

This study identified plastic cutting boards as a significant source of MPs contaminating our food. According to the results, when food preparation is done on a plastic cutting board, there is a possibility of 12 MPs being mixed into the food with each knife stroke. Although the experiment was conducted using lamb, there is a risk of MP contamination in any food cut on a plastic surface. Understanding the extent of this contamination is crucial for informing consumer choices. The number of MPs resulting from our study may be different from those of previous studies (Habib *et al.* 2021; 2022) The reason for the different dimensions and numbers of parts in the experiment is attributed to the cutting force and angle applied during the chopping process (Luo *et al.*, 2022). The important result of the study is that the use of a plastic surface during the chopping process contaminates the consumed product with a considerable number of MPs during food preparation. MPs mixed into food have been expressed in terms of particle size or grams in some previous studies (Udovicki *et al.*, 2022). Our purpose in this study is to investigate the size of MPs mixed into food to reveal the risk to human health while also highlighting how the resulting particle count accelerates the MP load.

Cox et al. (2019) reported the numerical value of the MPs found in human feces. Due to their chemical properties, plastics taken into the digestive system are expected to be excreted without being digested (Lu *et al.*, 2019). However, the size of the MPs may change the situation. MPs larger than 150 μm exhibit no absorption, whereas those smaller than 150 μm show absorption in the lymphatic system. Specifically, MPs equal to 110 μm are absorbed in the portal vein, and particles equal to or smaller than 20 μm gain access to organs (Lusher, 2017; Yuan *et al.*, 2022). According to the experimental results, it is observed that at least 28% and up to 66% of the MPs mixed into our food are MPs pieces smaller than 150 μm. When MPs of such small sizes reach the stomach during digestion, they can encounter digestive enzymes and stomach acid, causing their weak bonds to break down and potentially penetrate cells, shrinking to sizes smaller than 50 μm. Pollutants that damage mucosal cells and disrupt their defense barriers often cause gastrointestinal diseases. When MPs reach the intestines, they provide a surface area for various bacteria to colonize, and films can even form on plastic surfaces (Lu *et al.*, 2019: Tamargo *et al., 2022*). This disrupts the intestinal microecology, damages the mucosa, and increases inflammatory processes (Wang *et al.*, 2025).

In a study conducted on the feces of a human community living in coastal areas, where the majority of their diet consists of fish, it was reported that they encountered various types of plastics, with the highest prevalence of high-density polyethylene (HDPE), polystyrene (PS), and low-density polyethylene (LDPE) plastic types (Luqman *et al.*, 2021). According to the results of our experiment, the type of MPs in feces is expected to vary based on the plastic content of the cutting board used by individuals. In our study, it was determined that the plastic cutting boards were LDPE and mixed (PP, PVC, PS, PET) types. The use of plastic cutting boards or the performance of cutting on plastic surfaces leads to a significant amount and different types of MPs entering human food that cannot be ignored. Performing the chopping process on plastic surfaces poses a threat not only to human health but also to the environment. These MPs, created by breaking down a whole into smaller pieces by humans, are secondary plastics.

In terms of environmental pollution, the numbers, areas covered, accumulation rates, and ratios of MPs are considered. Natural factors such as sunlight (UV), salt water, and temperature variations (seasons) weaken the bonds of plastic polymers, causing them to break into smaller pieces (Moore, 2008; Tirkey & Upadhyay, 2021). While it takes years for a plastic whole to break into smaller pieces in nature, individuals performing chopping processes on plastic surfaces can accelerate this process to a few minutes. In our study, it was found that one person can generates during food preparation an average of 1235.5 pieces/day (total area/600 knife blows=375.59 μm^2/day) of MPs whit using plastic cutting board in a day. If at least a million people worldwide perform this process, it would result in the creation of 1,235,500,000 pieces/day and 37559000 μm^2/day of plastic load. The rate at which plastics disintegrate into MPs and the surface area the broken pieces can reach was highlighted by calculating based on just one million people to draw attention and create awareness. Although the exact number is unknown, the number of businesses and households using plastic cutting boards is certainly well beyond a million worldwide. By using plastic cutting boards, we not only cause MPs to enter our food but also affect other living things by accelerating the accumulation of MPs in nature. The reason why we draw attention to the number of MPs and their surface area is that when MPs enter natural environments such as sea, lake or soil in nature, they have the potential to affect the bacterial population of the environment in which they are found in terms of quality and quantity (Wang *et al.*, 2023) More studies are needed on the relationships between MP and bacterial community in terms of both human and environmental problems.

Conclusions

This study highlights the potential risks of plastic cutting board use to both human health and environmental pollution. Raising public awareness about the potential harm plastic cutting boards can cause to food and the environment is the first step toward reducing the harm they can cause both to themselves and to the environment. It is important to remember that the cheapest and easiest way is to take precautions before problems arise or escalate. Therefore, legislators should consider developing food safety protocols regarding food contact with plastic surfaces in the food sector and restricting the use of plastic cutting boards. Alternative cutting surfaces such as glass, bamboo, and porcelain should be developed and expanded to replace plastic cutting boards, and public awareness should be raised on these issues. Furthermore, further research is needed on MPs and their effects on human health.

Ethics Committee Approval	Ethics Committee approval was not required for this research paper, titled Health risks and environmental threats of the food prepared on plastic cutting boards.
Peer-review	Externally peer-reviewed.
Author Contributions	Conception/Design of Study-O.Ö.; Data Acquisition-İ.Ş., F.S., Ö.D.Y., D.Ç..; Data Analysis/ Interpretation-İ.Ş., F.S., Ö.D.Y., N.K., D.Ç.; Drafting Manuscript-O.Ö., İ.Ş., F.S.; Critical Revision of Manuscript-O.Ö., İ.Ş., Ö.D.Y., N.K., D.Ç.; Final Approval and Accountability-O.Ö., N.K.
Conflict of Interest	The authors have no conflict of interest to declare.
Financial Disclosure	The authors declared that this study has received no financial support.
Acknowledgments	This work was supported by the Research Fund of Istanbul University [grant numbers FBG-2002-38573] and Prof. Dr. Müfit Özuluğ for the design of a box and light (470 nm LED light) for the images.

Author Details

Oya Özuluğ

[1] İstanbul University, Faculty of Science, Department of Biology, İstanbul, Türkiye

0000-0002-9353-1366

İrem Şarlak
[2] İstanbul University, Institute of Graduate Studies in Sciences, Department of Biology, İstanbul, Türkiye
0000-0002-0486-8734 iremsarlak@gmail.com

Fahrettin Sarcan
[3] İstanbul University, Faculty of Science, Department of Physics, İstanbul, Türkiye
0000-0002-8860-4321

Özgün Deniz Yürekli
[2] İstanbul University, Institute of Graduate Studies in Sciences, Department of Biology, İstanbul, Türkiye
0000-0002-3336-0104

Nilgün Kaya
[4] Çanakkale Onsekiz Mart University, Faculty of Science, Department of Biology, Çanakkale, Türkiye
0000-0002-7494-5029

Doğan Çetin
[2] İstanbul University, Institute of Graduate Studies in Sciences, Department of Biology, İstanbul, Türkiye
0000-0002-5477-2386

References

Andrady, A. L. (2017). The plastic in microplastics: A review. *Marine Pollution Bulletin, 119*(1), 12-22. https://doi.org/10.1016/j.marpolbul.2017.01.082

Andreassen E (1999) Infrared and Raman spectroscopy of polypropylene. Polypropylene. Springer, Berlin, pp 320–328

Arthur, C., Baker, J. E. & Bamford, H. A. (2009). Proceedings of the International Research Workshop on the Occurrence, Effects, and Fate of Microplastic Marine Debris. September 9-11, 2008, University of Washington Tacoma, Tacoma, WA, USA. https://repository.library.noaa.gov/view/noaa/2509/noaa_2509_DS1.pdf

Barnes, D. K. A., Galgani, F., Thompson, R. C. & Barlaz, M. (2009). Accumulation and fragmentation of plastic debris in global environments. *Philosophical Transactions of the Royal Society B: Biological Sciences, 364*(1526), 1985-1998. https://doi.org/10.1098/rstb.2008.0205

Besley, A., Vijver M. G., Behrens P. & Bosker T. (2017). A standardized method for sampling and extraction methods for quantifying microplastics in beach sand. *Marine Pollution Bulletin, 114*(1), 77-83. https://doi.org/10.1016/j.marpolbul.2016.08.055

Cox, K. D., Covernton, G. A., Davies, H. L., Dower, J. F., Juanes, F. & Dudas, S. E. (2019). Human consumption of microplastics. *Environmental Science & Technology*, *53*(12), 7068-7074. https://doi.org/10.1021/acs.est.9b01517

Çullu, A. F., Sönmez, V. Z. & Sivri, N. (2021). Microplastic contamination in surface waters of the Küçükçekmece Lagoon, Marmara Sea (Turkey): Sources and areal distribution. *Environmental Pollution*, 268, 115801. https://doi.org/10.1016/j.envpol.2020.115801

De-la-Torre, G.E. (2019). Microplastics: an emerging threat to food security and human health. *Journal of Food Science and Technology, 57*(5), 1601-1608. https://doi.org/10.1007/s13197-019-04138-1

Dong, Y., Gao, M., Song, Z. & Qiu, W. (2020). As(III) adsorption onto different-sized polystyrene microplastic particles and its mechanism. *Chemosphere, 239,* 124792. https://doi.org/10.1016/j.chemosphere.2019.124792

Feng, Z., Zheng, L. & Liu, J. (2023). Classification of household microplastics using a multi-model approach based on Raman spectroscopy. *Chemosphere 325*, 138312. https://doi.org/10.1016/j.chemosphere.2023.138312

Gao, F., Li, J., Sun, C., Zhang, L., Jiang, F., Cao, W., & Zheng, L. (2019). Study on the capability and characteristics of heavy metals enriched on microplastics in marine environment. *Marine Pollution Bulletin, 144*, 61-67. https://doi.org/10.1016/j.marpolbul.2019.04.039

Geyer, R., Jambeck, J. R. & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances* 3(7), 1-5. https://doi.org/10.1126/sciadv.1700782

Habib, R. Z., Kindi, R. A., Salem, F. A., Kittaneh, W. F., Poulose, V., Iftikhar, S. H., Mourad, A., & Thiemann, T. (2021). Microplastic contamination of chicken meat and fish through plastic cutting boards. *International Journal of Environmental Research and Public Health*, *19*(20), 13442. https://doi.org/10.3390/ijerph192013442

Habib, R. Z., Poulose, V., Alsaidi, R., Al Kendi, R., Iftikhar, S. H., Mourad, A. H. I., Kittaneh, W. F. & Thiemann, T. (2022). Plastic cutting boards as a source of microplastics in meat. *Food Additives & Contaminants: Part A*. 27, 1-11. https://doi.org/10.1080/19440049.2021.2017002

Ivleva, N. P., Wiesheu, A. C. & Niessner, R. (2017). Microplastic in aquatic ecosystems. *Angewandte Chemie International Edition*, *56*(7), 1720-1739. https://doi.org/10.1002/anie.201606957

Koelmans, A. A., Besseling, E., Wegner, A. & Foekema, E. M. (2013). Plastic as a carrier of POPs to aquatic organisms: A model analysis. *Environmental Science & Technology, 47*(14), 7812-7820. https://doi.org/10.1021/es401169n

Liu, Z., Yu, P., Cai, M., Wu, D., Zhang, M., Chen, M., & Zhao, Y. (2019). Effects of microplastics on the innate immunity and intestinal microflora of juvenile *Eriocheir sinensis*. *Science of The Total Environment*, *685*, 836-846. https://doi.org/10.1016/j.scitotenv.2019.06.265

Lopes, C., Fernández-González, V., Muniategui-Lorenzo, S., Caetano, M. & Raimundo, J. (2022). Improved methodology for microplastic extraction from gastrointestinal tracts of fat fish species. *Marine Pollution Bulletin, 181*, 113911. https://doi.org/10.1016/j.marpolbul.2022.113911

Lu, L., Luo, T., Zhao, Y., Cai, C., Fu, Z. & Jin, Y. (2019). Interaction between microplastics and microorganism as well as gut microbiota: A consideration on environmental animal and human health. *Science of The Total Environment, 667*, 94-100. https://doi.org/10.1016/j.scitotenv.2019.02.380

Ludwig, V., Da Costa Ludwig, Z. M., Rodrigues, M. M., Anjos, V., Costa, C. B., das Dores, D. R. S. A, da Silva V. R. & Soares, F. (2018). Analysis by Raman and infrared spectroscopy combined with theoretical studies on the identification of plasticizer in PVC films. *Vibrational Spectroscopy*, *98*, 134-138. https://doi.org/10.1016/j.vibspec. 08.004

Luo, Y., Chuah C., Amin, Md. A., Khoshyan, A., Gibson, C. T., Tang, Y., Naidu, R. & Fang., C. (2022). Assessment of microplastics and nanoplastics released from a chopping board using Raman imaging in combination with three algorithms. *Journal of Hazardous Materials, 431*, 128636. https://doi.org/10.1016/j.jhazmat.2022.128636

Luqman, A., Nugrahapraja, H., Wahyuono, R. A., İslami, I., Haekal, M. H., Fardiansyah, Y., Putri, B. Q., Amalludin, F. I., Rofiqa, E. A., Götz, F. & Wibowo, A. T. (2021). Microplastic contamination in human stools, foods, and drinking water associated with Indonesian coastal population. *Environments, 8*(12), 138. https://doi.org/10.3390/environments8120138

Lusher, A. Bråte, I. L. N., Hurley, R., Iversen, K. & Olsen, M. (2017). Testing of methodology for measuring microplastics in blue mussels (*Mytilus* spp) and sediments, and recommendations for future monitoring of microplastics (R & D-project). 87. Published online December 1, Accessed June 15, 2024. http://hdl.handle.net/11250/2470297

Meyers, N., Catarino, A. I., Declercq, A. M., Brenan, A., Devriese, L., Vandegehuchte, M., Witte, B, Janssen, C. & Everaert, G. (2022). Microplastic detection and identification by Nile red staining: Towards a semi-automated, cost- and time-effective technique. *Science of The Total Environment, 823*, 153441. https://doi.org/10.1016/j.scitotenv.2022.153441

Moore, C. J. (2008). Synthetic polymers in the marine environment: A rapidly increasing, long-term threat. *Environmental Research, 108*(2), 131-139. https://doi.org/10.1016/j.envres.2008.07.025

Nava, V., Frezzotti, M. L. & Leoni, B. (2021). Raman spectroscopy for the analysis of microplastics in aquatic systems. *Applied Spectroscopy, 75*(11), 1341-1357. https://doi.org/10.1177/00037028211043119

Plastics Europe (2023). https://plasticseurope.org/knowledge-hub/plastics-the-fast-facts-2023/

Pongon, M. & Owen, A. (2020). Presence of microplastics in Ephemeroptera, Plecoptera, and Trichoptera of North Cascades National Park. Scholars Week. Published online May 18, 2020. Accessed June 15, 2024. https://cedar.wwu.edu/scholwk/2020/2020/72

Prata, J. C., Reis, V., Matos, J. T. V., da Costa, J. P., Duarte, A. C. & Rocha-Santos, T. (2019). A new approach for routine quantification of microplastics using Nile Red and automated software (MP-VAT). *Science of The Total Environment, 690,* 1277-1283. https://doi.org/10.1016/j.scitotenv.2019.07.060

Prata, J. C., Castro, J. L., da Costa, J. P., Duarte, A. C., Rocha-Santos, T. & Cerqueira, M. (2020). The importance of contamination control in airborne fibers and microplastic sampling: Experiences from indoor and outdoor air sampling in Aveiro, Portugal. *Marine Pollution Bulletin, 159,* 111522. https://doi.org/10.1016/j.marpolbul.2020.111522

Prata, J. C., Sequeira, I. F., Monteiro, S. S., Silva, A. L. P., da Costa, J. P., Dias-Pereira, P., Fernandes, A.J.S., da Costa, F. M., Duarte, A. C. & Rocha-Santos, T. (2021). Preparation of biological samples for microplastic identification by Nile Red. *Science of The Total Environment, 783*, 147065. https://doi.org/10.1016/j.scitotenv.2021.147065

Rainieri, S. & Barranco, A. (2019). Microplastics, a food safety issue? *Trends in Food Science & Technology, 84*, 55-57. https://doi.org/10.1016/j.tifs.2018.12.009

Sarcan, F., Dönmez, Ö., Kara, K., Erol, A., Akalın, E, Arıkan, M. Ç., Makhloufi, H., Arnoult, A. & Fontaine, C. (2014). Bismuth-induced effects on optical, lattice vibrational, and structural properties of bulk GaAsBi alloys. *Nanoscale Research Letters, 9,* 119. https://doi.org/10.1186/1556-276x-9-119

Sarcan, F., Fairbairn, N. J., Zotev, P., Severs-Millard, T., Gillard, D. J., Wang, X., Conran, B., Heuken, M, Erol, A., Tartakovskii, A. I., Krauss, T. F., Hedley, G. J. & Wang, Y. (2023). Understanding the impact of heavy ions and tailoring the optical properties of large-area monolayer WS2 using focused ion beam. *npj 2D Materials and Applications, 7,* 23. https://doi.org/10.1038/s41699-023-00386-0

Scopetani, C., Chelazzi, D., Mikola, J., Leiniö, V., Heikkinen, R., Cincinelli, A., & Pellinen, J. (2020). Olive oil-based method for the extraction, quantification and identification of microplastics in soil and compost samples. *Science of The Total Environment, 733*, 139338. https://doi.org/10.1016/j.scitotenv.2020.139338

Tamargo, A., Molinero, N., Reinosa, J. J., Alcolea-Rodriguez, V., Portela, R., Bañares, M. A., ... & Moreno-Arribas, M. V. (2022). PET microplastics affect human gut microbiota communities during simulated gastrointestinal digestion, first evidence of plausible polymer biodegradation during human digestion. *Scientific Reports 12*(1), 528.

Tirkey, A. & Upadhyay, L. S. B. (2021). Microplastics: An overview on separation, identification and characterization of microplastics. *Marine Pollution Bulletin, 170*, 112604. https://doi.org/10.1016/j.marpolbul.2021.112604

Tong, N., Zhu, C.-j., Song, L.-x., Zhang, C.-h., Zhang, G.-q., Zhang, Y.-x., 2016. Characteristics of Raman spectra of polyethylene terephthalate. Spectrosc. Spectr. Anal. 36 (1), 114–118.

Udovicki, B., Andjelkovic, M., Cirkovic-Velickovic, T. & Rajkovic A. (2022). Microplastics in food: scoping review on health effects, occurrence, and human exposure. *International Journal of Food Contamination, 9,* 7. https://doi.org/10.1186/s40550-022-00093-6

Wang, Y. F., Wang, X. Y., Chen, B. J., Yang, Y. P., Li, H., & Wang, F. (2025). Impact of microplastics on the human digestive system: From basic to clinical. *World Journal of Gastroenterology, 31*(4), 100470.

Wang, P. Y., Zhao, Z. Y., Xiong, X. B., Wang, N., Zhou, R., Zhang, Z. M., Ding, F., Hao, M., Wang, S., Ma, S., Uzamurera, A. G., Xiao K., Khan, A., Tao, Ş.T., Wang, W.Y., Tao, H.Y., Xiong, Y. C. (2023). Microplastics affect soil bacterial community assembly more by their shapes rather than the concentrations. *Water Research*, *245*, 120581.

Wagner, S., Hüffer, T., Klöckner, P., Wehrhahn, M., Hofmann, T. & Reemtsma, T. (2018). Tire wear particles in the aquatic environment - A review on generation, analysis, occurrence, fate and effects. *Water Research, 139*, 83-100. https://doi.org/10.1016/j.watres.2018.03.051

Xie, Y., Wang, H., Chen, Y., Guo, Y., Wang, C., Cui, H. & Xue, J. (2023). Water retention and hydraulic properties of a natural soil subjected to microplastic contaminations and leachate exposures. *Science of the Total Environment, 901,* 166502-166502. https://doi.org/10.1016/j.scitotenv.2023.166502

Vieira, M. F., Bovolato, A. L.d. C., da Fonseca, B. G., Izumi, C. M. S. & Brolo, A. G. (2023). A direct immunoassay based on surface-enhanced spectroscopy using AuNP/PS-b-P2VP nanocomposites. *Sensors, 23*, 4810. https://doi.org/10.3390/s23104810

Yadav, H., Sethulekshmi, S. & Shriwastav, A. (2022). Estimation of microplastic exposure via the composite sampling of drinking water, respirable air, and cooked food from Mumbai, India. *Environmental Research, 214*, 113735. https://doi.org/10.1016/j.envres.2022.113735

Yang, Y., Huang, Z.-l., Wang, J.-d., Jiang, B.-b., Yang, Y.-r., Song, W.-b., 2012. Measurement of properties of polypropylene copolymers by Raman spectrum. Spectrosc. Spectr. Anal. 32 (12), 3262–3266.

Yuan, Z., Nag, R. & Cummins, E. (2022). Human health concerns regarding microplastics in the aquatic environment - From marine to food systems. *Science of The Total Environment, 823*(153730), 153730. https://doi.org/10.1016/j.scitotenv.2022.153730

Zhou, Q. Zhang, H., Fu, C., Zhou, Y., Dai, Z., Li, Y., Tu, C. & Lou, Y. (2018). The distribution and morphology of microplastics in coastal soils adjacent to the Bohai Sea and the Yellow Sea. *Geoderma*, *322*, 201-208. https://doi.org/10.1016/j.geoderma.2018.02.015

Zheng, X., Feng, Q., Chen, J., Yan, J., Li, X. & Guo, L. (2023). Quantification analysis of microplastics released from disposable polystyrene tableware with fluorescent polymer staining. *Science of The Total Environment, 864,* 161155. https://doi.org/10.1016/j.scitotenv.2022.161155