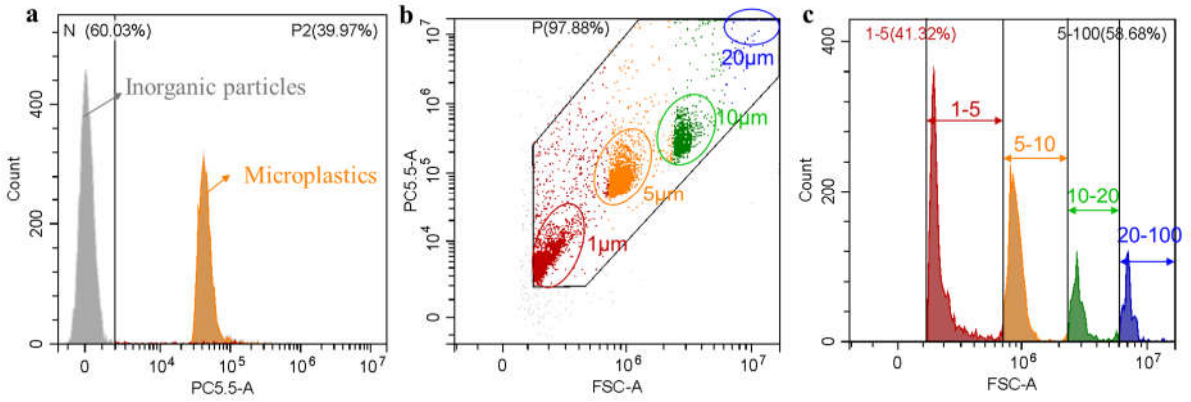
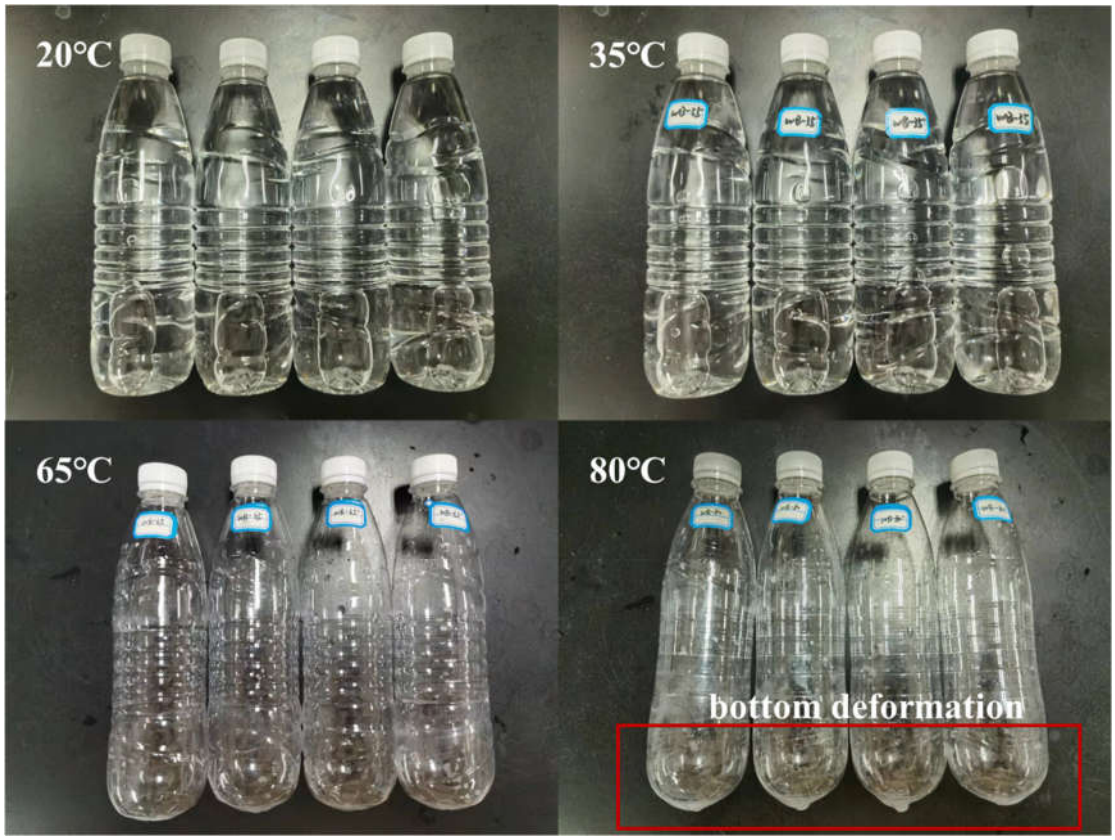
Supplementary Material for

Release Characteristics of Small-Sized Microplastics in Bottled Drinks Using Flow Cytometry Sorting and Nile Red Staining

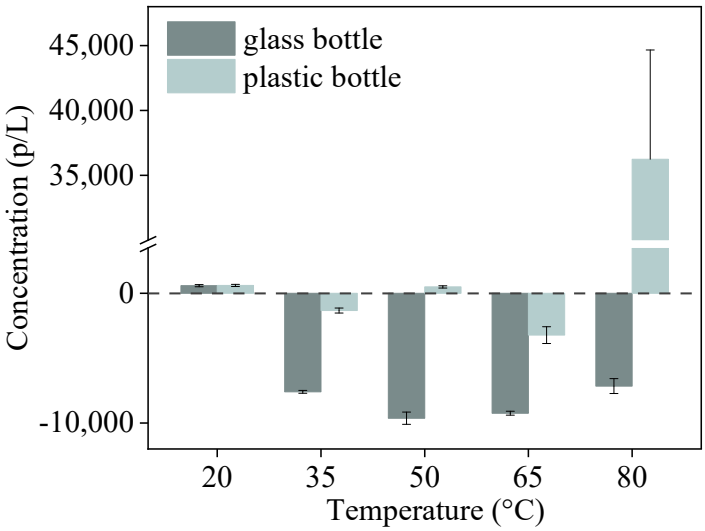
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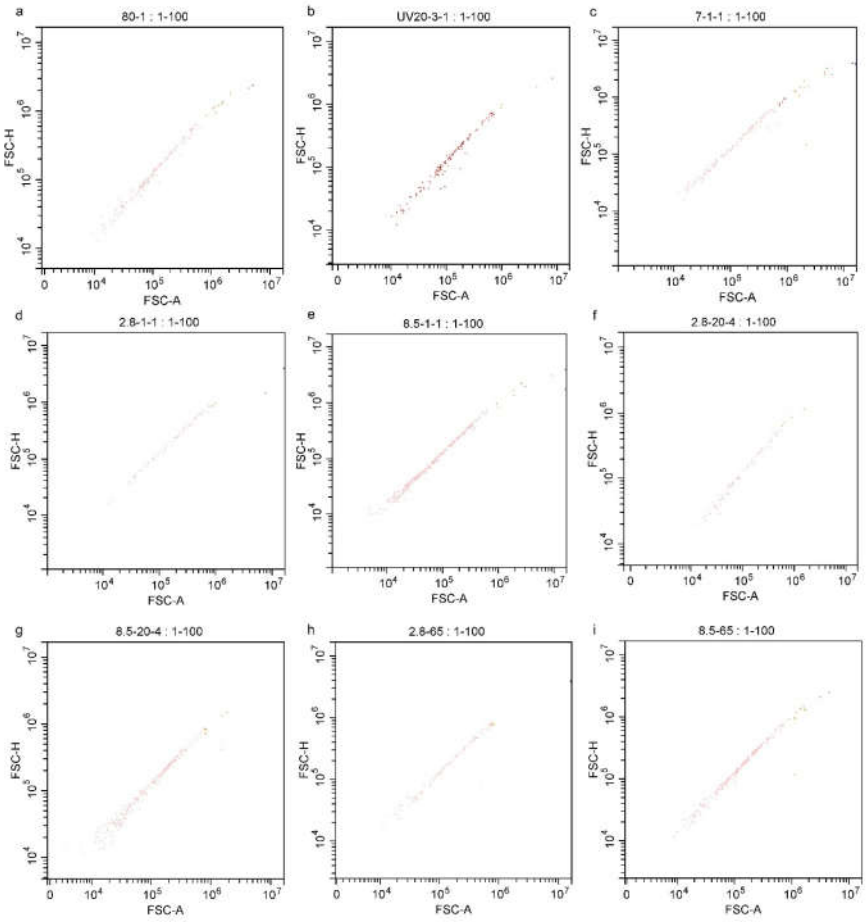
Supplementary Figure S1. Gating strategy in flow cytometry. a. Distinction of inorganic particles from microplastic particles in fluorescence channel PC5.5 after staining by Nile Red; b. PS microplastics with size of 1, 5, 10 and 20 μm in ultrapure water stained with NR in fluorescence channel PC5.5; c. Based on the FSC signal, determine the quantitative ranges for particles of four size classes.



Supplementary Figure S2. Deformation of PET bottles after heat treatment.



Supplementary Figure S3. Count of MP particles (1-100 μm) in plastic and glass bottles at different temperatures (20, 35, 50, 65, and 80°C).



Supplementary Figure S4. Log-log density plots of the forward scatter height (FSC-H) and area (FSC-A) with different testing groups: (a) temperature; (b) sunlight irradiation; (c-e) pH; (f-g)

temperature and pH; (h-i) sunlight irradiation and pH. If the particle has an FSC-H value of equal to the FSC-A value, it is spherical; otherwise, it is non-spherical.

Supplementary Table S1. Correspondence between the actual sunlight irradiation time and the experimental UV lamp irradiation time.

Lamp type	Lamp irradiation intensity at a distance of 10cm	The ratio of sunlight intensity to lamp irradiation intensity	Lamp irradiation time (h)	Sunlight irradiation time (h)
UVA-15 W	1.54 mW/cm^2	1.54	2	3.08
			3	4.62
			4	6.16
UVA-20 W	1.71 mW/cm^2	1.71	1	1.71
			2	3.42
			3	5.13
			4	6.84

Supplementary Table S2. The number of MP released from PET bottles at different temperatures.

T (°C)	Microplastic (p/L)					
	1-5 μm	5-10 μm	10-20 μm	> 20 μm	Total	Total release amount
20	28,108 ± 974	2,432 ± 468	360 ± 624	360 ± 624	31,261 ± 1,092	-
35	25,135 ± 1,720	2,432 ± 764	1,216 ± 764	1,149 ± 996	29,932 ± 4,436	-
50	28,176 ± 3,249	1,824 ± 764	1,216 ± 764	541 ± 624	31,757 ± 5,593	-
65	23,041 ± 3,249	2,432 ± 624	1,689 ± 807	878 ± 956	28,041 ± 5,636	-
80	62,703 ± 11,489	2,973 ± 1,800	676 ± 1404	1,149 ± 996	67,500 ± 15,689	36,239 ± 15,689

Supplementary Table S3. The number of MP released from PET bottles under UV irradiation.

Time (h)	Microplastic (p/L)					
	1-5 μm	5-10 μm	10-20 μm	> 20 μm	Total	Total release amount
1.71	32,523 ± 6,082	2,793 ± 624	721 ± 624	0	36,036 ± 6,677	4,775 ± 6,677
3.08	39,369 ±8,941	3,153 ± 624	1,532 ± 780	0	44,054 ± 8,140	12,793 ± 8,140
3.42	54,144 ± 9,603	5,586 ± 624	721 ± 624	360 ± 624	60,811 ± 9,209	29,550 ± 9,209
4.62	68,559 ± 6,699	5,135 ± 1,772	360 ± 624	0	74,054 ± 8,273	42,793 ± 8,273
5.13	58,649 ± 7,197	4,775 ± 1,219	0	360 ± 624	63,784 ± 5,486	32,523 ± 5,486
6.16	49,369 ± 3,167	3,604 ± 1,219	721 ± 624	360 ± 624	54,054 ± 4,350	22,793 ± 4,350
6.84	39,730 ± 3,117	3,604 ± 1,219	360 ± 624	0	43,694 ± 3,629	12,432 ± 3,629

Supplementary Table S4. The release concentration of MP particles in PET bottles with various pH values.

pH	Released microplastics (p/L)				
	1-5 µm	5-10 µm	10-20 µm	> 20 µm	Total
2.5	2,703 ± 468	1,261 ± 949	541 ± 1,387	2,342 ± 624	6,847 ± 1,387
5.0	1,802 ± 1,387	1,171 ± 1,560	0	901 ± 949	3,874 ± 1,360
7.0	2,432 ± 468	270 ± 2,703	270 ± 949	0	2,973 ± 4,066
8.5	6,937 ± 1,092	991 ± 624	991 ± 468	0	8,919 ± 1,892
11.0	5,045 ± 1,360	631 ± 624	631 ± 563	0	6,306 ± 2,511

Supplementary Table S5. The number of MP released from PET bottles with various pH values under different temperatures.

pH	T (°C)	Released microplastics (p/L)				
		1-5 µm	5-10 µm	10-20 µm	> 20 µm	Total
2.5	20	-845 ± 180	0 ± 180	0 ± 180	0 ± 180	-
	35	10,450 ± 5,997	811 ± 156	1,261 ± 468	0 ± 156	12,523 ± 6,578
	50	14,955 ± 2,029	-450 ± 156	360 ± 312	360 ± 312	15,225 ± 2,734
	65	20,811 ± 2,743	0 ± 624	360 ± 413	450 ± 270	21,622 ± 2,477
8.5	20	3,399 ± 360	529 ± 180	0 ± 180	90 ± 180	4,018 ± 900
	35	3,514 ± 3,288	360 ± 468	0 ± 413	360 ± 156	4,234 ± 3,534
	50	8,378 ± 7,431	901 ± 811	901 ± 468	-90 ± 312	10,090 ± 8,028
	65	14,775 ± 8,755	2,072 ± 780	450 ± 413	-450 ± 156	16,847 ± 9,557

Supplementary Table S6. The number of MP released from PET bottles with various pH values under sunlight irradiation.

pH	Time (h)	Released microplastics (p/L)				
		1-5 μm	5-10 μm	10-20 μm	> 20 μm	Total
2.5	1.71	901 ± 4,493	1,622 ± 826	0 ± 624	450 ± 270	2,973 ± 4,618
	3.42	18,468 ± 4,242	2,432 ± 624	360 ± 624	811 ± 156	22,072 ± 3,167
	6.84	23,694 ± 9,557	2,792 ± 949	1,622 ± 780	1,622 ± 780	29,730 ± 9,129
8.5	1.71	31,171 ± 7,384	360 ± 1,404	0 ± 624	-450 ± 624	31,081 ± 7,173
	3.42	22,342 ± 1,387	1,261 ± 1,219	360± 0	0 ± 1,404	23,964 ± 1,644
	6.84	14,865 ± 7,197	2,793 ± 1,505	811 ± 1,800	0 ± 1,404	18,468 ± 11,471

Supplementary Note S1. The rationale for selecting the five specified temperatures.

1) 20℃: Average room temperature during the experiment.
2) 35℃: Referring to the definition of high temperature by the United States and considering the climate and environmental characteristics of China, researchers have defined temperatures of ≥35℃ as high temperatures.
3) 50℃: For the convenience of travel, many people carry bottled drinks inside their vehicles. According to a study, under direct sunlight during summer, the temperature inside a sedan can reach 50℃ within 30 minutes.
4) 65℃: As environmental temperatures rise and exposure time increases, the temperature inside a vehicle will continue to increase. A study found that at an ambient temperature of 36.8℃, the temperature inside a vehicle reached a maximum of 67℃ within 15 minutes.
5) 80℃: The heat deformation temperature of traditional PET bottles is approximately 70-80℃. However, in low-latitude areas near the equator, vehicles exposed to prolonged extreme heat can reach temperatures exceeding 80℃. Taking these factors into consideration, we have chosen to include 80℃ as an experimental temperature to investigate the effects of extreme high temperatures on plastic bottles.

Supplementary Note S2. The irradiation of UV light and the equivalent sunlight conversion.

From the manufacturer's test data, the light intensity of the UV lamp at a distance of 10 cm from the light source was $1.54\,mW/cm^2$ (15 W) and $1.71\,mW/cm^2$ (20 W), respectively. According to meteorological data and the average intensity of solar radiation at the same latitude (Sorasan et al., 2021), the average intensity of solar radiation in summer at the experimental location was estimated to be $20\,mW/cm^2$, with the UV intensity accounting for approximately 5% of the solar radiation ($1.0\,mW/cm^2$). Therefore, the ratios of sunlight intensity to experimental light intensity were 1.54 (15 W) and 1.71 (20 W), respectively. The relationship between the experimental lamp irradiation time and actual sunlight irradiation time was thus calculated (Supplementary Table S1).

Supplementary References

Sorasan, C., Edo, C., González-Pleiter, M., Fernández-Piñas, F., Leganés, F., Rodríguez, A., & Rosal, R. (2021). Generation of nanoplastics during the photoageing of low-density polyethylene. *Environmental Pollution*, *289*, 117919. https://doi.org/10.1016/j.envpol.2021.117919