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Measuring the levels of plastic particulates pollution in the city of Mosul

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***Abstract*---**The current study aimed to investigate the present of microplastic particles (MPs) for tap water in 18 sites in Mosul city. The filtration results of tap water samples showed that the concentrations of microplastic particles varied from 54.5 particles/liter to 156.5 particles/liter and an average of 105.5 particles/liter. Located on the right banks / the city of Mosul. Microscopic examination revealed the presence of microplastic particles in all tap water samples in different shapes, as the vast majority were in the form of single fibers and some of them were in the form of intertwined fibers or pieces, of different sizes and colors.

***Keywords*---**Microplastic Sampling, tap water, Plastic fibers, Microplastic analysis, Microscope.

Introduction

Plastic has become widely used due to its versatility and excellent durability and its global production has increased significantly since the start of mass production from 1.5 million tons in 1950 to nearly 360 million tons in 2018 (Europe, 2019). Although plastic has benefited our lives in terms of cost and use however, the indiscriminate disposal of end-of-life plastics poses serious environmental problems as the plastic gradually breaks down into smaller pieces once it reaches the aquatic environment and accumulates due to its low biodegradability (Lam et al., 2020). Due to the small size of microplastics and their ubiquity, the topic of their effects on global ecosystems has been brought to the fore, so recently it has been demonstrated that microplastics enter the food web by absorption and ingestion by aquatic organisms (Desforges et al., 2015). Because of the presence of microplastics in food, it is possible for humans to be exposed to microplastics by eating food contaminated with microplastics, so an

understanding of the presence of microplastics throughout the water supply distribution chain will be needed in relation to human exposure and on a large scale to maintain on the quality of drinking water (Lam et al., 2020). The study by researcher Kosuth et al. (2018) looked for the presence of microplastics in tap water and proved that more than one-fifth of tap water samples in 14 countries contain microplastics and that (98.3%) of microplastics are fibers (Kosuth et al. 2018). The study of Tong et al. (2020) verified the presence of microplastic particles in tap water these particles were considered new pollutants emerging in aquatic environments and received great attention in recent years, and there are few studies that found pollution of microplastics in tap water. For example, these fine particles were found in tap water samples in different shapes, and they are in the form of fragments, fibers, pellets, and the most abundant forms in most samples were fragments, and these particles are identified as 14 different substances by precise Raman spectroscopy, and the majority of fine particles It consists of polyethylene and polypropylene, and based on this investigation, it appeared that drinking water treatment plants face the problem of microplastic pollution in tap water due to its potential environmental toxicity effects on humans (Tong et al. 2020).

Methods and Materials

Study Site

The city of Mosul was considered the center of the Nineveh Governorate. Located In the northern part of Iraq and along the Tigris River, considered Mosul is the second-most populous city in the country and contained two bank (Right and left bank). Eighteen regions were selected (from two bank), which included (residential regions, health centers, markets, and public parks) to measure the presence of microplastics in tap water. A site was chosen based on its pollution level, and population density was taken into account when selecting these areas.

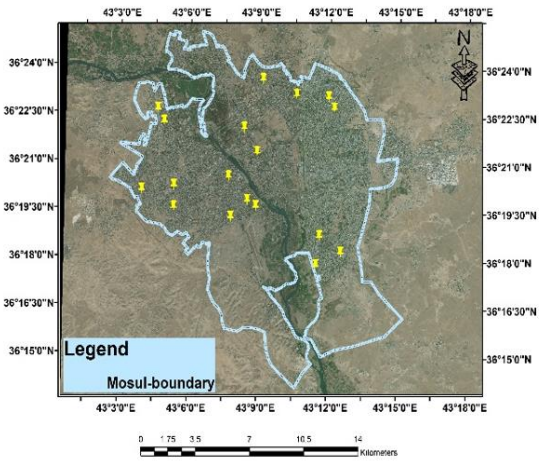

Figure 1. Site map of Mosul showing the neighborhoods from which the models were collected

Sample collection

Tap water samples were collected between November 2021 and February 2022, In Mosul, the GPS system (Global Positioning System) was used to determine study sites on both the left and right bank, 114 samples were taken from 250 ml glass bottles for 18 regions, where water samples were taken randomly and every two weeks (8 replicates per sampling site) (Pratesi et al., 2021). In order to determine if particle counts had changed between this period, the taps were run continuously for one minute, followed by the bottle being filled to continuous flow and thrown three consecutive times before collecting the last sample, which is a crucial step since it helps to clean and rinse the bottles before collecting samples (Ali et al., 2019). According to Lam et al., 2020, the cannula was sealed tightly, marked, and kept at 4°C until analysis (Lam et al., 2020). Laboratory experiments were conducted at the University of Mosul, which were studied on water samples. The experiments were conducted in the laboratories of the College of Science/Department of Life Sciences and the College of Environmental Science and Technology.

Sample analysis

The tap water was filtered according to the researcher's method (Lam et al., 2020). Took a volume (250 ml) of the sample was filtered through a microfiber filter using a Grid membrane, diameter of 47 mm, and Size (0.45) µm filter paper as shown in Figure (2).

Figure 2. Filtering the sample using a microfiber filter

To avoid laboratory contamination, the filter papers are placed in sterile glass Petri dishes and left for 24 hours to dry (Hidalgo- Ruz et al., 2012), taking into account the tightness of the closure as shown in Figure (3).

Figure 3. Shows filter papers on Petri dishes

Then, the optical analysis was performed using an anatomical microscope from (MOTIC) with an ocular lens with a magnification of (20X) and an objective lens with a magnification of (40X) as in Figure (4).

Figure 4. Determination of microplastic using a MOTIC-type anatomical microscope

Statistical analysis

Statistical analysis of data was supported according to the Analysis of Variance (ANOVA) test. This test shows the presence or unavailability of critical differences in the studied samples (which represent the presence of microplastics in the tap water), and this test is responsible for causing these differences in the studied variables at the level of significance ($P < 0.05$). The data were analyzed using the randomized complete block design within the environmental experiments.

Results and Discussion

The results are shown in Table (1) indicate the presence of microplastic particles in all tap water samples with varying concentrations ranging from 54.5 particles/liter to 156.5 particles/liter with an average of 105.5 particles/liter. Higher concentrations were found in the samples collected in the areas of the left banks than those in the areas of the right banks, and when the average was calculated for the areas of the two banks (left and right), it was found microplastics in the tap water on the right banks 59.5 particles / l, while the tap water contained in the left banks at 97.3 particles / l. In general, the tap water sample (restaurant) in the Al-Saheroon area on the left bank contained the largest number of plastic particles, equal to 156.5 particles/liter, followed by the tap water sample (house) in the Palestine area and equal to 117 particles/liter, and then followed by the tap water sample. house) in the Al-Mohandeseen area and equal to 111 particles/liter, followed by the tap water sample (house) Al-Hadba and equal to 101.5 particles/liter.

Table 1
Microplastics in tap water

N	sample type	Area name	Plastic Particle Count Rate (Particles/L)	Mean	Std.Deviation
1	Tap Water (Home)	Mushirifa	71	71.0000 ab	33.92429
2	Tap Water (Home)	17-Jul	74	74.0000 ab	37.27887
3	Tap Water (Grocery)	Jamie al-Kabeer	80.5	80.5000 ab	70.11623
4	Tap Water (Médecins Sans Frontières)	Nahrawan (Tanak)	80	80.0000 ab	52.50306
5	Tap Water (Home)	Yarmouk	65.1	65.1250 ab	40.08362
6	Tap water (Health Center)	Al-Resala	60	60.0000 b	50.68671
7	Tap Water (School)	Wadi Hajar	54.5	54.5000 b	40.28115

8	Tap Water (Grocery)	Al-Jawsaq	58	58.0000 b	57.68882
9	Tap Water (Workshop)	Al-Dawaasa	70	70.0000 ab	57.4506
10	Tap Water (Home)	Palestine	117.5	117.50 ab	90.73509
11	Tap Water (Home)	Sumer	87	87.0000 ab	47.55748
12	Tap Water (Restaurant)	Al-Saahiroon	156.5	156.50 a	180.06269
13	Tap Water (Home)	Al-Ziraee	87	87.0000 ab	77.26023
14	tap water (public garden)	Al-Muhandiseen	111	111.00 ab	86.18253
15	tap water (home)	Al-Hadba'	101.5	101.50 ab	105.15703
16	tap water (restaurant)	Al-Bareed	69.5	69.5000 ab	87.11077
17	tap water (home)	Second Qadisiyah	88.5	88.5000 ab	98.15294
18	tap water (home)	Al-Tahreer	57.5	57.5000 b	35.19334

According to the figure below, (Wadi Hajar, Al-Tahreer, Al-Jawsaq, and Al-Risala) had the least number of particles, which were (54.5, 57.5, 58, 60) particles /liter, respectively. The majority of microplastic particles appeared as single fibers, some appeared as intertwined fibers, and a few appeared in pieces of different sizes and colors (white/ transparent, Blue, Black, Red, Orange and Green).

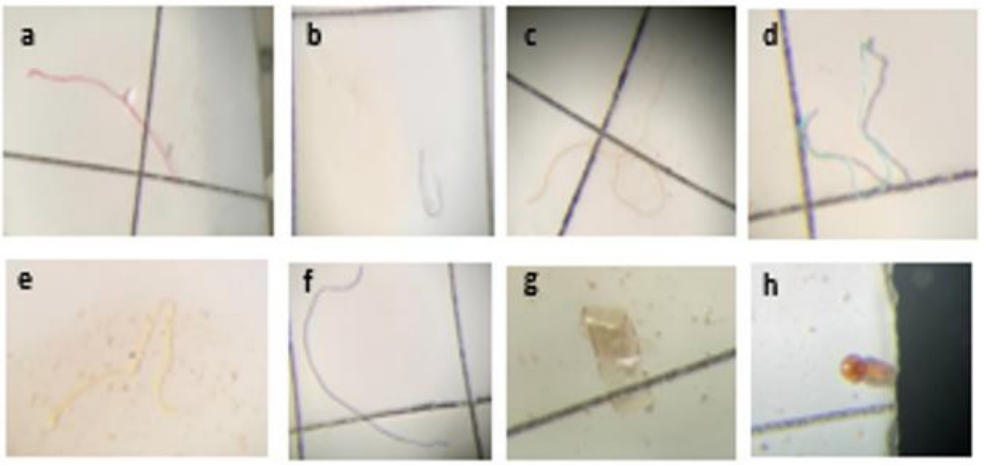

Figure 5. Various microplastics are shown in different shapes: a red microplastics (a), a blue plastic particle (b), an orange plastic particle (c), a green plastic particle (d), a yellow plastic particle (e), a black plastic part (f), a plastic particle in the form of pieces (h), and a plastic particle in the form of microbeads (g).

Based on the results of (the IDW) analysis using the ArcMap GIS program, the following figures represent the spatial distribution of water samples for the right and left banks of the city, respectively. Based on the number of microplastics in the model and their arrangement, this map was drawn ascending from the smallest to the largest, with the Wadi Hagar region on the right bank showing the less number of particles (76 particles), while the Al-sahiroon region shows the greatest number (472 particles) as showed figure (6).

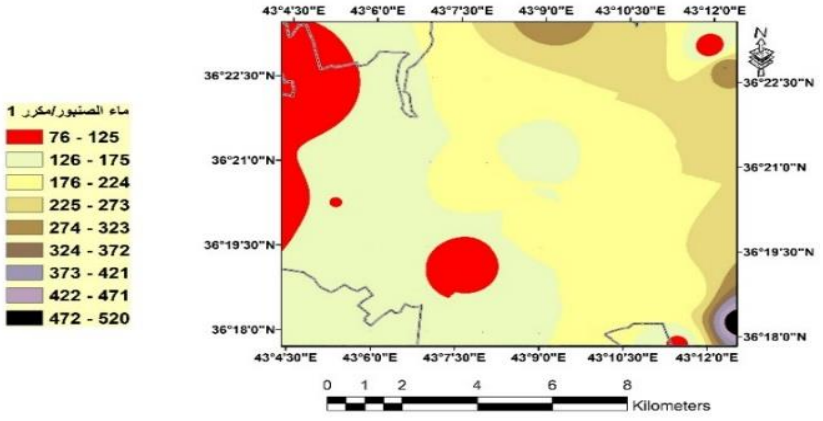

Figure 6. Percentage distribution of micro plastic for the first repeater ofthe tap water sample

For the second repeat of the tap water sample, and as shown in figure (7), there were the lowest numbers (4 particles) of particles in Al-Risala, Wadi Hajar, and Al-Jawsaq and the highest numbers (46.7 particles) in the second Qadisiyah region.

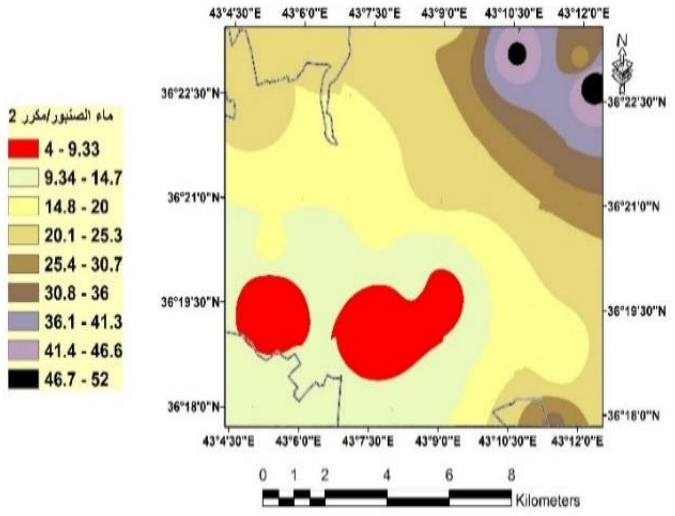

Figure 7. Percentage distribution of microplastics for the second repeater of the tap water sample

As shown in the third replication, and as shown in figure (8), the lowest number (16 particles) of microplastics was found at the Al-Jami' Al-Kabeer and Al-Risala on the right bank and Al-Tahreer on the left bank, while the greatest number (58.8 particles) was found in Mushairfa and Al-Saheroon and Palestine on the left bank.

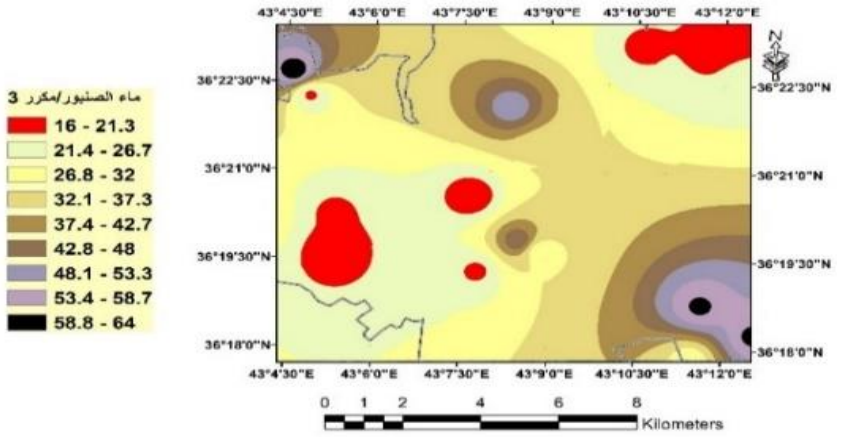

Figure 8. Percentage distribution of microplastics for the third repeater of the tap water sample

In a fourth repetition, and as shown in figure (9), the lowest number (12 particles) of microplastics was founded in Wadi Hajar, Al-Jawsaq, and Al-Dawasah in the Ghazlani project. In contrast, Palestine had the highest number (198 particles) of particles, Sumer was associated with the Al-Saheroon, and Alziraee was located in the Ancient Al- alaysar Project.

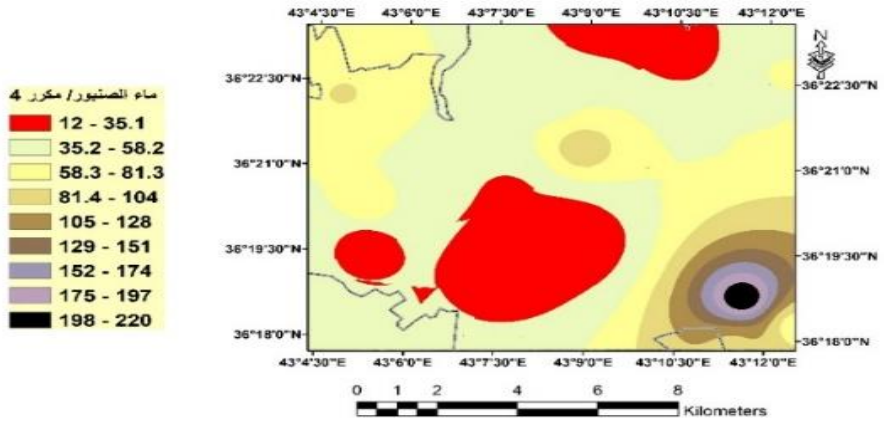

Figure 9. Percent distribution of microplastics for the four repeater of the tap water sample

As a result, and as shown in figure (10), the fifth replicator showed the existence of microplastics in the lowest number (20 particles) in the Palestine region of the

Al-Saheroon project on the left bank, and they appeared with the highest number (160 particles) in the Al-Jami' Al-Kabeer region of the ancient right (unified) project on the right bank.

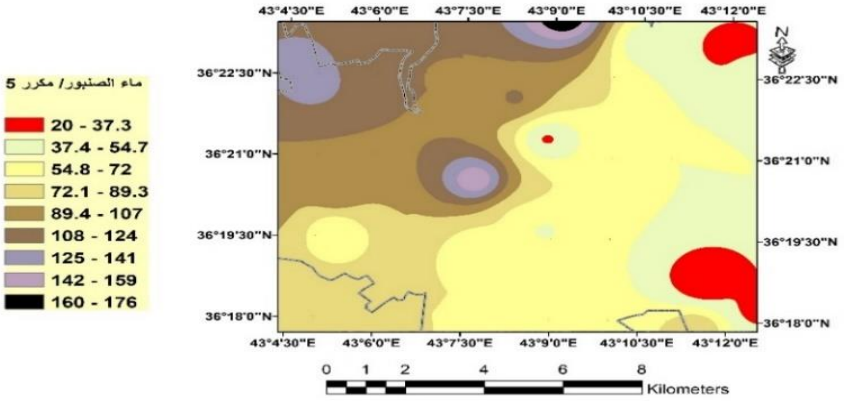

Figure 10. Percent distribution of microplastics for the fifth repeater of the tap water sample

According to the results of the sixth repetition, microplastics are found to be the lowest (36 particles) in Al-Hadbaa, Al-Bareed region of the new Al-Ayser project on the left bank, and the highest (225 particles) in the Palestine region affiliated with the Al-Saheroon project on the left bank, and as shown in figure (11).

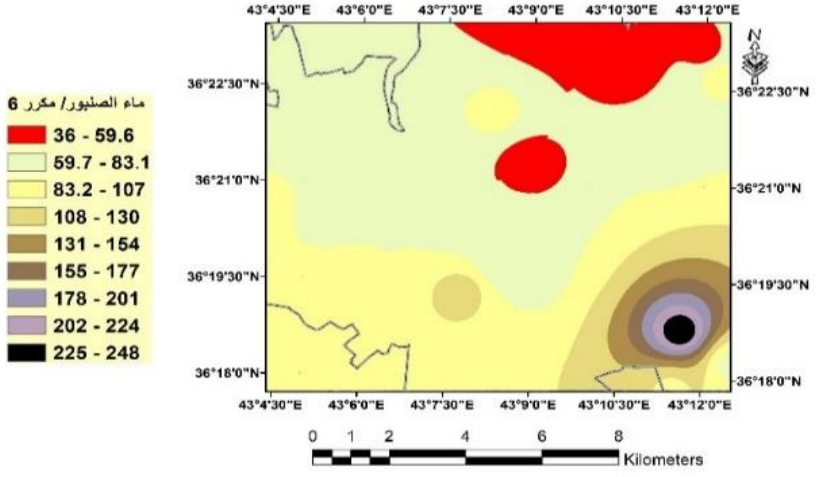

Figure 11. Percent distribution of microplastics for the sex repeater of the tap water sample

According to figure (12). There were fewer microplastics (64 particles) in Al-Jami' Al-Kabeer region, which Affiliate the ancient (unified) project, Compared to the Al-Saheroon region contained (348 particles) of the Al-Saheroon project on the left banks.

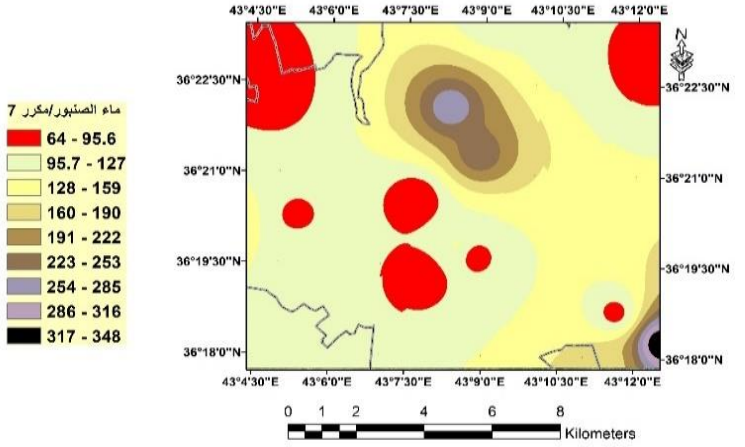

Figure 12. Percent distribution of microplastics for the seven repeater of the tap water sample

Lastly, microplastics were found with the lowest number (16 particles) in the AL-bareed region of the new Al-Aysar project / the left bank, and the highest number (128 particles) in the Al-Saheroon region of the Al-Saheroon project / the left bank too, as shown in figure (13).

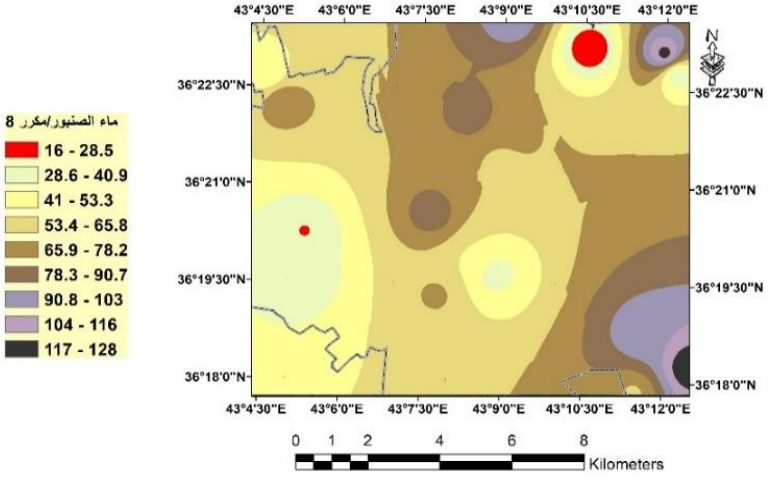

Figure 13. Percentage distribution of microplastics for the eighth repeater of the tap water sample

According to this study, microplastics were found in tap water in quantities between (54.5-156.5). This indicates a higher pollution level with plastic particles than that reported by Zhang et al., 2020 According to this study, tap water contains relatively few microplastics (0.6 ± 0.7 particles/L) and a low level of contamination. According to Feld et al., 2021, Danish drinking water contains 7 particles/L of microplastic, which indicates a low level of pollution by plastic.

Conclusion

1. Firstly, a microscopic examination revealed the presence of microplastics in all water samples, ranging from single fibers to intertwined fibers and microbeads, in different colors and sizes.
2. The average concentration of fine particles in tap water ranged from 105.5 particles/liter, indicating the average pollution of tap water compared to the results in the published studies.
3. The current levels of direct exposure to microplastics via drinking water do not cause major health problems, but the potential risks to human health should not be neglected.
4. As a result of the findings, it was determined that microplastics are caused by external factors such as washing water being thrown into waterways, and that is conbankred one of the factors causing microplastics in water as well as weather factors such as wind and rain, and finally, it reaches tap water.
5. As a result of the water treatment plants being ineffective in reducing microplastic particle pollution, the Al Saheroon area on the left bank had a high proportion of plastic particles.
6. The results of the statistical analysis showed that there were close notable differences between all the study regions, except in the regions (Al Saheroon, Palestine, Al Mohandeseen, and Al Hadbaa), where the results were very high.

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