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DETECTION OF MICROPLASTICS IN RIVER WATER OF KOCHI USING FT-IR SPECTROSCOPY

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ABSTRACT

Microplastics as the word itself shows are little plastic particles that are exceptionally small, normally under 5mm in size, scarcely unmistakable and causes contamination as it enters the earth. Kochi is taken as the examination territory as it is a standout amongst the most contaminated urban communities in India. According to reports, Kochi city creates around 380 tons of waste per day, of which 150 tons are biodegradable and 100 tons contain plastic waste. According to Kerala Suchitwa Mission measurements of 2018, Kochi municipal organization alone creates 16 tons of plastic wastesa day. The primary part of this plastic waste is dumping into a little town ofBrahmapuram, which was prior a wetland where rice was initially developed along the banks of the Chitrapuzha and Kadambrayar waterways. This examination is planned to decide the nearness of microplastics along the course of Kadambrayar which is streaming round the dumping yard of Brahmapuramby using FT-IR spectroscopy.

KEYWORDS: Microplastics,Plastic wastes,Pollution,River sediments,FT-IR spectroscopy

I. INTRODUCTION :

Plastic as a standout amongst the most adaptable items at any point made articulates on account of around 100 years of advancements. The innovation of plastic in 1907 changes the human life in both positive and negative viewpoints. In an idealistic sense, plastics are a standout amongst the most lovely innovations ever. They are exceedingly tough, adaptable, light weight and practical [Hahladakis et al., 2018]. Additionally, they discover their applications from attire to transport and considerably more [Andrady et al., 2009]. On the opposite side plastic is a noteworthy supporter of ecological contamination. The issue of plasticcontamination is getting a universal concern [Brennholt et al., 2017]. From now on the slogan of World Environmental Day 2018 is to 'Beat Plastic Pollution'. India had been picked as a host because of the expanding plastic contamination for making valuable move. According to the UNEP, one million plastic drinking bottles are created each moment and 5 trillion single utilize plastic sacks are obtained each year overall [Plastics Europe 2015]. The principle issue confronting is that larger part of the plastic item is intended for a solitary time use and afterward discarded [Thomson et.,al 2004]. These plastic wastes stay over decades as they have poor degradation efficiency and gets collected in seas, crisp water and ground surface and meddle with amphibian life forms and people [Klein et.,al 2015, Hahladakis et al., 2018]. India delivers about 5.6 million tons of plastic every year [Toxics interface 2014]. Furthermore, as it comes to Kerala 4-6 % of all out city strong waste created every year is plastic wastes [Scaria et al., 2013]. The primary reprobate nature of plastic is its life span which empowers long separation, transport and gathering [Klein et al., 2015]. Bioaccumulation of hydrophobic poisons on the outside of microplastics heightens the impacts of microplastics [Teuten et al., 2009]. Subsequently microplastics are considered as a wellspring of harmful synthetic substances as well as a sink for synthetics [Rochman et al., 2014]. Joined Countries Natural Program (UNEP) of 2014 proposed microplastics contamination as a rising issue.

The regular sort of engineered polymers incorporates high density polyethylene, low density polyethylene, PET, nylons, polypropylene, PVC, polystyrene and so forth [Barnes et al., 2009, Halle et al., 2016]. The larger part of primary microplastics (98%) are created from land-based exercises. Just 2% is produced from marine exercises [Barnes et al., 2009]. The biggest extent of these particles originated from the washing of synthetic clothes and from the scraped spot of tires while driving [Halle et al., 2016]. A large portion of the discharges to the seas are happening from the utilization of items (49%) or the maintenance of items (28%). The fundamental pathways of these plastics into the sea are through street overflow (66%), wastewater treatment frameworks (25%) and wind exchange (7%) [UNEP 2014].

As indicated by the US National Oceanic and Atmospheric Administration (USNOAA) microplastics can be delivered either as a primary item or as a secondary item [US NOAA 2013]. The primary sources incorporate cosmetics, pellets, synthetic garments [Free et al., 2014] and so on while optional microplastics are created by the breakdown of bigger plastic materials because of physical, chemicalor organic procedures [Wright et al., 2013]. The impacts of microplastics are found from single celled microorganisms to multi cell people and furthermore in air, soil, water and each purpose of nature [Bakir et al., 2012, Brownie et al., 2013, Kirstein et al., 2016].

The objective of this study is to provide a critical assessment of the presence of microplastics along the course of Kadambrayar which is flowing round the dumping yard of Brahmapuram and to analyse the overall contribution of Kochi to the emerging problem of microplastics pollution.

II. SCOPE OF THE STUDY & METHODOLOGY

This study aims at the determination and quantification of microplastics in the Kadambrayar river along the stretches of Brahmapuram using FT-IR spectroscopy.

STUDY AREA

Based on the preliminary analysis,

Kadambrayar which is a tributary of Periyar and flowing round Brahmapuram as shown in fig.2.3. is taken as the study area. Brahmapuram waste treatment plant which spreads over 110 acres is nearly 5 kms away from the Kochi's cybercity of Infopark. [23]. Brahmapuram which is located at 10.0010° N, 76.3788° E was earlier a wetland where rice was cultivated along the banks of the rivers Kadambrayar and Chitrapuzha.[24]. Later on, Brahmapuram became the waste dumping yard of Kochi with the unexpected High Court order of 2007[24].

As per the WHO statistics of 2018, with anoverall pollution index of 73% and drinking water pollution of 50%, Kochi is becoming one of the most polluted cities of India [27]. As per Kerala Suchitwa Mission statistics of 2018, Kerala produces 480 tonnes of plastic waste per day and of these Kochi municipal corporation alone generates 16 tonnes of plastic wastes a day[28]. The main portion of this plastic waste is dumping into Brahmapuram which subsequentlycauses pollution of Kadambrayar and Chitrapuzha.Kadambrayar provides water source for around 9 panchayats of Brahmapuram [25]. As per the Central Pollution Control Board report of 2011, Brahmapuram stretch of the creek was noted as one among the 150 most polluted river sites of India.

METHODOLOGY

Water and sediment samples are collected from various locations of Kadambrayar near Brahmapuramand sealed air tight in order to avoid contamination. The water quality analysis is conducted in the laboratory to evaluate pH, electrical conductivity, biological oxygen demand (BOD), hardness, chlorides, iron, nitrite and alkalinity of the water samples. pH and electrical conductivity are measured using water quality analyser. Dissolved oxygen (DO) is measured using Winkler method with azide modification and then BOD5day using titrimetric method. By using EDTA titration method, hardness of water is evaluated. Iron is measured using phenanthroline method and nitrites by colorimetric method.

The sediment samples are analysed as per US National Oceanic and Atmospheric Administration (US NOAA) protocol. Wet samples are first oven dried at 90°C for 24 hoursand are then disaggregatedmanually.The disaggregated samples are then sieved through a series of sieve sets and then subjected to wet peroxide oxidation using 30% concentrated H_2O_2 to digest the organic matter and then density separation is carried out using sodium chloride of density 1.3g/ml to separate the microplastics using floatation techniques. The supernatant was then filtered using filter paper and microplastics is extracted.

III. RESULTS AND DISCUSSIONS

The extracted microplastics as in fig.3.1.is then cleaned with 30% concentrated H_2O_2 and carryied out FT-IR spectroscopy. From the FT-IR results it can be understood that the samples collected from various locations of Kadambrayar contains a minimum number of microplastics pieces of 35 and a tremendous higher concentration of 507 pieces. The major microplastic pollutant present is of polyethylene, polypropylene, polystyrene and PET and among that the major contribution is of polyethylene. The percentage of microplastics in each sample varies from 0.5% - 2% by weight of sediment sample taken, which shows a tremendous level of plastic pollution in Kochi.

Fig.3.1. Microplastics extracted

Table.3.1. Water quality analysi

Sl No:	Parameters	Method of analysis	Sample 1 9º59′52”N 76º21′38”E	Sample 2 9º59′33”N 76º22′4”E	Sample 3 10º0′15”N 76º22′11”E	Permissible limit (IS 10500:2012)
1	pH	Water quality analyser	6.6	6.5	6.8	6.5-8.5
2	Electrical Conductivity	Water quality analyser	2.049mS	157.9µS	114.2µS	
3	Total Alkalinity(mg/L)	Titrimetric	80	40	40	200-600
4	Chloride(mg/L)	Titrimetric	44	24	32	250
5	Initial DO(mg/L)	Winkler method with azide modification	1.8	1.6	2.2	Minimum of 4
6	BOD(mg/L)	Titrimetric	136	132	104	Maximum of 3
7	Hardness (mg/L)	EDTA titration	210	20	30	300-600
8	Iron (ppm)	Water test kit	0.3	1	1	0.3
9	Nitrite (ppm)	Water test kit	2	0.5	0	1

IV. CONCLUSIONS :

From the studies we had conducted so far, following are the facts we inferred andfurther studies are needed for arriving at a better conclusion.

- The sediment sampes collected from various locations of Kadambrayar conains microplastic pieces varying from 35 to a maximum of 507 which shows a percentage of 0.5 – 2% of microplastics by weight of sediment samples taken.
- The major contributor of microplastic pollutant is polyethylene which is used as mainly for packaging purposes, toys etc.
- From the BOD analysis performed it is inferred thatKadambrayar is organicallypolluted due to the dumping of organic wastes.Generally a BOD level of 1-2 ppm is considered very good and there will not be much organic waste present in the water body. A water body with a BOD level of 3-5 ppm is considered moderately clean. In water with a BOD level of 6-9 ppm, the water is considered somewhat polluted because there is usually organic matter present and bacteria are decomposing this waste. At BOD levels of 100 ppm or greater, the water body is considered very polluted with organic waste.
- Also there is contamination due to iron and nitrites.

- When it comes to plastic pollution, the condition is very critical due to the heavy dumping of plastic products and due to the lack of proper disposal methods. It is clearly understood from the microplastic sampling that even in a small quantity of river sediments there is notable amount of plastic materials which indicates heavy plastic pollution.

V. REFERENCES :

1. S Sruthy and E V Ramaswamy (2016) - Microplastic pollution in Vembanad lake, Kerala India: The first report of microplastics in lakes and estuarine sediments in India – Environmental Pollution, 1-8.
2. Chandan Krishna Seth and AmritanshuShriwastav (2018), Contamination of Indian sea salts with microplastics and a potential prevention strategy, Environmental Science and Pollution Research.
3. Vigneshwari Easwar Kumar, Geetanjali Ravikumar and K. Immaculate Jeyasanta (2018), Occurrence of microplastics in fishes from two landing sites in Tuticorin, South east coast of India, Marine Pollution Bulletin, Volume 135, 889-894.
4. S. A. Naidu,V.Ranga Rao and K. Ramu (2018), Microplastics in the benthic invertebrates from the coastal waters of Kochi, Southeastern Arabian Sea, Environ Geochem Health Springer Nature.
5. Hannes K Imhoff and Robert Sigl (2017), Spatial and temporal variation of macro, meso and microplastic abundance on a remote coral island of Maldives, Indian ocean, Marine pollution bulletin.
6. Toxics Link Annual Report 2014-2015.
7. Carlo Giacomo Avio, Stefania Gorbi and Francesco Regoli (2016), Plastics and microplastics in the oceans: From emerging pollutants to emerged threat, Marine Environmental Research.
8. R Karthik, R S Robin and R Purvaja (2018), Microplastics along the beaches of southeast coast of India, Science of the Total Environment, Vol: 645, 1388-1399.
9. Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) 2017.
10. Jinping Peng and Jundong Wang (2017), Current understanding of microplastics in the environment: Occurance, risks, fate and what we should do, Integrated Environmental Assessment and Management, Volume 13, Number 3—pp. 476–482.
11. Wei-Min Wu, Jun Yang and Craig S. Criddle (2017), Microplastics pollution and reduction strategies, Front. Environ. Sci. Eng., Vol: 11, 1-6.
12. Wenfeng Wang and Zhen Li (2016), Microplastic pollution in inland fresh waters of China: A case study in urban surface waters of Wuhan, China, Science of the Total Environment.
13. Carlo GiakomoAvio and Lara Roberta Cardelli (2017), Microplastic pollution after the removal of costa Concordia wreck: First evidences from a biomonitoring case study, Environmental Pollution, Vol: 227, 207-224.
14. Luis Gabriel Antao Barboza and A. Dick Vethaak (2018), Marine microplastic debris: An emerging issue for food security, food safety and human health, Marine Pollution Bulletin, Vol:133, 336-348.
15. Luis Carlos De Sa and Miguel Oliveira (2018), Studies of the effects of microplastics on aquatic organisms: What we know and what should we focus our efforts in future, Science of the Total Environment, Vol:645, 1029-1039.
16. Fredric M Windsor and Rosey M Tilley (2019), Microplastic ingestion by riverine macro invertebrates, Science of the Total Environment, Vol:646, 68-74.
17. Jundong Wang and Zhi Tan (2016), The behaviours of microplastic in the marine environment, Marine Environmental Research, Vol:113, 7-17.
18. Elke Kerstin Fisher and Lisa Paglialonga (2016), Microplastic pollution in lakes and lake shoreline sediments-A case study on lake Bolsena and lake Chuisi, central Italy, Environmental Pollution, Vol:213, 648-657.
19. QiongxuanQiu and Zhi Tan (2016) Extraction, enumeration and identification methods of monitoring microplastics in the environment, Estuarine, Coastal and Shelf Science, Vol:176 102-109.
20. [Catarina F.Araujo and Mariela M. Nolasco

(2018), Identification of microplastics using Raman spectroscopy: Latest developments and future prospects, Water Research, Vol:142, 426-440.

21. Dr. S. Rabiyathul Basariya, and Dr. Ramyar Rzgar Ahmed, 2019. "The Influence of 'Adventure Tourism Activities' in promoting tourism business in mountain stations", African Journal of Hospitality, Tourism and Leisure, Volume 8 (2).
22. Dr. S. Rabiyathul Basariya, and Dr. Ramyar Rzgar Ahmed, Nov 2018. "A Study On consumer satisfaction and preference of colour TV brands in Chennai city", International Research Journal of Management and Commerce, Volume4, Issue 10.
23. Dr. S. Rabiyathul Basariya, and Dr. Ramyar Rzgar Ahmed, "A Study on Attrition: Turnover intentions of employees", Jan 2019. International Journal of Civil Engineering and Technology (IJCIET), Volume 10, Issue 9.
24. Dr. S. Rabiyathul Basariya, and Dr. Nabaz Nawzad Abdullah, Dec 2018. "A STUDY ON CUSTOMER'S SATISFACTION TOWARDS E-BANKING", International Research Journal of Management and Commerce, Volume 5, Issue 12,
25. 6. Devi A.R. Shakila, Basariya S. Rabiyathul,"Strategies influencing withholding of women employees in IT sector in Chennai, Tamil Nadu", Indian Journal of Public Health Research & Development, 2019, Volume : 10, Issue : 3, pp 1086-1089.
26. https://webbook.nist.gov/chemistry.
27. [22]. Julie Masura, Joel Baker and Gregory Foster (2015), Laboratory Methods for the Analysis of Microplastics in the Marine Environment, NOAA Marine Debris Division.
28. https://www.mapsofindia.com/maps/kerala/rivers/.
29. .https://www.thehindu.com/news/cities/Kochi/brahmapuram-waste-plant-back-in-spotlight/article25666705.ece.
30. https://www.thenewsminute.com/article/walk-through-ghost-village-brahmapuram-deserted-thanks-kochis-garbage-41040
31. https://www.thehindu.com/news/cities/Kochi/brahmapuram-waste-plant-sitting-on-a-powder-keg/article24989274.ece
32. .http://www.moef.nic.in/downloads/public-information/Rpt-air-monitoring-17-01-2011.pdf.
33. http://sanitation.kerala.gov.in/downloads/
34. .https://www.thehindu.com/news/cities/Kochi/kadambrayar-gets-new-lease-of-life/article19236599.ece